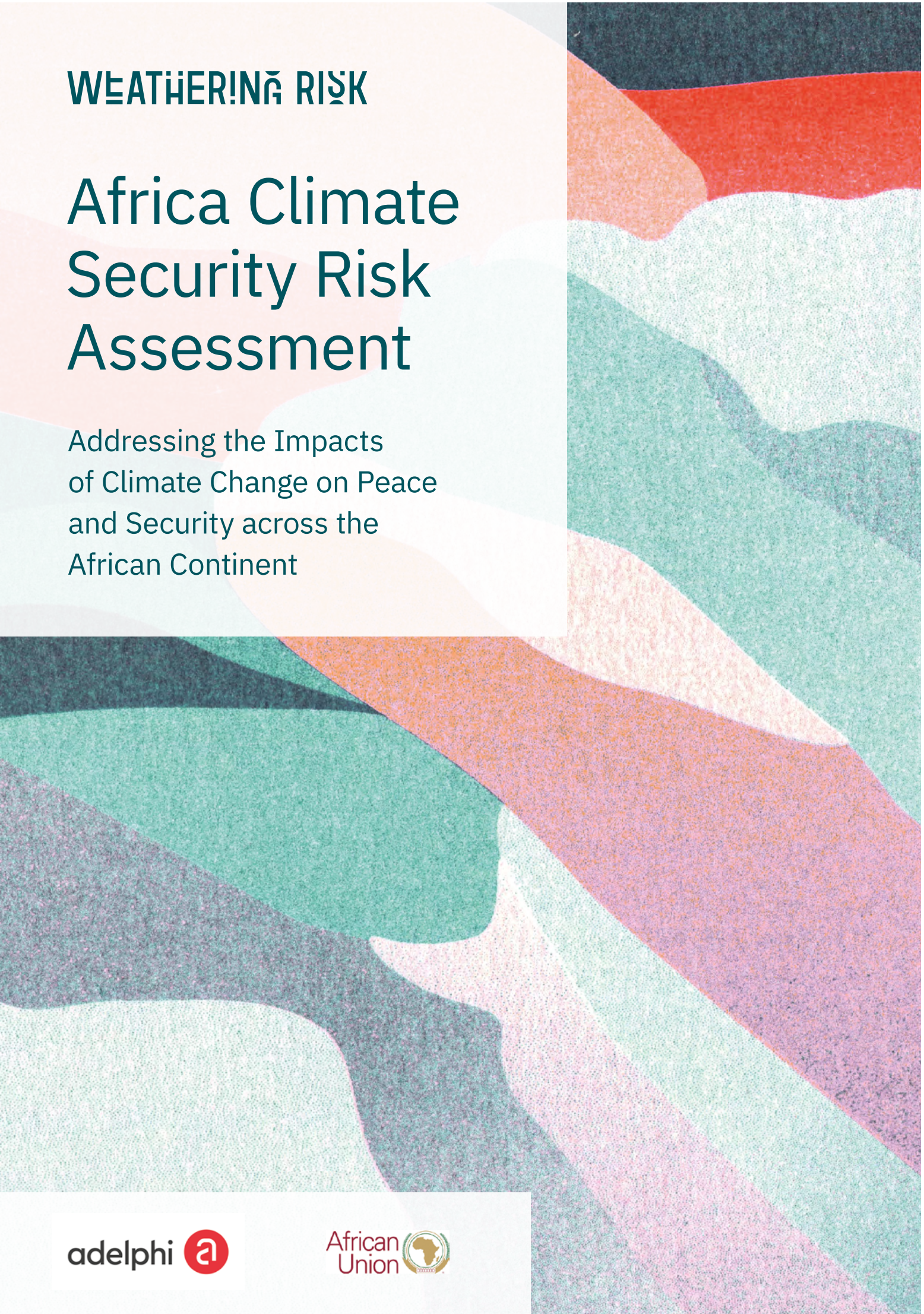
WEATHERING RISK

Africa Climate Security Risk Assessment

Addressing the Impacts of Climate Change on Peace and Security across the African Continent



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African Union

AUTHORS
Lukas Rüttinger (adelphi), Lukas Destrijcker (adelphi), Héctor Morales-Muñoz (adelphi), Adrian Foong (adelphi), Jakob Gomolka (adelphi), Lisa Binder (PIK), Taye Abdulkadir (AU), Titilope Akosa (Center for 21st Century Issues), Anna Belli (CGIAR), Matthew Brubacher, Mabaye Dia (UNOCA), Matthieu Guillier (Alp Analytics), Salma Kadry (CGIAR), Benson Kendyuio (CGIAR), Grascious Maviza (CGIAR), Chantelle Gloria Moyo (KAS), Serge Ndjekouneyoum (UNDP), Linda Ogallo (IGAD), Michel Saraka (ECOWAS), Barbora Šedová (PIK) and Victor Villa (CGIAR)

REVIEWERS
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Alt-Moabit 91, 10559 Berlin, Germany
+49 (0) 8900068-0
office@adelphi.de
www.adelpi.de/en

CONTACT:
Lukas Rüttinger
ruettinger@adelphi.de

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Executive Summary

Introduction

BACKGROUND

The effects of global warming in Africa are among the most serious threats to human security on the continent. Climate change impacts affect the security of African countries and societies both directly and indirectly by exacerbating existing political, peace and security, and socioeconomic and development challenges. These challenges particularly affect vulnerable social groups, such as women, young people, children, internally displaced persons (IDPs) and refugees, people with disabilities, and other minority groups.

While Africa is one of the lowest contributors to greenhouse gas (GHG) emissions, it is highly vulnerable to the impacts of climate change due to the intersection of different socioeconomic, political and environmental challenges. The climate crisis has already caused significant harm to biodiversity, water security, food production, life, health and economic growth, and climate change impacts are projected to worsen significantly over the coming decades.

Given these challenges, the Committee of African Heads of State and Government on Climate Change (CAHOSCC), together with the African Ministerial Conference on the Environment (AMCEN) and African Group of Negotiators (AGN), agreed to advance Africa's priorities in ensuring effective and holistic responses to climate change at national, regional and continental levels. As part of these efforts, the AU Peace and Security Council (AU-PSC), through multiple decisions, encouraged all member states, and the Regional Economic Communities and Regional Mechanisms for conflict prevention, management and resolution (RECs/RMs) to further enhance their climate change resilience and mitigation capacities, and develop credible climate early warning systems, as well as integrated responses to climate-related security risks. This is to be done in addition to expediting the finalisation of the Report of the Chairperson of the Commission on the Study on the Nexus between Climate Change, Peace and Security on the Continent.

The AU-PSC requested the AU Commission conduct a study on the nexus through its Press Statement (PSC/PR/BR. DCCLXXIV) of May 2018 on "the link between climate change and conflicts in Africa and addressing the security implications." It subsequently reiterated in the PSC Communiqué of the 1051st Meeting of 26 November 2021 to expedite the finalisation of a climate-related security risks assessment study, in consultation with AU member states, and to define the varying security impacts of climate change on the African continent, while taking steps towards mobilising a Common African Position on Climate Change, Peace and Security.

GOAL

The Africa Climate Security Risk Assessment (ACRA) serves these functions, and analyses the interlinkages between climate, peace and security across the African continent. It provides the basis for the development of a chairperson report on the nexus between climate change, peace and security on the African continent, as well as the Common African Position on Climate Change, Peace and Security.

The ACRA provides an in-depth analysis of key climate security risks from a continental perspective and emerging good practices to address them. This comparative analysis is based on regional assessments for Northern Africa, Western Africa, Central Africa, Eastern Africa and Southern Africa that include the main climate security risk pathways for each region, as well as regional responses and good practices. An additional focus is put on transregional geographies, in particular African island states, the Congo, Lake Chad Basin, transboundary waters and the Sahel. Figure 1 provides an overview of the outcomes of the different regional assessments that will be explored in the report. Finally, the report provides recommendations regarding how to better address climate-related security risks across the continent.

Key Climate Security Pathways

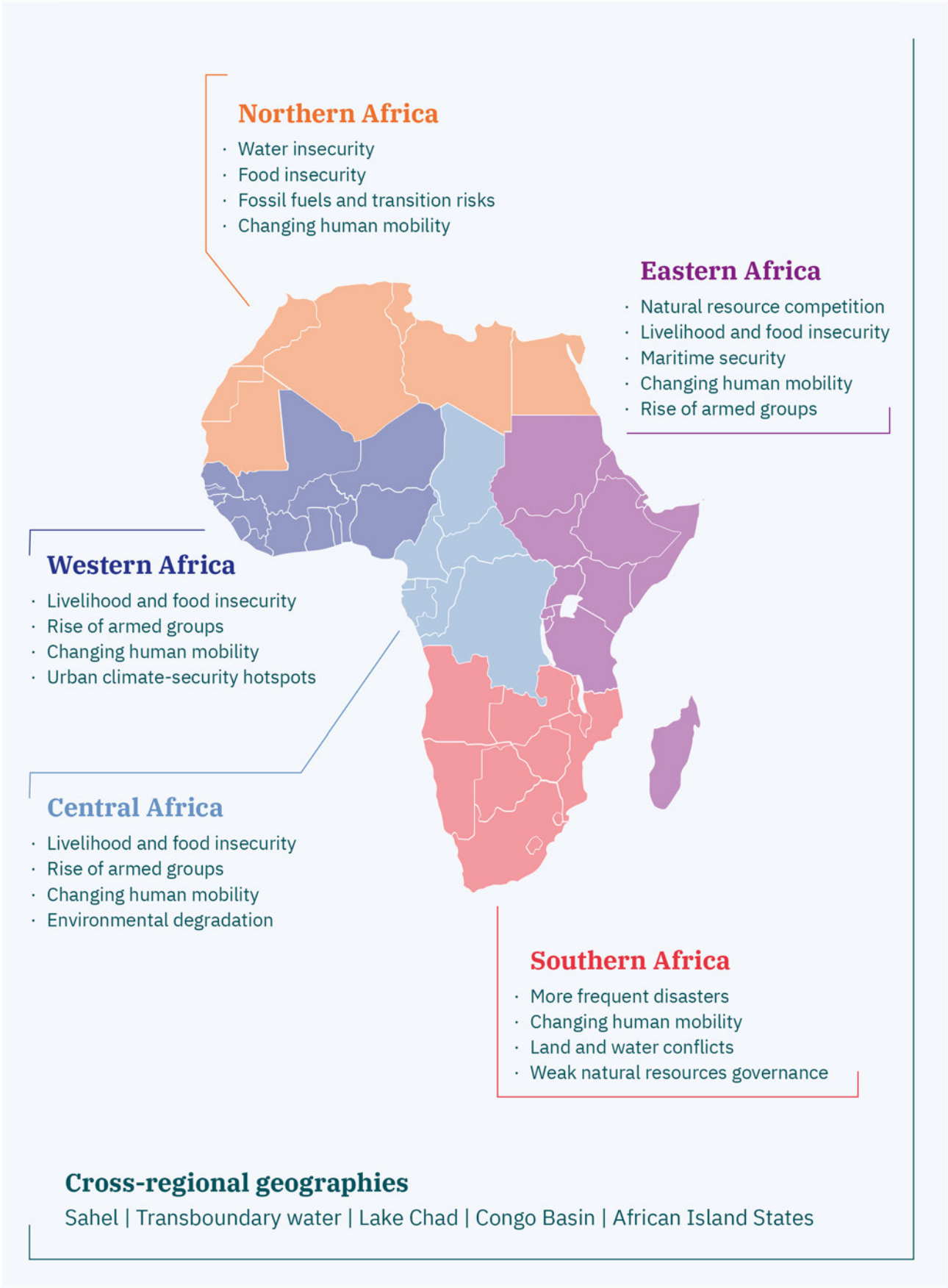

Figure 1: Key climate security risk pathways across African regions and geographies (elaborated by adelphi)

11 insights on climate change, peace and security in Africa

The understanding of the links between climate change, peace and security has increased significantly over recent decades and Africa is one of the best researched regions in the world on this topic. At the same time, a lot of the action to address climate-related security risks has also been focused on Africa, providing a good basis to distil emerging responses and good practices. The following chapter summarises the main results of the ACRA structured along 11 insights on climate, peace and security. The first six insights focus on how and what kind of climate-related security risks Africa faces. These are followed by five insights on responses and good practices to address the security risks arising from climate change.

1. **Natural resource management conflicts are an increasing and complex challenge**
   Increasing competition over natural resources is a key climate security challenge across the African continent, especially because many Africans are directly dependent on natural resources for food and livelihood security. Climate impacts are compounding other pressures on natural resources such as land, water and forests, and are affecting access to and the availability of resources. Where small arms are readily available, histories of conflict or social and ethnic cleavages exist, groups are marginalised, and natural resource and conflict management institutions are dysfunctional. This competition can turn into violent conflict. Tensions and conflicts over resources are increasing – mostly on a local level, but also in interstate competition.

2. **Livelihoods, and food, water and energy security are under pressure**
   Livelihoods, and food, water and energy security are under pressure across the continent. Climate impacts are increasingly aggravating other challenges around food, water and energy security. Today, 1.34 billion Africans experience water insecurity, 20 per cent of Africa's population are affected by hunger, and access to cheap and reliable energy is often lacking (FAO et al. 2023). Particularly, in already unstable situations, livelihoods, and food, water and energy insecurity can drive a number of security-related challenges. Effects include public discontent over food prices, declining government legitimacy after weather-induced disasters, maladaptive practices such as small-scale mining and charcoal production, and the recruitment into non-state armed groups.

3. **Climate-induced human mobility creates opportunities and risks**
   Human mobility has been an integral part of the way of life for many communities across Africa for centuries. It remains an important part of livelihood activities, and coping and adapting to change. Climate impacts are increasingly playing a role in these dynamics and are accelerating a number of mobility trends: mostly migration within countries and into cities, but also regional and international migration. The risks for both migrants and host communities increase when movements are forced, sudden, irregular and/or unplanned, or occur at a larger scale. Mobility-related demographic pressures can drive tensions and conflicts. However, if migration is well-managed and coordinated, it is and will remain an important driver of economic development and resilience.

4. **Non-state armed groups are actively exploiting climate security risks and governance issues**
   Climate-related security risks are providing a fertile breeding ground for non-state armed groups, such as militia, terrorist and criminal groups, in Africa. Climate impacts are also affecting their tactics. In particular, where state institutions are weak and corrupt, these groups can fill the gaps left by the state to provide services and governance. Climate impacts, through their effects on livelihoods, are also contributing to the ability of these groups to recruit new members. Armed groups can weaponise natural resources by attacking infrastructure and benefit operationally from climate-related hazards. In turn, their operations exacerbate environmental challenges when extracting resources and committing environmental crimes.

5. **Climate-related security risks in Africa have a geopolitical dimension**
   Climate-related security risks in Africa are highly dependent and influenced by a number of external factors. Geopolitics and policies in other parts of the world, especially with regard to food trade and food security, extrac-

tive resources, energy, trade, and migration. Geopolitics shapes climate insecurity drivers and Africa's ability to adapt to climate shocks. Interactions with international actors can help to strengthen food security and economic development, but can also drive conflict. Similarly, multinational companies can play an important role in offering socioeconomic opportunities, but can also exacerbate climate security risks, especially when they engage in corruption and rent-seeking practices that drive environmental degradation.

6. **Climate-related security risks are intersectional**
There are a number of individual risk factors that shape climate-related security risks, including gender, age, disability and socioeconomic status. Marginalisation, inequality and exclusion are experienced differently depending on how these factors intersect. In general, the more vulnerable an individual, the more they are impacted by climate-related security risks. Social groups that have historically been marginalised, such as women, young people, children, IDPs and refugees, people with disabilities, and other minorities, tend to be more affected by the compounding impacts of climate change as they often lack access to resources, opportunities or services necessary for coping and adapting. In particular, gender-based violence (GBV) in the aftermath of disasters is a key climate security risk across the continent.

7. **Early warning and early action systems are well developed, but key challenges remain in integrating the climate-conflict nexus**
Early warning analysis to inform planning and action is a major component of addressing climate-related security risks. These systems are also at the heart of prevention strategies, both in terms of preparing for natural hazards and addressing violent conflict or other threats to human security. Even though many African actors at different levels have developed extensive early warning and early action systems, some key challenges in terms of mainstreaming the climate-conflict nexus remain. In particular, African early warning systems require greater horizontal integration between climate and weather-focused early warning, and conflict early warning, as well as vertical integration across continental, regional, national and local levels.

8. **Nature-based solutions and integrated natural resource management approaches have proven effective in addressing climate-related security risks**
Across the continent, nature-based solutions and integrated approaches that link livelihoods, natural resource management and peacebuilding have proven to be effective in addressing many climate-related security risks and building resilience. The lessons they provide can guide future programming and upscaling. In particular, if done in a conflict-sensitive, bottom-up, participatory and inclusive way, using local and traditional knowledge and practices combined with an intersectional approach, nature-based solutions and environmental peacebuilding can have broader stabilising impacts, and build more resilient and sustainable livelihoods.

9. **Local, traditional and indigenous knowledge and solutions are key success factors for addressing climate-related security risks**
Local, traditional and indigenous practices, knowledge and institutions are often important success factors when it comes to sustainable natural resource management, peacebuilding and conflict prevention, and environmental protection. Many communities deeply understand their local ecosystems and practices adapted to their specific environments, which can be effective in helping communities cope with the impacts of climate change. Having often been disrupted by colonialism, traditional institutions and practices are also key for preventing and resolving conflicts peacefully. At the same time, with increasing climate pressures, certain traditional and customary practices are no longer effective or viable. Furthermore, in some cases, these practices can hinder climate adaptation, for example, by reinforcing gender inequalities. Thus, it is important to thoroughly assess and support existing practices, and reconcile them with science-based approaches.

10. **Africa is leading in institutional innovations and cross-sectoral cooperation to address climate-related security risks**
Recent years have seen an impressive increase in the creation of dedicated institutions and cross-sectoral cooperation mechanisms to address climate-related security risks. Globally, Africa is a leader when it comes to innovation in this area. In Western and Eastern

Africa, regional organisations and the United Nations have been at the forefront of institutional innovations. At the same time, there has been an increase in continental initiatives, such as the Climate Responses for Sustaining Peace initiative launched by the Egyptian COP27 presidency and the Africa Climate Mobility Initiative created in 2021.

11. **Responses are lagging behind risks**
While there has been a lot of progress in addressing climate-related security risks, responses still lag far behind the scale of risks Africa faces. Huge financing gaps remain across the continent for both climate action, and peacebuilding and conflict prevention. While there have been significant improvements in terms of strengthening capacities to assess and address climate-related security risks, significant capacity gaps remain across Africa. These capacities are still mostly lacking on the local and national levels. Strategies addressing climate-related security risks mainly focus on the regional level, while similar national-level strategies often do not exist or fail to apply a climate security lens. The implementation of policies is hampered due to a lack of clarity regarding ownership and coordination, as well as a lack of harmonisation between peace and security architecture on the one hand, and the climate and development pillar on the other hand.

Recommendations

Climate-related security risks are increasing across the African continent, particularly around natural resource competition, access to food, water and energy, migration and displacement, and armed groups. At the same time, insecurity and conflict are further driving environmental degradation, and hindering climate change adaptation and mitigation efforts.

In order to break this vicious cycle of increasing climate change impacts, environmental degradation, insecurity and instability, ambitious action is needed. This includes, first and foremost, ambitious mitigation action to reduce GHG emissions and keep warming to a minimum following the principle of common but differentiated responsibility. At the same time, efforts to adapt to climate change and directly address climate-related security risks must be massively scaled up. Addressing the links between climate change, peace and security is a key building block for broader development, and fostering a stable, peaceful and prosperous continent. The intersection between climate security and development forms a crucial nexus that presents opportunities to solve tensions between environmental stability and socioeconomic progress. The following six recommendations outline key areas that can help to better address climate-related security risks in Africa.

AFRICAN CHALLENGES NEED AFRICAN SOLUTIONS

While there are important commonalities in terms of the climate-related security risks that African countries and societies are facing, the pathways or specific ways they play out and their dynamics are always highly localised and context specific. Histories of conflict, marginalisation, identity, the behaviour of political, traditional and business leaders, the underlying political economy and power structures, and governance structures and institutions are all decisive in translating climate risks into security and conflict risks. These factors are highly contextual, and change from region to region, country to country and community to community. This means that, in order to address climate-related security risks, the following areas should receive particular attention:

- **Strengthen analysis, research and data collection:** To inform appropriate solutions, African analysis, research and data collection capacities have to be improved to provide more contextualised analysis of how climate-related security risks play out.

- **Use local and traditional knowledge and institutions:** Using local, traditional and indigenous knowledge and institutions are important success factors for climate security interventions and should be a key part of an integrated approach.

- **Harness the potential of the younger generation:** With access to appropriate tools, younger people can drive rapid development and innovation. However, this will require a strong foundation of education and employment opportunities.

- **Ensure African island states are not left behind:** Island states need specifically designed solutions, access to finance and capacity building. This should include enhancing maritime awareness and enforcement capacities, investing

in early warning and disaster risk reduction, developing an integrated approach to water, food and energy security, and regular dialogue and knowledge-sharing platforms.

FINANCING CLIMATE SECURITY ACTIONS

In order to address climate-related security risks in their whole breadth, and build more resilient and sustainable economies, societies and states in Africa, access to finance will be key. There are a number of specific areas that need urgent action:

- **Close the adaptation financing gap:** There is an urgent need to invest in risk prevention and resilience building if the worst climate-related security risks are to be avoided. This includes better and easier access to finance, and investment in absorption capacities. In addition, operationalising an international loss and damage mechanism is necessary to compensate for destruction already caused by climate change.

- **Reach the most vulnerable, conflict-affected and fragile contexts:** Financing for these contexts has to be ramped up and easily accessible, while capacities to manage these funds need to be strengthened, especially at the country level.

- **Strengthen African financing facilities:** Access to the African Risk Facility has to be improved and the African Peace Fund could play a pivotal role in addressing climate security risks on the continent. However, it urgently needs to be scaled up.

- **Provide integrated financing to scale up climate security actions:** With substantive dedicated climate security funding schemes, the initial experiences of addressing climate-related security risks and the emerging good practices documented in this report should be scaled up and further developed.

INSTITUTIONS, COOPERATION AND CAPACITIES FOR PREVENTIVE ACTION AND RESILIENCE BUILDING

Climate-related security risks will increase significantly over the coming years and decades. In order to prevent the worst impacts, there is a need to move away from a reactive, responsive approach to a more proactive, anticipatory approach that focuses on prevention and resilience building, and supports sustainable development more broadly. In order for this to happen, the following areas could serve as important entry points:

- **Mainstreaming climate security into strategies and policies:** Climate, peace and security should be fully mainstreamed in all relevant strategic and policy frameworks, including national adaptation plans, nationally determined contributions, climate change action plans, peace plans, interventions and architectures, defence strategies, stabilisation frameworks, and sectoral policies such as water, agriculture and energy.

- **Continue to strengthen the climate-conflict nexus in early warning and early action:** It is important that such systems draw clear linkages to indirect, cascading risks related to climate change and environmental stress by incorporating a clear set of climate security indicators. In addition, such systems should link to and build upon local institutions, indigenous knowledge and civil society.

- **Foster cross-sectoral cooperation:** The goal is to improve operational responses, in particular, by making peacebuilding and conflict prevention climate-sensitive, and climate action conflict-sensitive. As part of this effort, institutions must provide strong leadership and incentives to nurture such cooperation.

- **Develop and strengthen climate security capacities and institutions:** Organisations need dedicated climate security specialists, and vertical and horizontal cooperation and coordination structures. In addition, organisations and institutions at all levels should establish clear lines of responsibility and accountability. To nurture these developments, there needs to be a concerted effort towards exchanging experiences, providing training and building capacity in this field, for example, through an AU-led training facility for climate security.

- **African cities as transformative force:** African cities should leverage their human capital, increase efforts to tackle rising inequality and exclusion, and provide an enabling environment for the green transition. A particular focus should be put on improving cross-sectoral cooperation to foster localised solutions that address social, economic, environmental and political challenges in an integrated manner, such as through inclusive urban planning and development initiatives.

A STRONG CIVIL SOCIETY IS RESILIENCE

Civil society is at the forefront of addressing climate-related security risks. Civil society actors are advocates and catalysts for necessary change, and indispensable partners in building more resilient societies and states, particularly in conflict-affected and fragile contexts. In order to play an effective role in addressing climate-related security risks, the following areas are key:

- **Build capacities and awareness:** More climate security capacities for civil society will be pivotal to fill the action gap concerning these risks on the local level. To enable civil society action on climate-related security risks, it will be important to raise awareness, provide good practices, and finance training and capacity building.

- **Partner for implementation:** Efforts to harness the strengths of civil society should be scaled up to ensure delivery on the ground. This includes leveraging civil society experiences in implementing projects in challenging environments, networks and implementation structures, and local contextual knowledge and analytical capacities to establish effective partnerships and address climate security risks.

- **Protections for those at the forefront of climate security risks:** Environmental defenders and human rights activists require greater engagement, awareness and protection mechanisms. This includes prioritising investments in the protection, empowerment and capacity of environmental defenders.

- **Engage the private sector:** In collaboration with the private sector, civil society can facilitate the private sector's constructive involvement in addressing climate-related security risks. This may include ensuring that infrastructure developments are sensitive to both conflict and climate concerns, and yield tangible benefits for local communities.

INTERSECTIONALITY IS KEY TO ADDRESSING VULNERABILITY

The most vulnerable individuals and groups are the most affected by climate-related security risks. Gender, socioeconomic status, ethnicity, age, disability and sexual orientation combine and shape risks on an individual level. In order to ensure that the most vulnerable are reached, the following areas of action are key:

- **Understand differences:** It is imperative that when data is collected, it is disaggregated by gender, age and other factors that shape risk and resilience. In addition, climate security assessments need to critically reflect these factors and use an intersectional research lens. Climate security action needs to be tailored to also include the most vulnerable.

- **Ensure broad inclusivity:** To effectively address climate-related security risks, it is important to broaden participation and ensure that the voices of the most marginalised are part of the decision-making process from policies to projects on the ground. This includes programmes to enable and empower effective participation, developing leadership skills and establishing inclusive platforms.

- **Focus on the most marginalised and vulnerable:** Climate security action needs to focus on the most marginalised and vulnerable. This means that actions should be targeted towards women, children, young people, IDPs and refugees, people with disabilities, and other minority groups to ensure that interventions are inclusive and specifically address the root causes of marginalisation.

- **Address gender-based violence**: Action on GBV needs to be integrated across climate security programming and scaled up in general. This includes improving the legal, social and physical protection of women and girls on the move.

NO JUSTICE, NO PEACE

Addressing climate-related security risks is closely linked to ensuring climate justice. Africa is globally one of the worst-affected continents in terms of climate impacts, conflicts and their interlinkages, while being one of the least responsible in terms of causing climate change. This injustice needs to be addressed. In terms of climate-related security risks, this includes the following:

- **Amplify and unify African voices:** While some African countries have used the international stage to underline the urgent need to act on climate-related security risks, Africa's collective voice has not yet reached the level it should. A common position on climate, peace and security could be a key step in this regard. In addition, joint African diplomatic initiatives and capacities to urgently address climate-related security risks should be developed.

- **Ensure a just transition:** African countries and international partners need to ensure that there is sufficient investment into the green transition on the African continent, thereby enabling equal opportunities for growth and development. This includes developing local value chains for green technologies to address the perception that African countries are simply providers of valuable raw materials for the rest of the world.

- **Foster environmental justice:** Climate-related security risks must be addressed through an environmental justice approach, which includes recognising the human right to a clean, healthy and sustainable environment, as well as promoting the realisation of environmental protection and restoration through a rights-based approach. This includes integrating conservation efforts with ecosystem services, local livelihoods, and conflict prevention and resolution.

- **Reduce external risks:** Climate-related security risks are shaped by policies that are devised by countries outside of Africa. As such, non-African countries have a responsibility to ensure that key policies on food, migration, corruption, minerals and development cooperation are climate security-sensitive and do not exacerbate risks on the African continent.

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This report is authored by Lukas Rüttinger (adelphi), Lucas Destrijcker (adelphi), Héctor Morales Muñoz (adelphi), Adrian Foong (adelphi), Jakob Gomolka (adelphi) and Lisa Binder (PIK), Taye Abdulkadir (AU), Titilope Akosa (Centre for 21st Century Issues), Anna Belli (CGIAR), Matthew Brubacher, Mabaye Dia (UN-OCA), Matthieu Guillier (Alp Analytica), Salma Kadry (CGIAR), Benson Kenduiyo (CGIAR), Grascious Maviza (CGIAR), Chantelle Gloria Moyo (KAS), Serge Ndjek-ouneyom (UNDP), Linda Ogallo (IGAD), Michel Saraka (ECOWAS), Barbora Šedová (PIK) and Victor Villa (CGIAR).

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Introduction

BACKGROUND

The effects of global warming in Africa are among the most serious threats to human security on the continent. Climate change impacts affect the security of African countries and societies both directly and indirectly by exacerbating existing political, peace and security, socioeconomic, and development challenges, which especially affect vulnerable social groups, such as women, young people, children, internally displaced persons (IDPs) and refugees, people with disabilities, and other minority groups.

While Africa is one of the lowest contributors to GHG emissions, it is highly vulnerable to the impacts of climate change due to the intersection of various socioeconomic, political and environmental challenges. Regardless of the need for global common but differentiated responsibility for mitigating the climate crisis, Africa now has to deal with the impacts of climate change. The climate crisis has already caused significant harm to biodiversity, water security, food production, life, health and economic growth, and climate change impacts are projected to worsen significantly over the coming decades.

Given these challenges, the Committee of African Heads of State and Government on Climate Change, together with the African Ministerial Conference on the Environment and African Group of Negotiators, agreed to advance Africa's priorities in ensuring effective and holistic responses to climate change at national, regional and continental levels. As part of these efforts, the AU-PSC, through multiple decisions, encouraged all AU member states, and the Regional Economic Communities and Regional Mechanisms for conflict prevention, management and resolution to further enhance their climate change resilience and mitigation capacities, and develop credible climate early warning systems, as well as integrated responses to climate-related security risks. This is to be done in addition to expediting the finalisation of the Report of the Chairperson of the Commission on the Study on the Nexus between Climate Change, Peace and Security on the Continent.

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GOAL AND STRUCTURE OF THE REPORT

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APPROACH, ELEMENTS AND PROCESS

The approach and methodology used for this assessment was developed and tested as part of the Weathering Risk initiative. It combines state-of-the-art quantitative and qualitative methods

in an innovative way. The approach does not reinvent the wheel but rather builds upon other assessment methodologies, particularly existing approaches used for climate impact, vulnerability and resilience assessments, as well as peace and conflict analysis. It also builds upon experiences and lessons learned from previous climate security assessments such as:

- Shoring up Stability
- UNEP's Climate Change and Security project
- UN Climate Security Mechanism's toolbox
- Chatham House's climate change risk assessment
- The climate security research done on the African continent (Kumssa and Jones 2010; Seiyefa 2019)

The analysis covered the following elements (see Figure 2):

- **Climatic and environmental changes, and their direct impacts.** This includes first and second order climate impacts (e.g. temperature rise, and its impacts on agriculture, flooding and infrastructure), and significant non-climate-related and relevant environmental issues (e.g. deforestation, pollution and small-scale mining) (climate and environment lens).

- **The peace and security context**, which includes the history and state of economic, social and political (in)stability, past and ongoing security risks and conflict dynamics, the drivers and causes of insecurity, and the main actors that have an impact on security and stability (peace and security lens).

- **The interactions between climate change, security and peace**, and the **pathways** linking certain climatic impacts with specific security risks and conflicts demonstrate how security risks and conflicts affect resilience and climate change. For example, insecurity can contribute to heightened environmental degradation, which can undermine the resilience of local communities.

- At the centre of the analysis and spanning these elements are **important contextual factors shaping vulnerability and resilience** to climate and security risks (cross-cutting topics). These contextual factors normally play a decisive role in all pathways and include:
  > governance
  > traditional knowledge, culture and practices
  > gender and youth inclusion
  > social resilience factors (e.g. trust, grievances and social cohesion)
  > resilience capacities
  > access to livelihoods and public services

- **Identification of best practices and entry points for responses** to address climate-related security risks. Climate vulnerability is shaped by a multitude of interconnected elements, as such approaches that strengthen adaptation and resilience to climate-related security risks must be multidimensional. The emphasis should be on responses that specifically link climate change adaptation, peacebuilding, conflict prevention, development and livelihoods to build more resilient communities and states capable of withstanding both climate and conflict risks.

When using this framework, an emphasis was put on understanding the specific African and local context that climate security risks play out in. This included focusing on understanding how local knowledge and traditions, social institutions, formal and informal governance, and culture shape both vulnerability and resilience to climate-related security risks. It also included understanding how different geographies and risks interact with social, economic, cultural and political factors, including the distinct impacts on African island states compared to the rest of the continent. This understanding was crucial in identifying appropriate responses.

Equally important was the assessment's emphasis on understanding differences between groups, especially the most marginalised and vulnerable. This included understanding how, for example, different genders, ethnicities, age groups and differently abled people are affected by climate-related security risks.

The order in which the elements are presented here does not imply an order in which the assessment took place. The different elements covered in this analysis necessarily overlap. The overlaps underline the links between the different elements and are not meant to duplicate certain steps. Cross-cutting elements such as gender, social inclusion and governance were integrated across the different elements.

This methodological approach was presented, discussed, adapted (IFPRI et al. 2021) and agreed upon during a workshop held in Addis Ababa between 28 and 30 March 2023. The workshop brought together representatives from the AUC Department for Political Affairs, Peace and Security (AUC-PAPS), the AUC Department for Agriculture, Rural Development, Blue Economy and

Elements of the climate security assessment approach

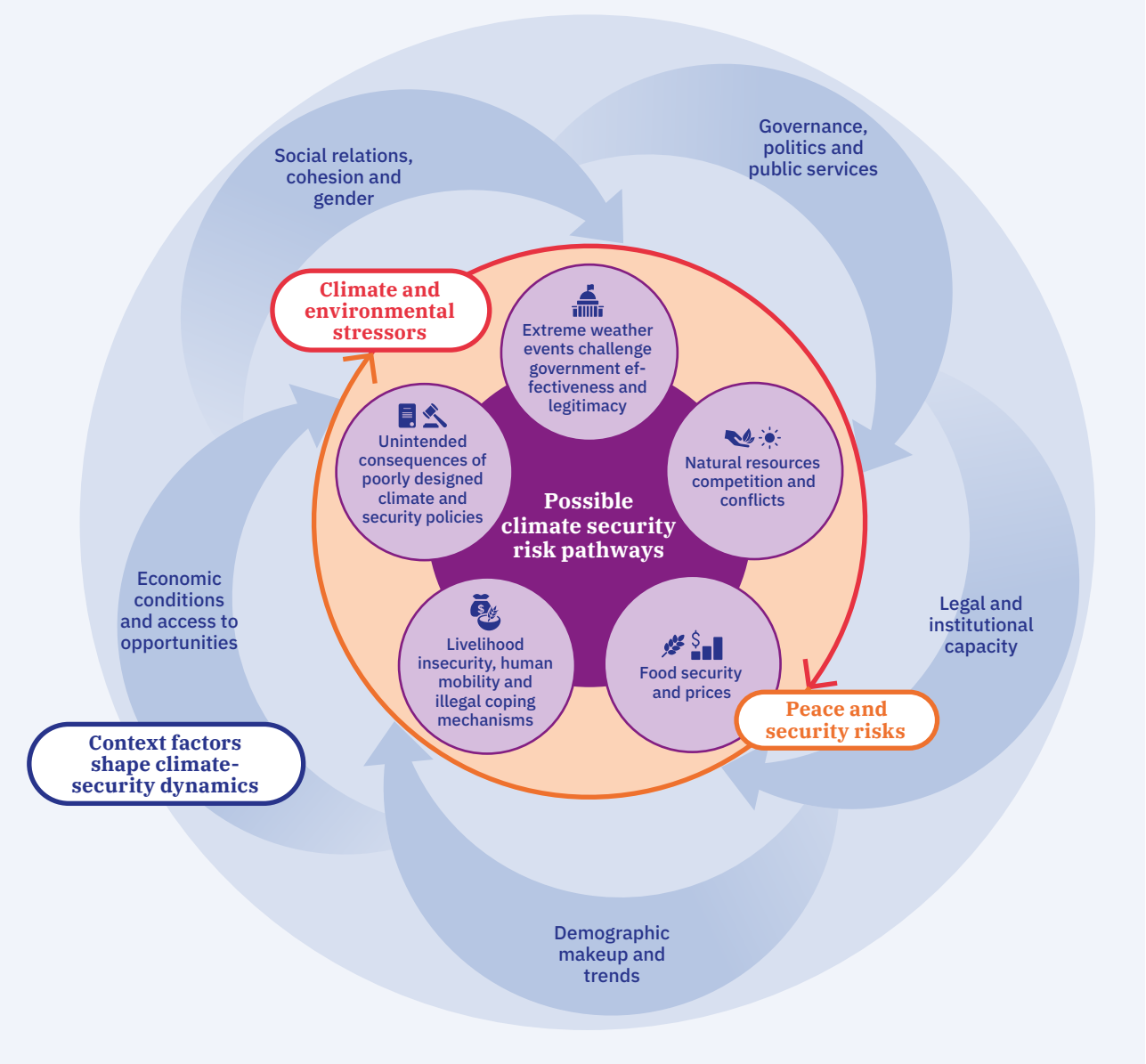


Figure 2: Weathering Risk methodology (elaborated by adelphi)

Sustainable Environment (AUC-ARBE), the AUC Department for Health, Humanitarian Affairs and Social Development, select AU agencies, the Regional Economic Communities, the Regional Mechanisms, non-governmental organisations (NGOs) and civil society organisations, topical experts, and relevant partners including the UN Development Programme (UNDP), German Development Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit, GIZ) and adelphi.

Conceptual foundations

The methodology and approach for the ACRA is based on the concept of "human security," which is people-centred, and includes economic, food, water, health, environmental, personal, community and political security. The framework also considers instability and fragility as the combination of exposure to risk, and insufficient coping capacity of the state, system and/or communities to manage, absorb and mitigate those risks. Political instability, (organised) crime, urban violence, terrorism and violent conflict are different ways in which insecurity manifests (OECD 2022b).

Climate-related risks, including climate-related security risks, are driven by a range of climatic hazards including slow-onset changes such as temperature rise, ocean acidification and changes in precipitation patterns, as well as fast-onset

events such as storms and floods. These hazards are referred to as climatic stressors or shocks. The impact of these climate stressors, including on security and peace, is dependent on the exposure and vulnerability of a certain community, economic sector or geographic area to the hazards. In this context, vulnerability means the degree to which geophysical, biological and socioeconomic systems are susceptible to, and/or unable to cope with adverse impacts of climate change.[1]

Climate-related security risks are driven by one or more climatic stressors that have certain direct and/or indirect impacts on human security, and challenge the peace and stability of states and societies. They are systemic risks that emerge through complex interactions between climate change, and different social, economic, environmental, demographic and political factors.[2] These interactions can be clustered around a number of specific impact pathways.[3] The concept of climate security risk pathways used in this framework is based on the best available knowledge and science in the field. Pathways are used to understand how climate change and insecurity are interlinked in specific contexts. They trace how specific climate impacts and security risks interact.[4]

Focusing on solutions

While the ACRA initially lays out the evidence of existing climate-related security risks, the main focus of the report is on solutions. The report includes an assessment of good practices and lessons learned that can help policymakers and practitioners link climate change adaptation to peacebuilding and conflict prevention. These good practices inform a series of actionable recommendations for policymakers on the regional and continental levels.

Data collection

The most effective approach to analysing climate-related security risks involves a combination of quantitative and qualitative data and methods. In particular, when exploring the knock-on effects of climate impacts – such as how increased extreme weather events or rising sea levels impact livelihoods, economies, social cohesion, conflict, political instability, trust in governments and GBV – qualitative data alone is often insufficient, while quantitative models are not yet able to capture the complex feedback loops and interactions linking climate impacts and security. Consequently, analysis of the available quantitative data should be combined with qualitative approaches.

The assessments of peace and security, contextual factors and pathways included qualitative data in the form of a thorough literature review and interviews. Slight differences, in particular between some of the regional chapters in terms of depth, are due to the fact that for some regions, such as Western Africa and Eastern Africa, research on climate-related security risks is much more advanced than in others, such as Northern Africa, Central Africa and Southern Africa. Moreover, consultations with key stakeholders were conducted for each region to gather inputs for the risk analysis, and to identify good practices and responses:

- The consultation for Northern Africa was held in Cairo in collaboration with the Cairo International Center for Conflict Resolution, Peacekeeping and Peacebuilding (CCCPA) on 30 April 2023
- The consultation for Eastern Africa was held in Nairobi in collaboration with the Intergovernmental Authority on Development (IGAD) on 5 May 2023
- The consultation for Southern Africa was held in Gaborone in collaboration with the Southern African Development Community (SADC) on 7 June 2023
- The consultation for Central Africa was held in Libreville in collaboration with the Economic Community of Central African States (ECCAS) and UN Regional Office for Central Africa (UNOCA) on 20 July 2023
- The consultation for Western Africa was conducted through various individual engagements with the Economic Community of West African States (ECOWAS) and regional experts between January and July 2023

A gender-sensitive and intersectional research approach ensured that the findings are disaggregated as much as possible by gender, age and identity groups to better understand the heterogeneity of risks and dimensions of resilience across contexts and actor groups. Special focus was put on capturing the voices and perspectives of marginalised groups that are harder to reach, including those of women, young people and people with disabilities.

To provide the best available quantitative climate change impact data for the analysis of climate-related security risks, the ACRA drew on the data and modelling work done by the Potsdam Institute for Climate Impact Research's (PIK) Inter-Sectoral Impact Model Intercomparison Project (ISIMIP). The ISIMIP provides a comprehensive and consistent picture of the world under different climate

change scenarios. It synthesises the results of various global and regional impact models to better understand how climate change impacts affect different sectors, such as water, agriculture and health, and how impacts on different sectors interact and amplify each other. Future climate impact projections are made for two future GHG emissions scenarios (representative concentration pathways, RCPs) under the SSP2 socioeconomic pathway.

RCP2.6 represents the low emissions scenario in line with the Paris Agreement, while RCP6.0 represents a medium-to-high emissions scenario. Please refer to the Annex for an explanation of how to read the plots provided in the regional chapters.

These models were used to provide scaled down data on a 50 x 50 km grid cell level for the following indicators:

Climate change impact indicators

Temperature and temperature change
Temperature change projections are based on daily mean near-surface air temperature data.

Runoff
Runoff is the amount of water discharged through surface and subsurface streams, including all precipitation, snow melt and irrigation water that is not absorbed by the soil nor evaporates.

Very hot days
Very hot days refer to days with a maximum near-surface air temperature above 35°C.

Heat-related mortality
Excess mortality attributable to heat is projected using the corresponding Tropical Rainfall Measuring Mission, which keeps population data from 2005 as a constant.

Soil moisture
Soil moisture projections are based on root-zone soil moisture estimates (the portion of soil moisture that is found within the rooting depth of plants).

Precipitation
Precipitation change projections are based on daily precipitation sums from the global climate models (GCM).

Crop yield
Crop yield projections are based on the global gridded crop models (GGCMs) and 2005 level land use patterns and agricultural management (irrigation, fertiliser use, growing seasons).

Sea level rise
National sea level rise projections were obtained from total sea level rise data averaged along the coastline of a country.

Heavy precipitation events
A heavy precipitation event is defined as a day in which the precipitation sum exceeds the 98th percentile of the daily precipitation sums of all wet days from 1861 to 1983, where a wet day is a day with a precipitation sum of at least 0.1 mm.

Species richness
Projections of species richness are based on probabilities of occurrence of amphibian, bird and mammal species.

Additional climate data from other sources was used to complement these projections, and to provide short overviews of past environmental and climatic changes where possible.

1 This is based on the definition of the IPCC (2018) and the conceptual approach put forward by the UN Climate Security Mechanism (2020).
2 This follows other research projects on the topic, such as CASCADES.
3 See the 10 Insights on Climate Impacts and Peace for a more detailed discussion.
4 For more information see www.weatheringrisk.org

11 insights on climate change, peace and security in Africa

The understanding of the links between climate change, peace and security has increased significantly over recent decades, and Africa is one of the best researched regions in the world on this topic. At the same time, a lot of the action to address climate-related security risks has focused on Africa, providing a strong foundation to identify emerging responses and good practices.

The following chapter summarises the main results of the ACRA structured along 11 insights on climate, peace and security. The first six insights focus on what kind of climate-related security risks Africa faces. These are followed by five insights on responses and good practices to address the security risks arising from climate change.

1. Natural resource management conflicts are an increasing and complex challenge

Increasing competition over natural resources is a key and growing climate security challenge across the African continent, especially because many Africans are directly dependent on natural resources for food and livelihood security. Climate impacts are compounding other pressures on natural resources such as land, water and forests, and are affecting access to and the availability of resources across the continent (IPCC 2022). In addition, pollution, and unsustainable land and water use – such as slash-and-burn farming and illegal mining or logging – cause biodiversity loss, soil degradation and deforestation across the continent. Where small arms are readily available, histories of conflict or social and ethnic cleavages exist, groups are marginalised, and natural resource and conflict management institutions are dysfunctional. This competition can turn into violent conflict (Dutta Gupta et al. 2021). For example, empirical research suggests that heat shocks, due to their impacts on crop yields and water availability, can increase the probability of conflicts by more than 50 per cent across the continent (Eberle et al. 2020).

MORE THAN JUST FARMER-HERDER CONFLICTS

While a lot of the research, literature and discourse on natural resource conflicts in Africa focuses on the well-documented cases of farmer-herder conflicts, the analysis in the regional chapters of this report clearly shows that the reality of natural resource conflicts is much more complex, involving different groups, resources and sectors. Herder-farmer conflicts are still present and an important challenge. However, for example in Eastern Africa, most violence involves pastoralists, as cattle raiding has turned from a tradition to a criminal business (IGAD CEWARN 2022b).

At the same time, conflicts between other groups, such as between farmers and fishers or between fishers and herders, have been increasing. Mining and its impacts on the environment are also creating conflicts between states and companies on one side, and local communities that feel excluded from the benefits while enduring most of its negative impacts on the other. For example, the conflict in northern Mozambique has among its root causes the mining of rubies and liquefied natural gas (LNG). The lack of fair governance and benefit sharing has created grievances that radical Islamists have exploited (Pirio et al. 2019; Ewi et al. 2022). Similarly, conservation efforts, while essential for the resilience and sustainability of African societies and globally, are also leading to conflicts with local communities and armed groups (Yitbarek 2020). For example, in the Congo Basin, the militarisation of conservation has contributed to an escalation in rent-seeking behaviour among environmental officers, as well as human rights violations and abuses against indigenous populations (Verweijen and Marijnen 2018). Finally, climate change is not only driving conflict between humans but also increasing human-wildlife conflicts, especially around conservation areas (Nyhus 2016).

IMPORTANT RISK FACTORS AND LOCAL DIFFERENCES

What these conflicts have in common is that the potential for violence is higher where political and social problems and conflicts already exist. Exclu-

sion and marginalisation often play an important role, as do existing social cleavages (Raleigh 2010; Dutta Gupta et al. 2021). This becomes especially explosive when political or business elites instrumentalise issues around land and water for their own benefit, and leverage their positions of power to ensure their own access to the exclusion of others. In general, political and business elites play an important role in either mediating or escalating conflict risks (Kanyangara 2016; Caroli 2023; Ferre Garcia et al. 2023; Sax et al. 2023).

Governance structures around natural resources are also important mediating factors. If they are functional, inclusive and legitimate, they can help to prevent conflicts and manage increasing pressures peacefully. Where they are not, they often exacerbate risks. Gender, ethnicity and other identity factors play an important role in these dynamics, while natural resource management often mirrors broader issues of marginalisation, such as the exclusion of women from decision-making structures and land ownership (Abebe 2014).

Another commonality is that the majority of these conflicts are sub-national and local conflicts, and as such the local context strongly influences their dynamics. Often the political economy, and actors, drivers and dynamics of conflict differ from one community to the next within the same region or country. The role of traditional leaders and other local conflict resolution mechanisms are often key in understanding and addressing these conflicts (Ide et al. 2014; Linke et al. 2015; van Baalen and Mobjörk 2018; Nhamirre et al. 2023).

INTER-STATE CONFLICT DYNAMICS

In addition to these local dynamics, competition over natural resources between states is increasing, particularly over transboundary water resources. This competition has up to now mainly led to political tensions between states and undermined cooperation, particularly around water basins such as the Nile Basin, the Juba-Shabelle Basin and the Zambezi Basin (FAO SWALIM n.d; Petersen-Perlman 2016). Large-scale infrastructure developments, particularly dams and irrigation infrastructure, often serve as triggers for tensions (Climate Diplomacy n.d.e, n.d.f, n.d.j). Looking into the future, the key question is whether the existing management institutions in many parts of the continent are capable of managing the increasing and converging pressures of economic development, population growth and climate impacts peacefully.

2. Livelihoods, and food, water and energy security are under pressure

Livelihoods, and food, water and energy security are under pressure across the continent. Climate impacts are increasingly aggravating other challenges around food, water and energy security. For example, close to a third of the total African population, some 424 million people, have no access to basic water services, with over 80 per cent of these people living in rural areas (AfDB 2023c). Similarly, access to cheap and reliable energy is often lacking, with an estimated 567 million people in Central Africa, Eastern Africa, Western Africa and Southern Africa lacking access to electricity (AfDB n.d.). Globally, the countries with the largest number of people without access to electricity are Nigeria (86 million), the Democratic Republic of the Congo (DRC) (76 million) and Ethiopia (55 million) (World Bank 2023g). At the same time, over 60 per cent of Africans face moderate-to-severe food insecurity, with 20 per cent undernourished (FAO et al. 2023). Food security is particularly strained by climate change, partly due to the fact that 90–95 per cent of African food production relies on rainfall. Since 1961, climate impacts have reduced the productivity growth of crops by 34 per cent, and maize and wheat yields have decreased across sub-Saharan Africa since 1970 (IPCC 2022). In already unstable situations, livelihood, food, water and energy insecurity can overwhelm governments and population groups, leading to a range of security-related challenges.

PROVISION AND PRICES AS A CATALYST FOR POLITICAL INSTABILITY AND PROTESTS

Disruptions to food, water and energy provision, and rapid price increases can feed pre-existing grievances, and trigger political instability and protests. For example, especially rapid increases in food prices have triggered protests across the continent (Zaki 2008; Johnstone and Mazo 2011; Lagi et al. 2011; Alshammari and Willoughby 2017; Soffiantini 2020; Ewi et al. 2022; Nhamirre et al. 2023). In addition, a lack of water and electricity provision have contributed to discontent. For example, in Libya, the ongoing conflict has repeatedly disrupted the power grid and power outages have become a focal point of public discontent, resulting in protests (Middle East Monitor 2014; Elumami and Al-Warfali 2022).

Import dependency and subsidies play an important role in these dynamics. Governments use subsidies for electricity, water and food to keep prices affordable. However, when global prices for commodities increase and/or local production cannot keep up with demand, governments may not be able to afford these subsidies any longer, making the relative price increases even greater. At the same time, subsidies often disincentivise the rational use of resources and can thus increase demand. This can, for example, be seen in Northern Africa's water governance. Domestic policy has, hitherto, often encouraged overconsumption by offering substantial subsidies to consumers, despite being one of the most water-stressed regions of the world (World Bank 2018). In addition, subsidies can have other unintended negative impacts. For example, widely employed food subsidies usually apply to select staple items such as bread and oil, which guarantee a high carbohydrate intake, but are nutritionally incomplete. Subsidies can, thereby, incentivise malnutrition. Egyptian food subsidies have been associated with negative health outcomes because of their emphasis on calorie-dense foodstuffs (Ecker et al. 2016). This effect is particularly pronounced during periods of economic shock and food price rises, when poorer Egyptians fall back on subsidised, less diverse and unhealthier diets (Abay and Karachiwalla et al. 2023).

DISASTERS AND THEIR LONG-TERM CONSEQUENCES

Weather-related disasters are increasing across the African continent. In 2022 alone, three tropical cyclones and two tropical storms hit Southern Africa, killing more than 890 people and displacing around 700,000 people. Between 2020 and 2023, Eastern Africa was hit by the longest and most severe drought on record, leading to at least five failed rainy seasons that displaced 2.1 million people in Somalia, Ethiopia and Kenya (IDMC 2023).

In addition to the loss of life, destruction of infrastructure, displacement and humanitarian crises they cause, weather-related disasters can exacerbate the risk of violence and political instability. Especially when government responses to disasters are perceived as unfair or insufficient, government responses can add to pre-existing grievances and trigger political protests (Ide et al. 2020; Owusu-Sekyere et al. 2021). One cross-regional study of drivers of flood-related political unrest found that the exclusion of ethnic groups from political power is an important risk factor (Ide et al. 2021). A case in point is the 2018 flooding of the Gagere River in northern Nigeria, an area marked by marginalisation and discrimination. The flooding resulted in over a hundred deaths and affected more than 19,000 farmers, triggering protests among flood victims who perceived government aid to be slow and inefficient (Ide et al. 2021). Further protests occurred in Mozambique and Zimbabwe following Cyclone Idai in 2019 when affected populations were left without adequate food, energy and water (Madurga Lopez et al. 2021).

At the same time, the costs of these disasters undermine the ability of governments to provide basic services and support development. In 2020, Ethiopia experienced flooding that caused an estimated USD 135 million in damages (Harmeling et al. n.d.). Meanwhile, the costliest natural hazard-induced disaster in Africa was Cyclone Idai in 2019, which resulted in an estimated USD 2.1 billion in damages. Between 1970 and 2021, disasters attributed to weather, climate and water extremes caused a combined USD 43 billion in damages (WMO 2023). These losses limit the ability of governments to invest in development, which can further constrain their capacities, undermine state legitimacy and drive anti-state sentiments.

MALADAPTATION

Communities and groups that experience increasing livelihood insecurity try to adapt as best as they can. In some cases, this means taking up livelihood activities that have negative effects on the environment, harm others or undermine social cohesion and stability. This includes participating in environmentally destructive activities, such as slash-and-burn farming, felling trees to produce charcoal, poaching, illegal fishing or engaging in small-scale mining (Scales and Friess 2019; Foong et al. 2020b). Some of these activities are also used by armed groups to finance themselves. For example, Al-Shabaab imposes taxes on and controls revenues from charcoal production in Somalia, while artisanal gold mining has become an important source of revenue for the Rapid Support Forces (RSF) in Sudan (Climate Diplomacy n.d.a; Bolognesi et al. 2015; Waal 2019).

3. Climate-induced human mobility creates opportunities and risks

Human mobility has been an integral part of the way of life for many communities across Africa for centuries. It remains an important part of livelihood activities, and coping and adapting to change. Economic, social, cultural, political and environmental factors are all shaping who, how and why people move. Climate impacts are increasingly playing a role in these dynamics and are accelerating a number of mobility trends. In general, migration has been increasing across the continent. Since 2010, the number of migrants in Africa has increased to 40 million, an increase of 30 per cent (IOM 2020a; Africa Center for Strategic Studies 2023).[5] Especially when movements are sudden, at a larger scale, irregular and/or unplanned, security risks for those who are moving as well as for host communities are likely to increase. Receiving areas often also face increasing pressures that, if not managed well, can develop into tensions and conflicts. However, if migration is well-managed and coordinated, it is and remains an important driver of economic development and resilience (Amakrane et al. 2023).

INTERNAL MIGRATION

First and foremost, climate impacts shape migration within countries, particularly from rural areas to cities, which constitutes by far the largest migration trend on the continent. Africa is the most rapidly urbanising continent in the world, with the percentage of people living in cities having grown from 15 per cent in the 1960s to 43 per cent in 2018, and this number is projected to exceed 50 per cent by 2030 (Mbiyozo 2023). This trend will be most pronounced in Western Africa and least in Eastern Africa (Cilliers 2018). By 2050, internal climate mobility within countries could reach up to 113 million people. The map in Figure 3 depicts the main internal climate mobility hotspots across the continent. The most affected region is expected to be Eastern Africa, where by mid-century over 10 per cent of the population, up to 55 million people, could be on the move internally due to climate impacts (Amakrane et al. 2023).[6]

Continental hotspots depicting the number of people moving out of and into specific areas owing to climate impacts

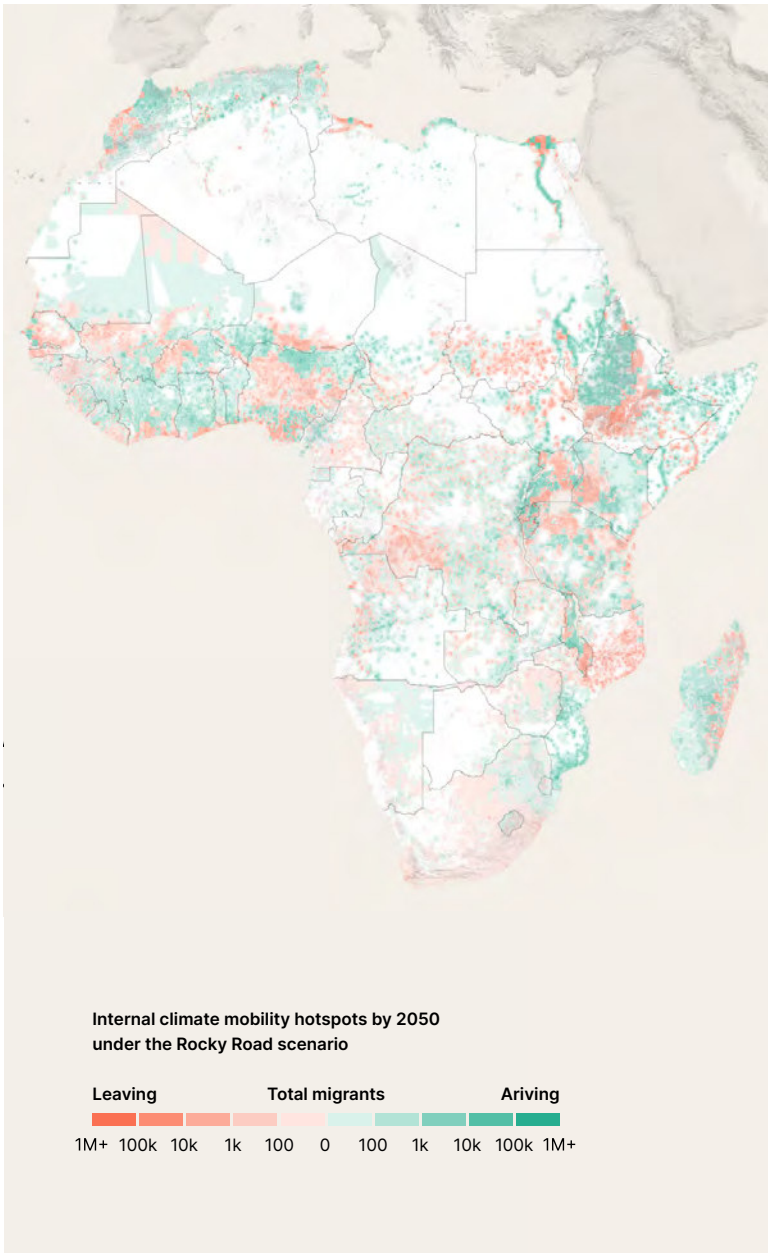


Figure 3: Climate mobility hotspots across the African continent (Amakrane et al. 2023)

5 This includes migration within, to and from Africa. However, it is very likely that this number is much higher in reality, as porous borders between countries lead to underreporting and many African countries have large data gaps regarding migration statistics.

6 This projection assumes a "rocky road" scenario in which global emissions are high and global warming is at least 2°C by 2050, as well as low levels of cooperation, high population growth, limited economic expansion and low educational attainment.

While cities often offer better access to education, health care and other services, newly arrived migrants also face significant risks. Between 2000 and 2030, the extent of urban land that is exposed to arid conditions and high-frequency flooding will likely increase by 700 per cent and 2,600 per cent respectively across Western Africa, Central Africa and Eastern Africa (Amakrane et al. 2023). This is especially the case in rapidly urbanising areas and informal settlements. In these areas, migrants often also face risks in terms of high levels of urban crime and insecurity. When cities cannot cope with the rapid inflow of new migrants, and offer access to services and livelihoods, tensions between population groups and grievances against governments can emerge. This can feed into conflicts and political instability, which is already largely urban based. In the future, instability in Africa is likely to predominately affect cities, particularly ungoverned and unplanned urban sprawls, rather than rural areas (Cilliers 2018). Against this background, fast-growing cities are emerging as climate security hotspots across the continent (Amakrane et al. 2023).

While rapid urbanisation is expected to continue, coastal cities across the continent could increasingly become sources of rather than destinations for climate migrants, with some estimates projecting up to 4.2 million climate migrants leaving cities by 2050. This is because of the higher exposure of coastal cities to sea level rise and coastal flooding, which could slow urban population growth rates. This is particularly the case for low-lying coastal cities in Western Africa and along the Gulf of Guinea, as well as areas along the northern coasts of Mozambique (see Figure 3) (Amakrane et al. 2023).

In addition to rural-urban migration, rural-rural migration is a widespread trend across the continent. Population groups move from areas where livelihoods are under pressure to other rural areas that offer better livelihood opportunities. For example, small-scale mining is often a major pull factor for migration, as evidenced by populations in Zambia and Zimbabwe migrating to mining sites in rural areas to cope with livelihood insecurity and climate change impacts, which has led to heightened vulnerability in both countries (Sax et al. 2023). All these internal migration trends also affect the areas that people leave. As the young, strong and better educated leave, these places experience significant demographic changes that can make them more vulnerable. At the same time, remittances sent back to these communities often play an important role in enabling people to remain at home (Amakrane et al. 2023).

DISPLACEMENT

Climate change is increasing the frequency and severity of weather-induced disasters, and with it the risk of displacement. At the same time, conflict is a major driver of displacement. As a result, displacement across the continent has been on the rise, tripling over the past decade to a record 36 million people in 2022 (Africa Center for Strategic Studies 2022a). In terms of internal displacement across Africa, around nine million people were displaced by conflict and seven million by disasters in 2022. This was an increase of around 17 per cent year-on-year, mainly driven by a three-fold increase in disaster-related displacements (IDMC 2023) (see Figure 4).

Displacement often goes hand-in-hand with a number of risks. Vulnerable social groups – such as people with low socioeconomic status, women, young people, children, people with disabilities and other minorities – face particularly high risks. For example, displaced women across Central Africa and Eastern Africa face heightened risks of GBV. This is due to the lack of employment opportunities, which are essential for maintaining financial independence from abusive partners, as well as the specific household roles such as fetching water and collecting firewood that women often undertake (Destrijcker and Foong et al. 2023). Female IDPs are also confronted with limited access to basic services, social safety nets and psychosocial support services, which disproportionately affects their physical and mental health and wellbeing (Laëtitia 2022; Siegfried 2022).

At the same time, challenges often arise in receiving areas. The situation in refugee camps and IDP settlements is often dire, and the large population concentrations put local water, energy and food resources under pressure (IOM 2020a). For example, in the Dadaab refugee camp located in north-eastern Kenya, the growing influx of refugees in and around the camp is putting pressure on grazing and water resources, affecting local pastoral activities, and giving rise to tensions and violence between and within host and refugee populations (Kumssa et al. 2014).

On the other end of the spectrum, there are also populations confronting disasters and extreme events that are unable to move due to various

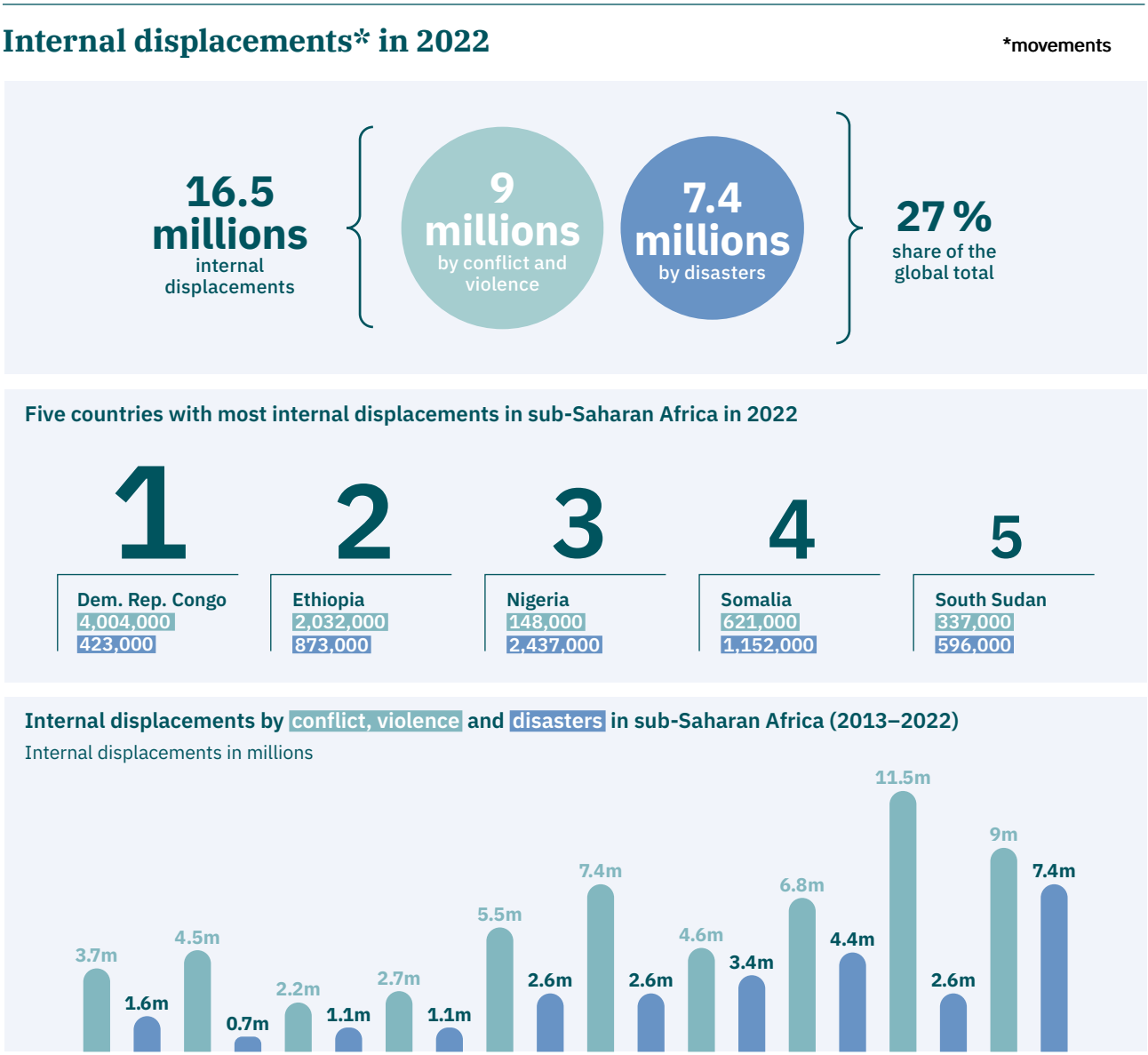


Figure 4: Number of internal displacements due to conflict and violence, as well as disasters across sub-Saharan Africa between 2013 and 2022. Internal displacements refer to the "number of forced movements of people within the borders of their country recorded during the year" (IDMC 2023)

socioeconomic reasons. Such trapped populations often lack the assets and social connections necessary to move in the first place, forcing them to endure further risks and vulnerabilities in their places of origin. Evidence of populations trapped by climate-related factors can be found in Zambia, where impoverished districts affected by extreme temperatures and droughts are characterised by high levels of immobility (Nawrotzki and DeWaard 2018).

REGIONAL

While most migrants tend to move within their own countries as it requires fewer financial resources and social networks, those who cross borders largely remain within the same region, typically moving to neighbouring economic hubs (Africa Center for Strategic Studies 2023; Mbiyozo 2023). Although this migration is commonly understood and described as being driven by economic reasons, climate risks and their impacts on livelihoods are increasingly influencing these movements. For example, within the SADC region, between 200,000 and 800,000 people are projected to migrate between countries because of climate change by 2050 (Amakrane et al. 2023).[7]

7 This projection assumes a "high road" scenario in which global emissions remain high and global warming is at least 2°C by 2050, as well as low population growth, high urbanisation, medium GDP, high educational attainment and the widespread adoption of inclusive development in Africa.

There are significant differences between African regions in terms of how easy it is for people to move and integrate into local labour markets. ECOWAS member states, for example, adopted a protocol in 1979 stipulating the rights of member state citizens to enter, reside in and establish economic activities in other countries in the region (UNECA n.d.b). Elsewhere, Uganda passed the progressive Refugee Act in 2006, which covers refugees' rights to work, freedom of movement and settlement, providing refugees an opportunity to earn a living, attain food security and access essential services (Akello 2009). Observers have pointed out that this open door policy has enabled refugees to contribute productively to Uganda's local economy, while at the same rebuilding their lives and communities (World Bank 2016).

However, the same level of support and welcome is not the case in other regions. In Northern Africa and Southern Africa, xenophobia has increased as politicians use migrants as scapegoats for economic, social and political problems. This has led to violent attacks against African migrants and refugees from outside the region, along with arbitrary arrests and collective expulsions from the country (Le Roux 2021; Cordall 2023). The situation for migrants and refugees transiting or residing in Tunisia is made even more challenging with the recent signing of an memorandum of understanding between the European Union and Tunisia on border management and migration controls (HRW 2023b). Similar instances can also be seen between African island states in the South-West Indian Ocean. In April 2023, Mayotte (which is a department of France) launched an operation to deport irregular migrants to their countries of origin, many of whom are from the Comoros and are seeking livelihood opportunities in the comparatively wealthier French department (Fabricius 2023).

Regional migrants tend to move to cities in neighbouring countries, further contributing to increasing pressures and challenges in urban areas. For example, in South Africa, townships with significant challenges in terms of infrastructure and poverty are the primary receptors of migrant populations (Le Roux 2021). In this context, migrants are often seen as competitors for scarce jobs, health care and housing (Sax et al. 2023). Increasing anti-migrant campaigns have led to incidents of looting shops and vandalising property, as well as instances of vigilante justice targeting suspected criminals and the killing of immigrants (UN 2022b).

Another form of regional mobility is seasonal migration, particularly in the form of transhumance in which pastoralists move between countries in search of pasture and water for their livestock (IOM 2022d). While this kind of mobility has a long tradition and history, it faces increasing challenges due to climate change, population growth and government interference. Many countries have imposed limitations on such movements, and pastoralists face political and social marginalisation. An area particularly affected by seasonal migration and transhumance-related insecurity are the borderlands between the Central African Republic (CAR), Chad and Cameroon. For example, in the Far North region of Cameroon, nomadic pastoralists have for generations migrated seasonally to the Waza-Logone flood plain, mostly coexisting peacefully with local farming communities. However, with increased climatic and environmental pressures, fertile land has become extremely scarce, resulting in conflicts between local farmers, sedentary agropastoralists, transhumant pastoralists and wildlife. Increased climate variability and unpredictability further aggravate this situation as nomadic pastoralists often extend their stay beyond the season (Huchon et al. 2020).

INTERNATIONAL

People tend to move first within countries and then to neighbouring countries. Only a small percentage of people move internationally, as doing so requires far greater financial resources, and often comes with more legal challenges and safety risks (Mbiyozo 2023). Some estimates suggest that cross-border climate mobility will only reach a maximum of 1.1 million people by 2050, compared to 113 million people moving within countries (Amakrane et al. 2023).[8] International climate-induced migration from the African continent to other continents is smaller compared to migration within the continent.

In the absence of sufficient and regulated ways to migrate, a significant share of movement is likely to be irregular. Data on irregular international migration is limited due in part to the inherent nature of such migration that takes place outside regulatory norms (IOM 2020a). Nevertheless, the drivers and consequences of such migration are

8 This projection assumes a "rocky road" scenario in which global emissions are high and global warming is at least 2°C by 2050, as well as low levels of cooperation, high population growth, limited economic expansion and low educational attainment.

important considerations for the overall security landscape of the African continent and beyond. For example, irregular international migration puts migrants at a high risk of being captured by criminal and non-state armed groups that engage in smuggling activities. The growing securitisation of borders both within Africa and globally means that migrants seeking to move internationally have limited access to legal channels for movement and frequently have to resort to more dangerous routes. This exposes them to a heightened risk of exploitation by migrant smugglers and human traffickers (IOM 2020a).

Some of the most dangerous intercontinental migration routes include the trans-Saharan route and the Mediterranean crossing, as well as the Red Sea crossing (Molenaar and El Kamouni-Janssen 2017). The latter, through which thousands of Ethiopian migrants and refugees pass on their way to Saudi Arabia, is considered among the deadliest routes in the world (Frouws and Horwood 2023). Migrants who move internationally face significant risks in terms of abuse and personal safety. Women and children face particular risks in terms of GBV and abuse, as well as of becoming victims of human trafficking, being exploited and discriminated in destination regions outside the continent (Sultan and Mlowezi 2019).

4. Non-state armed groups are actively exploiting climate security risks and governance issues

Climate-related security risks provide a fertile breeding ground for non-state armed groups such as militia, terrorist and criminal groups in Africa. Climate impacts also affect their tactics (Carter and Veale 2015). Where state institutions are perceived as weak, corrupt or illegitimate, these groups exploit the gaps left by the state to provide services and governance. Climate impacts through their effects on livelihoods contribute to the ability of these groups to recruit new members and make the use of natural resources as weapons more viable (Maystadt and Ecker 2014; van Baalen and Mobjörk 2018; Foong et al. 2020b).

BUILDING LEGITIMACY AND STRENGTH

There are a number of ways in which armed groups fill governance gaps. In Somalia, Al-Shabaab is providing cash and humanitarian aid to communities affected by the impacts of droughts, and the resulting poverty and lack of employment opportunities (Maystadt and Ecker 2014). In central Mali, armed groups have established themselves as providers of conflict resolution mechanisms and access to justice for disputes over natural resources, in the absence of effective governance by formal authorities (Ursu 2018). In poverty-stricken and marginalised regions of northern Mozambique, the extremist group Ahlu Sunnah wa-I-Jama'ah (ASWJ) has in the past attempted to gain legitimacy, especially among young people, by offering their own form of religious education (Pirio et al. 2019; Hamming 2021). In many areas of the CAR, armed groups regulate pastoralism through well-established systems of illegal taxation, as they control many of the country's key transhumance corridors. In these cases, pastoralists are required to provide services to armed groups and become – sometimes against their will – associated with them (Huchon et al. 2020).

RECRUITMENT

Recruitment into armed groups is a complex phenomenon driven by a range of factors. Negative experiences with state security services are often important drivers as are marginalisation, ethnic divisions, ideology, religion and socioeconomic factors (Alimi et al. 2012). However, recruitment often occurs against the background of livelihood insecurity, and lacking social and economic perspectives. Especially young people might see the economic incentives these groups provide as a way to escape hardship (Moaveni 2019; Vivekananda et al. 2019).

By further undermining local livelihoods climate impacts are exacerbating these dynamics. For example, in Somalia, many IDPs lack access to services, jobs and natural resources, and Al-Shabaab takes advantage of the lack of livelihoods, social cohesion and security in IDP camps, which have become significant recruitment grounds (Broek and Hodder 2022). Similarly, Boko Haram was able to ramp up its recruitment and violent activities in the Lake Chad region against a backdrop of social and economic inequality, and political marginalisation, which was compounded by the challenges local communities face in adapting to increasingly uncertain climatic conditions (Vivekananda et al. 2019). Similar instances have been observed among young pastoralists in Eastern Africa, particularly those facing high levels of political exclusion and injustice (IGAD CEWARN 2023). Likewise, in Central Africa, young people in rural communities have been enticed into joining armed

groups, with these groups promising greater socio-economic opportunities and help in protecting livelihoods, such as cattle and farmland (de Brier et al. 2020; Semba 2021).

ENVIRONMENTAL DEGRADATION AND FINANCING

Conversely, armed groups often exacerbate environmental challenges. Illegal resource extraction, and environmental crimes such as poaching, and illegal logging and mining are important sources of revenue for these groups. While this phenomenon occurs across the continent, the Congo Basin is a particular hotspot where these activities threaten the world's last remaining net carbon sink (see Congo Basin box) (Hillert 2023; Vinke et al. 2023). The DRC has an estimated deforestation rate of 0.83 per cent per year, ranking just behind Brazil and ahead of Indonesia in terms of net forest loss for the period 2010–2020 (FAO 2020). Over the past decade, violent extremist groups have spread across the Central Sahel, gaining control over smuggling and trafficking networks, as well natural resource sectors such as pastoralism, forestry and mining (Nagarajan 2022). Armed groups are also benefiting from livelihood practices that inadvertently further degrade environments. For example, Al-Shabaab wields control over taxes and revenues from charcoal production in Somalia (see Eastern Africa chapter section on armed groups).

TACTICAL CONSIDERATIONS

Climate impacts are influencing the tactical considerations of armed groups, shaping their decisions on when, where and how to operate. For example, wetter conditions can help with camouflage and drier conditions can make movement easier (van Baalen and Mobjörk 2018). This was, for example, the case in Uganda where the timing of rainfall events significantly influenced when conflict actors decided to act (Carter and Veale 2015).

At the same time, climate-related hazards can impede the operation of militaries and peacekeeping operations, particularly if they fail to anticipate extreme weather events. Unprecedented floods in South Sudan, for example, have hindered aid delivery and civilian protection in the past, and the UN Mission in South Sudan (UNMISS) has had to build up its capacities and adapt its preparations in anticipation of extreme weather events (Mandoreba 2023).

Another dynamic that can be observed is that armed groups target natural resources as part of their operations. For example, in Libya, militant groups have systematically attacked water pipes, leading communities to drill private wells and thereby exacerbate water scarcity (Gatenby 2017). Between 2012 and 2017, Al-Shabaab captured water points along the Juba and Shabelle rivers, poisoned water wells, and destroyed critical water infrastructure (Mohamud 2022; Strategic Foresight Group 2022). Similarly, in the CAR, armed groups have reportedly weaponised water resources by destroying water facilities and restricting access to water, both for civilians and enemy groups (Ngueuleu Djeuga 2015).

MARITIME SECURITY

Armed groups are increasingly active at sea and in coastal areas. Since March 2020, the armed group ASWJ has launched attacks on ports and coastal towns in northern Mozambique from the Indian Ocean. Although no longer in control of key port cities in Somalia such as Kismayo and Mogadishu, Al-Shabaab continues to use maritime tactics to boost its revenues, for example, through cargo smuggling and taxation (Lycan et al. 2020).

Many coastal African countries and particularly small African island states with their large exclusive economic zones (EEZs) have limited enforcement capacities, and can only partly control illegal fishing, trafficking activities and maritime terrorism (Hamad 2016). The growth of these activities has in some cases been climate related. For example, in Somalia, a combination of droughts and increase in foreign industrial fishing vessels has contributed to a rise in piracy (Belhabib et al. 2019).

Some African island states have also become hubs for smuggling and trafficking. In Western Africa, island states such as Cabo Verde are particularly affected by international drug trafficking routes originating in Latin America and destined for European markets. In the southwestern Indian Ocean, African island states are affected by their proximity to a major heroin trafficking route, and growing regional methamphetamine and cocaine routes. This has led to the growth of illicit criminal networks, both local and international, and corruption has been a key factor facilitating these developments (Bird et al. 2021). Island states in the region also lie along several transregional human trafficking routes, and serve as countries of origin, transit and destinations for victims of sex and labour trafficking (see African island states box).

5. Climate-related security risks in Africa have a geopolitical dimension

The way climate-related security risks play out on the African continent is highly dependent on and influenced by a number of external risks and pressures. Policies in other parts of the world impact livelihood and food security, as well as migration on the continent (Faruk and Bearak 2020), and multinational companies can exacerbate challenges around governance, environmental degradation and natural resource management. Africa's mineral and renewable energy resources offer opportunities and risks for a green transition, both within the continent and globally.

GLOBAL FOOD SUPPLY AND PRICES

Economic policies in countries outside Africa and developments on global markets influence food security in Africa. Many African countries, particularly in Northern and Western Africa, are highly dependent on food imports, and consequently on global markets and the policies of food producing countries. Past global food price crises have shown how prices can rise quickly through a combination of supply shocks caused by weather extremes and conflict, global market speculation, and policies such as export bans (Detges et al. 2020). These quick increases in food prices strongly affect local food security and provision, which when disturbed can increase grievances and risks of political instability (Alshammari and Willoughby 2017).

Fisheries is another area where countries outside of the African continent through their international fishing fleets can negatively impact local livelihoods and drive security-related issues, such as drug trafficking and piracy. This is particularly the case for coastal countries in the Horn of Africa and island states in the southwestern Indian Ocean. Due to their extensive EEZs, and limited governance capacities for monitoring and enforcement, many African coastal and island states are facing challenges in regulating the incursion and activities of foreign and oftentimes illegal fishing fleets. This not only exacerbates the issue of depleting fish stocks, but also creates tensions with domestic small-scale fisheries and has been one of the contributing factors to the rise in piracy in the region since the 2000s (Belhabib et al. 2019).

MULTINATIONAL COMPANIES, CORRUPTION AND RESOURCE EXTRACTION

Multinational companies can offer opportunities for socioeconomic development but also play an important role in exacerbating climate security risks, especially when they engage in corruption or rent-seeking behaviours, which can weaken state legitimacy and fuel grievances. At the same time, the practices of multinational companies can also harm the environment, for example, by accelerating deforestation rates and exacerbating the health risks faced by local populations through pollution (Sonno and Zufacchi 2022a).

The private sector can also be involved as conflict actors, particularly around natural resources. For example, companies can play a role in land-grabbing for large-scale agriculture and mining operations that can increase the risk of conflict in a given area (Sonno 2023). Such cases can be found in Liberia, for example, where private logging companies have been linked to political elites and multinationals. The activities and revenues of these logging companies have contributed to violence and conflict in the country in the past (Global Witness 2017). Similar trends have also been observed in areas of Eastern Africa, where competition over land is rising as a result of the increasing privatisation of land and acquisition by external investors (IGAD CEWARN 2021).

The risk is further amplified when politically unrepresented or marginalised groups are excluded from the benefits generated from multinational company activities (Sonno 2020; Sonno and Zufacchi 2022b). In the Congo Basin rainforest, companies involved in illegal logging or extractive industries have further marginalised indigenous groups (Schouten et al. 2022). Likewise, in various areas of Southern Africa such as Mozambique's Zambezia province, policies labelled "climate smart" have reportedly facilitated land grabbing by foreign investors for forest plantations, biofuel production and conservation. Moreover, these policies have often failed to take into account the needs and benefits of rural communities (Neef et al. 2023).

TRANSITION RISKS AND OPPORTUNITIES

Africa holds 30 per cent of the world's mineral reserves. These often critical minerals are crucial for the green transition, and include cobalt in the DRC, manganese in South Africa and lithium in Zimbabwe (SAIIA 2022). As the global demand for these minerals rises, these deposits present both risks and opportunities for Africa.

Extractive industries have a history of causing environmental harm, driving conflict and armed group activities. In addition, the extractive industries have been associated with labour and human rights violations and abuses, child labour, forced displacement, and corruption (Burger 2014; Idemudia et al. 2022). The mining sector in general has a long and complicated history on the African continent. Too often, resources have been exported without significant local value addition or broad development gains. A typical example of mining conflicts revolves around water. In Southern Africa's Okavango Delta, mining activities led to increased water consumption and pollution, impacting the region's ecosystem and the livelihoods of local communities (Darkoh and Mbaiwa 2014; Mosepele et al. 2018). Similarly, in South Africa, the Waterberg Coalfield has been the site of a protracted conflict between mining companies and local communities over water use and pollution (Ololade 2018; Simpson et al. 2019).

However, the extractive industries can also generate much needed revenue and provide support for social services. Looking into the future, as countries transition to greener and more sustainable energy production and industries, the demand for certain resources will increase and new sectors in green energy production could be developed across the African continent. This could provide opportunities, but only if past dynamics can be avoided. For example, green hydrogen produced by using solar power has a large potential for domestic use and export, particularly for countries in Northern and Southern Africa (EIB et al. 2022). However, it runs the risk of mirroring the export of other raw materials from the continent without adding much value locally.

MIGRATION

Migration is another area where policies from beyond the region have significant impacts on Africa, especially when these are driven by efforts to curb migration instead of allowing for regular and planned migration. Such policies are increasing risks for those who wish or need to move, and indirectly support groups that profit from irregular migration, which in turn exacerbates the vulnerabilities that migrants face. Some examples include the trafficking networks that exist around dangerous sea crossings, such as the Mediterranean Sea and Red Sea migratory routes (Molenaar and El Kamouni-Janssen 2017; Frouws and Horwood 2023).

Africa's large young population has the potential to drive economic development not only for the continent, but also for many high-income countries with aging populations on other continents that are facing significant risks to their own economic and social development. For example, several high-income countries in Asia, Europe and North America are facing shortages in their domestic workforces, particularly concerning elderly care. This challenge could be addressed by welcoming international migrant workers through ethical and sustainable recruitment pathways (Kumar et al. 2022).

6. Climate-related security risks are intersectional

There are a number of individual risk factors that shape how climate-related security risks affect individuals. These include low socioeconomic status, migration and displacement, gender, youth, disabilities, and ethnicity. Overall, women are disproportionately more vulnerable to disasters caused by natural hazards, particularly in terms of personal safety and GBV (Awiti 2022).

Social groups that lack social capital and have historically been marginalised often have limited access to resources, capacity-building opportunities, services, institutions and technologies necessary for coping with and adapting to climate change (Awiti 2022; Ayanlade et al. 2023). However, vulnerabilities are intrinsically intersectional. Weather-related disasters are a case in point. Not all similar-gendered people share the same risks factors. For example, a young, impoverished, single mother or an LGBTQ+ individual will be affected by an event differently than an affluent young mother or heterosexual individual, as climate change amplifies and interacts with various socioeconomic vulnerabilities experienced by specific groups (Mbiyozo 2022). Intersectional climate vulnerabilities manifest themselves in different ways, for example, in people's socioeconomic status, livelihoods, food security and mobility.

SOCIOECONOMIC STATUS

People's financial means play a critical role in their capacities to cope with the effects of climate change. In particular, when income is highly dependent on weather conditions, such as for herders and farmers, a person's access to resources can provide a crucial safety net when faced with climate hazards. For example, in the Horn of Africa,

wealthier pastoralists can more easily sell their livestock or assets in times of drought, diversify their income by purchasing land and focusing on irrigated cultivation or by investing in less climate-sensitive activities, such as starting a new business (Rodgers 2022).

A person's ability to cope with climate and environmental pressures is affected not only by individual or household access to resources, but also by one's educational background and social position in relation to others. Due to their lower social status in many societies across Africa and especially in rural areas, women are disproportionately more vulnerable to natural hazards (Awiti 2022). For example, drought-induced stress can drive harmful patriarchal practices, including differential feeding, child marriages and domestic violence (Soliman et al. 2022). Research in Southern Africa has found that women in drought-affected areas face a higher risk of domestic physical and sexual violence than women in non-drought areas (Epstein et al. 2020). Women also tend to face more constraints in market access and control over resources, which are both critical to building climate resilience (WFP 2019).

In most rural areas, women typically fulfil traditional domestic roles such as fetching firewood and water. However, environmental degradation can push women to travel longer distances or traverse hostile terrain, which exposes them to higher risks of violence (IFAD 2020). Longer and more arduous journeys also mean that women and children have less time to fulfil other household responsibilities, which can create tensions within households (Gevers et al. 2019).

Finally, as seen in many pastoral societies, the implementation of statutory, formal systems of land use and ownership has caused the breakdown of communal and customary natural resource governance. This has led to adverse impacts on women, who – due to their social roles and inequalities – tend to fall "between two stools" (i.e. that of customary practices and that of formal governance tenure). This materialises in the increased marginalisation of women (Flintan 2011).

LIVELIHOOD AND FOOD INSECURITY

The kind of livelihood activities individuals can engage in is often influenced by gender, ethnicity and age, which influences the risks or resilience of individuals to climate-related impacts. In particular, men often dominate natural resource management, while women are excluded from decision-making and, in some cases, even ownership, which reduces their resilience and livelihood opportunities. For example, in Mali, women constitute 40 per cent of the agricultural workforce, but only 10 per cent of landowners (Bouchama et al. 2018). Moreover, those who do own land are often allocated less productive land or are relocated from fertile land they previously cultivated (Nagarajan 2022).

Climate-induced food security affects people differently, with women particularly vulnerable to food insecurity on different levels, including availability, access, utilisation and stability. For example, during periods of food stress, women tend to adopt negative coping strategies, such as consuming less food. While women tend to have more control over decision-making with regard to food assistance, men tend to control cash assistance, which is vital for purchasing necessary food items (Petros et al. 2017). Women in drought-affected regions often suffer from macro- and micronutrient deficiencies, especially during reproductive years (Botreau and Cohen 2019). For example, through food insecurity, extreme temperatures as seen in many areas of Africa have a significant impact on women's fertility (Thiede et al. 2022). Women are at a particularly heightened risk of negative reproductive outcomes when giving birth during or in the aftermath of a disaster caused by natural hazards (Awiti 2022).

Climate-related impacts and risks are shown to increase the workload and responsibilities for women. In Eastern Africa, in response to droughts, some households are shifting their livestock composition from cattle or camel to sheep and goats, for which women are responsible. This increases women's scope of labour and responsibility compared to men (Kagunyu and Wanjohi 2014). For farming households, the need to diversify crops and adopt new agricultural technology is increasing agricultural labour demand for women, thus diverting their time from childcare and other household responsibilities (Awiti 2022). However, evidence shows that farming households headed by women are less likely to adopt climate-smart agricultural practices, as women tend to have limited access to the agricultural training, extension services and technology necessary for climate adaptation (IFAD 2020; Awiti 2022).

HUMAN MOBILITY

Human mobility is strongly gendered and shaped by intersectional vulnerabilities across the conti-

nent, particularly concerning the decision of who moves and who remains behind. In many cases, when faced by natural hazards, women, children, older people and people with disabilities tend to remain behind, while men migrate in search for alternative income opportunities, as is seen in rural-urban migration patterns (Rodgers 2022). However, those who are left behind often face increased climate risks, putting their livelihoods and personal safety at greater risk (Abebe 2014).

Men and women who move, particularly those who are forcibly displaced, face specific risks along the way, with women being at higher risk of abuse, discrimination, exploitation and other forms of insecurity (Mbiyozo 2022). At the destination, women often face unequal access to aid and support services, and the disintegration of social networks caused by (forced) migration undermines a critical resilience factor for women. Furthermore, women who migrate are likely to end up in jobs that are below their skills and education, further undermining their resilience (Mbiyozo 2022). For example, in the Lake Chad region, displaced women are increasingly resorting to negative coping strategies such as sex work, as they often have few (if any) alternative livelihood options after leaving behind most of their assets and savings in order to move (Vivekananda et al. 2019).

Climate-induced migration affects the vulnerabilities of young people in the long run. When families move or are displaced in the aftermath of a disaster, young people often experience educational disruptions, along with a sense of social isolation and loss of opportunities as they move to unfamiliar areas (Mbiyozo 2022).

Increased mobility often increases the pressures on resources and services at the destination, which can fuel grievances felt by host populations, and exacerbate xenophobic and violent attitudes towards migrant communities. Such trends are emerging in all regions across the African continent (Mumbere 2019). In Southern Africa, local residents have targeted and attacked the homes and businesses of migrant communities (Cinini and Mkhize 2021; Engelbrecht 2022; Mongale 2022), as migrants are often seen as "competitors" for jobs and essential services (Mbiyozo 2022). In Tunisia, reports of migrants from other African regions being abused or evicted from their homes are on the rise, with migrants increasingly perceived to be responsible for the country's economic downturn and food staple shortages (Moderan 2023).

ARMED GROUPS

Armed groups across the African continent are strongly tied with ethnicity and the social norms surrounding them. In Mali, for example, certain communities that have historically been sidelined from political power tend to be more susceptible to joining armed groups. In addition, pastoralist groups such as the fulani are often perceived to be associated with armed groups by other communities and security forces, and are therefore subject to attacks (Nagarajan 2022).

Young people and children are particularly vulnerable to recruitment into armed groups, given the high levels of unemployment, and limited education and job opportunities they face (Haer 2018). This trend is evident in all regions on the African continent. In the Lake Chad region, many young people, particularly those who have been displaced or have lost their livelihoods, view armed groups as a means of escaping hardship (Moaveni 2019; Vivekananda et al. 2019). Similar instances have been observed among young pastoralists in Eastern Africa, particularly those facing high levels of political exclusion and injustice (IGAD CEWARN 2023). Likewise, in Central Africa, young people in rural communities have been enticed into joining armed groups, as these groups promise greater socioeconomic opportunities and protection for livelihoods, such as cattle and farmland (de Brier et al. 2020; Semba 2021).

Recruitment into armed groups is also affected by gender with traditional notions of masculinity often playing an important role in the decision to join these groups. In Mali, men and boys sometimes see joining armed groups as a way to fulfil their roles as "protectors," and as a means to gain respect, dignity and better access to women, including through marriage or sexual violence (Nagarajan 2022). These notions of masculinity should not, however, negate the important roles women play in armed group recruitment and activities. Female members of armed groups have been known to hold important roles in gathering intelligence, supplying provisions and driving recruitment, and in some cases have been directly involved in fighting. In turn, armed groups make strategic decisions by forging alliances with other groups through marriages (Nagarajan 2022). For example, in some areas of Eastern Africa, community-based armed groups depend very strongly on women for logistical and recruitment support (ICG 2019).

7. Early warning and early action systems are well developed, but key challenges remain to integrate the climate-conflict nexus

Early warning analysis to inform planning and action is a major component of addressing climate-related security risks. They are also at the heart of prevention strategies, both in terms of preparing for natural hazards but also addressing violent conflict or other threats to human security. According to a UN Office for Disaster Risk Reduction (UNDRR) analysis, countries with substantial to comprehensive early warning system coverage have significantly less disaster mortality and affected people compared to those with limited or no coverage (Kumar 2022). Early warning systems led by African institutions could be divided into two categories. The first focuses on natural hazards and weather-related events, and the second on conflict and security events. However, both pillars lack mutual and complementary integration (Moyo and Phiri 2023; Nhamirre et al. 2023).

Collection and analysis of disaggregated data on the climate-conflict nexus is important to address multi-dimensional vulnerabilities. However, unfortunately, large areas of the African continent suffer from severe shortcomings in hydro-meteorological infrastructure and services, as well as multi-hazard monitoring capacities. Only an estimated 40 per cent of African countries have early warning systems, largely due to poor access to and availability of reliable data. Those systems that exist often suffer from quality issues (UNDRR 2022a). Despite these challenges, several organisations and African governments have developed early warning systems that focus on the local, national, regional or continental level.

CONTINENTAL EARLY WARNING

At the continental level, the African Union has continuously called on the AU Commission and its partners to effectively address climate-related security risks, including through integration in early warning systems (AU-PSC 2021).[9] The African Union has two major early warning systems that touch upon climate security. First, the Africa Multi-Hazard Early Warning and Early Action (AMHEWAS) programme – embedded in the AUC-ARBE – aims to integrate four elements of early warning, namely risk knowledge, monitoring and warning services, risk communication, and response capacity (AUC 2022). Outputs from AMHEWAS, such as the weekly Continental Watch, focus almost exclusively on the forecast of natural hazards, such as extreme precipitation, flooding and storms, but without drawing linkages with existing vulnerabilities regarding peace and security (AU 2023).

Second, the AUC-PAPS department oversees the Continental Early Warning System (CEWS). The CEWS was created as a tool for anticipating and preventing conflict within the broader framework of the Africa Peace and Security Architecture. The CEWS focuses on conflict drivers such as poor governance, poverty, transnational organised crime, inequality, and exclusionary practices and tendencies. Despite the vast evidence that climate change and environmental degradation are drivers of conflict in Africa, the CEWS does not draw interlinkages between climate change, environmental issues, and conflict and insecurity trends.

There have been efforts to strengthen collaboration across those two pillars, for instance, by developing joint outputs focusing on both climate and environmental indicators, as well as peace and security data. However, such initiatives have not been systematically operationalised. While AUC-ARBE has developed significant mechanisms and normative frameworks on climate change and environmental related initiatives, AUC-PAPS has not been able to fully articulate and integrate the early warning component of climate change into its strategies and operations.

Aside from AU early warning systems, there are several other initiatives, with one notable example being the African Centre of Meteorological Applications for Development (ACMAD) African Multi-Hazard Advisory Centre, which was established in Niger in late 2022. ACMAD aims to further enhance continental capacities by generating regular reports on continental hazard and disaster situations, and continental climate trends and impacts, as well as provide impact-based advice and observations. Similar to AMHEWAS, ACMAD's role is to support national meteorological services and other stakeholders during hazard seasons. However, it does not comprehensively integrate non-climatic indicators (UNDRR 2022c).

9 More specifically, during its 984th meeting held on 9 March 2021, the AU-PSC reiterated "the need for the AU Commission to mainstream climate change in all its activities particularly in early warning and prevention of climate change related violent conflicts in the Continent and, in this regard, reiterates its request for the Continental Early Warning System to include in its regular briefings to Council, looming climate change-related security threats in the Continent" (AU-PSC 2021).

REGIONAL EARLY WARNING

At the regional level, Eastern Africa has developed some of the most advanced early warning systems, with the IGAD leading the effort. Its capacity to assess climate, peace and security-related risks is spread across different initiatives. These include (1) the Conflict Early Warning and Response Mechanism (CEWARN), which analyses and shares information related to violent conflict, develops case scenarios, and formulates response options; and (2) the IGAD Climate Prediction and Applications Center (ICPAC), which provides climate services, including climate information-sharing, as well as climate forecasting and early warnings (ICPALD n.d; IGAD CEWARN n.d; IGAD 2022d).

Within IGAD, there is generally a high level of collaboration between specialised institutions and their respective mandates, reflecting the strong climate-conflict links of their work. For example, since its establishment in 2000, CEWARN's mandate, structure and early warning indicators have been broadened to include climate and environment (IGAD 2022d). A 2022 study on the climate-conflict nexus in the IGAD region exemplifies this, as it identified several climate-related factors (including on vegetation and natural hazard-induced disasters) as top predictors of conflict outcomes in the region, using both CEWARN and ICPAC data (IGAD CEWARN 2022a).

In Western Africa, the ECOWAS Warning and Response Network (ECOWARN) is arguably among the most advanced early warning systems for conflict prevention on the continent (Gnanguenon 2021). The West Africa Network for Peacebuilding (WANEP) has been a strategic partner for ECOWAS concerning the operationalisation of ECOWARN for many years. The collaboration has resulted in the development of National Early Warning Systems (NEWS), which help to integrate more grassroots engagement and information into the system, in all ECOWAS member states (Eze and Frimpong 2021).

The Permanent Interstate Committee for Drought Control in the Sahel (CILSS), along with its regional centre Aghrymet, are early warning initiatives specialised in providing climate forecasts, surveys and training across the Sahel region. One project facilitated by CILSS is the Système régional de prévention et de Gestion des crises alimentaires (PREGEC), which provides seasonal and water flow forecasts to farmers. Forecasts include climate predictions, and the tracking of agriculture and herding, which helps farmers prepare for extreme weather events. Both institutions also conduct hydrological and ecosystem surveys to track ecosystem evolution and degradation (Guillier and Brown 2022).

In Southern Africa, the SADC Regional Early Warning Centre (REWC) aims to strengthen SADC mechanisms for conflict prevention, management and resolution. While it mainly focuses on conflict-related data, the centre is beginning to incorporate more information on climate-related factors and collaborate with units focused on reducing disaster risks. However, there remains a need for more detailed and comprehensive integration of climate and conflict data in the REWC (Moyo and Phiri 2023; Nhamirre et al. 2023).

NATIONAL AND LOCAL EARLY WARNING

At the national level, as mentioned previously, less than half of African countries have developed multi-hazard early warning systems, with a clear majority located in Eastern Africa and Southern Africa. Major gaps remain in Maghreb countries, Western Africa and Central Africa (Kumar 2022). Within the different regions, there are major differences in terms of early warning. For example, Mozambique has taken steps to strengthen its early warning systems at the local level in recent years. Early successes were observed immediately after Cyclone Freddy struck the east coast of Southern Africa in 2023. The early warning strategy and relocation of communities prevented a more significant death toll, especially when compared to previous disasters such as Cyclone Idai or the less-developed early warning systems of other regional countries (IFRC 2022a, 2022b).

At the local level, early warning systems are known to be most effective when integrated into community and informal networks. For example, in Eastern Africa, civil society groups such as the East African Civil Society Organizations' Forum (EACSOF) have made important contributions to early warning systems across the region. In Kenya, civil society organisations are an integral part of the country's conflict early warning strategy. For example, religious councils and local peace committees have been instrumental in providing essential early warning information, as well as filling governance gaps where the state's presence and capacity to provide services is limited (Babatunde Amao et al. 2014).

CHALLENGES AND GAPS

Despite a range of early warning initiatives operationalised across the African continent and at different levels, there remain serious challenges and gaps in addressing climate-related security risks. Whether they focus on climate and environment or peace and security, early warning systems still lack integration across both pillars. This is the case for early warning systems at the continental level, but also for some at the regional and national levels. It is important that such systems draw clear linkages to indirect, cascading risks related to climate change and environmental stress by incorporating a set of climate security indicators. For systems such as CEWS, further exploration of this mainstreaming of climate change considerations into key normative frameworks is required. Early warning systems at the continental, regional, national and local levels also lack vertical integration. One key challenge remains the integration of local knowledge and data gathered through civil society networks into existing systems.

Climate security indicators also need to be integrated into the different data collection and analysis tools. Partnerships with local actors such as civil society organisations in the collection of primary data are critical in this regard. When data is managed in a central and transparent database, it can be analysed expeditiously and more effectively. The integration of community-specific pathways that link climate and security can also strengthen early warning systems and inform anticipatory action. Finally, data collection and analysis need rigorous triangulation, comparing different types of information against each other to produce new insights. The primary objectives of data analysis encompass recognising community needs, identifying populations most vulnerable to risks and enabling decision-makers to take informed action. These objectives can be achieved by consulting specialists and community members to interpret the data, creating a catalogue of solutions to climate impacts, and subsequently evaluating the effectiveness of these solutions through past experiences and strategies (GPPAC 2022).

8. Nature-based solutions and integrated natural resource management approaches have proven effective in addressing climate-related security risks

Across the continent nature-based solutions and integrated approaches that link livelihoods, natural resource management and peacebuilding have been shown to be effective in addressing many climate-related security risks and building the resilience of local communities. The lessons they provide can guide future programming and upscaling.

TRANSBOUNDARY ENVIRONMENTAL RESTORATION AND CONSERVATION EFFORTS

The Great Green Wall is arguably the most famous large-scale environmental restoration initiative from the continent. Launched by the African Union in 2007, the initiative aims to combat desertification in the Sahel by planting 100 million ha of trees, connecting Senegal to Djibouti, directly below the Sahara. By increasing tree cover, it intends to capture 250 million tonnes of CO2 and create 10 million jobs. The target is to have this green belt stretch 8,000 km across Africa by 2030, ushering in a new era of sustainability and economic growth (UNCCD 2020).

With only four per cent of its restoration target reached as of 2020 (UNCCD 2020), the initiative has suffered significant difficulties, including insecurity and corruption (Fröhlich 2020), spiralling costs and delays in resource mobilisation (Mirzabaev et al. 2019), fragmented oversight (Bove 2021), as well as design flaws (Turner et al. 2021). The project is worryingly behind schedule and most of the trees planted early on have since died. One key challenge was that the project was initially designed in a very top-down, strictly environmentally focused manner, without much consideration for socioeconomic indicators or the perspectives of local communities and regreening practices that already existed (Mutanda Dougherty 2023).

To address these shortcomings, the initiative revised its vision. Instead of the linear planting of trees, it now embraces a mosaic of land use practices (Gravesen and Funder 2022), with a greater emphasis on conflict-sensitive preservation, the nurturing of existing trees (Fröhlich 2020),

ensuring programmes enable more comprehensive development (Mbaye et al. 2021), including stakeholders more widely (Fröhlich 2020), and co-benefits for migration and security (Gravesen and Funder 2022). What started as an initiative to address a specific environmental threat in the Sahel has evolved into a broader strategy to promote sustainability and prosperity in the region, putting people at its centre. In 2021, additional funds to implement this new vision were pledged, aimed at reinvigorating and ramping up restoration, governance and private sector investment in the Great Green Wall (Mutanda Dougherty 2023).

Further south, the Greater Virunga Transboundary Collaboration (GVTC) ¬¬– a conservation agreement between Virunga National Park in the DRC, Volcanoes National Park in Rwanda and Mgahinga Gorilla National Park in Uganda – has resulted in several conservation successes, with environmental peacebuilding playing a key part in this. Conflict-sensitive bottom-up approaches have included shared agreements on landscape management, community conservation, tourism development and law enforcement (Refisch and Jensen 2016). The three countries now address broader environmental risks together thanks to international cooperation and trust-building efforts focused on mountain gorilla conservation by the transboundary secretariat. For instance, conflicts among fishermen in the DRC and Uganda prompted the inclusion of fisheries in the Transboundary Strategic Plan. The Greater Virunga Transboundary Collaboration GVTC is a pivotal platform and intergovernmental mediator for discussing contentious issues such as transboundary natural resource exploitation among the three countries. It remains a unique forum for engagement in the context of historically and currently tense relations (Refisch 2022).

INTEGRATED NATURAL-RESOURCE MANAGEMENT APPROACHES

There is a long history of environmental peacebuilding, which involves linking natural resource management and peacebuilding approaches to address natural resource-based conflicts. These approaches aim to (re)build relationships between groups, strengthen social cohesion, make natural resource management more sustainable and improve livelihoods.

There are many examples of environmental peacebuilding efforts at the local level across all African regions. For example, through the UN Peacebuilding Fund (UNPBF), several projects in Mali and Niger aim to train women to contribute to local conflict prevention efforts around climate-induced natural resource conflicts in their communities. In this endeavour, women have taken on the role of conflict mediators, resolving conflicts and benefiting from livelihood diversification opportunities including land ownership. The effort has also facilitated the organisation of women-led cooperatives enhancing women's leadership and local decision-making processes to reduce the impact of climate change and related tensions in their communities (UNPBF 2023). The Swiss organisation Centre for Humanitarian Dialogue supports a network of around 2,000 agropastoral mediators across Mali, Burkina Faso, Niger and Mauritania, who help resolve conflicts between farmers and pastoralists, and broker local agreements over the management of resources and demarcating corridors for the safe movement of livestock (Centre for Humanitarian Dialogue 2019). The Northern Rangelands Trust (NRT), a community-based organisation that aims to develop community-led conservancies in the northern and coastal regions of Kenya and Uganda, has made important achievements in building peace. The NRT has devoted considerable effort to involving women and young people as peace ambassadors, and ensuring continuity and local ownership of resource management processes (UNDP 2023c).

Another example of natural resource management involves Uganda's Karamoja Cluster, where local Food and Agriculture Organization (FAO) chapters initiated climate-smart agricultural interventions as an entry point to foster dialogue between conflicting herders. They achieved this by providing animal health services and organising vaccination campaigns, which were critical for herder communities' livelihoods. The issue of animal health holds cultural and economic significance, prompting even conflicting parties to agree to convene in vaccination workshops, creating a space for dialogue. This initial collaboration led to the establishment of local agreements for managing natural resources, and promoting sustainable and equitable use of land and water resources (FAO 2019b; UNDP 2022a).

LESSONS LEARNED AND BEST PRACTICES

These and other similar initiatives have shown that nature-based solutions, natural resource management and restoration activities can serve as important responses to address the various interconnected risks around climate change and con-

flict. They can help to prevent climate change by reducing CO2 emissions and addressing environmental degradation. If done in a conflict-sensitive, bottom-up, participatory and inclusive way, using local and traditional knowledge and practices, and creating economic and social benefits, they can also have broader stabilising impacts, and nurture more resilient and sustainable livelihoods (Woroniecki et al. 2020; IPCC 2022). When empowered in resource management, marginalised and vulnerable communities develop a sense of ownership and belonging within a community of practice, reducing the likelihood of conflicts arising from competition over resources (Roz Price 2020). For example, the Sustainable Rangelands Initiative in northern Tanzania engaged local communities by selecting volunteer rangeland monitors in collaboration with local leaders through data collection, assessment and mobile-based reporting. The project created possibilities to manage conflicts between communities, wildlife and rangers by promoting active management, data-driven decision-making and community engagement (Lichtenfeld et al. 2019).

Inclusive natural resource management initiatives are particularly significant for post-conflict situations, where they can support economic development and livelihood security for everyone, including young people, victims of armed conflict and former combatants. This is essential for successful peacebuilding efforts (Bruch et al. 2016; Morales-Muñoz et al. 2022). Examples from Sierra Leone, where alternative livelihoods to mining for young people were supported, and Liberia, where institutional arrangements were introduced to manage the timber sector and grant land titles to communities to safeguard forests following the peace agreement, demonstrate the critical role of socio-economic inclusion in sustaining peace (Beevers 2015; Keili et al. 2015).

Another valuable lesson concerns the role of gender inclusion in environmental peacebuilding. Women are often excluded from natural resource management and especially conflict resolution mechanisms. However, experiences from across the continent have shown that strengthening the role of women in natural resource management and conflict resolution can help to empower them and make these institutions more effective (UN WOMEN 2013). For example, in areas of South Sudan, women have traditionally and effectively acted as peacebuilders (Mai and James 2015). During and after the 2021–2022 floods, many women took on leadership roles, and provided education, social support and other care services, contributing to maintaining social cohesion and preventing conflict in the aftermath of the disaster (Mokgonyana 2023). In Burundi's peace process in 1998, Hutu and Tutsi women joined forces to protest against their exclusion from the peace table. Their initiative led to the creation of numerous women's NGOs and structures, helping women assert their rights, promote a culture of negotiation and address the consequences of the civil war, including unequal access to natural resources(Agbalajobi 2009).

While some environmental challenges can be overcome with technical solutions, peacebuilding processes require long-term trust building and integrative approaches. Developing adequate institutional capacity for dialogue and negotiation is important to ensure the long-term resilience of natural resource management and mitigate climate-related conflicts. This can be achieved by investing in training programmes, knowledge sharing, technical assistance and dialogue platforms to build skills and expertise in conflict resolution, and the ability to design effective processes, negotiate, coordinate and communicate with stakeholders (Brown and Keating 2015). Sustainable solutions that respect cultural and ecological contexts can be achieved with the input of local knowledge and traditional practices. Local community peace structures are also essential in addressing chronic conflict and resource disputes (Mercy Corps 2019). For example, a valuable lesson learned from Nigeria is that building the capacity of key community leaders through effective negotiation and mediation techniques can make local peace committees more successful at preventing conflicts and ensuring their sustainability (Mercy Corps 2017).

In addition, the links between local community initiatives and national policies are crucial. Nature-based solutions and environmental peacebuilding projects can effectively resolve community conflicts around natural resources by establishing reliable spaces for dialogue. However, national policies regarding land tenure or large-scale projects may negatively impact these spaces and the trust built within them, especially if the communities are not consulted beforehand.

9. Local, traditional and indigenous knowledge and solutions are key success factors for addressing climate-related security risks

Local, traditional and indigenous practices, knowledge and institutions have been an integral part of life in many regions across the African continent. If leveraged, they can be a key success factor for building resilience and sustainable peace.

NATURAL RESOURCE MANAGEMENT

Across the continent, traditional institutions and practices have been an integral part of natural resource management. Indigenous and local knowledge strongly influence climate adaptation responses in Southern Africa, Western Africa and Eastern Africa. Many African communities deeply understand their local ecosystems, and have developed farming, fishing and pastoral practices adapted to their specific environments. Some agricultural practices, such as terracing, intercropping and the use of drought-resistant crops, can be effective in helping communities cope with the impacts of climate change (Al-Zu'bi et al. 2022). Similarly, indigenous communities often understand local hydrological systems, which helps them efficiently manage water resources. Many traditional water management practices adopt holistic approaches, which preserve natural habitats and enhance water quality, contributing to the overall sustainability of water resources, while minimising conflicts over water pollution and degradation (Mavhura 2017; Zvobgo et al. 2022). Practices often prioritise cooperation and shared responsibility, a sense of ownership and collective stewardship over water sources. Ownership plays a crucial role in preventing conflicts over water by promoting sustainable water use and fair distribution (Mavhura 2017).

Projects in several countries, including Zimbabwe, Ghana, Tanzania, Kenya, Uganda and Nigeria, have demonstrated the use of indigenous and local practices to supplement water resources for agricultural and domestic use. These practices include groundwater exploration using indigenous approaches, rainwater harvesting and water conservation techniques for livestock by pastoralists. In addition, various methods commonly used to improve irrigation, such as traditional irrigation techniques utilising technology like drip irrigation and storage methods, are utilised during dry seasons (Elum et al. 2017; Bamutaze et al. 2019; Alam et al. 2022). In Ghana, some long-standing indigenous farming practices help to mitigate the adverse effects of climate change (Gibson and Anderson 2023). Proka, for example, is a historical farming practice of clearing land for cultivation. Instead of slashing and burning the brush, the sticks and leaves are left to rot, acting as an organic fertiliser, which expedites vegetation regeneration, while reducing the risk of wildfire (Awuah-Nyamekye 2019).

CONFLICT MANAGEMENT

Traditional institutions and practices are key for preventing and resolving conflicts peacefully. In many customary practices, reconciliation is prioritised over litigation. For example, traditional authorities have historically played an important role in managing and mediating cattle rustling activities (Idris 2018). Across Kenya, empirical studies show how local conflict resolution mechanisms have kept the risk of inter-group violence at very low levels (Ide et al. 2014; Linke et al. 2015; van Baalen and Mobjörk 2018). In South Sudan, church-based organisations have played an instrumental role in conflict resolution and peacebuilding between pastoralist groups, such as the Dinka, Murle and Nuer, by providing a space for dialogue and reconciliation between groups (Climate Diplomacy n.d.c). Traditional leaders such as clan elders have historically played an important role in managing and mediating cattle-rustling activities (Idris 2018).

Despite customary practices and actors playing a key role in conflict prevention and resolution, ensuring compatibility with human rights law and conducting proceedings in local languages remains crucial (Roz Price 2020). For example, in Angola, the FAO's Restoration of Traditional Pastoral Management Forums project revitalised traditional pastoral management systems and improved livelihoods. The project established many Jango, modern discussion forums that integrated traditional practices, which led to negotiating and implementing six management plans and resolving conflicts between pastoralists (FAO 2017a). Similarly, the Wajir Peace and Development Committee (WPDC), based in the Wajir District in Kenya, incorporates traditional Islamic mechanisms and values in its conflict resolution initiatives. The WPDC has made notable achievements in monitoring tensions and preventing violence in the district, while also raising awareness of gender equality and women's contribution to peacebuilding in communities (Lado Tonlieu 2021).

ENVIRONMENTAL PROTECTION

Indigenous and traditional practices and institutions are instrumental in maintaining the health and integrity of natural landscapes, and thereby in conserving natural resources such as forests. Examples include the Tepeth and Pokot societies in Uganda, where strict adherence to traditional resource management practices has kept the forests in relatively good condition, as well as areas along Kenya's coasts, where Kaya elders still have an active resource management role, and where tree growth and overall environmental conditions are maintained (UNDP 2023c).

Across the continent, indigenous communities and ethnic groups act as environmental defenders, playing a key role in ensuring ecosystem health, and creating socioeconomic opportunities through ecosystem services and ecotourism (Bennett et al. 2022). For example, in Nigeria, environmental defenders participate in ecosystem monitoring groups to help protect citizens from violent threats and support conflict prevention (Mercy Corps 2019). When they advocate for legal claims and policies, they support democracy and contribute to creating justice in conflict resolution mechanisms and preventing violent actions from escalating (Kumar 2019). Unfortunately, indigenous people and environmental defenders are often subject to human rights violations and abuse, especially in and around conservation areas where environmental crimes such as illegal resource extraction are vital parts of the conflict economy. This is especially of concern in the DRC, the African country with the highest number of attacks against environmental defenders. In 2020, at least 15 environmental defenders were killed in the DRC (Business and Human Rights Resource Centre 2021).

REMAINING CHALLENGES

In some cases, environmental and climate impacts are so strong that certain traditional approaches no longer work. For example, indigenous knowledge related to weather prediction has traditionally relied on observing animal behaviour, cloud patterns and vegetation phenomena. In Kenyan communities, traditional weather forecasting methods such as intestine reading and animal body language were long considered reliable. However, recent natural and social changes have negatively impacted its accuracy. The loss of specific trees crucial for forecasting, the lack of documentation, dwindling oral transmission, and the influence of subsistence abuse, modern education and religion have led to increased discrepancies between indigenous knowledge-based forecasts and reality (Ayal et al. 2015; Filho et al. 2023).

Some traditional practices can also have unintended negative impacts. Examples include the overdependence of local communities on energy from forest biomass, poaching or moving into biodiversity hotspots and clearing them for crop farming, most dramatically through slash-and-burn practices (UNEP 2013). Another example is short-term migration for work, which can be effective for generating additional income and strengthening climate resilience; however, evidence from Ghana shows that it can also create a shortage of household farm labour, which reduces the ability of households to plan. If remittances are not used for long-term solutions, it can also lead to overdependence on external sources, eventually leaving no other option but to abandon farm operations (Antwi-Agyei et al. 2018).

Sometimes traditional knowledge and actors can drive resistance to necessary change. An example can be seen in northern Kenya's drylands, where pastoralism is the main livelihood. Cattle-keeping dominates, but recurring drought and land-use changes pose challenges to this way of life. One adaptation option is to shift from cattle and sheep to camels and goats, which are more water-stress tolerant. However, cultural factors – such as the significance of cattle (which are tied to social status and masculinity) in Boran communities, the lack of traditional knowledge about camels and the fact that Boran people do not traditionally consume camel milk or meat – pose barriers to this transition (Wario 2017; Few et al. 2021).

In Bobirwa, Botswana, the uptake of seasonal climate forecasts is limited due to cultural adherence to traditional practices and religious convictions. Similarly, in Ghana, smallholder farmers have been hesitant to adopt new technologies and innovations that can help them address the effects of climate change. This resistance to change is often due to a general lack of confidence in science among smallholder rural farmers, who may have had negative experiences with past climate forecasts and other failed innovations. In addition, some farmers have resisted using climate-resilient seed varieties, because they do not see the value in investing their limited resources in unknown new supplies (Antwi-Agyei et al. 2018).

Thus, it is important to thoroughly assess and support initiatives that understand customary

practices and reconcile these practices with science-based approaches. One example can be found in Nigeria where community projects promote the use of renewable energy sources, reducing the overdependence on forest biomass for energy and mitigating ecosystem depletion. Similarly, communities are developing efforts to control erosion by planting native erosion-resistant trees on sloping terraces and active gully sites. They employ techniques such as terrace mounds around farms to control flood inundations, and utilise materials such as periwinkle and palm kernel shells for erosion control (Okeke et al. 2023). In addition, integrating traditional and seasonal forecasting methods can help farmers adapt to changing climates and improve the accuracy of local climate information. For example, in Botswana, engaging religious leaders during traditional community meetings involving weather-related ceremonies has proven effective in disseminating and promoting the uptake of climate information (Few et al. 2021).

10. Africa is leading in institutional innovations and cross-sectoral cooperation to address climate-related security risks

Recent years have seen an impressive increase in the creation of dedicated institutions and cross-sectoral cooperation mechanisms to address climate-related security risks. Globally, Africa is a leader when it comes to innovation in this area.

REGIONAL ORGANISATIONS

In Western and Eastern Africa, regional organisations have been at the forefront of institutional innovations. ECOWAS, and the UN Office for West Africa and the Sahel (UNOWAS) are engaged in a major collaborative effort with the UN system, government agencies and civil society organisations to address the impact of climate change on peace and security in Western Africa. This includes the creation of the ECOWAS-UNOWAS Working Group on Climate Change and Security, and the establishment of the UN Regional Working Group on Climate Change, Security, Environment and Development (UN-CCESD). In April 2022, following a first-of-its-kind regional conference on climate security in Western Africa, representatives of countries in Western Africa and the Sahel signed a call to action, committing to inclusive, evidence-based analysis and policymaking on climate security in the region, as well as to integrated partnerships and collaboration, and to scale up climate financing (UNOWAS 2022).

In Eastern Africa, the IGAD is leading the way in mobilising regional political will and facilitating cooperation to address climate security risks. Its efforts are reflected in the high level of collaboration between its specialised institutions, and other regional and international organisations. For example, the Food Security and Nutrition Working Group (FSNWG) is a regional platform that focuses on providing early warning analysis of food insecurity. The FSNWG is currently co-chaired by the ICPAC and FAO, with members comprising approximately 80 organisations including several UN agencies (ICPAC n.d.). In June 2023, the heads of state in the IGAD region endorsed a decision to establish the regional Climate Security Coordination Mechanism that aims to anticipate, prevent and mitigate the outset of climate-induced conflict and displacement, with technical support provided by IGAD specialised institutions and programmes (IGAD 2022a; ICPAC 2023b).

In Northern Africa, regional organisations including the League of Arab States (LAS) and the Arab Water Council (AWC) are involved in shared platforms such as the Climate Security Initiative and the Regional Climate Security Network. These platforms help to coordinate responses to climate security challenges and to integrate a security perspective into climate action (Arab Water Council 2022a).

Southern Africa, through its regional organisation, the SADC, focuses on climate security through its Regional Resilience Framework. This framework integrates approaches to disaster risk reduction, climate adaptation and sustainable development. In particular, the SADC has developed extensive regional action plans on transboundary water management. In Central Africa, the thematic lens of transhumance is used to address climate-related insecurity. For example, since 2019, the region has hosted two international conferences on transboundary transhumance where clear linkages between climate change, international mobility, and peace and security were drawn. Similarly, Central Africa is increasingly engaged in linking environmental protection and conservation with human security, and hosted the One Forest Summit in 2023.

DEDICATED CLIMATE SECURITY CAPACITIES

At the same time, different organisations across Africa have started to create dedicated climate security positions and capacities. For example, several UN bodies and missions working on peacebuilding and security at the regional level have begun to incorporate elements of climate sensitivity into their operational structures. In particular, both the UN Assistance Mission in Somalia (UNSOM) and UNMISS have their own dedicated environmental and climate security advisers (see Eastern Africa chapter). In addition, the Office of the Special Envoy for the Horn of Africa has a climate security adviser who, in close cooperation with other UN agencies and regional organisations such as the IGAD and African Union, coordinates the implementation of sustainable natural resource management and climate resilience initiatives in the region. The UNOWAS and UNOCA, for Western Africa and Central Africa respectively, also have dedicated climate security personnel.

The Consultative Group for International Agriculture Research (CGIAR), a consortium of international research organisations, has started to create dedicated climate security initiatives across the continent. It has established climate security hubs for the MENA (Cairo), Eastern Africa (Nairobi), Southern Africa (Pretoria) and Western Africa (Dakar) regions. It uses a multidisciplinary approach to produce and align climate, land, water and food systems science with peacebuilding efforts that address conflict through environmental, political and socioeconomic solutions. To this end, the CGIAR has developed several tools and innovations, such as the Climate Security Observatory (CSO), which visualises how climate can contribute to conflict, where climate and insecurity intersect, who are the most vulnerable groups, and what responses could be implemented. In addition, the CGIAR has developed the Climate Security Sensitiveness Scoring Tool (CSST), an ex ante programming assessment tool for conflict-sensitive and peace-responsive climate action. These tools have been central within the CGIAR's Climate Resilience (ClimBeR), and Fragility Conflict and Migration (FCM) initiatives, which are currently implemented in 30 countries worldwide, of which 20 are located in Africa (CGIAR 2023a).

CLIMATE SECURITY INITIATIVES AND ACTIONS

There have also been various initiatives and actions on different levels that address climate-related security risks. For example, the Climate Responses for Sustaining Peace initiative, which was launched by the Egyptian COP27 presidency, is an ongoing continental effort to facilitate African knowledge sharing and capacity building. The initiative focuses on climate adaptation and peacebuilding, climate-resilient food systems, climate-induced displacement, and climate financing. The first consultation meeting was held in March 2023. By focusing on African participants, the consultation meeting facilitated constructive exchange.

Several initiatives aim to amplify the voices of under-represented groups in policymaking, such as women and young people. For example, the African Youth Climate Assembly (AYCA) aims to gather young African changemakers and showcase youth-led solutions to address climate insecurity. Similarly, in 2022, the Aswan Forum launched the youth dialogue Empowering African Youth Voices for a Peaceful and Climate-Resilient Future (Aswan Forum 2022).

The Africa Climate Mobility Initiative – a collaboration between the AU Commission, UNDP, UN Framework Convention on Climate Change (UNFCCC), International Organization for Migration (IOM) and World Bank – focuses specifically on climate change and human mobility. Created in 2021, it aims to generate political momentum and a common policy agenda on climate mobility in Africa, and to support implementation capacity and partnerships on the continent. The first major outcome of the initiative was a comprehensive African climate mobility report published in 2022, which sets out an agenda for action to address climate mobility on the continent (Amakrane et al. 2023).

The African Development Bank Group's 2022–2026 strategy for addressing fragility and building resilience focuses on building resilience to various vulnerabilities, including climate change. The strategy aims to address the root causes of conflict and fragility, and emphasises investment in crisis prevention across different fragile countries. It also promotes inclusiveness, peacebuilding, addressing forced displacement, and supporting safe and orderly mobility/migration to take advantage of opportunities. The strategy emphasises partnerships that complement each other, and collaborate to promote knowledge and analysis, policy dialogues and advocacy, and operations. This includes climate-displacement nexus interventions such as the bank's Transition Support Facility and other internal financing mechanisms to prevent and address climate-induced forced displacement (AfDB 2022a).

11. Responses are lagging behind risks

While there has been a lot of progress in addressing climate-related security risks, responses still fall significantly short of addressing the scale of needs.

CLIMATE FINANCING

Across the African continent there remain significant financing gaps for both climate action and peacebuilding. The latest Intergovernmental Panel on Climate Change (IPCC) report states that annual climate financing flows to the African continent are billions of U.S. dollars lower than the lowest adaptation cost estimates. Meeting the targets set out for adaptation in the nationally determined contributions for African countries would require an additional USD 41.3 billion annually in funding (Global Center on Adaptation 2022). Existing commitments are also inadequately dispersed. Between 2014 and 2018, only 46 per cent of commitments were dispersed, compared to 96 per cent for other development projects (IPCC 2022). Moreover, over half of all climate-related investments are concentrated in only 10 of the 54 African countries (Meattle et al. 2022). The current flow of funds for adaptation in Africa is insufficient and falls billions of U.S. dollars short of the estimated minimum cost. The African Development Bank has stated that Africa will require USD 2.7 trillion by 2030 to address its climate change needs (AfDB 2023a).

Between 2016 and 2019, adaptation financing for Africa steadily increased. This was followed by a notable increase in 2019–2020 due in part to significant infrastructure projects supported by mobilised private climate finance (OECD 2022a). Nonetheless, this climate financing mainly takes the form of loans (accounting for up to 71 per cent of climate finance in Africa) and other non-grant instruments (the majority of which are non-concessional). This is considered unjust and unhelpful for the most vulnerable communities in the most fragile African contexts (OECD 2022a; OXFAM 2023).

Even more concerning, financing is not going to those contexts and countries that are the most vulnerable to climate impacts and security risks. The Green Climate Fund (GCF) acknowledges that co-financing for least developed countries and African countries that are affected by fragility, conflict and violence is lower than the co-financing leveraged in other African countries (Independent Evaluation Unit 2023). A metadata analysis of 955 projects (USD 14.4 billion) conducted in 146 countries, including 56 fragile states, revealed that conflict and fragility hinder access to and implementation of climate financing. Projects supported by vertical funds in extremely fragile states are much smaller than those in fragile or non-fragile states. From January 2014 to June 2021, only one extremely fragile state in Africa, the DRC, had access to vertical fund climate financing (UNDP 2021a). A similar study on climate funding in conflict and fragile states found that as of 2020 only 29 per cent of all Global Environment Facility-funded projects were implemented in conflict-affected contexts. Furthermore, several projects in conflict-affected African countries have been cancelled or dropped, or have faced prolonged delays due to security issues (GEF Independent Evaluation Office 2020).

African island states face particular hurdles in accessing climate financing due to limited human and technical capacities, undermining their ability to ensure access to and successful completion of projects supported by climate financing (UN OHRLLS 2022). Furthermore, some of these island states are classified as middle or high-income countries, and hence are not eligible for concessional financing or official development assistance (ODA). More generally, disaster risk reduction financing remains an extremely small proportion of total ODA. For every USD 100 spent on total ODA, the maximum amount a vulnerable country received for disaster risk reduction was USD 1.30 (Togo). Many African countries, including highly vulnerable ones such as Liberia, Zambia, the DRC and Uganda, received less than USD 0.01 (Alcayna 2020). Finally, some donors such as the UNPBF and EU financing instruments have priorities to fund projects that specifically address climate-related security risks. However, specific larger-scale funding instruments for climate-related security are practically non-existent.

CAPACITY AND IMPLEMENTATION GAPS

While there have been notable improvements in terms of capacities to assess and address climate-related security risks, there are still significant gaps. On one hand, some donors such as the UNPBF and various EU financing instruments prioritise funding for projects that specifically address climate-related security risks. However, specific larger-scale funding instruments for climate-related security are practically non-existent.

In general, there is a relatively small pool of global and regional expertise when it comes to climate-related security risks. Dedicated climate security capacities and personnel are being introduced in many organisations, but are not widespread across the African continent. Furthermore, African research capacities still fall short of adequately examining needs, particularly on the local and national level. Between 1990 and 2019, climate-related research on Africa received just 3.8 per cent of global funding, and 78 per cent of this funding went to EU and North American institutions, with only 14.5 per cent reaching African institutions. This trend is also reflected in research on climate-related security risks, with most research capacity concentrated outside of Africa (IPCC 2022).

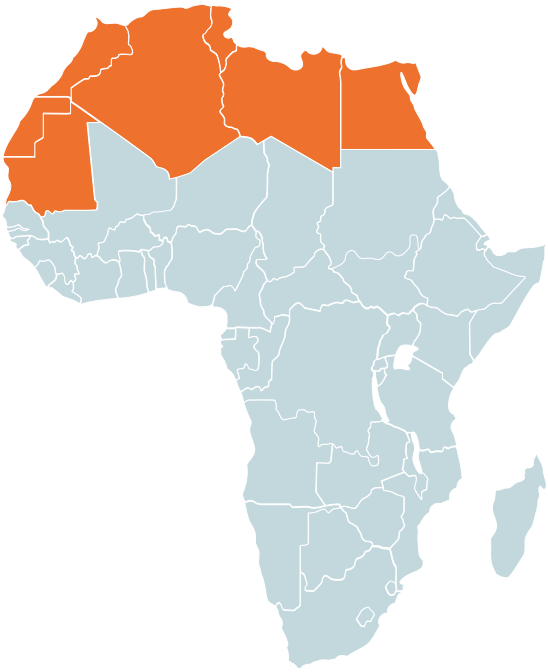
While there are regional strategies that address climate-related security risks, similar strategies on the national level often do not exist, which creates implementation gaps. In general, many African countries face difficulties implementing responses to climate security risks. In some instances, necessary policy responses to climate security risks are contradicted by policies in other domains. For example, acute water scarcity across the continent, particularly in Northern Africa, is exacerbated by subsidy regimes that encourage or at least do not discourage excessive water use and continued investment into fossil fuels. Given the expected decline in demand for fossil fuels over the coming decades, these investments risk becoming stranded assets (World Bank 2018).

A significant barrier to implementing climate security strategies is the lack of clarity regarding ownership and coordination of these topics on different levels. Some regional organisations such as the IGAD and ECOWAS have dedicated structures and mechanisms, while others have still not created such institutional arrangements. This is largely mirrored on the national level where responsibilities are spread across different sectors and ministries. This fragmentation inhibits the development and execution of coherent and effective climate security policies (Office of the Special Adviser on Africa 2018). Governments often also lack mechanisms for effective coordination and collaboration between national and local stakeholders, which would ensure the integration of climate-related security risks.

Regional climate security risks and responses

The following chapters describe the links between climate change, peace and security in each of the five African regions. Each regional chapter starts by providing the overall geographic, socioeconomic and political context, and an overview of the main current and future climate impacts. Each chapter also provides an overview of the main climate security pathways, describing how climate change and security interact, and identifying effective responses and good practices to address climate-related security risks. In between the different regional chapters, five transregional geographies that share particular climate-related security risks (i.e. African island states, the Congo Basin, the Lake Chad Basin, transboundary waters and the Sahel) are further explored.

Northern Africa



Summary

KEY CLIMATE IMPACTS

Temperature: Air temperature increases are particularly pronounced in the Northern Africa region, with increases higher than anywhere else on the African continent and twice as high as the global average. By 2080, air temperatures will very likely have increased by between 2.3°C and 4.3°C from pre-industrial levels. Temperature rise will be comparatively greater further inland and will correspond to an increase in the number of very hot days, with up to 37 more very hot days by 2030 and 84 more very hot days by 2080 in the most affected regions.

Precipitation*: Precipitation in Northern Africa is very low, but will see a sustained and steady decline. The extent and regional concentration of this decline have a high degree of uncertainty. Under a medium-to-high emissions scenario, it will further decline by up to 43 per cent in Egypt, 21 per cent in Algeria and 17 per cent in Libya by 2030.

Sea level rise: The region is very likely to experience at least 0.2 m and perhaps as much as 0.4 m or even 0.7 m of sea level rise by 2050, depending on future emissions pathways. Under high emissions scenarios, up to 1.0 m of sea level rise is possible by 2100, with a high degree of uncertainty.

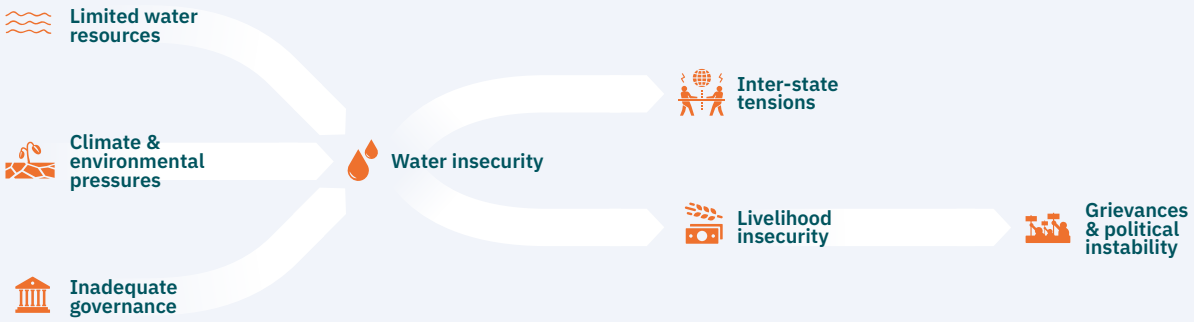
Flooding*: Floods caused by torrential rains in the otherwise dry region are already a regular feature of the Northern African climate. The frequency of floods has increased in recent decades and extreme precipitation patterns are predicted to increase further due to climate change with high certainty.

Droughts*: Northern Africa is already regularly exposed to droughts. The region will very likely see a further decline in rainfall, though variability of this remains uncertain. The reduction of precipitation will decrease resilience to prolonged periods of droughts.

* Climate projections with high uncertainty need to be interpreted with great caution. Please refer to the Annex for an explanation of uncertainty in climate projections.

CLIMATE SECURITY PATHWAYS IN NORTHERN AFRICA

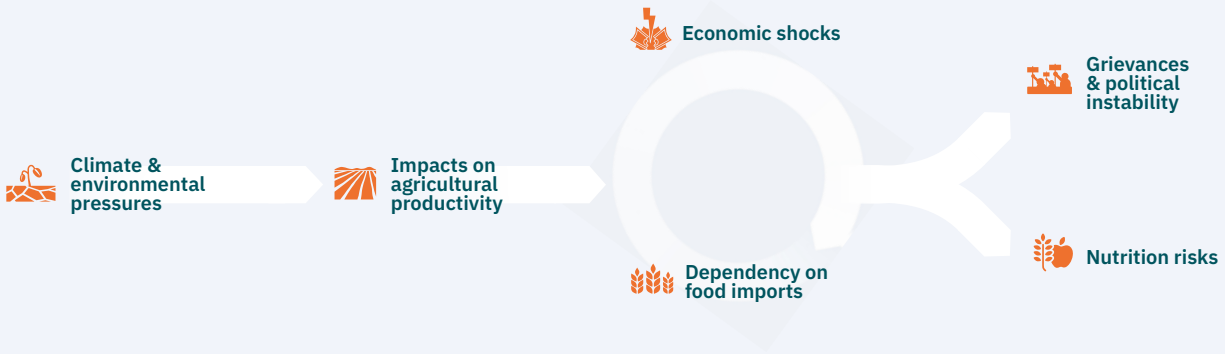
Pathway 1: Rising water insecurity



Northern Africa is already grappling with severe water scarcity, but a number of trends heighten this challenge. Depletion and (transnational) competition for water resources put further pressure on already vulnerable countries due to their dependency on fossil groundwater and the Nile River. Mismanagement can exacerbate supply issues through pollution and saltwater intrusion.

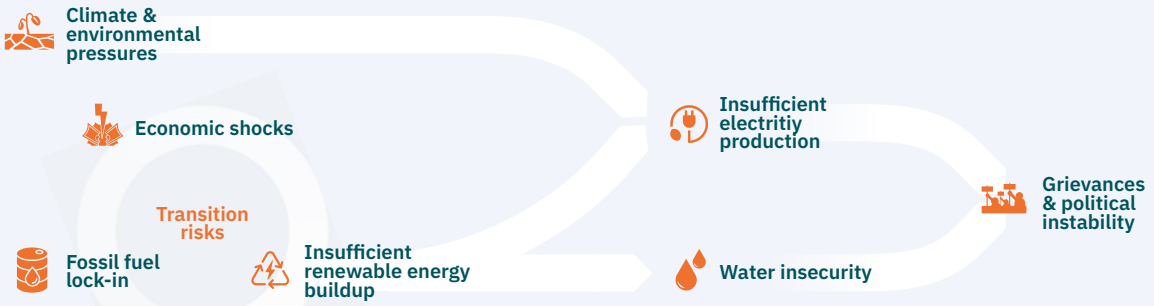
Meanwhile, a lack of cooperation and the mismanagement of transboundary water resources, such as aquifers and the Nile River, have ignited tensions and pose risks. At the same time, water shortages are already impacting economies and daily life, particularly in agriculture, and have the potential to exacerbate grievances and contribute to political instability.

Pathway 2: Ensuring the supply of food



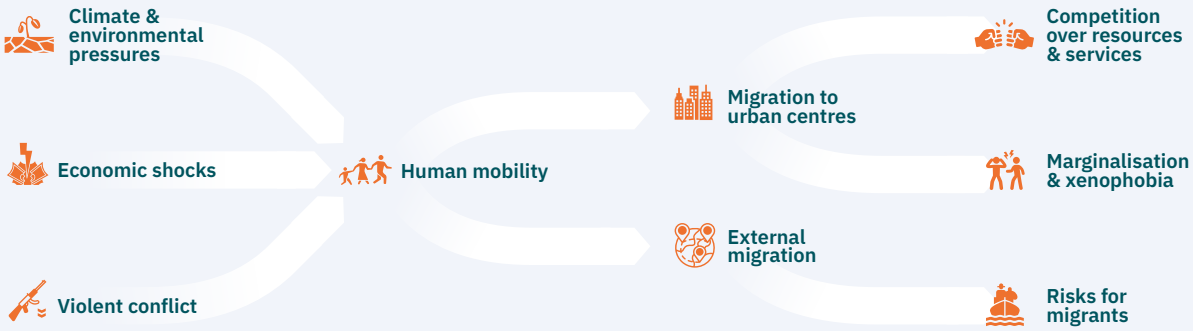
All Northern African countries are highly dependent on food imports, which entails a number of political and economic risks. Due to their small domestic sector already under pressure from climate change combined with import dependency, Northern African countries are reliant on the international availability and price stability of agricultural goods, mostly grain – two factors that are increasingly endangered by climate change effects. As a result, in moments of crisis, food imports can become a bottleneck, accelerate political grievances, and act as catalysts of political instability as happened during 2007, 2008 and 2011. Negative effects on populations are exacerbated by regressive subsidy policies and connected nutritional problems.

Pathway 3: Fossil fuel dependency and the Green Transition



Countries in the region have one of the lowest rates of renewable energy production worldwide. Meanwhile, a number of countries, such as Libya, Algeria and Egypt, remain invested in fossil fuel extraction and export. Though individual countries have made significant progress in their green transitions, this fossil fuel "lock in" effect hinders the adoption of renewable energy solutions and endangers the region's economic prospects as fossil fuel demand is set to decline. Beyond these macroeconomic risks, insufficient electricity supply has been a major part of public discontent. Growing populations and increased per capita electricity consumption, exacerbated by rising temperatures, will continue to place immense pressure on the region's inadequate energy infrastructure.

Pathway 4: Human mobility, migration and displacement



Human mobility is a growing issue in Northern Africa, as the region harbours some 1.5 million IDPs and three million migrants mostly from outside the region. While most movement within the region is currently conflict induced, projections forecast that up to six per cent of Northern Africa's population could be induced to move due to climate change effects, alongside migrants from other areas of Africa. While a vital adaptation strategy, poorly managed human mobility into urban centres intensifies pressures on communities, resources and services, which can intensify other climate security dynamics in the region.

Context

GEOGRAPHY

The Northern Africa region as defined by the African Union includes Egypt, Libya, Tunisia, Algeria, Morocco, the Sahrawi Republic (whose claims on Western Sahara are not accepted by a number of countries including Morocco) and Mauritania.[10] Unlike in other common definitions of North Africa, this does not include Sudan. The region is characterised by three distinct geographical and hydrological areas. In the east is the relatively small, but vitally important and fertile Nile Valley and Delta in Egypt. To the west, along the Mediterranean coast is the Maghreb, which stretches from Libya to Morocco following the Atlas Mountains. Moving south, the region gives way to the Sahel, a dry steppe region, which covers the majority of the Northern African region.

SOCIOECONOMIC CONTEXT

The combined GDP of the Northern Africa region is around USD 850 billion in 2022 (Statista 2022). The regional economy is heavily dominated by Egypt, Africa's second largest economy (World Bank 2023d). Northern African economies remain highly unequal, but have the lowest absolute poverty rate of all African regions at around three per cent (World Bank 2023e).

Northern African economies contracted sharply during the COVID-19 pandemic, pushing most of the region into recession. In 2022, the economy began to rebound with growth expected to be around five per cent, but this is unevenly distributed (Gatti et al. 2022). The war in Ukraine, however, has pushed up food and fuel prices, thereby favouring hydrocarbon export countries such as Algeria and Libya. The high commodity prices in combination with high public spending during COVID-19 created strong inflationary pressures, with Egypt registering the highest rate at 10 per cent in 2022 (Gatti et al. 2022). Although governments softened the inflationary impact with subsidies, the spending added to currency inflation and increased fiscal deficits, which nearly doubled in 2019 and 2020 (African Development Bank Group 2021).

POLITICAL INTEGRATION

Northern Africa is the least integrated region in Africa due to long-standing political enmities between countries in the region, such as between Morocco and Algeria (Lounnas and Messari 2018). Although Northern African countries are member states of multiple regional economic-political mechanisms, they are not all members of the same mechanism. The most important regional mechanism is the Arab Maghreb Union (AMU). Based in Marrakech, the AMU was created in 1989 to establish a common market with a view to prospective political integration (Mahjoub et al. 2017). However, due to Egypt not being a member and intra-regional rivalries, the AMU remains relatively weak leaving each state to develop their own bilateral trade agreements. The lack of intra-regional cooperation is reflected in the emphasis on bilateral rather than regional programming of key partners such as the European Union (Colombo 2018). Moreover, with the exception of the Maghreb region, Northern Africa is seldom perceived as a region on its own. Instead, Northern African countries form part of either Africa-wide, Arab or Mediterranean regional mechanisms, such as the African Union, the League of Arab States or the Union for the Mediterranean. The only strictly Northern African organisation is the North Africa Regional Capability (NARC), the military cooperation established in 2007 as Northern Africa's contribution to the African Standby Force.

DEMOGRAPHICS AND MOBILITY

The population in Northern Africa is diverse with the majority Arab population sharing the space with other ethnicities including the Amazigh, a population that has influence in Morocco and Libya. The majority of the region's approximately 210 million people live in the north along the coast, with nearly half of that number located in Egypt's Nile Valley (Haars et al. 2016). To varying degrees, the growth rates of Northern African countries have trended downwards as educational attainment, particularly of women, has improved and populations have urbanised. All populations, however, continue to grow quickly in total number due to exponential growth and population momentum (Khamis 2017).

The population growth in Northern Africa is spurred on by the inflow of migrants. Historically, the relative economic opportunity of the region made it a destination for migration from other parts of the continent (Kuschminder 2020). As of 2020, approximately 3.5 million international migrants reside in Northern Africa with the vast majority coming from within continent. Of this,

10 This report uses the African Union's classification system for geographic regions (https://au.int/en/member_states/countryprofiles2).

nearly half are now refugees and asylum seekers rather than economic migrants (IOM Migration Data Portal 2021). While most of these remain within the region, a small group continue towards Europe. In first half of 2022, over 35,000 migrants entered Europe from the central Mediterranean (Libya, Tunisia, Algeria) and over 6,000 from the western Mediterranean (Morocco) (Frontex 2022). Tragically, over 3,000 people have died on their way to Europe (UN News 2022).

PEACE AND SECURITY

Most of the countries in Northern Africa were affected by the Arab Spring, although the consequences of the uprising have differed significantly. While governments in the north-east, including Egypt, Libya, Tunisia and eventually Algeria, were swept aside by popular discontent in 2011, governments in the north-west, including Morocco and Mauritania, survived largely unscathed. After the governments in Egypt, Libya, Tunisia and Algeria were removed in the hope of installing more democratic and responsive institutions, the political situation in these countries consolidated.

Although the prospect of social unrest and political instability remains present (to varying degrees) in some Northern African countries, the overall security situation in the region has improved. Active incidents of social unrest have declined and, in parallel with global trends, terrorism has gradually reduced since 2014 (Institute for Economics and Peace 2022). Although Jihadi groups continue to operate in the Sahara, most of this activity is in countries to the south of Northern Africa (Institute for Economics and Peace 2020). The exception to this trend is Libya, which has experienced reoccurring and endemic conflict since 2011.

Climate change and impacts[11,12]

TEMPERATURE RISE

Since the 1970s, climate change in Northern Africa has increased annual air temperatures by between 0.2°C and 0.4°C every decade (Binder 2022b). The average rate of temperature increase is higher than in any other African region and approximately twice as high as the global average (IPCC 2022). By 2080, air temperatures will very likely have increased by between 2.3°C and 4.3°C from pre-industrial levels (WMO 2022). The temperature increase will be comparatively larger in central Algeria and southeastern Mauritania, while lower along the coastlines.

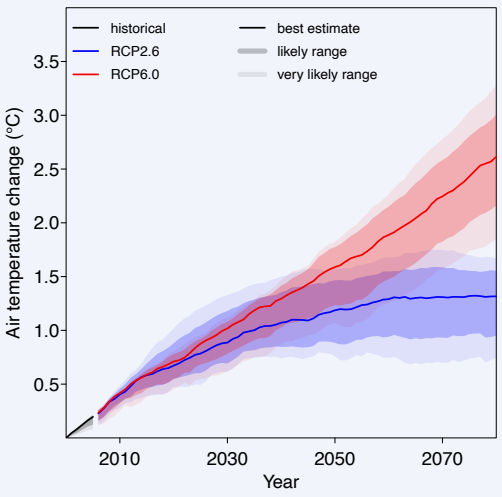


Figure 5: Temperature rise in Northern Africa (Binder 2022b)

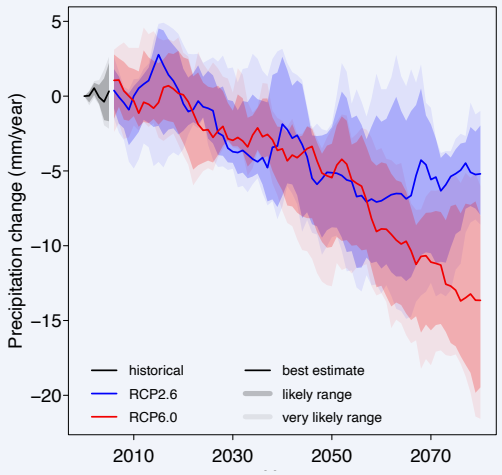


Figure 6: Changes in precipitation in Northern Africa (Binder 2022b)

The annual number of very hot days is projected to rise. Under medium-to-high future GHG emissions (RCP6.0), the largest increases are expected along the northeastern coasts, in southern Western Sahara and southeastern Mauritania, where the number of very hot days is projected to increase by up to 37 per cent by 2030 and by up to 84 per cent by 2080 (IPCC 2022). This will result in the hot season in Northern Africa lengthening by one month between 2021 and 2050 (Founda, Varotsos, Pierros and Giannakopoulos 2019). Heat waves will be most pronounced in the cities.

11 Please refer to the Annex for guidance on how to read the plots and an explanation of the concept of uncertainty in climate projections.
12 The summary of the key climate impacts in this section is based on: Binder L. 2022. Climate Change in North Africa. Berlin: Potsdam Institute for Climate Impact Research.

CHANGES IN PRECIPITATION

In Northern Africa, the amount of precipitation generally decreases from east to west, with Egypt's Alexandria receiving less than 200 mm of rain annually, while the coast of Morocco receives 1,200 mm (World Bank 2021b). Similarly, precipitation decreases as one moves away from the coast to the southern desert. The exception to this pattern is Mauritania, which receives most of its rainfall in the southern Sahelian region between June and October.

Precipitation levels have declined significantly since the 1970s, although there was some recovery in the 2000s (IPCC 2022). According to future projections, although there is uncertainty regarding the extent of decline and regional distribution, precipitation will steadily decline due to climate change. Under the RCP6.0, precipitation will decrease by -2.76 mm by 2030 and by -13.65 mm by 2080. Under this scenario, precipitation will decline by up to 43 per cent in Egypt, particularly in the Nile Delta, 21 per cent in Algeria and 17 per cent in Libya by 2030 (Gado et al. 2022). Though precipitation is already so low that countries in the region are dependent on other non-renewable water sources, this is set to exacerbate water scarcity. With all Northern African countries predominantly consisting of desert, water scarcity may contribute to further desertification.

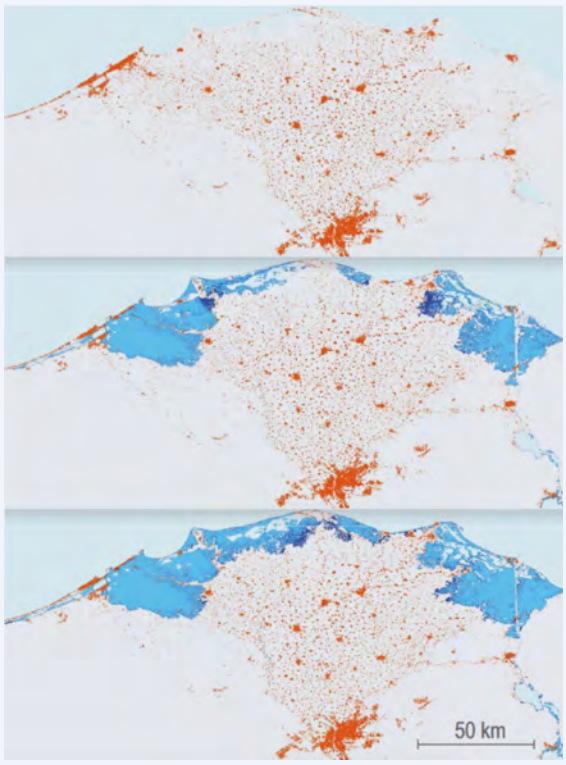


Figure 7: (Projected) flooding along the Egyptian coast, from top to bottom: present day, 2050 and 2100. Orange indicates existing infrastructure. Blue shows permanent flooding, with light blue for RCP2.6, and darker shades of blue for RCP4.5 and RCP8.5 (IPCC Africa Ch. 9)

SEA LEVEL RISE

In the Mediterranean Sea, the annual rise in sea level is between 2.5 mm and 3.1 mm annually, slightly lower than the global average (WMO 2022). Under a high emissions pathway following SSP1-2.6 this would result in 0.2 m sea level rise across the entire Mediterranean region by mid-century and 0.4 m sea level rise by 2100 (Zittis et al. 2021). Under a high emissions pathway following SSP5-8.5, the Mediterranean region including the Northern African coast could see up to 0.7 m sea level rise by the end of the century, with a low likelihood of a range of up to 1.0 m.

As the vast majority of the population is located along the coast or along the low-lying Nile Delta, Northern Africa's population is highly exposed and vulnerable to rising sea levels. Low-lying coasts in Tunisia and Egypt are particularly vulnerable (Hzami et al. 2021). The IPCC projects that by 2030, sea level rise will affect between 48.6 million and 52.3 million people in low-lying coastal areas in Northern Africa (IPCC 2022). The Nile Delta will see substantial land losses by as early as 2050 (see Figure 7). Beyond immediate infrastructure damage from higher water lines, rising sea levels will also result in saltwater intrusion into groundwater reserves and river deltas in the region. Saltwater intrusion already reaches 30 km into areas of the Nile Delta and some 100 m into coastal aquifers, depending on preventive pumping and water withdrawal (Agoubi 2021). Further sea level rises could render even larger delta areas and parts of aquifers unusable (USGS 2019).

FLOODING AND DROUGHT

Flooding caused by torrential rains is not uncommon in Northern Africa, particularly in communities located in or near mountain regions. River flooding can also be severe. In recent decades, flooding has increased in a third of river basins (Tramblay et al. 2022). Projected climate change is expected to increase extreme precipitation across most of the Sahara, although less so in the north (Seneviratne et al. 2021). That stated, due to sea level rise and changing precipitation patterns, all countries face the potential for greater flood damage along the coast.

Figure 8: Fossil aquifers of Northern Africa (Mazzoni 2018)

Droughts, in Northern Africa, are already a regular phenomenon. However, increasing aridity in the southern Mediterranean region is straining annual surface and ground water resources, making countries less resilient to droughts (Seneviratne et al. 2021). Rising temperatures and population growth will only increase water insecurity as demand for freshwater resources grows in the future.

Climate security risk pathways

RISING WATER INSECURITY

Northern Africa is already experiencing the impacts of water insecurity. The region is one of the driest in the world and has restricted water resources (Hofste et al. 2019). Egypt draws almost exclusively from its limited river sources and has a dependency ratio of 97 per cent (FAO 2016). Libya, Tunisia and Algeria draw their water almost exclusively from fossil water reserves in non-renewable deep aquifer systems. The three main aquifer systems – the Nubian Sandstone Aquifer System (NSAS), the North Western Sahara Aquifer System (NWSAS) and the smaller Murzuq Aquifer – are all being actively depleted. Morocco possesses no fossil water reserves and is fully dependent on renewable groundwater resources, while Mauritania depends on renewable groundwater but has some access to fossil aquifers. Climate change impacts and a rapidly growing population will further decrease the per capita availability of water throughout the region. In addition, water resources are increasingly under pressure from rising water consumption related to urbanisation and agriculture, and a lack of water management. This combination of declining supply and rising demand has a number of important security implications.

LIMITED WATER SUPPLIES

Northern Africa's limited water resources, on which all countries in the region depend, has the potential to be a source of regional tensions. The central Northern African countries' dependence on fossil groundwater makes them particularly vulnerable. While the joint management of the NWSAS by Algeria, Libya and Tunisia, and the NSAS between Libya and Egypt have been largely cooperative since the 1960s (African Development Bank 2022), competition for transnational water resources has led to mismanagement including unsustainable depletion. As a result of the high levels of exploitation, the extraction rate of the NWSAS is over three times its recharge rate (Mohamed and Gonçalvès 2021).

A further problem is pollution, particularly of the Bounaïm-Tafna Basin between Morocco and Algeria (Chibani 2022). Contamination from industrial discharge pollutants and, in particular, saltwater intrusion into excessively depleted coastal basins are likely to further decrease supply (Hamed et al. 2018). Even more than rising sea levels, unregulated groundwater extraction in coastal areas can lead to salt water inflows so significant as to potentially render large parts of the freshwater reservoir unusable (Mabrouk et al. 2018).

While the fossil water reserves of the NSAS and NWSAS are set to last for some 200–300 years at current extraction rates, the Murzuq Aquifer on

which Libya heavily relies could expire as early as the 2030s, putting the country under severe water stress (Mazzoni 2018). Libya's Great Man-Made River (GMMR) project, under construction and partially operational since the 1980s, aims to remedy this by channelling water from the NSAS to the dry north of the country. However, since the country began experiencing political instability in 2011, the construction and maintenance of the GMMR pipelines has been disrupted (MEI 2022). With areas of the country under militia control, security breaches against GMMR infrastructure have occurred, affecting its operation. In addition, management and future expansion of the project have been compromised by destruction, electricity outages and economic mismanagement.

The Nile as a flashpoint of tensions

In the eastern part of the region, tensions have centred around the Nile as a water source. Although the Nile is Egypt's primary source of water, its headwaters lie in Ethiopia. This fact underlies Egypt's concern over Ethiopia's building of the Great Ethiopian Renaissance Dam (GERD). From the Ethiopian perspective, the dam's potential to provide 16 GW of electricity is of vital strategic importance for its growing economy. Its success is a source of national pride as well as financial importance, particularly as nearly a million Ethiopians bought shares in the government bonds issued to finance the project (Abtew and Dessu 2019). Moreover, given that Ethiopia's hydropower earnings depend on maximising flows through the GERD near the border, it has effectively incentivised itself to release the water downstream rather than abstract it for domestic irrigation. From an Egyptian perspective, however, the construction of the dam threatens Egypt's water supply and gives a foreign power control over a resource of existential importance. As such, the filling of the reservoir was perceived to further threaten Egypt's water supply. As a result, Egypt virulently opposes the GERD and insists on binding guarantees from Ethiopia regarding water releases to which Ethiopia has refused to agree (Egypt Independent 2022). This situation increases tensions in the region and lowers the prospect for inter-regional cooperation.

Concern over the effects of the GERD project is compounded by uncertainty about future water supplies in the Nile Basin. Evaporation already leads to losses of between 2.5 billion m3 and 10 billion m3 per year around Lake Nasser, and the new reservoir will add to these (albeit at smaller scale). Overall, higher losses to evaporation due to higher temperatures are expected (Gado and El-Agha 2021), while higher temperatures will tend to increase irrigation needs. Increasingly erratic precipitation patterns and the potential of lower precipitation in the Ethiopian highlands create the potential of lower water volumes in the Nile River. At the same time, rising sea levels threaten to lead to saltwater inflows into the Nile Delta, polluting Egypt's available freshwater. As 18.1 per cent of the delta lies below the mean sea level, and a further 12.7 per cent has an elevation of between 0 m and 1 m, the delta is highly vulnerable to flooding (Hereher 2010). Even just 0.5 m of sea level rise – which is likely to be reached by 2100, according to most scenarios – would displace two million people and cause over USD 35 billion worth of damages in lost property in Alexandria and surrounding coastal towns alone (Africa Center for Strategic Studies 2022b). This slow onset climatic pressure, in combination with increasing demand from all riparian countries, will compound tension over this vital natural resource (Berhane 2014). Unfortunately, despite repeated high-level interventions, tensions regarding the management of the Nile River have so far failed to be resolved through an agreement (Mbaku 2020).

Water shortages

In addition to these regional challenges, water shortages are already affecting economies and people's daily lives, particularly of those working in the agricultural sector. The agricultural sector is the largest consumer of water in the region. Egypt, for example, uses up to 85 per cent of its freshwater for agriculture, while the sector consumes around 80 per cent of freshwater in Morocco and Libya (Belhassan 2022).

As water resources are becoming scarcer and agricultural livelihoods are increasingly under pressure, these factors can contribute to grievances and political instability. For example, in April 2016, Egypt's government banned water-intensive irrigated rice crops in the Nile Delta to reduce water use, which led to demonstrations by farmers concerned about economic losses due to being unable to sell profitable rice (Hussein 2016). Conversely, in Morocco, the lack of regulation on the water-intensive farming of water melons has led to social unrest, with citizens blaming their own water scarcity on deregulated farming practises (Mekouar 2017). Persistent water shortages have also exacerbated wider grievances, which have led to popular protests in Libya. Water shortages and deteriorating infrastructure in Libya have

made water pipes a target for sabotage by militant groups, incentivising communities to drill private wells and exacerbating the water scarcity situation in the country (Gatenby 2017).

Reduced water access also has economic implications. While agriculture's contribution to GDP is decreasing across the region as countries shift to more service-based economies, agriculture continues to employ large segments of the population (Houdret et al. 2017). This is particularly the case for Morocco and Mauritania, where the agricultural sector constitutes 33 per cent and 31 per cent of employment, respectively (World Bank 2021d). Even in Libya, where agriculture's share in GDP is only around three per cent, some 18 per cent of the population are employed in this sector (TradingEconomics 2023). The agricultural sector still features as a central component of most national economic growth plans. Algeria, for instance, is working to nearly double its domestic wheat production to offset import costs (Ould Ahmed 2018). However, wider economic losses can have destabilising effects. The World Bank estimates that economic losses due to climate-related water scarcity could cost the region between six per cent and 15 per cent of its GDP by 2050 (World Bank 2018). The loss of government revenue can significantly impact the ability of Northern African governments to fulfil their functions, while simultaneously increasing livelihood insecurities for those dependent on agriculture, contributing to further political discontent and instability.

Water governance

In general, water governance has up to now often played an aggravating role in Northern Africa's water problems. Domestic policy has hitherto largely encouraged overconsumption by offering substantial subsidies to consumers. Despite being one of the most water-stressed regions in the world, Northern Africa has the highest level of water subsidies (World Bank 2018). The challenge for governments is that populations, particularly in countries such as Libya where water is essentially free, have become accustomed to low water tariffs. Unfortunately, low water tariffs inhibit water rationalisation and investment. When governments are no longer able to provide cheap water, grievances can escalate into political instability. Thus, unsustainable water subsidies exacerbate political instability when they are implemented instead of encouraging water efficiency through conservation and reuse.

On the supply side, insufficient government intervention is further endangering water resources. Since the 1980s, exploitation of fossil water has grown significantly. The total number of withdrawal points increased from 8,800 in 2000 to 18,160 in 2008, with the vast majority located in Algeria (Chekireb et al. 2022). Moreover, the agricultural sector accounts for most of this growth, with the vast majority being unauthorised. In Tunisia, for instance, out of the 5,600 wells drilled in to the NWSAS, only 80 have received a permit (Chekireb et al. 2022). Left unaddressed, such actions decrease water availability and further contribute to security issues in the region.

National investment into desalination plants could offer some relief for acute water scarcity, but has often been neglected in favour of the further expansion of groundwater pumping infrastructure, as seen in the case of Libya and the GMMR project (Altaeb 2021). Desalination plants have been constructed or are being planned (e.g. in Morocco and Egypt), but are energy-intensive and largely powered by non-renewable electricity from national grids, increasing fossil fuel demand and resulting in an energy-water nexus (Eljechtimi 2022; Lewis 2022).

Looking into the future, trends towards greater scarcity are set to accelerate. For the MENA region as a whole, demand is set to increase by 50 per cent by 2050 with a decrease in water supply of 12 per cent (Droogers et al. 2012). Per capita water resources, already well below the 1,000 m3 per year threshold in Northern Africa for water, is likely to fall further from 500 m3 per year in 2022 (al-Kady 2022) to 350 m3 per year by 2050 in Egypt, according to some projections (UNEP 2015b).

ENSURING THE SUPPLY OF FOOD

The combination of population growth, socioeconomic changes, and environmental and climate shifts places the supply of a number of key goods and services under intense stress. In no other sector, however, are these pressures felt as immediately as in the food sector. Food security is a well-known challenge for Northern Africa. Climate change, however, disrupts the delicate balance of the current model. Changing climatic conditions and rising water scarcity endanger domestic agriculture, with the region already heavily reliant on international exports. Given the macroeconomic challenges of the region, this dependence on food imports might itself become a risk as climate

change effects worsen. Essential for political buy-in, insecure access to food has repeatedly contributed to social unrest in the recent past.

The state of food insecurity

No Northern African country covers their food needs from domestic production alone. All countries in the region are net-food importers. Food imports make up a significant part of all imports, ranging from 25 per cent of all merchandise imports, in the case of Mauritania, to 12 per cent, in the case of Tunisia (World Bank 2023c). Food imports are significant not just compared to the overall economy, but also compared to domestic food supply. Egypt's capacity to grow enough food to satisfy domestic demand was surpassed in the 1970s and has been outpaced ever since (Nikiel and Eltahir 2021). Egypt is the world's largest importer of wheat; its imports account for about 62 per cent of its entire wheat consumption, of which 85 per cent comes from Russia and Ukraine (Abay and Diao et al. 2023). Algeria imports 75 per cent of its food (Tanchum 2021), while Tunisia imports 70 per cent of its grain (Agence Tunis Afrique Press 2021).

Reliance on food imports

By acting as an alternative to domestic agriculture, which would place further strain on limited water supplies, food imports help to circumvent climate challenges at home and alleviate water scarcity. However, dependence on food imports renders Northern African countries vulnerable to shocks within their own economies and the world market.

In non-crisis times, the export of commodities has allowed Northern African countries to retain a positive balance of trade, enabling them to finance food imports. However, during crises, this often changes. Most recently, the combined shocks caused by the COVID-19 pandemic, the war in Ukraine and reduced rainfall have led to sharply rising food prices worldwide. In 2022, some 60 per cent of regional inflation occurred in the food commodities sector, placing further pressure on a population that was already experiencing income losses due to the COVID-19 pandemic (IMF 2022). This decreases affordability, particularly for the poor. As a result, a third of Northern Africa's population were food insecure in 2022 (FAO et al. 2023).[13]

Higher food prices on international markets also bring macroeconomic problems for countries' trade balances. For some countries in Northern Africa, their direct exposure to trade shocks, as importers of Russian and Ukrainian cereals, combined with limited existing stocks, due to drought and crop failure prior to the eruption of the war in Ukraine, have aggravated food insecurity. Concurrently, there was a surge in the price of oil and natural gas, which has compounded the burden for oil-importing countries, such as Egypt, and created windfall revenues for oil-exporting countries, such as Libya and Algeria.

The price increase has led to higher import costs and diminished government resources for oil imports. Consequently, this has exacerbated macroeconomic disparities, triggering significant currency devaluations in Egypt and Morocco, and leading to additional price hikes across various goods and services (Abay and Karachiwalla et al. 2023). Thus, dependence on food imports increases vulnerability by accelerating moments of crisis.

Over the coming years, globally changing climatic zones and extreme weather events will likely lead to further supply shocks and more volatile grain prices on the international market (Zhang et al. 2022). Combined with the economic difficulties climate change poses for Northern African countries, the cost of food imports relative to GDP will further increase. This heightens food insecurity in the region, as both domestic and international climatic changes can result in shocks that will upset the sociopolitical balance.

Nutrition risks

Adding to this are underlying health risks related to malnutrition and food safety. All Northern African populations face a moderate problem of obesity and childhood stunting due to malnutrition (Global Nutrition Report 2023). Childhood stunting has remained a problem even as economic growth has accelerated. This is largely due to unbalanced diets that are too reliant on carbohydrates, and deficient in fruits, vegetables, legumes and nuts. The prevalence of such diets in Northern Africa leads to micronutrient deficiency, which results in additional health problems (Global Nutrition Report 2023).

The public health challenge of inadequate nutrition adds to wider food insecurity in Northern Africa. It also correlates with other issues of food security. In particular, widely employed food subsidies usually

13 In the FAO's classification, Northern Africa includes Sudan but excludes Mauritania, unlike in the official AU denomination.

apply only to select staple items, such as bread and oil. These foodstuffs guarantee a high carbohydrate intake, but are nutritionally incomplete. Consequently, subsidies can incentivise malnutrition. Egyptian food subsidies have been associated with negative health outcomes because of their emphasis on calorie-dense foodstuffs (Ecker et al. 2016). This effect is particularly pronounced during periods of economic shock and food price rises, when poorer Egyptians fall back on subsidised, less diverse and unhealthier diets (Abay and Karachiwalla et al. 2023).

Food insecurity and political instability

Access to food has played a particularly critical role during the political turmoil of the past few decades. There have been incidents where increasing food prices were associated with the risk of political unrest and conflict. For instance, rapid price increases triggered civil unrest in areas of Egypt and Morocco in the 1970s and 1990s, respectively. In addition, rapid price increases contributed to the widespread unrests that unfolded during the Arab Spring across some Northern African countries (Zaki 2008; Johnstone and Mazo 2011; Alshammari and Willoughby 2017; Soffiantini 2020; Läderach et al. 2022). More recently, food price increases have also contributed to strikes and protests in Northern Africa (France24 2022).

These food price shocks have occurred despite high food subsidy regimes across the region. While food subsidies provided a social safety net during the 2007–2008 food price shock in Egypt, they also brought various problems. This included a reduction in availability due to smuggling and demand spikes for certain foodstuffs, which in turn led to fiscal shocks for the state (Trego 2011).

As climate impacts jeopardise natural resource-based sectors – if climate adaptation, mitigation and early action are not put in place – the supply risks associated with food, water and energy sectors will intensify. As discussed, agriculture already uses up the majority of the available freshwater in all Northern African countries. With water resources limited and under strain, domestic agriculture cannot easily scale up to meet growing food demand. In addition, local agriculture will increasingly come under pressure from changing climatic conditions in the region. Higher temperatures and lower precipitation increase soil salinity. In combination with unpredictable rains and heat stress on plants, this is lowering agricultural productivity (Molina et al. 2020). Projections expect that crop yields could fall by 20–55 per cent from their 2010 outputs by mid-century, with higher impacts on less resilient products including key cereals (WFP and ODI 2015).

FOSSIL FUEL DEPENDENCY AND THE GREEN TRANSITION

Northern Africa has one of the lowest shares of renewable electricity production globally (OurWorldInData 2022), and remains heavily invested in the extraction and use of fossil fuels. By continuing to rely on fossil fuel production and consumption, Northern African countries are endangering their domestic energy security and exposing their socioeconomic development to transition risks. At the same time, the green transition opens up new spaces to address socioeconomic development in Northern Africa more broadly.

Fossil fuel lock-in

Libya, Algeria and Egypt are major oil producers, while Algeria and Egypt are Africa's two largest gas producers accounting for some 60 per cent of the entire continent's production. Mauritania, though not historically a fossil fuel exporter, is in the process of becoming a natural gas exporter (Georges 2022). This makes their economies dependent on global oil and gas demand and prices. While the war in Ukraine has led to a temporary increase in fossil fuel prices and demand for new sources of gas, demand for oil and gas is likely to resume its long-term decline. The International Energy Agency, major multinationals as well as the Organization of Petroleum Exporting Countries all predict demand will decline by as much as 75 per cent by 2030 (IEA estimate), though estimates vary (bp 2020; Hodari and Elliott 2020; IEA 2021).

For major exporters, such as Algeria and Libya, falling demand and prices pose a great risk as hydrocarbons are currently the primary source of foreign exchange and a major source of public revenue. As stated by the World Bank, although there is uncertainty as to the pace of the decline of oil and gas, countries that are currently reliant on oil and gas exports cannot afford to wait to diversify their economies and invest in the low-carbon transition (Peszko et al. 2020). Falling oil and gas revenues pose a major macroeconomic problem for countries dependent on a delicate macroeconomic balance to provide economic growth and import food.

Energy subsidies for fossil fuels, as they have long been common in Northern African countries, further solidify domestic demand for oil and gas, and

thereby further lock in a fossil economy. Despite policy reforms, all Northern African countries continue to subsidise fossil fuels for consumers. Libya has one of the lowest petrol prices in the world, which encourages both domestic consumption and widespread smuggling (Eaton and Tim 2018). In turn, smuggling ends up hurting both the state, which loses subsidies to smugglers, as well as consumers, who end up paying more than the subsidised market rate because of shortages caused by smuggling (TRACIT 2019).

Transition risks

However, as long as fossil fuel prices remain high, the countries most exposed to transition risks have the least incentive to diversify their economies and so are the least prepared to deal with its effects. Algeria and Libya are examples of this dynamic and continue to have the lowest rates of electricity production from renewable energy sources in the region. While all the other countries in the region have made significant advances in renewable energy, electricity production from renewable energy (excluding hydroelectricity) remains below one per cent of the total energy mix (World Bank Data 2023). With an exceptionally narrow tax base and few other viable economic sectors, Libya has the additional exposure of having few other options for public revenue and, therefore, has the highest exposure to declining oil demand alongside Iraq (Cornish et al. 2021).

Other countries have begun their green transitions. Natural gas continues to account for an overwhelming share of electricity production in Egypt, although its solar capacity is growing. Morocco still mostly relies on coal for electricity production, but is leading the region for renewables, with renewable sources accounting for around 30 per cent of its electrical capacity and more than 10 per cent of its electricity supply (IRENA 2023c). This comes after a concerted investment effort into wind and solar energy in the last few years (Bennouna 2022). Mauritania has a renewable capacity of 27 per cent, while seven per cent of Egypt's energy capacity is currently renewable (IRENA 2023a, 2023b). Expanding renewable energy capacity has the additional advantage of increasing energy sovereignty for Mauritania, Morocco and Tunisia, which are currently highly dependent on fossil energy imports (IRENA 2023b, 2023c, 2023d).

Ensuring electricity supply

A lack of investment in green energy not only stunts economic growth prospects, but also endangers domestic energy supply. As Northern Africa's population is growing and consuming more electricity per capita, only reliable and readily available sources of energy, such as solar power, can match demand. Otherwise, the supply of electricity is at risk of becoming a focal point of popular discontent akin to water and food. A growing economy and population create constant pressure on utility companies to produce more electricity. Concurrently, higher ambient temperatures lower the efficiency of electricity production and per capita demand for electricity could increase by up to 25 per cent in Africa to account for greater cooling needs during hotter periods (van Ruijven et al. 2019). The additional stress on electricity grids to power air conditioning during summer months has already led to power outages across the region. In addition, lower precipitation and water runoff have the potential to impede hydroelectricity production in Egypt, which currently satisfies some five per cent of its electricity demands from hydroelectric plants along the Nile River (U.S. Energy Information Administration 2022).

Consequently, electricity demand already often outpaces supply. Frequent power outages have at numerous occasions become a triggering factor for wider frustration with governance, as evidenced by protests in Egypt in 2014, and in Libya in 2018 and 2022 (Middle East Monitor 2014; Elumami and Al-Warfali 2022). Insufficient supply forces electricity providers to react with load shedding, temporarily turning off sections of the national grid to avoid a complete blackout. In Libya in 2017 and 2020, local militias disabled emergency breakers to prevent electricity providers from shutting down electricity in their areas (Reuters 2020). This led to an inability to balance the grid, resulting in repeated and prolonged blackouts across the entire country. This led to demonstrations and anti-government unrest. The blackouts also damaged infrastructure, and incentivised Libyans to steal from and attach illegal connections to the grid (Libya Observer 2020). Thus, social unrest and the failing provision of electricity are mutually reinforcing.

Beyond immediate provision to consumers, electricity is crucial for providing other key goods and services. The reliance among all Northern African countries, excluding Egypt, on groundwater resources in turn increases energy demand. Electricity is necessary to ensure groundwater extraction and distribution, as in the case of Libya's GMMR project. Disruptions in the electricity sector could endanger the supply of water. In turn, an

ability to distribute and pump groundwater affects agriculture, which is reliant on groundwater. Retaliation can also be sociopolitical. In July 2020, local militias in Wersheffana cut power supply to Libya's south. Militias in the south responded by forcing the GMMR authority to disrupt the water supply to western and central Libya (Clingendael 2020). Problems in the electricity sector can, thereby, aggravate water and food insecurity.

HUMAN MOBILITY, MIGRATION AND DISPLACEMENT

Migration remains a dominant topic in Northern Africa. Countries within the region have around 1.5 million IDPs, mostly in Libya, and harbour some three million regional migrants, mostly from Western, Central and Eastern Africa. Both internal and regional migration are set to rise as a consequence of climate change, with environmental challenges triggering displacement and follow-on effects, such as loss of livelihood and conflict. While migration is an important adaptation measure, the lack of pre-emptive policy measures can become a driver of tensions and conflict. Insufficiently managed, migration can aggravate other climate security challenges by increasing population pressure on resources and services.

Displacement

Over recent years, Northern African countries have experienced an increased number of disaster-related displacements. Climate change increases the frequency and intensity of disasters, which are a push factor for displacement. Between 2010 and 2019, there were 17,000, 29,000 and 4,400 new disaster-related displacements recorded in Morocco, Algeria and Tunisia, respectively. At the same time, most of the new displacements recorded in Libya (1,409,000) and Egypt (30,000) were conflict-related (IDMC 2021). Weather-related events, particularly flooding, have been a key driver of disaster-related displacement in the region, accounting for 58 per cent of disaster-induced displacement in the MENA region. Poor soil absorption can result in seasonal rain, leading to flash flooding in the otherwise arid region (IDMC 2021).

Internal and regional migration

Northern Africa remains a destination for internal and regional migration (IOM Migration Data Portal 2021). Urban centres, particularly Libyan cities prior to the outbreak of the Libyan civil war, are major regional migration magnets for people looking to benefit from economic opportunities (IOM Migration Data Portal 2021).

Within Northern Africa, excluding Mauritania, between 4.5 million and 13 million people – depending on mitigation and adaptation pathways – could move within their own country due to climate change by 2050. Most of these movements will be due to severe water stress pushing people out of coastal and urban areas, and into urban centres with better water availability (Clement et al. 2021). The number of people moving because of climate change effects could thus constitute up to six per cent of the entire Northern African popula-

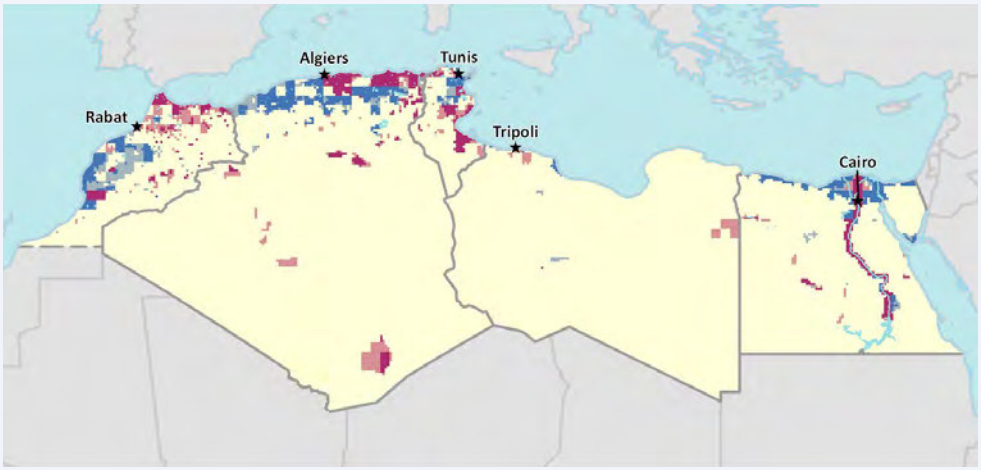


Figure 9: Projected in- and out-migration hotspots in Northern Africa, excluding Mauritania, by 2050 (Clement et al. 2021)

tion. These outflows could affect both rural areas as well as major towns, and result in migration to urban centres with better water access. As Figure 9 illustrates, coastal areas affected by rising sea levels and declining water availability, such as Alexandria, Kelibia, Oran, Agadir and Safi, could see outflows, similar to more rural inland areas with reduced water access (Clement et al. 2021). Migration is expected to largely flow towards urban areas with sufficient water availability including Cairo, and upstream along the Nile Valley and central Nile Delta, as well as Algiers, Tunis and Tripoli.

Combined with the region's high population growth, increased migration would place severe stress on resources and services in cities. In addition to water scarcity, overburdened electricity grids and insecure food provision could aggravate the tense situation in many Northern African cities. Migration will thus contribute to turning cities into climate security hotspots if the cities fail to adjust to higher demands and increase their capacities.

Migration beyond the region

Most migration in Northern Africa is cross-regional with inflows from Western, Central and Eastern Africa. Much of this migration involves short-term movements to pursue employment opportunities. In Libya, for instance, seasonal migrants from Chad, Niger and Sudan continue to arrive during the short agricultural season before returning to their countries of origin (Wenger and Abulfotuh 2019). Such seasonal migration is primarily associated with movement from areas where land is degraded and land-based livelihoods are endangered. Inhabitants of such regions where livelihoods are under pressure tend to move towards areas with more favourable conditions for pasture, agricultural production, water resources and employment opportunities, resulting in rural-rural, urban-rural and circular in-migration (Rusca et al. 2023). Such labour migration can serve as a well-established risk diversification strategy that is economically beneficial for both regions (Läderach et al. 2022).

Despite the risks and costs, migration pressure continues to push the population northwards. Currently, there are an estimated 3.2 million international migrants in Northern Africa (UN DESA 2020). According to the World Bank, climate induced migration from Eastern, Central and Western Africa could increase to 86 million by 2050 (Clement et al. 2021).

As irregular migration flows increase, so does pressure on migration routes. Initially, during the vacuum that followed the Libyan revolution in 2011, Libya became the main conduit of irregular migration to Europe. Entrepreneurial armed groups and criminal networks became increasingly adept at charging fees to the extent that profits from human smuggling were estimated to be as much as USD 978 million in 2016 (Eaton and Tim 2018). The dramatic rise in seaborn migration and the high number of deaths, however, caused Italy and the European Union to establish agreements with the Libyan government and local actors, many of whom had profited from smuggling, to reduce the number. As a result, arrivals from the central Mediterranean route, which includes Tunisia, Libya and Egypt, reduced from 119,369 in 2017 to 2,779 in 2019 (IOM 2021c). As migration flows follow the path of least resistance, restrictions in Libya pushed migration to the western corridor, with the number of irregular migrants crossing from Morocco to Spain increasing from 8,613 in 2016 to 58,525 in 2018 (IOM 2021c).

As EU policies seek to reduce irregular migration from Northern African countries, many migrants remain in transit countries, and lack integration into social and economic governance (Boubakri et al. 2021). Conflict with public authorities and local resentments can increase tensions. In addition to migration from other African regions, decreasing living conditions in Libya and Tunisia partly driven by climate change and high prices are causing an increasing number of Northern Africans to move to Europe. While previously viewed as transit countries, by 2020, the number of Tunisian, Libyan and Egyptian migrants doubled as livelihoods within these countries declined (Villa and Pavia 2023).

Migrant groups most at risk

Migratory experiences are not homogenous. Women, children and older people often face unique human security challenges. Women account for 80 per cent of people displaced by extreme weather events globally (UNDP 2016). It is estimated that around 6.3 million women and girls were internally displaced in the MENA region at the end of 2019 (IDMC 2021). Women often have unequal access to emergency relief and the disintegration of social networks undermines a critical resilience factor for women, amplifying pre-existing vulnerabilities and creating new ones (Rusca et al. 2023; Savelli et al. 2023). Despite this, there are persistent data gaps across governments and humanitarian organisations, which necessitate

capacity-building efforts to strengthen their abilities to collect, store and analyse data disaggregated by sex, age, and other social and economic factors, as well as enhance their capacity to assess small-scale displacement events (IDMC 2021).

Responses and good practices

Across Northern Africa, a number of successful responses to climate security risks are emerging. Some problems and solutions have long been identified by national and local actors, and are being implemented at various stages. Other challenges are novel and are being tackled through concentrated practises that are yet to be scaled up.

In this section, interventions are presented in three parts: (1) regional approaches, (2) national approaches and (3) local approaches.

REGIONAL APPROACHES

Interstate cooperation

Though political integration in the region has been slow, Northern African countries have found a number of ways to cooperate. This allows countries in the region to balance their strengths and weaknesses, reducing the vulnerability of those sectors most severely threatened by climate change, such as food and energy.

Northern African countries have begun preparations for what might be an eventual common electricity market. The North African Power Pool (NAPP) is one of five African power pools established in the 1970s as part of pan-African ambitions to create an integrated electricity system. The premise of the hubs is to enable countries to buy and sell electricity through interconnected grids, and leverage their comparative advantages. The central body operationalising the NAPP is the Maghreb Electricity Committee (COMELEC). Originally created in 1974 and based on the institutional framework of the Arab Maghreb Union (AMU), COMELEC brings together the various national electric companies. Membership in COMELEC was later extended to Mauritania. Although not formally a member, Egypt, which boosts a 220 kV connection to Libya, is in practice also integrated.

However, although further planning is taking place, grid connections are largely not operational at present (Hatim 2020). Morocco, Algeria and Tunisia have established multiple transmission interconnections since the 1950s (Tsebia et al. 2023). While five connecting lines between Algeria and Tunisia have been constructed, the lines connecting Algeria and Morocco are not utilised.

The potential benefits are extensive. Not only will these connections stabilise the regional grid, but – as more renewable energy projects harnessing Northern Africa's high radiant energy capacity come online – the region could potentially export electricity to Europe via Morocco and to the Middle East via Egypt. This could contribute significantly to an emerging Mediterranean electricity ring (MEDRING) or Mediterranean electricity grid (MEDGRID) (Ruggiero 2014; Medgrid 2023). The first steps towards such a pan-regional integration are underway. In December 2022, the European Union pledged a grant of about EUR 307 million for the construction of ELMED, a transmission line between Italy and Tunisia (MED-TSO 2022b). This follows the Masterplan of Mediterranean Interconnections proposed by the Association of the Mediterranean Transmission System Operators (MED-TSO), developed with EU sponsorship, to establish 19 interconnections along five corridors in the Mediterranean region (Lounnas and Messari 2018; MED-TSO 2022a).

Integration of European, Northern African and Middle Eastern grids would establish a common market for electricity. In the long term, an integrated Mediterranean grid would enable Northern African countries to capitalise on the region's abundant renewable energy potential, particularly solar power. Once they have expanded their renewable electricity production, Northern African countries could sell electricity to Europe on a larger scale, providing a secure source of revenue that would help to diversify fossil fuel-based economies (Werenfels and Westphal 2010). Consequently, ongoing efforts towards grid integration also contribute to the macro-economic stability of Northern Africa. In addition, energy partnerships between Northern Africa and the European Union could encompass renewable hydrogen exports to Europe (see National Approaches).

Managing fossil water reserves

As the fossil aquifers are largely transnational, their management requires monitoring on a regional level. International organisations such as the UN Economic and Social Commission for West Asia have played a crucial role in quantifying groundwater in Northern Africa, providing data that is essential for effective management (ESCWA 2019). Regional data on fossil aquifers can form

the basis for agreements and regulations regarding extraction, and unsustainable depletion and contamination.

Although no treaty exists regulating NWSAS water, an important step forward was taken in 2007 when the three countries came together with the support of the Sahara Sahel Observatory (OSS), the UN Environmental Programme (UNEP) and funding from the GEF. With the OSS acting as the coordination unit, the three countries established the Consultation Mechanism, which facilitates information sharing (e.g. shared databases) and common research initiatives between the countries.

Climate security networks

On the regional level, a number of non-governmental actors have facilitated knowledge gathering on climate change, peace and security. One such effort is the Climate Responses for Sustaining Peace (CRSP) initiative launched by the Egyptian COP27 presidency. The CRSP aims to facilitate knowledge sharing and capacity building within Africa, focusing on climate adaptation and peacebuilding, climate-resilient food systems, climate-induced displacement, and climate financing. The initiative has up to now focused on various activities, including capacity building. A first training session for African national officials was held in March 2023. The session aimed to enhance knowledge and understanding of how to comprehensively assess and respond to climate-induced risks to advance climate adaptation, resilience and peacebuilding in Africa. A second training session took place in September 2023. Furthermore, the CRSP co-hosted the Climate, Peace and Security Experts Academy in New York in June 2023 in collaboration with the UNDP. The academy invited government officials, including from fragile and conflict-affected countries and territories, UNDP country office staff, and experts on climate and environmental peacebuilding. In addition, the CRSP has begun the publication of research reports on the topic, including a joint report with UNDP, Re-envisioning Climate Change Adaptation Policy to Sustain Peace: A Typology and Analysis of National Adaptation Plans.

In addition, regional organisations partly or completely encompassing Northern Africa have initiated debate on climate security issues. The League of Arab States (LAS) hosts the Climate Security Initiative. Together with the Arab Water Council, the LAS also runs the Regional Climate Security Network, which aims to coordinate responses to climate security challenges and integrate a security perspective into climate action between states in the Arab region and Northern Africa (Arab Water Council 2022b). The NGO CGIAR hosts the MENA Climate Security Hub, conceptualised as a platform for convening regional expertise on climate security issues. Such regional efforts can be mobilised to close knowledge and data gaps, synergise efforts from the local to the regional level and build the capacities of key stakeholders in the region (CGIAR 2023b). Regional expert networks and platforms, whether hosted by NGOs or states, can provide technical expertise to governments and policymakers on how to integrate climate, peace and security considerations into climate, agriculture, water and energy policies, projects and interventions.

NATIONAL APPROACHES

Infrastructure and restoration projects

Northern African countries have demonstrated successful leadership with ambitious projects to restore and protect natural and man-made environments against climatic changes.

Originally conceptualised to fight desertification, Algeria's Great Green Dam was launched in 1962 and has since restored 300,000 ha of degraded forest previously threatened by the expansion of the Sahara desert (UNFCCC 2015). While the effects of climate change, in the form of higher temperatures and lower precipitation, eclipse desertification, the prevention of desertification remains a precondition for protecting arable land.

Responding more concretely to climate change challenges, Egypt is implementing an Integrated Coastal Zone Management plan, which will dredge and strengthen dikes, stabilise sand dunes with vegetation, create reed fences, and conserve marsh lands (UNDP 2023a). Such measures to protect against flooding are essential to prevent widespread displacement from populous coastal centres.

Subsidy reform

Northern African countries have begun to tackle subsidy policy reform. If conducted correctly, subsidy reform could reduce certain climate security risks and increase the resilience of Northern African populations. Though often driven by economic motivations, subsidy reform can also help to strengthen state capacity. Mauritania was prompted to reform its subsidy system by its fiscal deficit. However, this also offered an opportunity to rebalance its state budget and implement more

sustainable policies (Megersa 2020). Although often seen as helpful for the poor, subsidies are regressive. As those with higher incomes consume more, subsidies for consumption amplify inequalities. By encouraging price distortions, and opportunity for rents and smuggling, subsidies often contribute to shortages (Sovacool 2017). By replacing subsidies with more targeted social programmes, subsidy reform can improve the efficiency of government support for the most-in-need segments of the population.

The Egyptian government has begun reforming the Tamween food subsidy system, for example, by introducing a smart card for purchasing bread and other staple foods in 2015. By restricting subsidised purchases to the most-in-need segments of the population, the reform has slightly reduced the number of eligible recipients and freed up state resources. However, around 70 per cent of the population still consume subsidised bread. Replacing broad food subsidies with targeted cash transfers has been shown to significantly improve the welfare of the poorest households, assuming it does not increase state deficits to the point of stifling economic growth (Breisinger et al. 2023). Subsidy reform that does not dismantle the social safety net but rather restructures it to be more purposeful in protecting the most vulnerable can contribute to resilience.

Egypt has marginally increased the wheat flour extraction rate for its standard issue bread (SandP Global 2022). This move, intended to reduce the need for grain imports, has improved the nutritional quality of bread by moving closer to whole wheat production – tackling food dependency as well as nutritional problems.

More comprehensive subsidy reform has been undertaken in the energy sectors of some countries. In Morocco, expenditure for energy subsidies peaked at 6.6 per cent of GDP, while subsidies took up 12.5 per cent of GDP in Egypt in 2012. Both countries have since managed to reduce the overall size of their subsidy programmes (IEA 2022). Libya has reduced its subsidy spending, although it still spends a significant part of the state budget on subsidies (IEA 2022). Algeria, by contrast, has not yet reduced its energy subsidies. Tunisia announced subsidy reforms during IMF negotiations in 2022 (World Bank 2023h). However, these commitments have not yet been enacted, with its energy minister having been dismissed.

In 2022, Egypt spent around USD 3 billion on subsidies, with energy subsidies still not entirely eliminated in spite of previous commitments. However, Egypt has managed to reduce fossil fuel subsidy expenditure through a concerted policy effort since 2013 (WRI 2021). This phase out is increasing the price of fossil fuels, such as petrol, and is thereby discouraging wasteful and emissions-intensive behaviours. Morocco began a systematic reform process to dismantle the subsidy regime in 2012. By 2021, all energy subsidies had been removed except those on liquefied petroleum gas (typically butane gas used for cooking and heating). In 2013, a new pricing system, which was sensitive to global price changes, was introduced. This soon succeeded in significantly reducing the GDP share of subsidies (Auktor and Loewe 2022). Morocco's remaining subsidy for gas, however, resulted in record deficits for the state budget as global gas prices increased, exposing the continued macroeconomic risk of subsidies (Rahhou 2023).

Both Morocco and Egypt succeeded in at least partially reducing socially regressive and unsustainable subsidies in a way that addresses the social dimension of climate security risks. The Moroccan subsidy reform was particularly successful because it was accompanied by a comprehensive information campaign, as well as distributional and welfare policies, which ensured that poorer segments of the population were protected from cost of living increases (Verme and El-Massnaoui 2017; Innovation for Sustainable Development Network 2019). In Egypt, likewise, public discontent was muted by social benefits financed by increased taxation on the wealthy and business. However, discontent about energy subsidy reforms in Egypt was pacified by doubling-down on and increasing food subsidies (WRI 2021).

Green transition

To satisfy Northern Africa's ever-increasing demand for electricity, additional power will need to be brought on grid in a manner that is compatible with the current re-orientation to renewables. Regional investments in renewable energy are highest in Morocco and Egypt, the latter of which (excluding hydropower) increased by 560 per cent between 2010 and 2020 (IEA 2020b). This impressive result was made possible by creating a positive investment environment, which included reforming subsidy regimes. Here, Egypt was particularly effective. The result of these reforms cannot be understated. National expenditures on fuel subsidies, which consumed some USD 21 billion in

2013, dropped from 9.2 per cent of GDP to 2.2 per cent in the first year to 0.3 per cent by 2020. Over the next five years, Egypt will add 25.5 GW of new power, including 1 GW of photovoltaic and 840 GW of wind capacity (IEA 2020a). Larger infrastructure projects are being introduced, including the 1.8 GW Benban Solar Photovoltaic Park, which will be one of the largest in the world. This will allow Egypt to save revenue, while simultaneously shifting from an electricity deficit to a surplus. The country's long-term real GDP growth prospects have also improved significantly. Egypt now has a real prospect of achieving its national objective of sourcing 42 per cent of its electricity mix from renewables by 2035 (IRENA 2018).

Northern African countries have attracted international investments to boost their renewable capacity. For example, the Nexus on Water, Food and Energy is a partnership between Egypt, and the European Bank for Reconstruction and Development. As part of its energy pillar, the project received financial support from the U.S., Germany and a number of other partners, among others, to retire 5 GW of fossil fuel capacity by 2025, and to invest in at least 10 GW of solar and wind energy by 2028 in a just transition. Furthermore, the first EU-Northern African agreements have been concluded. Among other things, Egypt has signed a memorandum of understanding with the European Union to promote renewable hydrogen production (European Commission 2022). This partnership could see European investments enhance Egyptian production capacity, facilitating exports to the European Union, bolstering renewable energy generation in Egypt and strengthening Egypt's economy. The partnership serves as a model for the larger EU-Mediterranean Renewable Hydrogen Partnership, which will encompass Northern African countries. Multiple European countries are planning to partner with Northern African countries on a pipeline project to export hydrogen, termed SoutH2 Corridor (Ivanova 2023).

LOCAL APPROACHES

Adopting sustainability

Beyond broad policy changes, increasing resilience to climate security risks takes place locally. Northern African countries have begun adopting numerous projects at various scales to improve sustainability and address climate security risks.

Such projects can simply be dedicated to producing green energy locally, such as the planned project to install floating solar panels over Lake Nasser (Elshafei et al. 2021). Floating solar panels over Egypt's largest standing body of water would provide a local source of green electricity bolstering the national grid. Moreover, the solar panels would significantly reduce water evaporation from the lake, partly remedying lower inflows into the Nile River. Other local green electricity projects are found throughout the region, such as the GIZ-supported Green Municipalities project in Algeria (Communes Vertes 2020). Installing local solar panels eases the nationwide green transition and increases local resilience to potential blackouts.

Local sustainability efforts are even more tangible when addressing water scarcity, as this is a more localised phenomenon. In Libya, the IOM implemented its community stabilisation programme Together We Build with funding from the European Union in 2017. The project's aim was to engage community representatives in rehabilitating neighbourhood water wells in the city of Sabha (Gatenby 2017; IOM 2017). The programme represents a successful local-level intervention for sustaining access to water for households. By involving local stakeholders in the decision-making process, the programme strengthened water's status as a shared public good, while also diversifying local water supplies and preventing water scarcity.

Amplifying marginal voices

One of the most impactful means for local and community groups to address climate security threats is to influence national and regional policies through advocacy and participation. Platforms that provide a space for local knowledge and citizen science enable those most directly affected by the consequences of climate change and exposed to the security threats of these developments to contribute often highly valuable input for achieving sustainable and secure adaptation. Civil society organisations such as the Global Network of Civil Society Organisations for Disaster Risk Reduction (GNDR) have facilitated the sharing of information among various civil society actors in Northern Africa through reports such as Views from the Frontline (GNDR 2023). The North African Network for Food Sovereignty advocates for more local autonomy and the provision of resources to engage in farming in the region (Open Democracy 2020). Furthermore, a number of other organisations with a focus on the MENA region, such as the Arab Network for Food Sovereignty, integrate Northern African participation (APN 2023).

Initiatives targeted specifically at vulnerable groups, including women and young people, amplify the voices of groups who need greater representation. For example, a first youth dialogue entitled Empowering African Youth Voices for a Peaceful and Climate-Resilient Future was hosted by the Aswan Forum for Sustainable Peace and Development in 2022. The dialogue gathered recommendations about how to advance integrated climate change and security responses. The outcomes of the dialogue were presented at COP27 (Aswan Forum 2022). Such alternative voices not only highlight differentiated risks that are insufficiently addressed, but also provide positive impulses for solutions through entrepreneurship, innovation and technology. Accounting for specific needs and vulnerabilities across different demographics and localities builds resilience at all levels.

Transboundary waters: surging competition

Many of Africa's largest freshwater basins span several countries. Since pre-history, these basins have been a vital source of water for communities and civilisations across the continent. More recently, these basins have seen the development of major infrastructure projects, some of which have become points of contention between riparian countries, as the projects affect upstream and downstream water access and availability.

Adding to these pressures are various socioeconomic and environmental factors. Economic and population growth are fuelling demand for food, water and energy in and around Africa's major water basins. Climate change, through its impacts on rainfall and interannual variability in river flow, will likely put additional pressure on transboundary water resources and could further increase competition (Siam and Eltahir 2017; Roth et al. 2018). These pressures are particularly urgent as the majority of transboundary water resources in Africa – 65 per cent of all transboundary river basins and more than 90 per cent of all transboundary aquifers – are not regulated by any transboundary agreement (African Development Bank 2022).

Political tensions and competition

Political tensions and conflicts over transboundary waters have history in Africa. For example, the construction of two major dams on the Senegal and Bafing rivers, in response to severe droughts in the 1970s, altered the rivers' hydrology and disrupted local production systems. Consequently, these changes sparked land tenure disputes between ethnic groups and elites along the Mauritanian-Senegalese border, as well as violent conflicts between farmers and herders. These incidences resulted in thousands of people being killed or displaced, and led to Mauritania and Senegal breaking diplomatic ties, which nearly resulted in war between the countries (DeGeorges and Reilly 2006; Salmone 2010).

Today, competition and tensions are rising over many transboundary waters. A particularly contentious issue has been Ethiopia's Grand Ethiopian Renaissance Dam (GERD) in the eastern Nile Basin. Construction of the GERD began in 2011, but has since been marred in disputes. For Ethiopia, the GERD represents an important source of hydropower for economic development and poverty eradication. For Egypt, the GERD's operations could threaten the country's water security, particularly as Egypt grapples with worsening water scarcity as a result of increasing salinisation in the Nile Delta and growing irrigation demands. As the third riparian of the Nile Basin, Sudan's stance has alternated between supporting upstream Ethiopia and downstream Egypt (Climate Diplomacy n.d.e, n.d.f).

Disputes can also be seen over other freshwater bodies, such as Lake Turkana and Lake Victoria. Competition over natural resources in the basins, including water and fish stocks, have led to cross-border communal clashes and, in the case of Lake Victoria, armed conflict (Le Ster 2011; Glaser et al. 2019). The impacts of climate change are affecting access to and the availability of lake resources, as well as pushing people to extend fisheries activities deeper into lakes and potentially across borders, potentially intensifying competition and political tensions in the region.

Multilateral efforts to address transboundary water competition

At the same time, riparian countries across Africa have taken steps to strengthen cooperation and mutual capacities on transboundary water management.

The Nile has long been the subject of diplomatic negotiations. **The Nile Basin Cooperative Framework Agreement (CFA)** has been under negotiation since 1995, but was delayed by disagreements about whether to recognise older water-sharing agreements (African Development Bank 2022). When a treaty was finally presented in 2010, only three countries ratified it, with Egypt and Sudan choosing not to. In parallel, the **Nile Basin Initiative (NBI)** was established in 1999 and consists of 10 member states that share the Nile Basin. The NBI provides an important platform to strengthen development and water resource cooperation between riparian countries. Furthermore, the NBI has signed multiple memorandums of understanding with other regional organisations, including the Lake Victoria Basin Commission (LVBC) and IGAD, which provide

vertical linkages to broader political forums to support sustainable and cooperative water governance (NBI 2020). However, the NBI has had limited success in addressing tensions and disagreements over transboundary water development in the Nile Basin. Attempts to establish a permanent Nile Basin Commission have been held back by opposition to the CFA by several member states, and the inability of member states to resolve ongoing political and legal disputes Krampe et al. 2020). A trilateral treaty between Egypt, Sudan and Ethiopia, the Agreement of Declaration of Principles (DOP), was signed in 2015 to address political tensions around the GERD construction (Agreement of Declaration of Principles 2015). However, the DOP requires further negotiations about the operation of the GERD, which have not yet yielded agreement.

Transboundary resource management is vital for climate security, with water management being an essential aspect. The Lake Chad Basin Commission (LCBC), established in 1964, is the oldest African transboundary water management commission and promotes sustainable water resource management and conflict resolution in the basin. The LCBC also created the Multi-National Joint Task Force, composed of troops in Benin, Cameroon, Chad, Niger and Nigeria, to address crime and violence, including extremist groups like Boko Haram. Security coordination includes harmonising border control measures and exchanging defence information. Meanwhile, the Authority of the Niger Basin (ANB) promotes integrated development in various fields, such as energy, agriculture, fishing, forestry industry and fluvial navigation.

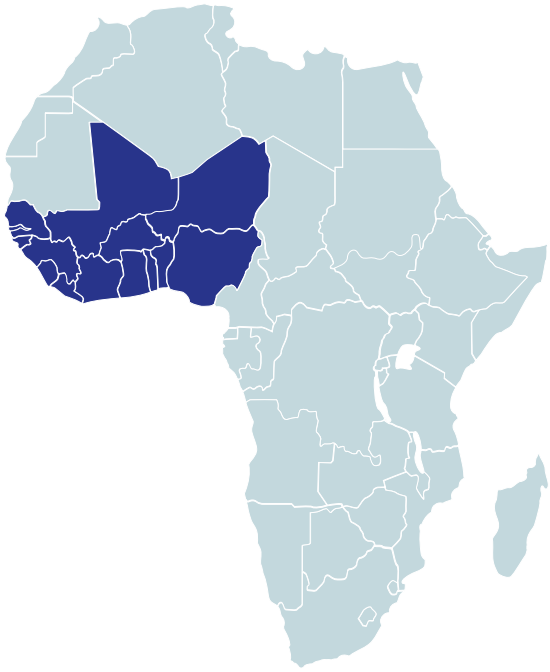
Meanwhile, the **Senegal River Basin Development Organisation (OMVS)** tackles hydropower, fluvial navigation, sustainable and concerted use of water, and livelihoods in the Senegal River Basin. The OMVS was established by Mali, Mauritania and Senegal in 1972 to support food security, strengthen economic resilience to extreme weather, accelerate economic growth, and preserve ecosystems and local livelihoods (Ndiaye n.d.). The OMVS is recognised as an exemplary model of integrating divergent water needs into projects that would not have been feasible for any single member state (OiEau 2010; Bruckmann 2021). Thanks to a robust financial and legal framework, the OMVS has been able to co-plan and manage infrastructure (World Bank 2021g). These installations are key to the region's water and energy security, supplying 60 per cent of drinkable water in Dakar, and 100 per cent in Nouakchott and Saint Louis, as well as 800 GWh per year of electricity (Komara 2014). The OMVS integrated Guinea in 2006 (Ndiaye n.d.). Initially focused on economic development, the OMVS is increasingly shifting to climate change adaptation and participation to address local conflicts (Bruckmann 2021). Consequently, the OMVS is becoming more responsive to civil society organisations, which are now included in monitoring and mitigating the environmental impact of the OMVS (Ndiaye n.d; Grain de Sel 2005).

In addition, there have been **advancements in the management of aquifers in Southern Africa and Northern Africa.** This includes the management of groundwater and surface water within Southern Africa's shared watercourse systems, which is governed by agreements signed in 2000. There is also the SADC's Regional Strategic Action Plans for Integrated Water Resource Management (IWRM), which promotes sustainable groundwater management (UN Water 2021). In Northern Africa, the agreement of the Joint Authority for the Study and Development of the Nubian Sandstone Aquifer System (NSAS) is supported by Egypt, Libya, Sudan and Chad. While the agreement does not regulate water management, subsequent agreements defined monitoring and data-sharing guidelines. The UN-supported Regional Action Programme for the Integrated NSAS Management led to the signing of the Regional Strategic Action Plan for the Nubian Sandstone Aquifer System in 2013 (African Development Bank 2022). The NWSAS is governed by the trilateral Mécanisme de concertation for management and study, and is supported by steering and scientific institutions in each of Algeria, Libya and Tunisia (African Development Bank 2022). However, while transboundary agreements for the region's most important aquifers exist, these agreements do not always translate into effective action for sustainable water use.

14 Member states include Burundi, the DRC, Egypt, Ethiopia, Kenya, Rwanda, South Sudan, Sudan, Tanzania and Uganda, with Eritrea as an observer.

15 For more information, refer to the Southern Africa chapter section on responses and good practices.

Western Africa



Summary

KEY CLIMATE IMPACTS

Temperature: Climate change has led to an increase in temperatures over Western Africa of between 1°C and 3°C since the 1970s. Temperatures are projected to rise with high certainty by between 0.6°C and 3.1°C by 2080 compared to the year 2000. Temperature rises will affect the entire region, although they will be less intense along the coast. In line with rising mean annual temperatures, the annual number of very hot days is also projected to increase with high certainty.

Precipitation*: Although precipitation projections are highly uncertain, scenarios suggest an overall stagnation or decrease in precipitation in the near future, with a trend of lower rainfall in the west and higher rainfall in the east. Heavy precipitation events are expected to become more intense in Western Africa. At the same time, the number of days with heavy precipitation is expected to increase.

Flooding*: The proportion of people in Western African exposed to flooding has grown substantially in recent decades, with the proportion of people exposed to flooding having increased by over 50 per cent in many countries between 2000 and 2015. With the projected increase in occurrence and intensity of heavy rainfall events – combined with longer and more intense periods of drought, and rapid population growth – the risk of urban and river flooding in Western Africa is expected to increase, and affect more and more people.

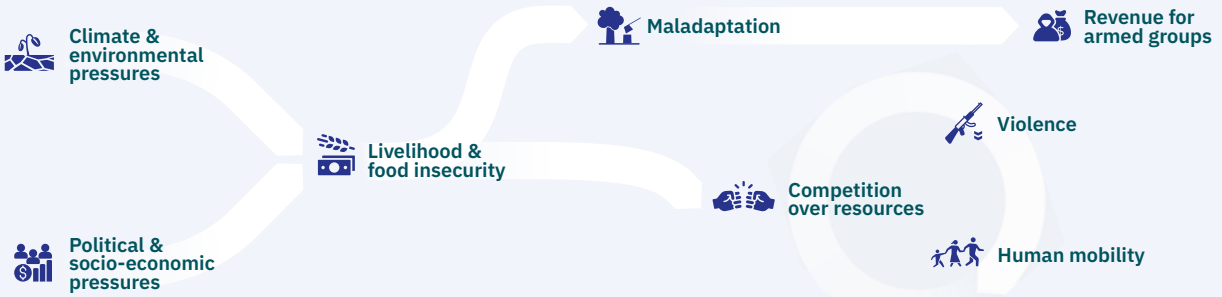
Droughts*: The Sahel droughts of the 1970s and 1980s were some of the most significant climate anomalies of the 20th century. With a 40 per cent decrease in long-term average rainfall in the 1980s, these droughts had dire impacts on the population. Despite the recent recovery in the overall amount of precipitation, high interannual fluctuations between dry and wet phases remain recurrent. Climate projections, especially under a high-emissions scenario, point to an increase in meteorological droughts and rainfall deficits across large areas of Western Africa.

Sea level rise: Sea levels along the Western African coast have been rising at rates above the global average and have contributed to substantial shoreline erosion along some coasts. Under a low emissions scenario, sea level rise is projected to be 10 cm by 2030 and 34 cm by 2080, compared to the year 2000. Under a medium-to-high emissions scenario, the long-term rise will be significantly higher (40 cm). Consequently, by 2030, depending on future population growth in the region, between 43.6 million and 47.2 million people living in low elevation coastal zones will be exposed to sea level rise, making them highly vulnerable to frequent and severe flooding, and erosion. This increases the risks of drought and saline intrusion, which undermine agricultural productivity.

* Climate projections with high uncertainty need to be interpreted with great caution. Please refer to the Annex for an explanation of uncertainty in climate projections.

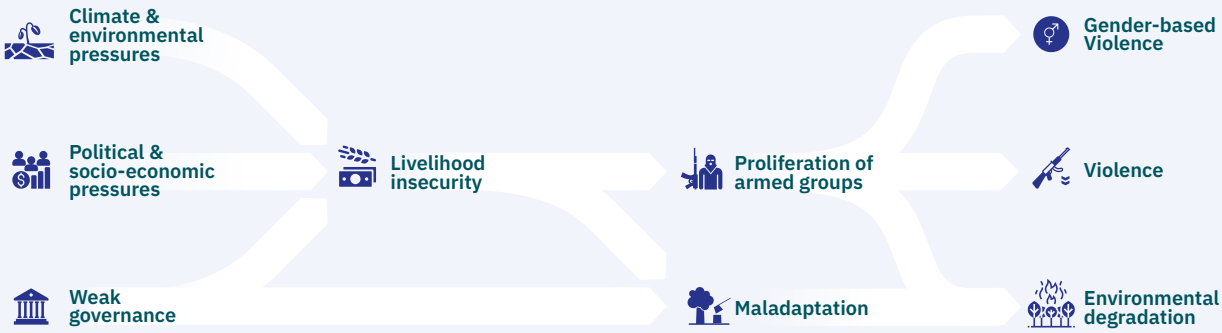
CLIMATE SECURITY PATHWAYS IN WESTERN AFRICA

Pathway 1: Livelihood and food insecurity driving conflicts over natural resources



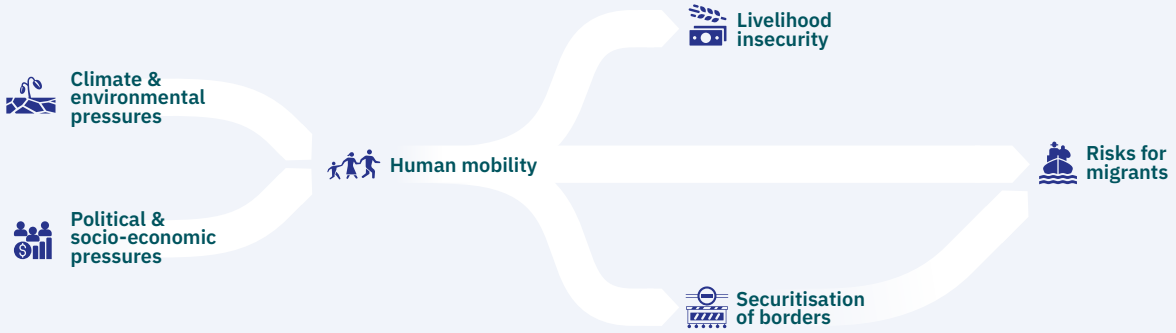
Climate change contributes significantly to increased livelihood and food insecurity among communities across Western Africa, particularly those directly dependent on natural resources, such as farmers, fishers and pastoralists. These changes exacerbate competition within and between different livelihood groups over water, land, fisheries and forestry, which if poorly managed can quickly turn violent.

Pathway 2: Climate change driving the profileration of armed groups and violent extremism



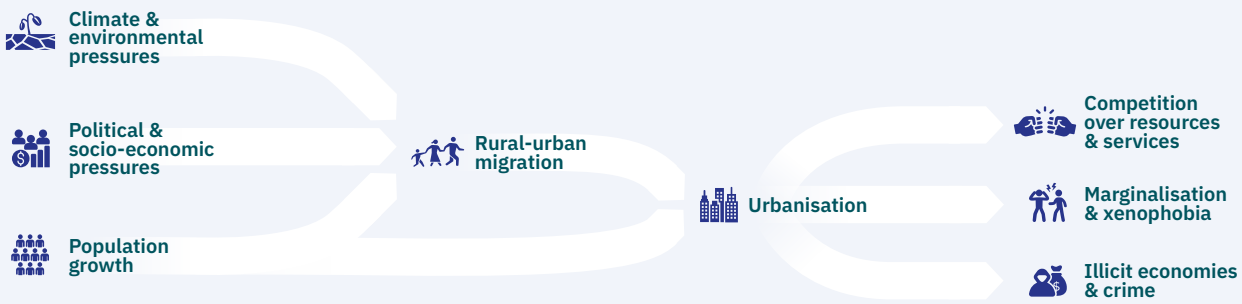
The direct and indirect effects of climate change create conditions in which some groups in Western Africa, particularly young people, are more likely to engage in illicit and criminal activities as coping mechanisms. In addition, lacking or harmful responses to climate-related security risks can fuel societal grievances, increasing the vulnerability of affected people to recruitment into armed groups and violent extremism. At the same time, the proliferation of armed groups in Western Africa directly and indirectly causes environmental degradation, for example, through their involvement in extractive industries, and by hampering the implementation of environmental policies, conservation efforts and climate action.

Pathway 3: Climate-induced changes in migration patterns can increase insecurity and conflict



Human mobility has traditionally been one of the main strategies for people in Western Africa to adapt to the effects of climate change and environmental pressures, often with success. However, climate change impacts, particularly extreme weather events can cause sudden and unplanned changes in human mobility that increase people's vulnerability, contribute to severe demographic pressures in certain geographic areas and heighten the risk of conflict. This can be observed across the spectrum of different forms of mobility, including displacement, seasonal migration and transhumance, rural-urban movements, and regional and international migration.

Pathway 4: Western African cities as hotspots of climate security risks



Climate change is driving rural-urban migration in Western Africa, contributing to rapid rates of urbanisation in the region's cities, leading to severe demographic pressures that increase the risk of rural poverty, poor public services, infrastructure constraints, urban crime and insecurity. Coastal cities, which already face specific risks in terms of rising sea levels, flooding and erosion, and dwindling fish stocks, are particularly vulnerable.

Context

GEOGRAPHY

The Western Africa region as defined by the African Union includes Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, the Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo.[16] The 15 countries of the region encompass a range of climate zones. The northern areas of Mali and Niger are predominantly arid, as are the northernmost regions of Senegal. Most areas of Senegal, the Gambia, northern Guinea Bissau, southern Mali, Burkina Faso, southern Niger and northern Nigeria are semi-arid. Further south, sub-humid tropical weather dominates across Guinea, Sierra Leone, northern Ghana, Togo, Benin and southern Nigeria. Finally, large areas of Liberia, as well as the southern regions of Côte D'Ivoire, Ghana and the very south of Nigeria have a humid tropical climate (Binder 2023). Several large rivers intersect these belts, including Senegal, the Gambia, Volta and Niger rivers, as well as Lake Chad. Except for the Cabo Verde Islands, every country in the region shares at least one river, lake or basin with its neighbours (CILSS 2016).

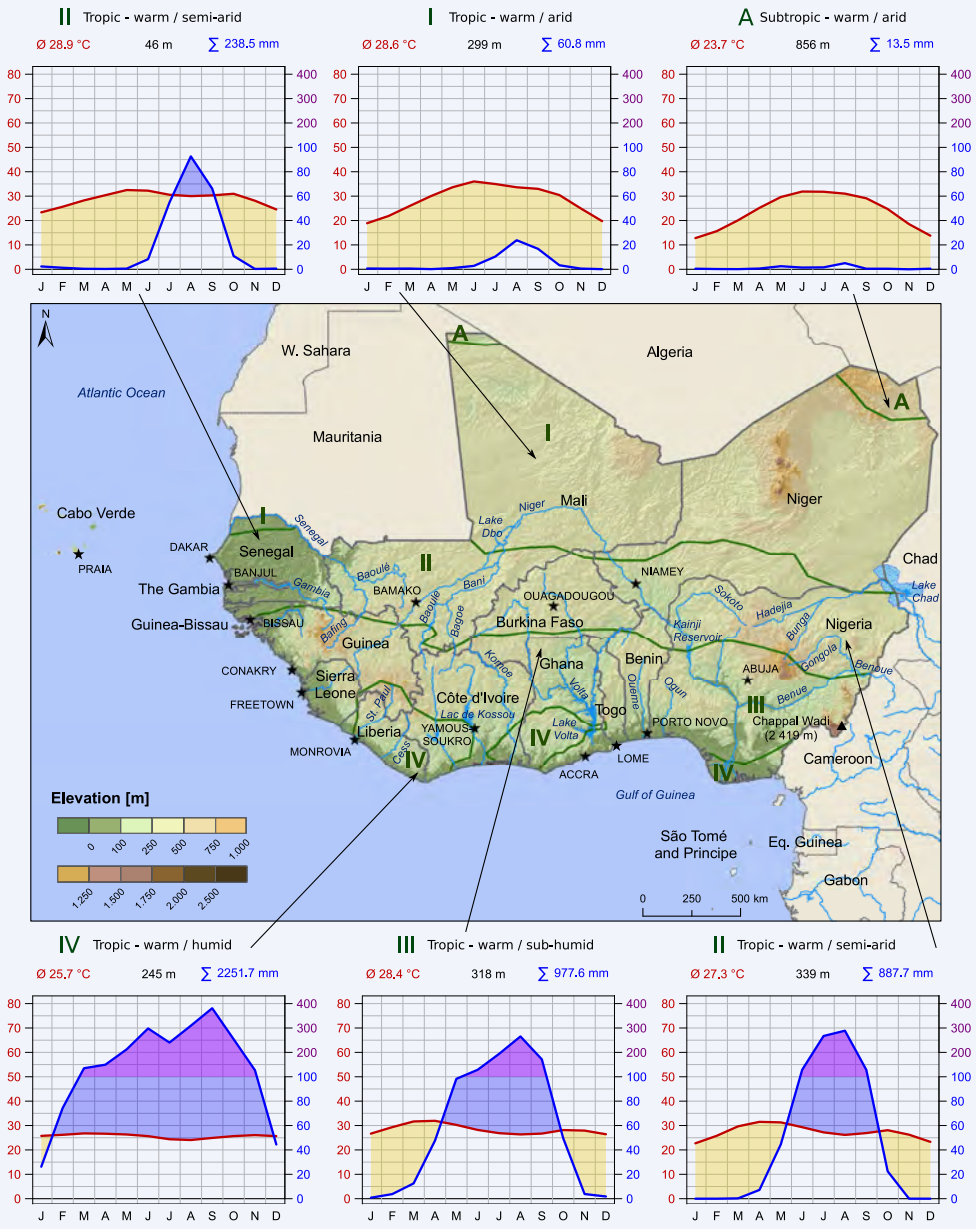


Figure 10: Topographic map of Western Africa with existing precipitation regimes and agroecological zones (Binder 2022c)

16 This report uses the African Union's classification system for geographic regions (https://au.int/en/member_states/countryprofiles2).

Western Africa's forests vary in quantity and quality. For example, Liberia and Guinea Bissau are densely forested, with 79.1 per cent and 70.4 per cent forest cover, respectively, as of 2021. In contrast, Niger is sparsely forested, with less than five per cent forest cover as of 2018 (Uzu et al. 2022). The tropical forests on the coast are especially biodiverse, particularly the Guinean forests of the West Africa Biodiversity Hotspot, which stretches from Guinea and Sierra Leone eastwards to the Sanaga River in Cameroon, and is home to a wide number of endemic plant, bird, mammal and fish species (CEPF 2015). The forests provide key ecosystem services to local populations and are vital carbon sinks for the region. Despite this, deforestation has been widespread, with a nine per cent decline in forest cover throughout coastal Western Africa between 2010 and 2018. This has had the added impact of releasing 575 million tonnes of sequestered carbon (RSPB 2023). The region's minor timber industry means deforestation mostly takes the form of slash-and-burn conversion to agricultural land use (CILSS 2016). Western Africa also hosts dry forests particularly in the semi-arid savannahs between the tropical coast and the Sahel. Besides their crucial importance for local populations and animals, these forests are key in the fight against desertification (Chidumayo and Gumbo 2010).

SOCIOECONOMIC CONTEXT

Western Africa has experienced a surge in economic growth since the early 1990s, with the region's combined GDP rising from USD 105 billion in 2000 to more than USD 659 billion in 2020. The three largest economies in the region – Nigeria, Ghana and Côte d'Ivoire – accounted for one-quarter of Africa's GDP in 2020 with Nigeria making up two-thirds of Western Africa's GDP (African Development Bank 2021). This means there is a huge disparity in terms of economic development within Western Africa, with countries such as Guinea-Bissau, Liberia and Sierra Leone being among the poorest in the world (Mullan and Davies 2021). While regional trade could harmonise the region's economies, Europe and North America account for nearly three-quarters of total exports (African Development Bank 2019). Despite holding an estimated a third of Africa's gas and oil reserves, and significant hydroelectric potential, electrification rates in Western Africa remain low, with an estimated regional rate of 53 per cent in 2019 (World Bank 2021e).

Most Western African countries find themselves performing low in terms of human development, with countries such as Niger, Mali, Guinea and Burkina Faso all among the 10 lowest scoring countries in the world (UNDP 2022a). In terms of gender inequality, many Western African countries score generally low, with Mali, Benin, Guinea and Niger among the worst performers globally. However, some countries perform better in certain sub-indexes. For example, Liberia is the best performing country globally in terms of gender parity in economic participation and opportunity. In contrast, Senegal, Mali and Benin exhibit the least gender parity in this sub-index at the continental level. Finally, Cabo Verde scores among the best countries in the world with regard to gender parity in terms of health and survival. Nigeria, the Gambia and Sierra Leone are among the lowest performing countries globally in terms of political empowerment (WEF 2023).

POLITICAL INTEGRATION

Integration in Western Africa is well advanced. The main regional organisation is the ECOWAS, providing a range of cooperation avenues including economic and monetary integration, freedom of movement for people, peacekeeping, cultural exchanges, and health care. All Western African countries are members of the Community of Sahel-Saharan States (CEN-SAD), with Mali, Burkina Faso and Niger among the founding members. The CEN-SAD includes arid countries from Western, Northern, Eastern and Central Africa. Despite the CEN-SAD emphasising regional security as a key area for deepened cooperation among member states, few concrete activities have been undertaken, and no clear linkages with climate and environmental security have been drawn.

After a series of military coups and attempted coups in recent years, including in Mali (2021), Guinea (2021), Burkina Faso (2022), Niger (2023), and Gabon (2023), political integration and cooperation in the region has been under severe pressure. The new governments in Niger, Mali, and Burkina Faso formed the so-called Alliance of Sahel States, primarily a security pact against Islamist terrorism but with political, economic, and monetary ambitions, drawing from popular discontent with perceived neo-colonial foreign influence and lack of development (Reuters 2023; Yabi 2023; Kongo 2024). ECOWAS imposed heavy economic sanctions unless civilian-led government is implemented and threatened military intervention against Niger, with the three Alliance members subsequently quitting ECOWAS (Melly 2023). This bifurcation is shifting intra-regional and geopolitical relations, narrowing space for political dialogue and compromise.

DEMOGRAPHICS AND MOBILITY

In 2021, the population of Western Africa was 414 million (UN DESA 2022a) and was growing rapidly at an estimated rate of 2.75 per cent a year (CILSS 2016), as a result of high fertility rates across many countries in the region (Walther 2021). The free movement zone established by the ECOWAS in 1979 – enabling citizens of member states to freely enter, stay, settle and work in any other member state – facilitated the free movement of people (OECD Sahel and West Africa Club 2006), despite perennial issues such as road disrepair, insecurity and corruption (African Development Bank 2019). For Western Africa, migration is largely a regional phenomenon, with nearly two-thirds of migrants remaining within the region, primarily in Côte d'Ivoire, Nigeria and Burkina Faso (IOM Global Migration Data Analysis Centre 2021).

PEACE AND SECURITY

Over the past two decades, the occurrence of large-scale civil wars in Western Africa have decreased. However, there has been a significant increase in recurrent coups, election violence, intercommunal violence, extremism and criminal activities (IOM Global Migration Data Analysis Centre 2021). Insecurity has surged in many areas of the region. Notable hotspots include areas of the Central Sahel and the Lake Chad Basin. Since 2015, casualties in these areas have soared, as armed groups have targeted civilians, and battle regional and international counterinsurgency and counterterrorism operations, as well as community-level self-defence groups. In 2019, civilian deaths in the region rose by a staggering 1.87 per cent compared to 2016, with civilian deaths linked to militias increasing by 8.50 per cent in just four years from 2015 to 2019 (Krieger 2022).

Western Africa is home to several ECOWAS-led military operations and regional security initiatives. In 2023, active missions included the ECOWAS Intervention in the Gambia (launched in 2017) and the ECOWAS Stabilization Support Mission in Guinea-Biseau (launched in 2022). The Accra Initiative was launched in 2017, and covers Benin, Bukina Faso, Côte d'Ivoire, Ghana and Togo. It aims to prevent the spillover of terrorism from the Sahel, and to address transnational organised crime and violent extremism in member states' border areas. The Multi-National Joint Task Force is a combined force active around the Lake Chad Basin, and composed of troops in Benin, Cameroon, Chad, Niger and Nigeria. Another key element of Western Africa's security architecture is the G5 Sahel, an institutional framework between the five Sahel countries of Burkina Faso, Chad, Mali, Mauritania and Niger. It was founded in 2014 with a seat in Mauritania, and coordinates development policies and security matters (Allen 2023) (see Sahel box).

In 2023, with more than a third of ECOWAS member states being led by military factions following coups, the weakening of ECOWAS could derail cooperative efforts around international security, including the G5 Sahel. This poses a threat to cross-border security, and could worsen existing humanitarian crises, food insecurity, transnational crime and environmental hazards (Dan Suleiman 2023).

Climate change and impacts[17,18]

AIR TEMPERATURE

Climate change has led to an increase in temperatures across Western Africa by between 1°C and 3°C since the 1970s, with the highest temperature rises across the Sahel and Sahara regions (Binder 2022c). In addition, Western Africa has experienced a rise in the frequency of very hot days. Between 1961 and 2014, the frequency of very hot days (over 35°C) increased by one to nine days per decade. Hot nights have also increased in frequency, while the number of cold nights has declined. Along with rising air temperatures, heatwaves have increased in intensity, duration and extent, compared to the last two decades of the 20th century (IPCC 2022).

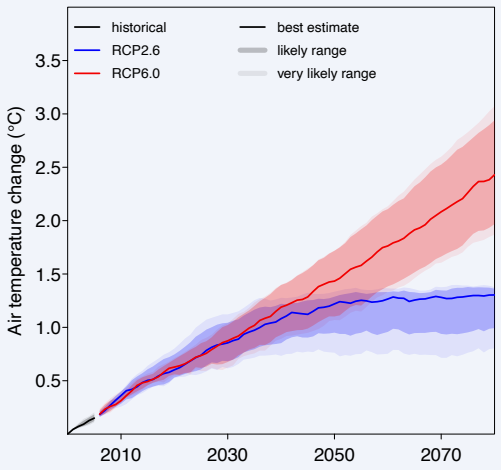


Figure 11: Air temperature in Western Africa (Binder 2022c)

17 Please refer to the Annex for guidance on how to read the plots and for an explanation of the concept of uncertainty in climate projections.
18 The summary of the key climate impacts in this section is based on: Binder L. 2022. Climate Change in West Africa. Berlin: Potsdam Institute for Climate Impact Research.

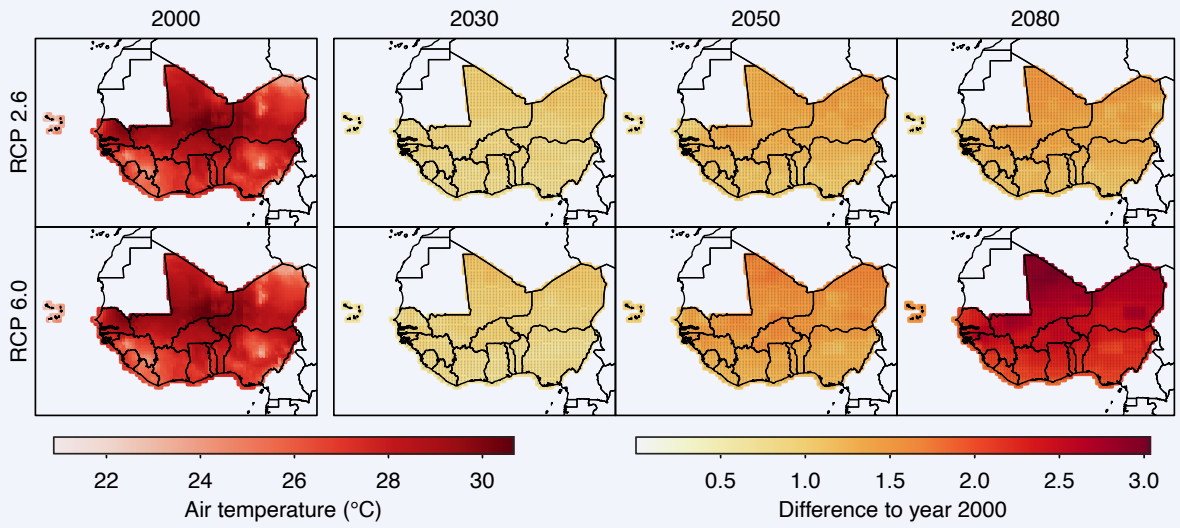


Figure 12: Regional air temperature projections for Western Africa for different GHG emissions scenarios (Binder 2022c)

Depending on the climate change scenario, temperatures across Western Africa are projected to rise with high certainty by between 0.6°C and 3.1°C by 2080 compared to 2000. Temperature rises will affect the entire region, but will be less intense along the coast. The median climate model predicts a temperature increase over Western Africa of approximately 0.85°C by 2030 and 1.3°C by 2080 under the low emissions scenario. Under the medium-to-high emissions scenario, air temperature will increase by between 0.6°C and 1°C by 2030, and by between 1.9°C and 3.1°C by 2080 (very likely range). The median climate model predicts temperature increases of 0.9°C by 2030 and 2.4°C by 2080 (Binder 2022c).

In line with rising mean annual temperatures, the annual number of very hot days (i.e. days with a daily maximum temperature of above 35°C) is projected to increase with high certainty. Around the year 2000, there were on average 194 very hot days per year, with a maximum of 283 very hot days per year in Senegal. The coastlines were much less affected than the Sahel zone further north. Under the low emissions scenario, projections point towards an average annual increase of between 22 and 37 very hot days by 2030 and 2080, respectively, with varying distributions. Very hot days will rise substantially more under a medium-to-high emissions scenario, where the average annual increase will be 28 days by 2030 and 73 days by 2080. In the long run, the increase will be very high in almost all southern regions, with up to 52 additional very hot days per year projected by 2030 and 131 days by 2080. This rise will be substantially smaller in the northern Sahelian zone, although it will still amount to at least nine additional very hot days per year by 2030 and 27 days by 2080 in the north of Niger (Binder 2022c).

PRECIPITATION

Western Africa experienced a decreasing trend in precipitation between 1960 and 1980. At the same time, precipitation variability sharply increased during the same period (Pausata et al. 2020; IPCC 2022). During the 1970s and 1980s, the region was recurrently hit by severe droughts with devastating socioeconomic impacts. Declining precipitation trends ended around 1990 and a trend towards wetter conditions began in the mid-1990s. However, cumulative precipitation amounts have to date not returned to the level of the 1960s and heavy precipitation events are making a greater contribution to the total increase in precipitation (IPCC 2018; Binder 2022c).

Rainfall projections are much less certain than temperature projections. The scenarios suggest an overall stagnation or decrease in precipitation in the near future, though with a trend of lower rainfall in the west and higher rainfall in the east (see Figure 13). However, projections are highly uncertain. Rainfall events are also expected to rise in intensity, depending on warming, but again with limited certainty as to the extent of this rise

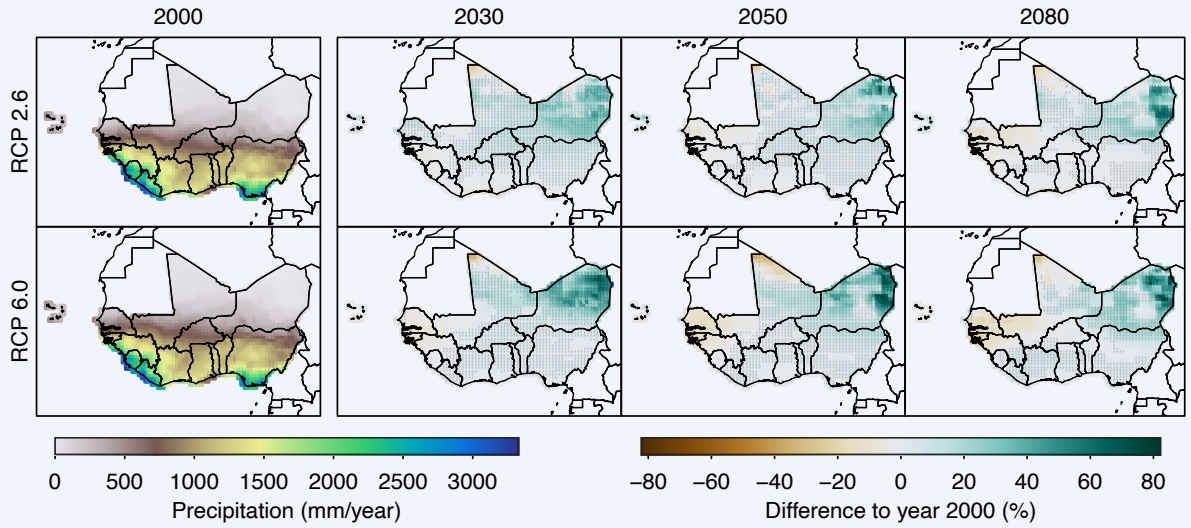


Figure 13: Regional projections of the annual mean rainfall for Western Africa for different GHG emissions scenarios, compared to the year 2000 (Binder 2022c)

(Seneviratne et al. 2021). The impacts of climate change on torrential rain and river flows in Western Africa are uncertain, but research suggests an increase across eastern areas of the region (Rameshwaran 2021; GFDRR 2022). Drought projections are similarly highly uncertain, although the scenarios suggest longer droughts in western areas of the region under a high-emissions scenario (Binder 2022c).

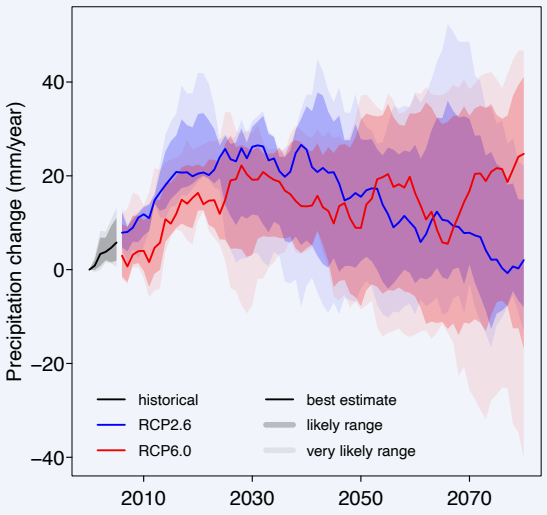


Figure 14: Precipitation in Western Africa (Binder 2022c)

Heavy precipitation events increased in intensity over the Central Sahel region from 17 per cent between 1970 and 1990 to 21 per cent between 2001 and 2010, as well as over the Gulf of Guinea (IPCC 2018). However, a lack of available data and scientific agreement make it difficult to attribute past heavy precipitation events to climate change (Seneviratne et al. 2021). In response to global warming, heavy precipitation events are expected to become more intense in Western Africa – as in many parts of the world – due to the increased water vapour holding capacity of a warmer atmosphere. At the same time, the number of days with heavy precipitation is expected to increase (Seneviratne et al. 2021). Under a 2°C scenario, multi-model median projections suggest an increase in heavy precipitation days by 15 per cent compared to the pre-industrial period. This number increases to 30 per cent (best estimate) under a 4°C scenario (Seneviratne et al. 2021).

FLOODING

Precipitation variability and land use patterns strongly impact flooding risks across Western Africa. During the drought of the 1970s and 1980s, flows in the major river systems declined by 20–60 per cent. This was not only due to a decrease in precipitation but also due to an increase in water use. Since 1990, as rains have recovered, the flows of some rivers, including the Niger, have also recovered (IPCC 2018). This has resulted in more frequent and intense flooding in the Sahel region (Nka et al. 2015). The propor-

tion of people exposed to flooding has also grown substantially, with the number of people in many Western African countries exposed to flooding increasing by over 50 per cent between 2000 and 2015 (IPCC 2022). According to ThinkHazard, the risk of future urban flooding is high for all countries of Western Africa, except Togo, which has a medium hazard level (GFDRR 2022).[19] With more extreme precipitation events, as is projected for Western Africa, increased runoff and flooding from precipitation are expected to also increase (IPCC 2018).

The increasing intensity of heavy rainfall events and increased flooding risks in the eastern Sahel, combined with longer drought durations and rapid population growth are likely to exacerbate water stress. A previous assessment of climate risks in the Sahel projected that per capita water availability would decrease by 76 per cent by 2080 compared to 2000 in both the low-to-medium and high emissions scenarios (OSCDS and UNHCR 2022). This suggests that, although projections vary throughout the region, water security will decrease overall. Water insecurity will likely also accelerate the spread of diseases, as heavy rain events and flooding exacerbate the risks of malaria, diarrhoea, and other vector-borne and communicable diseases (Binder 2022c).

DROUGHTS

The Sahel droughts of the 1970s and 1980s were some of the most significant climate anomalies of the 20th century. With a 40 per cent decrease in long-term average rainfall in the 1980s, these droughts had dire impacts on the population (Pausata et al. 2020). Despite the recent recovery in the overall amount of precipitation, significant interannual fluctuations of dry and wet phases persist (IPCC 2018).

Under the low emissions scenario, models project a rise in consecutive dry days over larger areas of the Guinea coast, with an increase by around five to seven days for areas of Mauritania, Senegal and Mali. In contrast, in most areas of Niger and northernmost Nigeria, the number of consecutive dry days is expected to decline (Klutse et al. 2018). At the same time, the frequency and intensity of meteorological droughts is projected to increase across the Niger and the Volta River basins, which would likely have severe implications on future water supply from the two regional water systems (IPCC 2022). Under the high emissions scenario, there will be a more certain increase in meteorological droughts and rainfall deficits. For example, the duration of droughts in western areas of Western Africa will rise from about two months between 1950 and 2014 to around four months in the second half of the 21st century (Ukkola et al. 2020). In general, the increased risk of drought will occur primarily during the pre-monsoon season (IPCC 2018).

SEA LEVEL RISE

Sea levels along the Western African coast have been rising at rates above the global average and have contributed to substantial shoreline erosion along some coasts (Ranasinghe et al. 2021). In response to climate change, averaged over the entire Western African coastline, the median climate model projects a sea level rise of 10 cm by 2030 and 34 cm by 2080 under the low emissions scenario, compared to the year 2000. Under a medium-to-high emissions scenario, the long-term rise will be significantly higher (40 cm). Consequently, depending on future population growth in the region, between 43.6 million and 47.2 million people living in low elevation coastal zones will be exposed to sea level rise by 2030 (IPCC 2022). Due to sea level rise, coastal regions of Western Africa are highly vulnerable to frequent and severe flooding, with erosion leading to drought and saline intrusion, thereby undermining agricultural productivity (Goxho 2021).

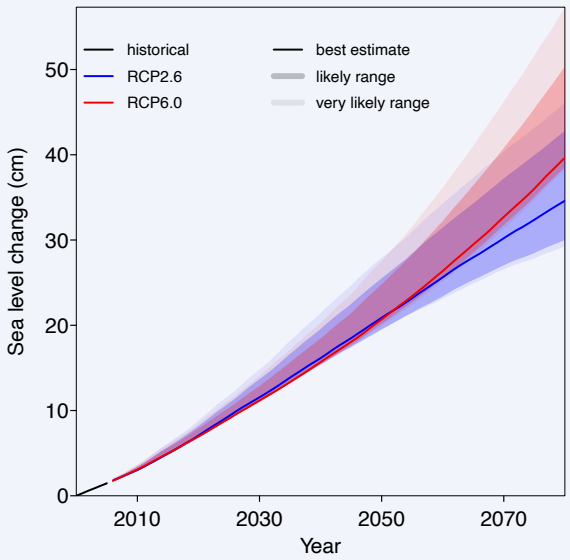


Figure 15: Sea level rise in Western Africa (Binder 2022c)

Climate security risk pathways

LIVELIHOOD AND FOOD INSECURITY DRIVING CONFLICTS OVER NATURAL RESOURCES

Climate change contributes significantly to increased livelihood and food insecurity for communities across Western Africa, particularly those directly dependent on natural resources, such as farmers, fishers and pastoralists. These changes exacerbate competition within and between different livelihood groups over water, land, fisheries and forestry, which if poorly managed can quickly turn violent.

Climate-induced food insecurity and instability

Western Africa scores low at the global level in terms of food security, but significantly better compared to Eastern Africa and Central Africa. However, with an estimated 14.6 per cent of the population (62.8 million people) undernourished in 2022, it scores worse compared to Northern Africa (7.5 per cent; 19.5 million people) and Southern Africa (11.1 per cent; 7.6 million people). Moreover, the prevalence of undernourishment has risen gradually over the past two decades (from 12.2 per cent in 2005). Meanwhile, the prevalence of severe food insecurity has risen sharply, from 11.4 per cent (41 million people) in 2005 to 22 per cent (94.4 million people) in 2022 (FAO et al. 2023).

The differentiated impacts of climate change on food systems in Western Africa are likely to lead agricultural economies to shift substantially, with negative impacts on food security. In 2014, the IPCC predicted that crop-growing periods in Western Africa could shorten by 20 per cent by 2050, causing a 40 per cent decline in cereal yields and a reduction in cereal biomass for livestock (IPCC 2014). Climate change also has an important impact on food security derived from marine resources. The warming and acidification of the ocean threaten fish populations, which are crucial sources of protein for diets in Western Africa. Fish constitutes more than 30 per cent of protein intake in coastal countries and is a crucial staple in its dried form in most Western African hinterlands (Beatley and Edwards 2018; Schmidt and Muggah 2021).

Beyond the humanitarian impacts of food insecurity on the health and development of individuals, food security issues also risk impacting the stability of Western Africa. However, the link between food insecurity and conflict is complex. Food insecurity can stoke grievances, and mobilise protest and rebellion, but can also dampen conflict behaviour. Moreover, conflict risks are highest when there are changes in the conditions of food access, whether towards greater scarcity or availability. This suggests that conflict is a result of institutional failures to mediate access to food rather than the scarcity of food itself (Hendrix and Brinkman 2013). Western Africa saw widespread food-related unrest in 2007–2008, particularly in Senegal, Guinea, Côte d'Ivoire and Burkina Faso. Currently, the region faces its worst food crisis in 10 years due to a combination of climate impacts, conflicts, the economic impact of the COVID-19 pandemic and more recently the war in Ukraine. The risk of further food-related unrest and related instability remains high (OXFAM 2022).

Violent competition between herders and farmers

The economic resilience and livelihoods of many populations in Western Africa are highly weather-dependent and thereby vulnerable to climate change. Crops and livestock account for an estimated 60 per cent of livelihoods and 35 per cent of the combined GDP of Western Africa (CILSS 2016; USAID 2018). As farming and pastoralism are often the economic backbone of rural communities, climate-induced livelihood insecurity can quickly drive maladaptation and competition over natural resources. Consequently, natural resource conflicts are a challenge across the region, ranging from community-level conflicts around water in Western African basins (DeConing and Krampe 2021) to competition between herders, farmers and fishers (Climate Diplomacy 2022).

Arguably, the most widespread livelihood-related conflicts in Western Africa occur between farmers and herders, as observed on a large scale in countries such as Nigeria, Mali and Burkina Faso. In response to drought and climate-induced losses of pasture, there have been significant shifts in transhumance routes towards regions with more fertile ground, which are often farmland. In the Central Sahel, while arable land is shrinking year-on-year due to the effects of climate change and environmental degradation, demographic expansion requires that areas under cultivation expand. This results in fertile land becoming increasingly scarce and valuable. In the Mopti region of central Mali, levels of agricultural production have risen

19 No data was available for Cabo Verde.

sharply in recent decades despite increasing land scarcity. The poorly regulated rush towards fertile land has led to violent local conflicts, mostly along ethnic lines, and mainly between herders and farmers, such as the Fulani and Dogon groups (ICG 2020; Nagarajan 2022).

In the Nigerian state of Benue, similar scarcity in fertile land has led to severe clashes, as herders – passing through agricultural land in search of pasture – destroy crops (Tade 2020). In the Gambia, one study found that reductions in agricultural productivity, and increases in saltwater intrusion, food insecurity, poverty and inequality were aggravated by the effects of climate change, and were the principal cause of resource conflict between and within communities (Sambou and Ceesay 2023). Farmer-herder conflicts across Western Africa are increasing in frequency and severity. Half of the 15,000 fatalities recorded since 2010 occurred between 2018 and 2020, with fatalities concentrated in Nigeria and Central Sahel countries (Brottem 2021). In Nigeria, a study found that fatalities from such conflicts had nearly doubled in four years, from over 500 in 2014 to almost 1,000 in 2018 (Adigun 2022). Indeed, herder-farmer conflicts in Nigeria are estimated to be more deadly than violence committed by Boko Haram (Daniel 2021).

Natural resource conflicts between livelihood groups

However, natural resource management conflicts are not limited to herder-farmer disputes, but involve other livelihood groups and even occur within livelihood groups. For example, in Ghana, agriculture accounts for about 21 per cent of GDP, and especially in the country's northern provinces such as the Bawku province, the convergence of the effects of climate change and colonial-induced ethnic tensions between the Kusasi and Mamprusi people have exacerbated conflicts over arable land between farmer (Strouboulis et al. 2023). Local chiefdoms have played a key role in governing environmental resources and acting as traditional custodians of land and informal law enforcement and justice structures since pre-colonial times, but access and control are also vital for their socioeconomic standing and political power. Partly triggered by colonial demand of land in the 19th century, many current conflict risks in Ghana stem from decades-long competition over chieftaincy succession, and control over territory and resources (Sackyefio-Lenoch 2014).

Natural resource conflicts include disputes over dwindling marine fish stocks, as evident along the Gulf of Guinea, which result in a significant reduction in maximum catch potential (Beatley and Edwards 2018). In Senegal, increasing temperatures have caused the northward migration of sardinella, the species of greatest economic value and importance for food security in the region. Consequently, Senegalese fishermen have been compelled to venture across the border into Mauritania for fishing, resulting in confrontations with the coastguard (Beatley and Edwards 2018). As Western African coastal communities see their livelihoods threatened, the most resourceful young people migrate out of the region, while those that stay behind face unemployment. In severely affected areas like Agbavi in Togo, the circumstances have become dire enough that young men have resorted to joining criminal networks engaged in fuel smuggling and illegal beach-sand mining. This illicit activity not only worsens erosion but also compounds other challenges faced by the community (Fagotto 2016).

In Mali, both fishers and farmers face grave environmental challenges including soil infertility, silting of rivers, and depleted fish numbers and variety. Pastoralists also see changes in water bodies, a reduction in quality and quantity of pasture, and the disappearance of grass species. Competition between but also within these livelihood groups erodes social cohesion and increases hostility, with oftentimes violent clashes over access and control of natural resources (Nagarajan 2022).

Conflicts related to natural resources, however, do not always hinge on scarcity. The creation of new resources can also generate conflicts over access and control. For example, a development project in Burkina Faso that aimed to bolster rice production by introducing water resources altered the local demographic and political balance. The project attracted non-local farmers from different ethnic groups, which led to conflicts around resource allocation, and escalated tensions between native and non-native land users (ICG 2020).

To cope with losses in livelihoods such as farming and pastoralism, many of Western Africa's rural poor have tried their luck in other sectors, particularly artisanal and small-scale mining. However, conflict over mineral resources, such as over diamonds in Sierra Leone, and oil and gas in Nigeria, is a perennial issue in the region (Olanrewaju 2020; Abdullahi 2021). Propelled by the dis-

covery of a Saharan gold vein in 2012, countries such as Niger, Mali and Burkina Faso have seen a proliferation of artisanal and small-scale gold mining, underpinned by growing illicit markets in cyanide, a chemical widely used in the extraction process that has detrimental environmental and health impacts. Illicit gold mining also affects security in Western Africa, as it reinforces existing patterns of transnational smuggling, international crime and corruption (Global Initiative Against Transnational Organized Crime 2023). The contamination of chemicals used in artisanal and small-scale gold mining can damage agricultural livelihoods, exacerbating tensions within and between communities, and cause violent conflicts, such as in Mali's Kayes region (Koné and Adam 2021).

Another source of tension is forestry. For example, in Côte d'Ivoire, deforestation for the cultivation of perennial crops, such as cocoa and coffee cultivation, has led to a dramatic reduction in arable land and forest. Since 1960, Côte d'Ivoire has lost over 80 per cent of its forest cover. In this context, tensions between local and migrant communities over the sharing and tenure of the land and forest are increasingly leading to outbreaks of violence, which contribute to the displacement of populations, further increasing the pressure on natural resources in host communities (UNEP 2017b).

CLIMATE CHANGE DRIVING THE PROLIFERATION OF ARMED GROUPS AND VIOLENT EXTREMISM

The direct and indirect effects of climate change create conditions in which some social groups in Western Africa, particularly young people, are more likely to engage in illicit and criminal activities as negative coping mechanisms. In addition, lacking or harmful responses to climate-related security risks can fuel social grievances that increase the vulnerability of affected people to recruitment into armed groups and violent extremism. At the same time, the proliferation of armed groups in Western Africa directly and indirectly causes environmental degradation, for example, through their involvement in extractive industries, or by hampering the implementation of environmental policies, conservation efforts and climate action.

Climate vulnerability and recruitment

Livelihood insecurity driven by climate stress can increase the pressure on vulnerable, especially young, people to engage in criminal and illicit activities, such as smuggling and trafficking, banditry, and illegal resource extraction. In Western Africa, many radical Islamist and armed groups are deeply intertwined in criminal networks, offering vulnerable young people a perceived pathway to more lucrative socioeconomic opportunities (Toupane et al. 2021). Especially in the Central Sahel and around the Lake Chad Basin, but increasingly also in rural areas in coastal countries, socioeconomic marginalisation and unemployment have been a significant entry point for recruitment, as armed groups exploit existing grievances (Strouboulis et al. 2023).

While the drivers of recruitment are complex, and always specific to the context and the individual, socioeconomic factors – in addition to other factors such as negative experiences with state authorities, social status and ideology – are generally considered among the most important drivers of youth radicalisation and armed group recruitment across Western Africa (Groupe d'Etudes et de Recherches sur les Migrations et Faits de Société 2021). In Senegal, several studies found that poverty, unemployment and the lack of livelihood options were the main motives identified by young people for joining Jihadist armed groups; factors which also exacerbate the effects of climate change and environmental degradation (Lopez et al. 2021; Sambe et al. 2022). Climate fragile settings – especially when combined with weakening land and natural resource management, fragmented governance frameworks, and high levels of corruption – offer more opportunities for armed groups to thrive by facilitating criminal activities and undermining trust in government (Nantulya 2016; International Crisis Group 2020).

Violent extremism and transnational criminality

Over the past decade, violent extremism has been of particular concern across Western Africa, especially in the Central Sahel and the Lake Chad Basin. Most recently, concerns have escalated in certain Gulf of Guinea countries, particularly Benin, Togo, Ghana, and Côte d'Ivoire, regarding the southward movement of Jihadists, who have already gained control over significant portions of the Sahel region. Additionally, armed groups are active in wooded areas along the border between Benin and Burkina Faso. Likewise, northern Benin and Togo have experienced an increase in Jihadist assaults, posing a threat to security in coastal nations further to the south (International Crisis Group 2023).

Some of the most lucrative sectors that criminal groups and Jihadis in Western African focus

on include arms, drugs, human trafficking and kidnapping for ransom. The latter is estimated to be the main source of revenue for Jihadist groups (Lounnas 2018). The majority of victims of human trafficking are women and girls, and an estimated three out of four victims are children (UNODC 2021b). Nigeria is a well-evidenced country with strong criminal networks that focus on trafficking. At the same time, Nigeria is a country of origin, transit and destination, which is affected by both domestic and cross-border trafficking (UNODC 2021b). Armed groups are also increasingly involved in drug trafficking, with cocaine imported from Latin America through multiple maritime entry points. These entry points span the coastline between Senegal and Guinea, and further south, with Côte D'Ivoire playing a prominent in recent years (Bird 2021). In recent years, terrorist and criminal groups have developed strong working relationships to grow their businesses. These networks often depend on the complicity or participation of local actors and state agents, who profit from illicit dealings (Gaye 2018).

The Ghana-Côte d'Ivoire-Burkina Faso tri-border is a key route in illicit arms trafficking, such as small arms and fertiliser for improvised explosive devices (Strouboulis et al. 2023). As seen in regions across the world, extremists in the Sahel have weaponised access to critical natural resources for strategic or tactical purposes, and as a means to terrorise, coerce and subjugate local populations (Strouboulis et al. 2023). Starting from 2021, Jihadist groups from the Sahel have begun to encroach upon W National Park, a vast nature reserve situated along the borders of Benin, Burkina Faso and Niger. Their incursion into the park has disrupted longstanding conservation activities and adversely affected local livelihoods, fueling tensions between settled farmers and nomadic herders over land and water (International Crisis Group 2023). In Mali, in recent years, extremist groups have expanded their lucrative activities in artisanal mining and the illegal gold trade, which leads to further deterioration of the security situation. For instance, in 2021, two terrorist groups engaged in a fierce battle to control gold mining sites in Mali's Gourma region (Abderrahmane 2022). The involvement of armed groups in illicit mining also causes severe damage to the environment, including through the dredging of rivers, and use chemicals such as mercury and cyanide, which present high risks for agriculture, fishing and herding due to groundwater contamination that can lead to animal and human poisoning (Koné and Adam 2021).

CLIMATE-INDUCED CHANGES IN MIGRATION PATTERNS CAN INCREASE INSECURITY AND CONFLICT

Human mobility has traditionally been one of the main strategies used by people in Western African to often successfully adapt to climate change and environmental pressures. However, climate change impacts, particularly extreme weather events, can cause sudden and unplanned changes in human mobility that make people more vulnerable, contribute to severe demographic pressures in certain geographic areas and increase the risk of conflict. This can be observed across the spectrum of different forms of mobility, including displacement, seasonal migration and transhumance, rural-urban movements, and regional and international migration.

Internal and regional climate migration

The vast majority of climate migration in Western Africa happens within countries and by 2050, up to 32 million Western Africans are expected to have to move within their countries because of climate change. Internal climate migration is not uniform across Western African countries as some areas are more adversely impacted by climate change than others. Countries that are expected to witness the highest numbers of internal climate migrants are Nigeria and Niger, followed by Senegal, Mali, Benin and Burkina Faso (Clement et al. 2021).

Major climate in- and out-migration hotspots could expand and intensify by 2050. For example, eastern Niger, and the central border area between Nigeria and Niger could see major climate in-migration due to favourable climatic conditions projected in these regions. Meanwhile, the southwest of Niger and the north of Benin are projected to become climate out-migration hotspots due to water stress. Another major climate out-migration hotspot could be in western Mali, around Bamako and the Koulikoro region, due to water stress and crop losses. The southeast, southwest and coastal states of Nigeria are expected to see climate out-migration as well due to sea level rise compounded by storm surge, water stress and crop yield losses (Clement et al. 2021).

When migrants decide to leave their country, most remain within Western Africa, moving from rural areas to urban centres. For example, climate change and related livelihood insecurity are among the key drivers of migration from landlocked Sahelian countries towards the coast. Given the arid climate of departure countries, it has

been suggested that one of the factors driving this migration is the limited in-situ adaptive capacity of populations (Leal Filho et al 2022). Drought-induced food and livelihood insecurity have led to high levels of migration from Sahelian countries over the last decades, with farmer households especially likely to move in case of high dry season temperatures (Teye 2022).

The most common form of intra-regional migration is rural-urban. Most migrants move to cities in coastal countries in search of socioeconomic opportunities, with some cities growing up to nine per cent per year (Devillard et al. 2015). In addition to rural-urban migration, seasonal migration such as transhumance has been a mainstay of Western African societies for centuries and is an important climate adaptation strategy (Teye 2022). While it is difficult to give precise numbers, an estimated 70 per cent of Western Africa's cattle population is expected to be managed through transhumance, involving tens of millions of pastoralists (IOM Global Migration Data Analysis Centre 2021).

Seasonal and intra-regional climate migration help to strengthen the economic resilience and food security of families, and migrants often times decide to permanently settle in their destination countries, with cities as destinations of choice (Jarawura 2013; Dreier and Sow 2015). However, some populations are unable to move as a response to climate change, notably because of a lack of endowments. This often includes the poor and aged, and those who lack the social capital to migrate. Impediments to mobility can also include negative perceptions of migrants, which hinder individuals moving across regions and continents alike (Puig Cepero et al. 2021). Moreover, in patriarchal communities, women are often immobile, both because of a lack of resources and cautions against migrating (Teye 2022).

Displacement

Western Africa is home to millions of IDPs and refugees, a number that has spiked since the deterioration of the security situation in 2016. The Western African countries that host the most refugees and IDPs include Nigeria, Niger, Mali and Burkina Faso. In 2023, Nigeria and Burkina Faso were home to about 3.5 million and two million IDPs, respectively, while Niger hosted some 300,000 refugees and asylum-seekers (UNHCR 2023b).

The increase in the frequency and severity of extreme weather events exacerbates displacement across the region. From 2008 to 2022, natural hazard-induced disasters and extreme weather events ranging from flash flooding, droughts, storms and cyclones led to the displacement of more than 17 million Western Africans (Leal Filho et al 2022). Rapid sea level rise and coastal degradation have also led to involuntary movement, as seen in the evacuation of the Western African port towns Keta in Ghana and St Louis in Senegal. Meanwhile, flash flooding exacerbated by river silting has affected communities in Sahelian countries, displacing more than 30,000 in Burkina Faso in 2017 (Teye 2022). According to the World Bank, between 0.3 million and 2.2 million people living along the Western African coast could be forced to move out of the 5 km coastal belt by 2050 due to sea level rise compounded by storm surges and flooding (Clement et al. 2021).

Migration and human security

Climate change can severely affect existing mobility dynamics with significant implications for the human security of populations, whether they are on the move, hosts or involuntarily immobile. As part of their journey, migrants can be particularly vulnerable to trafficking, marginalisation and other abuses. These incidents include death, detention, extortion, kidnapping, physical abuse, robbery, and sexual assault and harassment (Mixed Migration Centre 2020). When arriving in a host community, migrants often have to deal with new social, political and economic realities, which can further undermine the ability of these populations to pursue livelihoods (Mobjörk et al. 2020).

Western African migrants attempting long journeys and dangerous crossings are particularly vulnerable to abuse. Notoriously dangerous routes include trans-Saharan and trans-Sahelian migration, which often require assistance from human smugglers to cross inhabitable terrain or international borders. Male migrants are primarily subjected to forced labour and physical violence, while female migrants are more exposed to sexual violence and trafficking (UNODC 2021a). The Sahel and Sahara Desert are also key transit points for migrants moving to Northern Africa or even to Europe. Although migration routes constantly shift depending on accessibility and safety, the two main routes in recent years have been along the Western African coast towards Morocco or the Central Sahelian route, with Niger being a key transit country (Yayboke and Aboneaaj 2020). Although inter-continental migration remains marginal, it is increasingly securitised by strict and sophisti-

cated controls at international borders, which has led to a build-up of migrants, notably in Niger and Northern African countries. Migrants respond to this tightening by resorting to increasingly dangerous routes, with higher risks of abuse and death (International Centre for Migration Policy Development 2022).

People from Western Africa who decide to migrate to Northern Africa or Europe often do this because of socioeconomic reasons, with climate change impacts one of the main push factors as it exacerbates livelihood insecurity (Clement et al. 2021). If successful, economic migrants can send remittances from their destination back home to support their families, which can be a vital lifeline in times of climate and environmental stress. In some areas of Western Africa, entire households or even combined families support the migration of young members to more prosperous regions in the hope of receiving remittances later on (IOM 2021b). For instance, in Mali's Kayes region, which is highly dependent on agriculture, migration has traditionally been one of the key adaptation strategies and resilience-building mechanisms. Due to their "culture of migration," Kayesians are by far the largest group of Malians in France and other European countries (Kayes 2020). Similarly, in Burkina Faso, remittances from international migrants have helped households back home to improve their agricultural livelihoods by modernising techniques, diversifying their sources of income, and covering health and education expenses (Tapsoba and Hubert 2022).

WESTERN AFRICAN CITIES AS HOTSPOTS OF CLIMATE SECURITY RISKS

Climate change is driving rural-urban migration in Western Africa, contributing to rapid rates of urbanisation in the region's cities, and leading to severe demographic pressures that increase the risk of rural poverty, poor public services, infrastructural constraints, urban crime and insecurity. Coastal cities, which already face specific risks in terms of sea level rise, flooding and erosion, and dwindling fish stock, are particularly vulnerable.

Increasing pressures

Even in the best-case scenario of 1.5°C global warming, urban populations exposed to severe droughts across Western Africa are projected to increase by around 65 million compared to 1986–2005 (Liu W et al. 2018). The risk of urban flooding along coasts and river deltas is high across the region (GFDRR 2022). Urbanisation driven by population growth and intra-regional migration, displacement and climate change will continue to figure among the major transformations affecting Western Africa. Urbanisation dynamics in Western Africa are cross-border in nature, and shape relations between rural and urban areas, gender equality, political participation, public services, and peace and security (OECD 2020).

Forty per cent of Western Africa's population live in cities, with the urban population growing at between 1.6 per cent and 3.1 per cent per year (Ofoezie, E. I. et al 2022) – a rate which is much higher than the global average of 1.7 per cent for 2021 (World Bank 2022). The region's urban population as a proportion of the total population has risen from under 10 per cent in 1950 to 40 per cent in 2020 (Walther 2021). As exemplified by the wave of urbanisation following the great droughts of the 1970s and 1980s, rural-urban migration is an important adaptation strategy to climate shocks and will likely intensify as climate change impacts increase (OECD Sahel and West Africa Club 2010). As major urban centres in Western Africa are mainly coastal, many people are vulnerable to rising sea levels, flooding and coastal erosion (Croitoru et al. 2019). These challenges are further exacerbated by the intensive and unbridled use of resources and rapid urban expansion (Mbaye 2020), which has already led to the evacuation of several coastal towns, as seen in Senegal and Ghana (Schmidt and Muggah 2021). According to the World Bank, the costs of environmental degradation and climate change in coastal areas of Benin, Côte d'Ivoire, Senegal and Togo were as high as USD 3.8 billion in 2017, some 5.3 per cent of the combined GDP of the four countries. Moreover, coastal degradation, such as flooding, erosion and pollution, is estimated to cause more than 13,000 deaths per year in these four countries as well as high levels of urban displacement (Croitoru et al. 2019).

The rapid urbanisation of Western African countries means governments are struggling to provide the required services to new urban dwellers. As public services struggle to meet demand, urban migration is increasing suburban poverty (Brown and Crawford 2008). Informal settlements combine high population density with insufficient sanitation, water and electricity, as well as increased vulnerability to climate change impacts such as flooding (Joiner et al 2012). This socioeconomic disempowerment is often combined with a lack of representation and participation, which can lead

to urban improvement and adaptation initiatives that fail to take the interests of the urban poor into account (Puig Cepero et al. 2021). Finally, climate change directly causes urban displacement. For example, towns in Senegal and Ghana have been evacuated because of sea level rise and erosion (Croitoru et al. 2019).

Human security in cities

Populations, livelihoods and resources in Western Africa are mostly concentrated along the coast. The three most populous cities in the region, Lagos, Abidjan and Accra, are coastal. These populations are very vulnerable to the increasingly severe manifestations of climate change. For example, fish stocks are decreasing in quantity and quality, with diets significantly dependent on this food source for protein intake (Beatley and Edwards 2018; Schmidt and Muggah 2021). Coastal agricultural productivity is simultaneously impacted by flooding, erosion and saline intrusion (Goxho 2021).

Urban migration coincides with increased crime, as organisations exploit cities as illicit markets and hubs for trafficking. Due to rapid urbanisation and demographic pressure, major Western African cities have experienced increased human trafficking, including for prostitution, forced labour and the selling of children, as well as illicit trade in arms and drugs (UNODC 2005; Alemika 2013), with women disproportionately affected (Puig Cepero et al. 2021). Coastal insecurity is dominated by crime and illegal extraction, and intensified by climate-induced rarefication of livelihoods, including smuggling and sand mining. The reduction of fish stocks has led to clashes between coastguards and fishers, and subsequent riots. As fishing declines, the economic resilience of communities and towns alike is affected, leading individuals to migrate out of the affected regions (Beatley and Edwards 2018).

While the emergence of armed opposition groups in the Sahel has ruralised conflict in Western Africa, cities remain centres of conflict due to the concentration of infrastructure, wealth and political power. In major Western African cities such as Lagos and Jos, gangs struggle for power, challenging state monopoly on the legitimate use of violence and forcing vigilante violence on urban dwellers (Bekker and Fourchard 2013).

Responses and good practices

Across Western Africa, a number of responses to address climate-related security risks have emerged. The following section will highlight some of the initiatives being done at the (1) regional, (2) national and (3) local levels.

REGIONAL APPROACHES

Transboundary resource management cooperation has been a key axis of regional action on climate security, with water management an important entry point. The oldest transborder water management commission, the Lake Chad Basin Commission (LCBC), which was established in 1964, promotes the sustainable management of the basin and refers conflicts between its members to the International Court of Justice. As early as 1994, it had created the Multi-National Joint Task Force, a combined force composed of troops in Benin, Cameroon, Chad, Niger and Nigeria, which aimed to address trans-border crime and violence, and, especially since 2009, counter extremist groups such as Boko Haram. Security coordination also includes the harmonisation of border control measures as well as the exchange of defence information. Similarly, the Authority of the Niger Basin (ANB) promotes the integrated development of the basin in fields ranging from energy and agriculture to herding, fishing, forestry and industry. Meanwhile, the Senegal River Basin Development Organisation (OMVS) tackles hydropower, fluvial navigation, sustainable and concerted use of water, and livelihoods.

The OMVS is an example of how transboundary cooperation can successfully balance economic development with quality-of-life improvements and ecosystems with robust planning and information systems. Other transboundary initiatives, such as the Gambia River Basin Development Organisation (OMVG), the LCBC and the ANB, have had less success than the OMVS due to basin characteristics and lack of collective action (Guillier and Brown 2022).[20] The younger Volta Basin Authority (VBA) has experienced significant difficulties in collecting data and mobilising resources. Moreover, the basin's geographical characteristics lead to relatively localised transboundary issues that favour bilateral rather than multilateral cooperation (World Bank 2021g).

Similarly, the World Bank Project Cooperation in International Waters in Africa (CIWA) has been an

20 The Gambia Basin is relatively small and the Niger Basin has endorheic water flow.

important actor regarding water security in Western Africa, partnering with the various regional authorities on a number of projects. For example, in 2013, the CIWA and LCBC developed a regional water security framework for the Lake Chad Basin. The project noted the importance of granular data and modelling in areas with complex natural interaction (CIWA 2023). The CIWA also led the Sahel Groundwater Initiative, a technical assistance project that aims to improve groundwater exploration, expertise and regional cooperation, and its use for small-scale irrigation in Ghana, Burkina Faso, Niger, Nigeria and Côte d'Ivoire (CIWA 2022).

Apart from transboundary water management, Western African countries collaborate in numerous other domains to strengthen climate resilience. Notably, the Great Green Wall initiative, launched in 2007 by the African Union, aims to tackle climate insecurity in the region by planting thousands of trees across the Sahel. In turn, this will contribute to carbon sequestration, restore ecosystems and provide sustainable livelihoods through agroforestry (Schmidt and Muggah 2021). The example of the Great Green Wall (see page 33 and page 138 for a more detailed analysis of the Great Green Wall) demonstrates that, despite many implementation difficulties, projects can find renewed momentum by questioning their assumptions, integrating participatory and inclusive processes, and considering the lived experiences of affected populations (Mutanda Dougherty 2023).

Given the complexity of the links between climate change, environmental degradation, and peace and security, and the impact of these links on development and humanitarian action, experts stress the need to address the climate and security nexus through an integrated approach with all actors and stakeholders involved. However, in Western Africa, siloes continue to persist between the climate change and security fields (Guillier and Brown 2022). A recent initiative to enhance integration and cross-sectoral collaboration is the UN Regional Working Group on Climate Change, Security, Environment and Development (UN-CCESD) in Western Africa. Founded in 2021, its objective is to encourage UN information sharing and cross-pillar coordination to reduce the adverse implications of climate change and environmental degradation on human security, and to address the impacts of these phenomena on mobility and peace in the region. Another example is the UN Integrated Strategy for the Sahel (UNISS), which partly covers Western Africa (see Sahel chapter).

The UNDP is the main UN structure that deals with the interconnected fields of climate, disaster risk reduction, governance, conflict prevention, peacebuilding and natural resource management. The UNDP's Sahel Resilience Project integrates various interventions in which it collaborates at the regional level, with actors such as the African Union, ECOWAS and LCBC, as well as at the national level, where it aims to enhance disaster risk reduction strategies and resilience building. The project is being implemented across five areas of intervention: data for decision-making, risk governance, preparedness for recovery, resilient urban areas and regional engagement (UNDP 2021b). The project stems from the growing realisation of the links between climate change and security, and the significant silos that exist between various fields (Guillier and Brown 2022).

Climate change is also a regional priority issue for the ECOWAS, as captured in the recently adopted Regional Climate Strategy and Action Plan (2022–2030), which describes climate change as a factor that reshapes the world, and increases the risk of instability and insecurity in all its forms. It further stipulates how climate impacts across the region exacerbate conflicts linked to scarcity and use of natural resources, food and livelihood insecurity, and migration and displacement, among other challenges (ECOWAS 2022). The ECOWAS's approach to climate security also translates in various thematic focus areas, such as on transhumance. For example, the ECOWAS meets regularly with the largest regional herders' network, the Billital Maroobé Network (*Réseau Billital Maroobé*, RBM), to take stock of the latest transhumance campaigns and to mitigate risks such as inter-communal conflicts. According to the IOM, a key ECOWAS partner with regard to regional climate mobility, some core gaps related to transhumance remain. These gaps include the region's lack of a unified understanding of transhumant movements, their numbers and routes, and the direct impact this has on their ability to make sound policy decisions, as well as the need for localised conflict mitigation approaches to successfully address reoccurring transhumance-related conflicts (IOM 2022d).

ECOWAS and UNOWAS are engaged in a major collaborative effort with the broader UN system, government agencies, and civil society organisations to address the impact of climate change on peace and security in Western Africa. Significant initiatives have been undertaken in this regard, such as the creation of an ECOWAS-UNOWAS

Working Group on Climate Change and Security, and the establishment of the UN-CCESD. In April 2022, following a first-of-its-kind regional conference on climate security in Western Africa, representatives of countries in Western Africa and the Sahel signed a call to action, committing to inclusive, evidence-based analysis and policymaking on climate security in the region, as well as integrated partnerships and collaboration, and scaling up climate financing (UNOWAS 2022).

A key component to address climate-related security risks in Western Africa is risk-informed planning through early action systems. ECOWARN is an observation and monitoring tool for preventing conflicts and aiding decision making. The West Africa Network for Peacebuilding (WANEP) has for many years been a strategic partner for ECOWAS in operationalising ECOWARN. Over the years, the collaboration has resulted in the development of national early warning systems in all ECOWAS member states, which help to integrate more grassroots engagement and information into the system (Eze and Frimpong 2021). Even though ECOWARN is widely considered among the most advanced early warning systems for conflict prevention on the continent, it does not integrate much climate and environmental data into its forecasts and analysis (Gnanguenon 2021).

In addition, Western Africa has developed early warning systems focusing specifically on climate and environment. The CILSS, along with its regional centre Aghrymet, specialises in providing climate forecasts, surveys and training. Forecasts include climate predictions, and tracking of agriculture and herding, respectively helping farmers prepare for extreme weather events and identifying fall-back areas for herders in case of drought, using satellite and drone imaging. Both institutions also conduct hydrological and ecosystem surveys designed to track ecosystem evolution and degradation. Aghrymet supports effective agricultural adaptation by providing farmers with specialised climate information. One project facilitated by the CILSS was the PREGEC, which provides seasonal forecasts as well as water flow forecasts to farmers. However, Aghryment does not include many peace and security indicators in its forecasts and analyses, and as with ECOWARN lacks enhanced mainstreaming of the climate-conflict nexus (Guillier and Brown 2022).

Finally, numerous initiatives across Western Africa aim to address intersectional vulnerabilities to climate change, focusing in particular on women and children. The work of UNWOMEN in linking women, peace and security, with climate and environmental issues has made a major contribution to making climate adaptation sensitive to specific vulnerabilities. In Niger, for example, UNWOMEN has articulated its action around several axes, including integrating climate vulnerabilities in the 2020–2024 National Action Plan on Gender (UN Women 2020).

NATIONAL APPROACHES

Several interventions in Western Africa link national climate objectives to peace and security goals. For example, in Sierra Leone, the UNDP and the national government have worked towards increasing electricity supply to the cities of Freetown, Bo and Kenema to contribute to national peace and security. In 2007, Sierra Leone's government identified the country's power crisis as a key risk to peace and stability. Thus, the project not only aimed to address development issues, but also address feelings of neglect and disillusionment due to the lack of adequate power (UNDP 2010). There is rigorous scientific evidence available that illustrate the causal linkages between access to energy and renewable energy projects, and associated social and economic benefits. Several studies also illustrate the positive effects of energy and electrification, particularly lighting, on individual perceptions of safety and security. This has been especially evident among women and girls in fragile settings, but also on crime rates and violent conflict (Energy Peace Partners 2022).

In Ghana, the Ministry of Food and Agriculture collaborated with the Ministry of National Security to launch the Ghana Cattle Ranching Project to address farmer-herder conflicts. Under the program, large swaths of land were fenced off for cattle to graze (Strouboulis et al. 2023). However, the project faced several challenges, primarily related to complex land tenure arrangements through chiefdoms, identity, perceptions of land grabbing, and dynamics of access to animal feed and water sources, as well as concerns of corruption and rent-seeking behaviour among chiefs and security officers. One study concluded that there was a need to reconsider the cattle ranching policy by better understanding the complexity of conflicts

21 Land degradation neutrality is defined by the UNCCD as "a state whereby the amount and quality of land resources, necessary to support ecosystem functions and services and enhance food security, remains stable or increases within specified temporal and spatial scales and ecosystems."

and widening public consultation (Ahmed and Kuusaana 2021).

In 2023, in Mali, the government with support of the UNDP launched a six-year project aimed at enhancing climate security and the sustainable management of natural resources. The project is targeting the long-term sustainability of vulnerable productive areas in, for example, Bandiagara, Douentza, Mopti and San through nature-based solutions and the more peaceful management of natural resources. Through this initiative, Mali aims to reach its climate goals, as set out in the country's Nationally Determined Contribution under the Paris Agreement, which include achieving land degradation neutrality (UNDP 2023b).[21] Similarly, the Mali Climate Fund tries address the effects of climate change by investing in a green and resilient economy. Its theory of change is very much aligned with climate, peace and security objectives, and aims to enhance national capacities to better understand the middle ground between climate change, and socioeconomic and human factors, as well as address risks in the most vulnerable sectors, such as water management, agriculture, food security and energy (AEED 2023). Nigeria has been hosting an African Ministers' Council on Water (AMCOW) post-COP28 Stakeholders Dialogue in Abuja, where the Council's secretariat is headquartered, in early 2024 on operationalising data for sustainable water use (AMCOW 2024).

Some conservation efforts at the national level in Western Africa integrate climate adaptation, resilience, and peace and security objectives into efforts to conserve and protect the natural environment. For example, in Liberia, the UNDP and FAO work together with the Forestry Development Authority (FDA) to strengthen the management of community forests and protected areas in Liberia. Initiatives focus on improving the governance of community forest management bodies, building the capacities of forest regulatory institutions, empowering national civil society and non-governmental organisations, scaling natural resource management pilots, and promoting sustainable livelihood incentives for forest fringe communities (MPTF 2023).

Some national early warning initiatives in Western Africa include regular forecasting, such as the CGIAR collaboration with Vodafone, and the Council for Scientific and Industrial Research in Ghana, to provide real-time climate information to farmers and improve adaptation (Nguyen et al. 2020). The CGIAR is also promoting climate-smart agriculture across Western Africa, including the climate-proofing of value chains, supporting national agricultural investment plans and nationally determined contributions, and developing climate-smart agricultural investment plans. For example, in Mali, the CGIAR developed climate-smart models merging farming, forestry and herding, and diffused demand-driven practices and technologies through participatory processes to enable community-based adaptation. The CGIAR's Inclusive Climate Change Adaptation for a Sustainable Africa project aims to mainstream gender in climate policies, practices and negotiations (Nguyen et al. 2020).

LOCAL APPROACHES

Some evidence from peacebuilding programming at the local level in Western Africa suggests that climate resilience building contributes to a reduction in conflict and insecurity, and conversely peace allows for better access to and management of natural resources (Kurtz and Elsamahi 2023). For example, in Nigeria, Mercy Corps conducted a randomised impact evaluation of a programme to reduce conflict over natural resources between farmers and herders, mostly through mediation and conflict sensitivity training for local leaders. It concluded that mediation training had a positive effect on both leaders and their communities, with significant improvements to perceptions of security, but also a causal relation with a reduction in violence, including in farmer-herder conflicts (Reardon et al. 2021). Similarly, in Nigeria, research on collaborative projects between farmers and pastoralists found indicative evidence of improved trust between those conflicting groups (Mercy Corps 2019). These results are in line with other research, for example, on the violence reducing effects of community education with regard to land disputes in Liberia (Blattman et al. 2014; Kurtz and Elsamahi 2023).

In Burkina Faso, the organisation TreeAid provides an example of how forest conservation can be linked to conflict prevention and resolution, as well as reductions in poverty and hunger. Its forest governance programme supports local communities to protect and restore forestry by setting up forest management plans and committees, as well as supporting enterprise groups. The project has a strong focus on the inclusion and participation of women, as they have traditionally been marginalised from forestry management (TreeAid 2023). TreeAid also actively contributes to conflict man-

agement, particularly between communities and forest conservation agents, by facilitating dialogue between local officials, agropastoralists and other livelihood groups that depend on the forest (Tarif 2023). Similarly, in Senegal, local civil society organisations have established local consultative forums to create a platform for awareness-raising among communities on national forestry legislation, but also to enhance participatory dialogue around reforestation and environmental protection, and how this could be linked to strengthened economic resilience (Tarif 2023).

Other climate security interventions in Western Africa have focused on addressing gender issues related to climate vulnerability. For example, with support from the UNPBF, several projects in Mali and Niger aim to train women to contribute to local conflict prevention efforts around climate-induced natural resources conflicts in their communities. Through these endeavours, women have taken on the role of conflict mediators, resolving conflicts and benefiting from livelihood diversification opportunities including land ownership. These efforts have also facilitated the organisation of women-led cooperatives, enhancing women's participation in and leadership of local decision-making processes to reduce the impact of climate change on and related tensions in their communities (UNPBF 2023).

Western Africa has a wealth of indigenous knowledge and practice of land management, pastoralism and agriculture, which can help communities to build resilience against climate change impacts. In Ghana, long-standing indigenous farming practices help to mitigate the adverse effects of climate change (Gibson and Anderson 2023). Proka, for example, is a historical farming practice that involves the clearing land for cultivation. Instead of slashing and burning the brush, the sticks and leaves are left to rot, acting as an organic fertiliser that expedites vegetation regeneration while reducing the risk of wildfire (Awuah-Nyamekye 2019).

Over the past decade, the subregion of Liptako Gourma has been plagued by localised violent conflict, with climate change and environmental degradation one of the key drivers. Several initiatives aim to address the climate-conflict nexus in the subregion. For example, the EIP Trust Works environmental peacemaking project aims to integrate an understanding of the climate change, environmental and natural resource-related dynamics involved in conflicts as entry point for dialogue and trust building. By identifying existing peace initiatives, the project wants to foster collaboration between conflicting parties around issues of shared interest (EIP 2023).

The French Development Agency (AFD) 3 Frontiers Project (P3F) aims to support agropastoral communities in Liptako Gourma to improve environmental protection, transhumance, and the prevention and resolution of conflicts related to natural resource management (Alliance Sahel 2020; Le Gret 2021). Furthermore, the Swiss Centre for Humanitarian Dialogue (HD) supports a network of around 2,000 agropastoral mediators across Mali, Burkina Faso, Niger and Mauritania to help settle local conflicts between farmers and pastoralists, and broker local agreements over the management of resources and demarcating corridors for safe movement of livestock (Centre for Humanitarian Dialogue 2019). A number of agropastoral associations active in Liptako Gourma also play an important role in the broader context of environmental peacemaking efforts.[22]

Large organisations are heavily engaged in the Liptako-Gourma subregion. In 2021, the World Bank launched a new USD 350 million project to support community-based recovery and stability, aimed at simultaneously addressing emergency and climate change needs, heightened pressures from forced displacement, competition over natural resources, and regional data monitoring gaps. In close collaboration with the subregional organisation *Autorité de développement Intégré de la région du Liptako-Gourma*, which was created in 1970, the project supports a regional peace and stability dialogue, while at the same time deploying community-centred development platforms to localise implementation (World Bank 2021a).

22 In Liptako Gourma, these include the Association pour la Promotion de l'Elevage dans le sahel et la Savane, the Réseau des Organisations Paysannes et de Producteurs en Afrique de l'Ouest and the RBM.

Lake Chad: Not a shrinking lake, but a fluctuating one

Lake Chad is an ecological miracle, a huge freshwater lake in an otherwise arid region. It is shared by Chad, Cameroon, Niger and Nigeria. The lake supplies water to around 50 million people and is the basis for the livelihoods of an estimated 20 million. All-in-all Lake Chad's river basin covers an area of more than eight per cent of the African continent.

While Lake Chad shrank dramatically in the 1970s and 1980s due to the combined effects of climate variability and unsustainable water management, such as irrigation and dam-building activities, Lake Chad is not currently shrinking. More recent research using satellite data has shown that overall – taking account of the combined surface water extent of the northern and southern pools, plus the total water storage, ground water and soil moisture – the lake is actually in a period of expansion and has been for the past two decades. Some evidence even suggests that total water volumes stored within the lake water and the aquifers beneath have been increasing more recently (Pham-Duc et al. 2020).

However, there is greater variability and uncertainty than ever before in recorded history, leading to fluctuations in the size of the northern pool, as well as greater unpredictability regarding when and how much rain may fall (Pham-Duc et al. 2020). The timing and duration of the rains also varies erratically, and there have been shifts in the timing of the season and increases in extreme weather events (Taylor et al. 2017). Moreover, because of the shallowness of the lake and higher ambient temperatures, vegetation cover is increasing, particularly in shallow areas. In turn, this is slowing water movement across the lake, hampering fishing activity and boat transport across the lake, and providing a misleading perception that large parts of the lake have disappeared or transformed into a vast swamp (Pham-Duc et al. 2020).

A 2019 climate security assessment identified four key climate-related security risks that emerge through the interaction of increasing climate variability and conflict (Vivekananda et al. 2019):

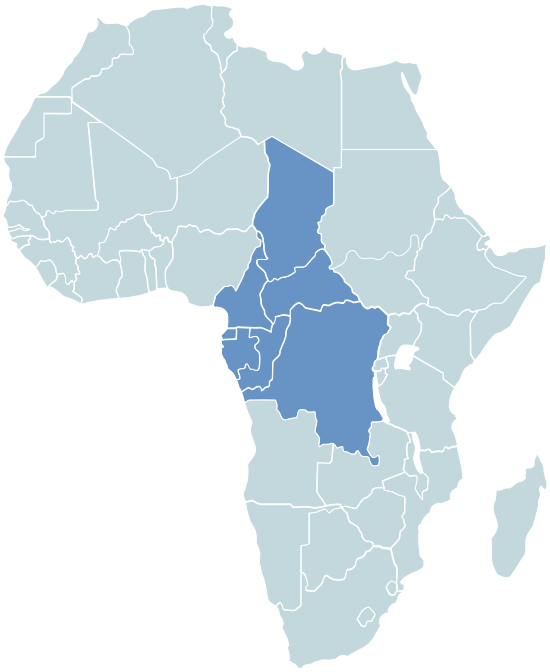
1. Climate and conflict undermine livelihoods: Prior to recent conflicts, there was a rich tapestry of cross-border trade. Moreover, people living around the lake relied on a range of livelihood systems that allowed them to switch between different activities (farming, fishing and pastoralism), as well as crops, grazing routes, fishing areas, depending on whether there was more or less water. The conflict has undermined these livelihood systems and decreased resilience.

2. Increased competition over natural resources: Natural resource conflicts are not a new phenomenon in the region, but the conflict has eroded existing conflict management systems and displacement has led to a clustering of people around urban centres. Together with the impact of climate change, this has led to more people competing over fewer resources in the area.

3. Recruitment into armed groups: Recruitment is a complex phenomenon. It takes place in the context of stark social and economic inequality, perceived lack of state legitimacy, increasingly vulnerable livelihoods, and the lure of financial incentives offered to potential recruits. Climate change compounds this risk as it undermines already fragile economies and livelihoods.

4. Heavy-handed military responses: While national militaries and the Multi-National Joint Task Force, working with community militias, have had some success in bringing relative peace to the region, their heavily militarised approaches have often undermined livelihoods by restricting movements and have often eroded state-citizen relationships.

Central Africa



Summary

KEY CLIMATE IMPACTS

Temperature: Since the 1960s, mean annual air temperatures over Central Africa has increased by between 0.75°C and 1.2°C, and the average air temperature is projected to rise by between 0.9°C to 3.1°C by 2080 compared to the year 2000. The magnitude of increase will vary, as temperatures in the already hotter regions further north rise by more than temperatures towards the south. In line with this, the annual number of very hot days is also projected to rise, especially in northern regions.

Precipitation*: Rainfall projections in Central Africa are highly uncertain and past precipitation trends challenging to discern. Available data suggest a drying trend since the 1950s. In the future, despite a clear trend for northern Chad where precipitation is expected to increase, it is expected that the average amount of annual precipitation will remain relatively constant across most of Central Africa. However, the intensity and frequency of both heavy precipitation events and dry spells will increase across vast areas of Central Africa.

Droughts*: Similar to precipitation trends, data on drought frequency and intensity are subject to uncertainty in Central Africa, both for past trends and projections. With the general decline in average precipitation amounts over the last decades, there is some evidence of an increase in droughts since the mid-20th century. Some studies point towards increased droughts in the Congo River Basin under moderate and high emissions scenarios. Even though drought occurrences are projected to be higher for northern and southern regions of the African continent, the actual drought risk will be among the highest in some central African countries, mainly due to high vulnerability and population growth.

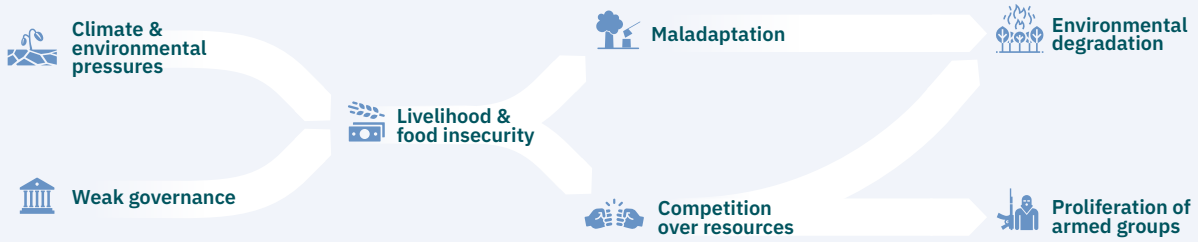
Flooding and landslides: Although a lack of observational data makes it challenging to identify past trends regarding hydrological extremes, vast areas of Central Africa are highly vulnerable to flooding and landslides. Future projections point to a climate-related increase in heavy precipitation events across all of Central Africa, indicating an increased risk of flooding and landslides in the future.

Sea level rise and coastal vulnerability: In response to climate change, sea levels rose at a rate of around 3.6 mm per year along the coasts of Central Africa between 1993 and 2021. Climate models project a median sea level rise of 12 cm by 2030 and around 36 cm by 2080 under a low emissions scenario, compared to 2000 levels. Under a high emissions scenario, the long-term rise will be higher, amounting to around 42 cm. Rising sea levels threaten coastal communities, and can cause erosion and saline intrusion into coastal waterways and groundwaters, leading to degradation of fertile coastal lands, as well as marine pollution, reduction in marine resources and degradation of water quality.

* Climate projections with high uncertainty need to be interpreted with great caution. Please refer to the Annex for an explanation of uncertainty in climate projections.

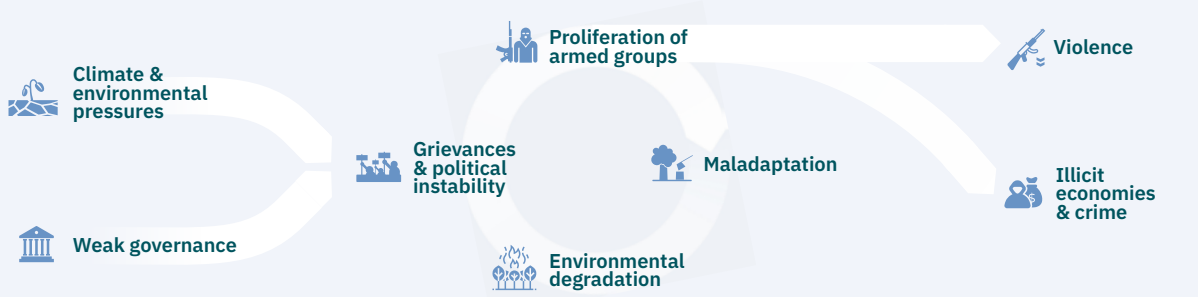
CLIMATE SECURITY PATHWAYS IN CENTRAL AFRICA

Pathway 1: Livelihood and food insecurity driving conflict over natural resources



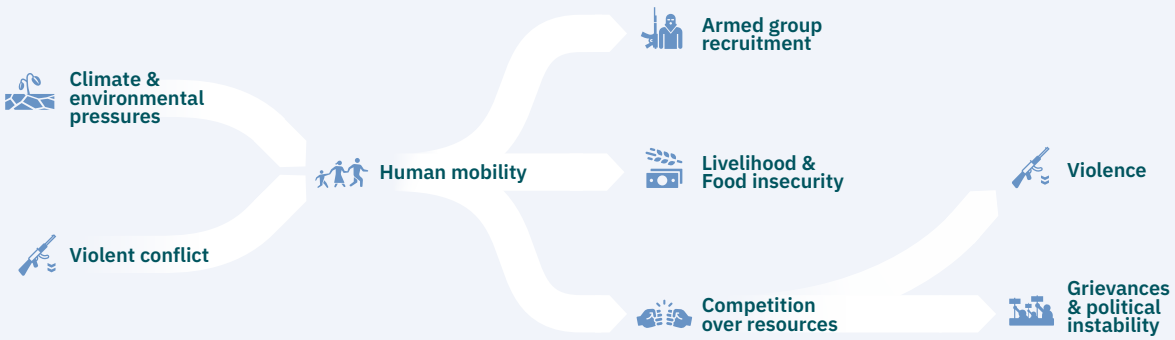
Climate-induced livelihood and food insecurity is driving competition over natural resources in Central Africa, particularly with regard to agriculture, pastoralism and forestry. In areas with weak or inadequate governance, concentrated pockets of natural resources, ongoing conflict and violence, and readily available small arms, competition can quickly turn violent. Climate and environmental pressures on traditional livelihoods also drive coping mechanisms that further harm the environment and social cohesion, such as illegal mining, logging and poaching.

Pathway 2: Climate impacts exacerbate the proliferation of armed and criminal groups



The proliferation of armed groups in Central Africa is already a severe threat to human security and stability in the region, especially in areas where state authority is absent, weak, causing harm and actively contributing to instability. Climate change and environmental degradation exacerbate existing socioeconomic vulnerabilities, fuelling societal grievances and marginalisation, which facilitate the rise and growth of armed groups. At the same time, armed groups in Central Africa generate revenue by illegally taxing pastoralism and exploiting natural resources, including illicit mining, which further drives their growth, causes environmental degradation and weakens resilience to natural hazards.

Pathway 3: Climate impacts exacerbate challenges around human mobility, contributing to increased conflict and security risks



Mobility has historically severed as a key strategy for Central Africans to cope with and adapt to increasingly severe climate impacts and environmental stressors. This is particularly true for those whose livelihoods directly depend on natural resources, such as farmers and pastoralists. Climate change can severely worsen existing challenges around human mobility, especially as it contributes to increased, unplanned and poorly managed movements. Climate migration and disaster-induced displacement can take different forms, either temporary or permanent, internal or international.

Pathway 4: Loss of biodiversity and environmental degradation intensifies human insecurity and violent conflict, and vice versa

Insecurity and violent conflict in Central Africa are deeply intertwined with and negatively affect the natural environment, as well as conservation efforts, human-wildlife relations and extractive industries. These dynamics threaten the last net carbon sink in the world, the Congo Basin Rainforest. While these linkages are often less investigated in Central Africa, the natural environment can be considered both a driver of and a "silent victim" of armed conflict.

Context

GEOGRAPHY

The Central Africa region[23] consists of nine AU member states: Burundi, Cameroon, the CAR, Chad, the DRC, the Republic of the Congo, Equatorial Guinea, Gabon, and São Tomé and Príncipe. Central Africa is home to several large freshwater bodies, including major rivers such as the Congo and Ubangi, both constituting dense systems of tributaries. The Congo River is the second-largest river in the world in terms of discharge volume. An estimated 77 million people in the Congo Basin depend on its abundant water resources, accounting for about 30 per cent of Africa's total freshwater supplies (Lossow 2017). The region also includes other large water bodies, such as Lake Tanganyika, the second largest and deepest lake in the world by water volume, spanning the entire border between Tanzania, Burundi and the DRC. Further north, Lake Albert, Lake Kivu and Lake Edward form part of the East African Rift System. Lake Chad, which borders Chad, Cameroon, Niger and Nigeria, is largely fed by precipitation further south in the humid tropics (Vivekananda et al. 2019).

Considering the presence of numerous water bodies, most Central African countries boast abundant freshwater resources. The total amount of renewable water available per capita per year is 154,632 m³ in DRC (highest per capita freshwater availability on the African continent), 76,406 m³ in Gabon and 19,942 m³ in the CAR. This is in stark contrast to arid Chad and mountainous Burundi, where water resources are limited to 2,865 m³ and 1,087 m³ per person per year, respectively (FAO 2019a). In light of the water stress threshold of 1,700 m³ per person per year, Burundi's per capita freshwater availability is low.

The Congo Basin is surrounded by highlands and mountains to the northwest, on the border between Nigeria and Cameroon, and especially to the east, where the East African Rift System hosts some of Africa's highest mountain ranges and the largest lakes. Off the western equatorial coast in the Gulf of Guinea lie volcanic islands, including Bioko, part of Equatorial Guinea, and the island nation of São Tomé and Príncipe. The latter, consisting of two mountainous islands formed by extinct volcanoes, is the second smallest African state (CIA 2022).

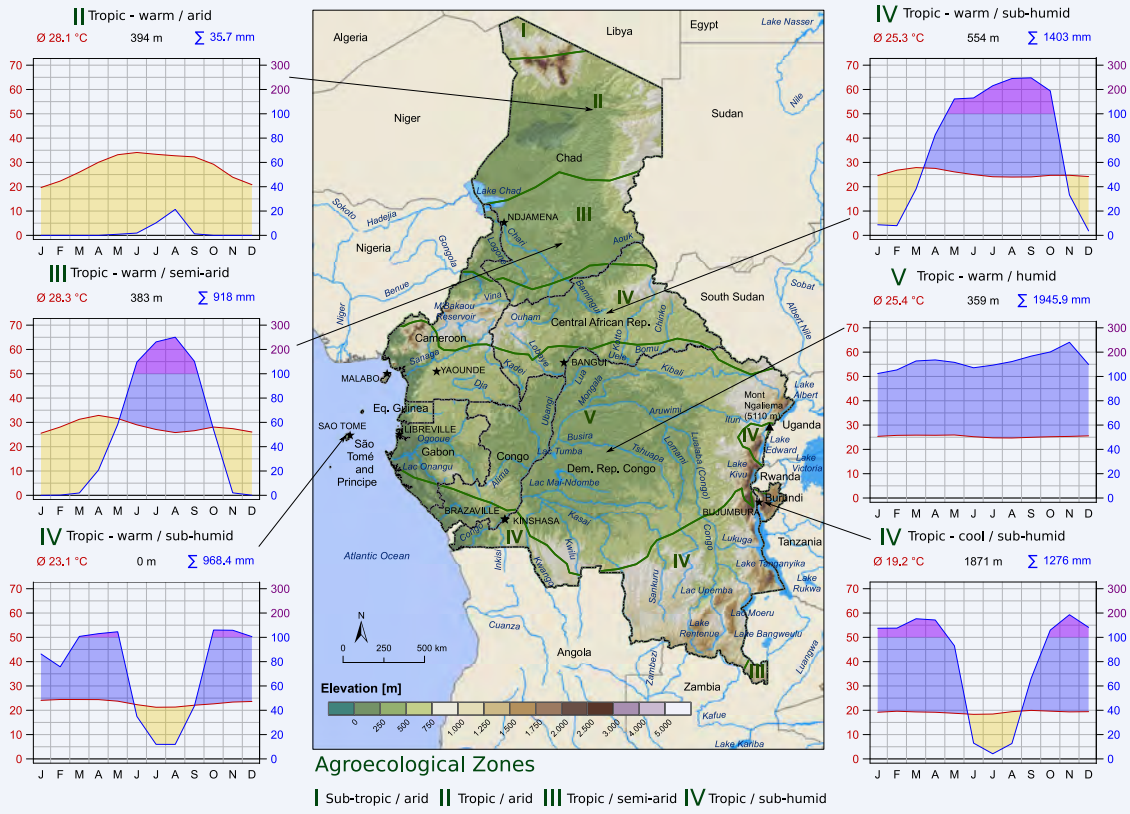


Figure 16: Topographic map of Central Africa with existing precipitation regimes and agroecological zones (Binder 2022a)

Central Africa is also characterised by dense humid forest, with the Congo Basin forest the second largest continuous tropical forest track after the Amazon (for more information see the Congo Basin box).

Central Africa comprises several diverse agroecological zones with specific temperature and moisture regimes. These range from arid conditions in the Sahara Desert in northern Chad to tropic-arid and semi-arid in the Sahel and Savannah regions in the south of Chad to mostly tropical, sub-humid to humid conditions in the Congo Basin. The migration of the Intertropical Convergence Zone strongly affects precipitation patterns across Central Africa, as its seasonal shift determines the wet and dry seasons (Binder 2022a). Areas north and south of the equatorial zone experience higher seasonal variability with distinct rainy seasons. The length of the rainy season and annual rainfall amounts decrease south and north of the equator. The ocean, in combination with other influences such as relief and vegetation, leads to various local climates near the coasts (Haensler et al. 2013).

SOCIOECONOMIC SITUATION

Central African economies are highly focused and dependent on natural resources, making them vulnerable to climatic stress and environmental impacts (World Bank 2021c). Apart from São Tomé and Príncipe, Gabon, and the Republic of the Congo – where the majority of the population works in the service industry[25] – in all other Central African countries agriculture accounts for the highest percentage of employment (AU and OECD 2022). The agricultural sector is mostly rainfed and consists largely of subsistence farming for local production, with limited regional or international export. Agricultural employment is also largely informal, with informal employment accounting for 90 per cent of total employment in Central Africa in 2018 (ILO 2020).

Despite the high percentage of employment in agriculture, the sector is far from the most profitable for Central African economies. The domestic value added content resulting from the exploitation of mining products is considerably higher than that of other sectors (AU and OECD 2022). Apart from São Tomé and Príncipe, Central Africa is rich in natural resources including oil, cobalt, gold, diamonds, uranium, manganese, copper and forestry resources. Oil drilling is the main foreign exchange earner in six countries in the region: Chad, Cameroon, the Republic of the Congo, the DRC, Equatorial Guinea and Gabon (UNECA 2020). Copper, oil and bituminous minerals account for the lion's share of Central Africa's total exports – nearly 87 per cent in Chad, over 61 per cent in the Republic of the Congo and 63 per cent in Equatorial Guinea. The DRC is widely considered to be the richest country in the world regarding natural resources and untapped mineral deposits, particularly cobalt, diamonds, gold and copper (AU and OECD 2022).

Central Africa is one of the African subregions that is the least integrated into global value chains. However, there are significant differences between the individual countries. For example, the Republic of the Congo and Gabon are more integrated in global value chains through their extractive sectors (AU and OECD 2022). In both countries, this trend is primarily attributed to the dependence on the oil sector, which constitutes the majority of exports. Furthermore, the diversification plan pursued by the Gabonese government has yielded beneficial outcomes by fostering the development of new value chains, particularly evident in the agriculture, food processing, and timber sectors (AfDB 2021). On the other hand, countries such as the CAR, Chad and Burundi participate comparatively less in global value chains (AU and OECD 2021).

Despite the abundance of natural wealth in Central Africa, populations remain very poor overall. This is due to the unequal distribution of income from this natural wealth. Inadequate skills development and low productivity are hobbling the competitive edge and economic diversifi¬cation potential of Central African countries, and most Central African countries face long-term development issues (UNECA 2020). The UNDP's Multidimensional Poverty Index ranks Central African countries among the lowest in the world (UNDP and OPHI 2022). Similarly, in the UNDP's Human Development Index, three out of the five lowest scoring countries in the world are located in Central Africa: Chad, the CAR and Burundi (UNDP 2022a). In the World Bank's Ease of Doing Business rankings, the 20 lowest scoring countries include six countries from Central Africa, with the CAR, the DRC and Chad scoring the lowest within Central Africa (World Bank 2023a).

23 This report uses the African Union's classification system for geographic regions (https://au.int/en/member_states/countryprofiles2).
24 The climate graphs display temperature and precipitation values, which are averaged over an area of approximately 50 x 50 km.
25 In São Tomé and Príncipe, Gabon, and the Republic of the Congo, the retail and wholesale sector is a significant source of employment, accounting for more than 40 per cent of all jobs (AUC/OECD, 2022a).

In general, the state of food security provides a reliable indicator of socioeconomic development within a region. In Central Africa, the levels of food insecurity are among the worst in Africa, comparable with Eastern Africa. In 2022, the prevalence of undernourishment was estimated at more than 29 per cent for the region (57 million people), an increase of nearly seven per cent compared to 2010 and the highest regional rate in Africa (FAO et al. 2023).

DEMOGRAPHICS AND MOBILITY

Central African countries have some of the fastest growing and youngest populations in the world, causing severe demographic pressures and socioeconomic challenges (World Bank 2023f). The total population of Central Africa is close to 170 million people, with the median age estimated around 17 years old. About half of the population is urban. The DRC has the highest population number (89 million), followed by Cameroon (26 million) and Chad (16 million). Countries such as São Tomé and Príncipe (219,000), and Equatorial Guinea (1.4 million) are the least populated. Over the last two decades, the annual population growth rate for Central Africa has remained relatively stable at around three per cent (UNDESA 2022b).

As intra-regional mobility is limited because of dense vegetation and the lack of interconnecting roads, the majority of Central African migrants move to other African regions or other continents. In 1983, the Economic Community of Central African States (ECCAS) adopted the Protocol on Freedom of Movement and Rights of Establishment of Nationals of Members States. This protocol includes provisions for freedom of movement, residence and establishment for all citizens in the ECCAS region. However, the protocol has not been fully implemented. In practice, the free movement of people is only allowed in a few member states and remains highly susceptible to inter-state relations.

POLITICAL INTEGRATION

All member states are part of the ECCAS, even though some countries are also members of other regional communities, such as the *Communauté économique et monétaire de l'Afrique centrale*, the SADC and the East African Community (EAC). Despite existing regional entities, Central Africa has long suffered from a lack of regional integration. Many countries have stronger ties outside the region, partly due to low levels of intra-regional trade and limited transportation infrastructure (Ndione 2014). Central African countries are politically integrated through the ECCAS, which works on a number of pillars, including peace and security, the common market, environment and natural resources, land use planning and infrastructure, gender, and human development.

Finally, some Central African countries are also members of multiple regional organisations. For example, Burundi is a member of both the EAC and ECCAS, and the DRC is a member of the EAC and SADC in addition to being an ECCAS member state. The CAR, the DRC, Congo and Burundi are also members of the International Conference on the Great Lakes Region (ICGLR). Although the ICGLR does not have an explicit focus on climate and environmental security, its legally binding Pact on Security, Stability and Development lists 10 protocols, including one on the illegal exploitation of natural resources (ICGLR 2006). Furthermore, the ICGLR Peace and Security Programme recognises the risk of environmental conflicts and the negative effects of climate change on human security (ICGLR 2023).

PEACE AND SECURITY

Multiple Central African countries, including the DRC, the CAR, Burundi, Cameroon and Chad, are experiencing or have experienced in recent years intra-state conflict. Many also have multiple armed and insurgency groups active within their territories. For example, in eastern DRC, an estimated 120 armed groups operate with diverse interests and objectives, directly and indirectly contributing to prolonged insecurity in the wider region, which has displaced millions of civilians over the years (Kivu Security Tracker 2021). Meanwhile, Cameroon is beset in a violent conflict between the government and separatists from the English-speaking minority. The conflict, which started in 2017, has killed over 6,000 people and displaced more than 700,000 people. At the same time, Cameroon faces a reinvigorated Jihadist insurgency with deadly attacks in the Lake Chad area. The war with Boko Haram, centred in the Far North, has killed thousands of civilians and displaced hundred thousands, and triggered the rise of vigilante self-defence groups (ICG 2023).

Central African countries have hosted several international military interventions aimed at protecting civilians, addressing the threat of armed groups and supporting national stabilisation efforts (Palik et al. 2022). For example, the DRC has hosted a UN peacekeeping presence since 1999, with

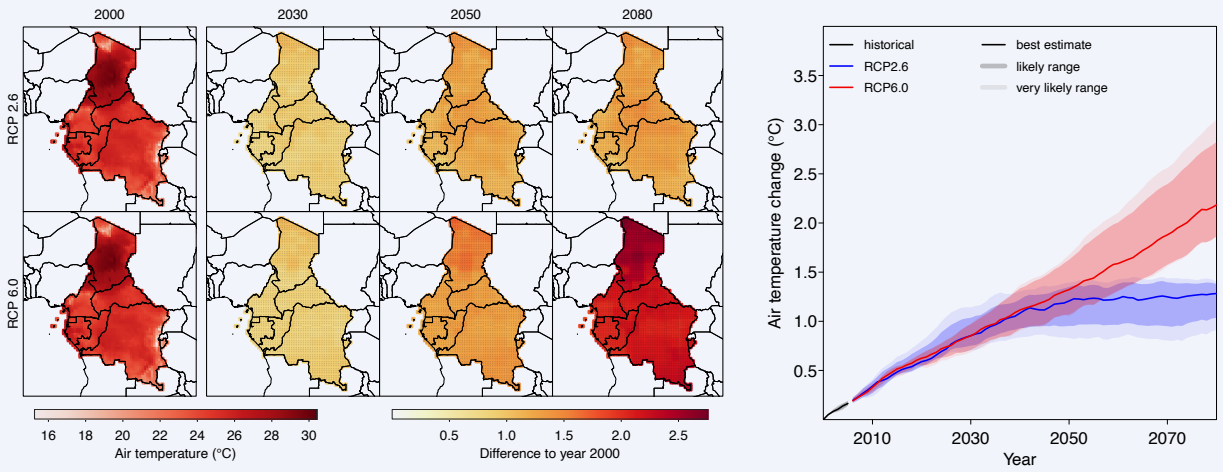


Figure 17: left, air temperature projections for Central Africa for different GHG emissions scenarios (regional variations); right, air temperature projections for Central Africa for different GHG emissions scenarios compared to the year 2000 (Binder 2022a)

the current deployment of the UN Organization Stabilization Mission in the DRC (MONUSCO). In 2022, with violence once again inflamed in eastern DRC, the EAC decided for the first time in its history to deploy a regional force, consisting of troops contributed by Kenya, Burundi, Uganda and South Sudan (Russo 2022). Similarly, the CAR deploys a UN stabilisation mission (MINUSCA) and has hosted numerous international peace operations in the past.

Climate change and impacts[26,27]

The entire Central African region is highly vulnerable to climate-related impacts. According to the ND-Gain Climate Vulnerability Index, which compares the vulnerability of different countries to climate change and their readiness to improve resilience, Chad is the most vulnerable to and least prepared country for climate change in the world. The CAR and Guinea-Bissau follow in second and third place, respectively, while the DRC ranks fifth, last in the rating (ND-Gain 2022). Similarly, according to the World Risk Index, Central Africa is the most vulnerable region in Africa to natural hazard-induced disasters,[28] even though it is far less exposed than Northern Africa, which has the highest exposure to natural hazard-induced disasters on the continent. In terms of coping and adaptive capacities to natural hazard-induced disasters, Central Africa scores the lowest among all African regions. Three out of the five most vulnerable countries in the world are located in Central Africa, namely Chad (second most vulnerable country after Somalia), the CAR (the fourth most vulnerable after South Sudan) and the DRC (the fifth most vulnerable country) (Atwii et al. 2022).

CLIMATE CHANGE

Air temperature

Since the 1960s, mean annual air temperatures over Central Africa has increased by between 0.75°C and 1.2°C (IPCC 2022). Depending on the climate change scenario, the average air temperature is projected to rise with high certainty by between 0.9°C to 3.1°C by 2080 compared to the year 2000 (very likely range). The magnitude of increase will vary, as temperatures in the already hotter regions further north will rise comparatively more than those towards the south (Binder 2022a).

In line with rising mean annual temperatures, the annual number of very hot days is also projected to rise. A sharp increase is expected over the CAR, southern Chad, northern Cameroon and southern DRC (see Figure 17). Hot days in coastal areas in the west and areas bordering the lakes (in the east of the DRC and western Burundi) will rise comparatively less. In São Tomé and Príncipe, daytime temperatures will not exceed the 35°C threshold in either scenario (Binder 2022a).

26 Please refer to the Annex for guidance on how to read the plots and for an explanation of the concept of uncertainty in climate projections.
27 The summary of the key climate impacts in this section is based on: Binder L. 2022. Climate Change in Central Africa. Berlin: Potsdam Institute for Climate Impact Research.
28 These include earthquakes, cyclones, droughts, sea level rise, tsunamis and floods.

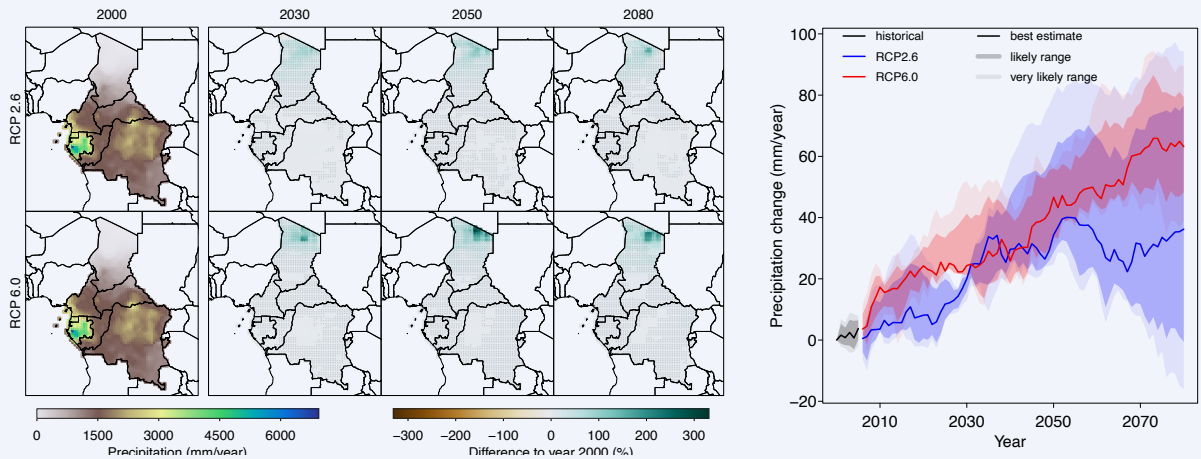


Figure 18: left, precipitation projections for Central Africa for different GHG emissions scenarios (regional variations); right, annual mean precipitation projections for Central Africa for different GHG emissions scenarios, compared to the year 2000 (Binder 2022a)

Precipitation

Due to a lack of meteorological observations[29] across the entire region, rainfall estimates are uncertain and past precipitation trends challenging to discern. Available data suggest a drying trend since the 1950s. The increase in droughts also affected the Congo Basin region between 1979 and 2014. This raised concerns as it has been associated with a decline in water storage and forest productivity (Zhou et al. 2014; Nicholson et al. 2022).[30] Compared to the 1979–2014 period, and especially to the recent dry period of 2000–2014, a return to wetter years was observed between 2016 and 2020, which could be related to warming of the land and oceans (Nicholson et al. 2022). However, rainfall estimates for the Congo Basin for recent decades vary, partly due to a lack of observational data (Binder 2022a).

Precipitation projections over Central Africa are highly uncertain. As the plots below illustrate, precipitation will primarily increase over northern Chad (see Figure 18). This finding is congruent with studies pointing towards a substantial increase in rainfall over the Sahel over the next few decades (Schewe and Levermann 2022). Despite a clear trend for Chad, many other areas are subject to uncertainties over the direction of change, though it is expected that the average annual amount of precipitation will remain relatively constant across most areas (except for Chad). However, the precipitation characteristics are projected to change. Heavy precipitation events will increase, while the frequency of dry spells during the rainy season has also been projected to rise across most of the Congo River Basin (Haensler et al. 2013; Karam et al. 2022).

Drought

According to the Emergency Events Database (EM-DAT), between 1950 and 2023, the number of drought disasters in Central Africa was lower compared to other African regions. However, Burundi and Chad registered a relatively high number of drought-related deaths (EM-DAT n.d.). In line with this, an index that measures social vulnerabilities to droughts ranked Burundi and Chad among the six most drought-vulnerable countries in Africa, along with Somalia, Niger, Mali and Ethiopia. This high susceptibility is the result of multiple vulnerability factors, including water availability and management, economic welfare and institutional capacities, and the availability of agricultural infrastructures and technologies (Naumann et al. 2014).

With the general decline in the average amount of precipitation over recent decades, there is some evidence of an increase in meteorological, agricultural and ecological droughts across Central Africa between 1950 and 2012 (Seneviratne et al. 2021). During this period, the Congo River Basin experienced a significant increase in the frequency and severity of droughts due to a combination of declining rainfall and hotter climatic conditions. Consequently, the Congo River Basin has been identified as a global drought hotspot (Spinoni et al. 2019).

In general, however, the drying trend in the region is subject to uncertainty, along with the precipitation trends of the last few decades. Similarly, future changes with regard to drought frequency in Central Africa are uncertain (Seneviratne et al. 2021; IPCC 2022), though some studies point towards increased droughts in the Congo River Basin under moderate and high emissions scenarios (Karam et al. 2022). Even though increases in future drought occurrences are projected to be higher for northern and southern regions of the African continent, the actual drought risk will be among the highest in some Central African countries, mainly due to high vulnerability and population growth. This high drought risk is an especially acute concern in Chad, the CAR and the DRC (Ahmadalipour et al. 2019).

Flooding and landslides

Hydrological extremes in the region are also of concern. Central Africa is particularly vulnerable to flooding events. Although a lack of observational data makes it challenging to identify past trends regarding hydrological extremes, the large-scale flooding in Cameroon and Chad in 2022 was exacerbated by climate change (World Weather Attribution 2022). Similarly, the rise in water levels in Lake Tanganyika has led to devastating damage, loss of life and displacement for Congolese and Burundian communities (Davies 2021; Johri 2022). Future projections point to a climate-related increase in heavy precipitation events across the entire Central African region, including the Congo River Basin, indicating an increased risk of flooding for the future (Binder 2022a).

According to the ECCAS Risk Atlas, the areas at highest risk of river flooding in Central Africa are located in the Lake Chad Basin, including along the Chari and Logone rivers in Chad, and along the Congo River and its tributaries. Kinshasa (the DRC) is among Central Africa's most vulnerable cities to flooding caused by rain and is also highly vulnerable to riverine flooding. Landslides are most prevalent in Cameroon, notably in western areas of the country; in the Great Lakes region, especially around Lake Kivu; and in western border regions of Burundi and Rwanda. In urban areas, the Central African cities with the highest risk of landslides are Brazzaville (Republic of the Congo), Libreville (Gabon) and Mbuji Mayi (the DRC) (ECCAS 2021b).

Sea level rise and coastal vulnerability

In response to climate change, sea levels rose at a rate of around 3.6 mm per year along the coasts of Central Africa between 1993 and 2021. This rate

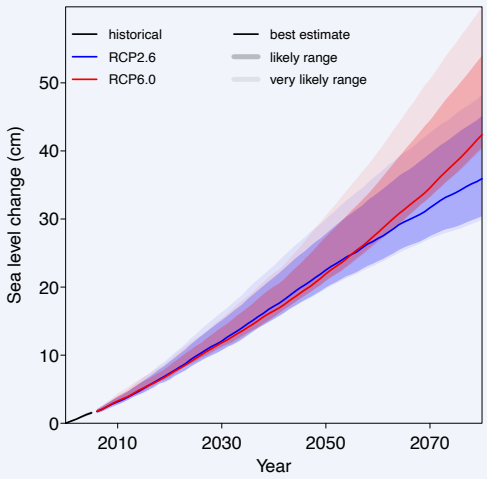


Figure 19: Sea level rise in Central Africa (Binder 2022a)

is above the global mean sea level rise of 3.3 mm per year for the same period (WMO 2022). Climate models project a median sea level rise of 12 cm by 2030 and around 36 cm by 2080 under RCP2.6, compared to the year 2000. Under RCP6.0, the long-term rise will be higher at around 42 cm. Rising sea levels threaten coastal communities, and can cause erosion and saline intrusion into coastal waterways and groundwaters (Binder 2022a). This can lead to degradation of fertile coastal lands, as well as marine pollution, reduction in marine resources and degradation of water quality, which are all essential for the livelihoods of coastal communities.

Finally, infrastructure along the Central African coast lacks resilience to climatic shocks and could deteriorate rapidly with increasing coastal pressures (Nguenko and Adewumi 2020). The Central African cities considered the most vulnerable to coastal flooding are Douala (Cameroon), Pointe Noire (Republic of the Congo) and Port Gentil (Gabon) (ECCAS 2021a).

29 For example, with many meteorological stations having fallen into disuse or now obsolete, the climate of the CAR is one of the most poorly monitored in the world.
30 It should be noted that forest degradation and the related decline in ecosystem services in the Congo Basin are also largely impacted by human activities. For example, in the DRC, shifting cultivation has been identified as the major cause of primary forest loss. Conflict has increased illegal logging, mining and hunting as people seek refuge in forests (Shapiro et al. 2021).

Climate security risk pathways

LIVELIHOOD AND FOOD INSECURITY DRIVING CONFLICT OVER NATURAL RESOURCES

Climate-induced livelihood and food insecurity are driving competition over natural resources in Central Africa, particularly in agriculture, pastoralism and forestry. With large areas of the region lacking effective governance and containing concentrated pockets of natural resources, as well as suffering from ongoing conflicts, violence and readily available small arms, competition can quickly turn violent. Climate and environmental pressures on traditional livelihoods also drive coping mechanisms that further harm the environment and social cohesion, such as illegal mining, logging and poaching.

Increasing competition over natural resources

Competition and tensions over natural resources are increasing across Central Africa. In Burundi, for example, an estimated 90 per cent of the population live from subsistence agriculture based on rain-fed production methods, which are under pressure from climate change and other environmental challenges. At the same time, the country is experiencing a very high population growth rate and is densely populated, which further intensifies competition for natural resources (UNOCA 2022). A major driver of conflict in Burundi is disputes over land ownership, which are worse in areas where people who were displaced due to insecurity have returned to find they have lost access to their property and, consequently, become entangled in competition over scarce land resources. Burundi's legal framework and practices restrict women's access to land ownership, making them especially vulnerable (IOM 2021a).

Intense agriculture, major deforestation and the wide-scale use of pesticides have reduced soil productivity and led to erosion. Water pollution from agriculture is one of the main environmental problems, as it affects lake water quality and ecosystems, which has an adverse effect on fishing. When climate pressures increase, these tensions and vulnerabilities are expected to worsen, increasing the risk of violent conflict (UNOCA 2022). For example, in the DRC's western Kwamouth territory, cycles of attacks and reprisals occurred due to longstanding disputes over chieftaincy power and land rights in 2022 and 2023. While these conflicts were primarily the result of customary tax disputes, conflict along ethnic lines in Kwamouth could worsen in the future as resources become scarcer (HRW 2023a).

Another example of this dynamic involves the Lake Chad Basin, which is the basis for millions of people's livelihoods, including fishing, farming, pastoralism and agriculture. The surrounding population is heavily dependent on the lake and surrounding environment. It is estimated that around 90 per cent of people's livelihoods in this area are climate sensitive (Vivekananda et al. 2019). However, around the Lake Chad Basin, water security has been under constant threat due to hydroclimatic variability, population growth, the unpredictability of water demand-supply dynamics, increasingly frequent and intense natural hazard-induced disasters (e.g. drought), and socioocultural complexities acting as direct or indirect drivers of conflicts over land and water (Asah 2015; Sayan et al. 2020) (see detailed discussion of climate security risks in the Lake Chad Basin box).

The DRC, the CAR, Chad and Cameroon face increasing competition over natural resources, which regularly escalates into violence and conflict. Typically, this type of conflict is highly localised, playing out either within or between livelihood groups. For example, in the Far North of Cameroon, due to climate change and more specifically the considerable variability in the surface water of Lake Chad, fishers and farmers tend to dig large trenches to retain the remaining water from the river so that they can fish and farm. However, muddy trenches trap and sometimes kill livestock, leading to hostilities between herders, and fishers and farmers (UNOCA 2022). While this type of intercommunal violence often appears small-scale, it has the potential to quickly escalate. In 2021, violent clashes over scarce resources displaced thousands inside Cameroon and forced more than 30,000 people to flee to neighbouring Chad (UNHCR 2021).

Similarly, competition over livelihoods and natural resources can intensify when demographic pressures increase, especially between displaced persons and host communities (UNOCA 2022). Violent competition over natural resources often remains under the radar as the international community and governments tend to focus on national-level peace processes. In the CAR, conflicts between herders and farmers in rural areas constitute a conflict-within-conflict, which further destabilises the country and often passes overlooked at the political level (ICG 2014).

Food insecurity

Livelihood insecurity in Central Africa is oftentimes directly linked to malnutrition and hunger.

In 2022, some 39 per cent (76 million) of Central Africans were estimated to be severely food insecure and 78 per cent (154 million) moderate or severely food insecure. Furthermore, 37 per cent of Central African children (under 5 years old) experience stunting, by far the highest proportion across all African regions. The increase in hunger in Central Africa is primarily driven by food inflation and increasing costs of imports, but also extreme climate events (FAO et al. 2023). While different livelihood sectors have always coexisted in Central Africa, tensions within and between groups can increase when climate change affects the availability of and access to natural resources. In such circumstances, people resort to adaptive practices that harm others, which leads to erosion of social cohesion and drives further conflict (UNOCA 2022).

Mining

Another important livelihood that is closely interlinked with climate and environmental security is mining. The DRC is often considered the world's most geologically blessed country, with untapped deposits estimated at USD 24 trillion (Global Edge 2023). Despite this potential wealth, the DRC has been unable to leverage these as transformative assets to promote socioeconomic and human development, which is partly due to the weakened governance structures resulting from decades of colonial resource extraction policies and conflict (Katunga 2006). The extraction of natural resources, which are frequently exported without contributing significantly to domestic industry or other sectors, benefits only small groups, exacerbating what is already a dire and highly unequal socioeconomic situation. For example, vast amounts of gold extracted through artisanal mining is smuggled out of the DRC through neighbouring countries, leading to economic losses and a lack of benefits for local communities (USAID 2021).

Mining often involves illicit networks, including armed groups for which the mining and/or taxation of mining activities is an important financing source (Vinke et al. 2023). This is further aggravated by rising international demand for minerals. In this context, competition over the extraction and control of these resources often turns violent. Extracting these resources puts tremendous pressure on the country's biodiversity, with pollution, deforestation and soil erosion threatening biodiversity (Pattison 2022). Tropical rainforests such as the Congo Basin are proven global hotspots for mining-related deforestation (Hund et al. 2023). For example, weak or inadequate governance structures partly originating from colonial rule and conflict in the DRC are major obstacles to protecting the country's forests from the expansion of both legal and illegal mining, which are key causes of deforestation (Schneider 2020; Auffredou 2022).

Extractive industries threaten ecosystems and environmental conservation efforts in Central Africa. The region is home to several protected areas, including transboundary conservation initiatives such as the Trinationale Dja-Odzala-Minkébéand and Sangha Tri-National complexes, which cover areas of Gabon, Cameroon, the CAR and the Republic of the Congo. Both protected areas are under enormous pressure from illegal artisanal miners, mostly mining for gold and diamonds, but also semi-industrial mining. Artisanal miners move into the forests, and often into protected areas, without any authorisation. The mining sector has become one of the main drivers of deforestation and defaunation, operating with high levels of impunity in both parks. Environmental impacts are disastrous and range from erosion to the diversion of watercourses through siltation, as well as ecosystem pollution, poaching and fragmentation of wildlife habitats. In particular, human and ecosystem health is highly vulnerable to mercury pollution, which is a consequence of gold mining. For example, an estimated 15 tonnes of mercury are used annually in the DRC's artisanal gold mining operations, which has devastating effects on aquatic systems, among other ecosystems, and human health (UNEP 2017a; Kanyinda et al. 2020). Across Central Africa, and especially near or within protected areas, artisanal mining is extremely poorly regulated, without legal frameworks that formalise and empower authorities to control activities (Tchoumba et al. 2021).

CLIMATE IMPACTS EXACERBATE THE PROLIFERATION OF ARMED AND CRIMINAL GROUPS

The proliferation of armed groups in Central Africa is already a severe threat to human security and stability in the region, especially in areas where state authority is absent, weak, causing harm and actively contributing to instability. Climate change and environmental degradation exacerbate existing socioeconomic vulnerabilities, fuelling societal grievances and marginalisation, which facilitate the rise and growth of armed groups. At the same time, armed groups in Central Africa generate revenue through illegally taxing pastoralism and

exploiting natural resources, including illicit mining, which further drive their growth, cause environmental degradation and weaken resilience to natural hazards.

An advantageous operating environment
First, armed groups proliferate, as they can operate more easily in fragile and conflict-affected environments where the state has little to no authority and lacks legitimacy. As climate change can weaken governance, it can also play to the advantage of actors that undermine state authority. Second, livelihood insecurity caused by, among other factors, climate change makes people more vulnerable to recruitment into armed groups (Nett and Rüttinger 2016). When livelihood sectors such as agriculture and pastoralism come under intense pressure, armed groups profit by providing affected people access to illicit income-generating activities such as mining, as well as by collecting illegal taxes and extortion. Armed groups can also bolster their legitimacy by providing basic services, which the state may not provide, such as protection, humanitarian assistance or access to basic goods. These services can assist communities affected by climate impacts to adapt, which enables armed groups to gain popularity and recruit more people (UNOCA 2022).

In the Lake Chad Basin, climate change has compounded core drivers of the conflict and deepened the humanitarian crisis. Negative experiences with state interventions in the region have also increased local grievances (Iocchi 2020). These feedback loops play into the ability of armed opposition groups' efforts to recruit, retain and re-recruit people, especially young people (Ifabiyi 2013; Vivekananda et al. 2019). Being a member of an armed group often provides vulnerable young people access to better socioeconomic conditions and perspectives, as well as a sense of belonging and meaning. Many young men and women, especially those who are displaced or who have lost their livelihoods due to climate insecurity, see a life in armed groups as more dignified, with more opportunities to gain status, power and respect (Moaveni 2019; Vivekananda et al. 2019). Similarly, in the CAR, young people in rural communities have been vulnerable to armed group recruitment, especially when armed groups can offer seemingly better socioeconomic opportunities and provide protection to livelihoods such as cattle or farmland (de Brier et al. 2020; Semba 2021).

Contestations around the exploitation of natural resources
In countries such as the CAR and DRC, armed groups are primarily focused on gaining profits from illicit natural resource exploitation, for example, by creating illegal taxation and roadblocks to profit from the industry (Jaillon et al. 2018; Brier et al. 2023). In some cases, armed groups control mines and directly manage extraction. It is important to note that national security forces and state agents are also intertwined in illicit trade through similar mechanisms used by non-state actors, often maintaining close links with transnational organised criminal networks involved in large-scale smuggling and money laundering (Matthysen et al. 2019). Key products include gold, timber, charcoal, 3T minerals, diamonds and wildlife. Shifts in access and the availability of natural resources can also exacerbate harmful and illicit exploitation by armed groups (UNEP et al. 2015).

This appears especially evident when governmental actors increase pressure on networks of illicit exploitation. Research in the DRC illustrates key mechanisms through which contestations around illegal resource exploitation interact with armed conflict and conservation efforts. For example, armed groups often seek to hamper conservation efforts in order to gain revenue from illegal resource exploitation. In addition, mining in and near protected areas in the DRC has fostered competition between political-military networks, involving both state agents and non-state actors, and creating new and exacerbating existing violent competition (Verweijen et al. 2022). On the other hand, conservation efforts can exacerbate conflict through increased deployment of enforcement agencies, which can affect conflict dynamics (Verweijen and Marijnen 2017). State agents responsible for environmental protection often also engage in environmental crime, facilitating illegal access to resources and engaging – either collaboratively or in competition – with armed groups. This is a particular risk when state agents receive poor salaries, or when salaries are not paid on time or at all (Schouten et al. 2022).

Maritime security
Coastal economies are important sources of revenue for some Central African countries. For example, São Tomé and Príncipe's economy depends almost entirely on the coastal zones. However, infrastructure along Central African coastal areas is generally in poor condition and threatened by climate pressures, such as coastal erosion, sea

level rise and human activities, such as dredging and pollution (UNESCO and IOC 2020). Environmental degradation is known to be one of the main drivers of illegal, unreported and unregulated fishing, as well as overfishing and maritime crime, such as arms, drugs and human trafficking, and piracy and armed robbery at sea. These maritime threats can fuel violence and corruption, and result in the proliferation of armed groups and criminal networks, especially in densely populated, highly vulnerable coastal areas of Central Africa (Walker 2021; UNOCA 2022).

CLIMATE IMPACTS EXACERBATE CHALLENGES AROUND HUMAN MOBILITY, CONTRIBUTING TO INCREASED CONFLICT AND SECURITY RISKS

Mobility has historically been a key strategy for coping with and adapting to increasingly severe climate impacts and environmental stressors for Central Africans. This is particularly true for those whose livelihoods depend directly on natural resources, such as farmers and pastoralists. Climate change can severely worsen existing challenges around human mobility, especially as it contributes to increased, unplanned and poorly managed movements. Climate migration and disaster-induced displacement can take different forms, either temporary or permanent, internal or international.

Pastoralism and transhumance

An important point to note is that human mobility – whether in the form of seasonal migration, economic migration or transhumance – is by no means a new phenomenon in Central Africa, as it has long been a key livelihood strategy. Pastoralism is a major economic activity in many countries in Central Africa, including Cameroon, the CAR and Chad. According to Chad's 2017–2021 National Livestock Development Plan, the sector accounts for between 30 per cent and 50 per cent of the country's exports, excluding oil. Livestock production is estimated to involve 40 per cent of the working population (CNUCED 2019).

Even though pastoral migration patterns change from country to country, as well as within countries, climate and environmental pressures increasingly shape these dynamics. Pastoral movements are either pendular (moving from one point to another, and returning by the same path) or circular (following a loop), but rarely random. However, with climate change and increased environmental pressures, the direction of these movements has become highly unpredictable, including for pastoralists themselves, which directly affects natural resource competition, and thus peace and security. This can be seen in countries such as Chad, Cameroon, the CAR and the DRC where the seasonal migration of pastoralists and their cattle is a source of friction and violent conflict. In recent years, these conflicts have worsened due to a multitude of drivers, including climate change, which shifts migration routes further south (ICG 2014).

Transhumance – the migration of herders and their cattle across and within national boundaries to exploit seasonally available resources – has also become increasingly interwoven with armed group dynamics as herders seek protection from armed groups and the latter gain economic profits from the cattle trade (de Brier et al. 2020). The securitisation of pastoralism has been institutionalised in many areas of the CAR through well-established systems of taxation as transhumance corridors are completely regulated by armed groups. In these cases, pastoralists are required to provide services to armed groups and become – sometimes against their will – associated with them. The spread of firearms among transhumant pastoralists and their alleged involvement in arms trafficking is further driving intercommunal hostility (Huchon et al. 2020).

In the past, when the region was relatively stable, people tended to follow designated migratory routes and specific protocols. For instance, if a herd caused damage to a field, village leaders and chief herders would typically negotiate an informal resolution based on established compensation norms. If this failed to address the issue, local authorities could intervene or pursue legal measures. However, since the onset of the civil war in 2013 in the region, exacerbated by the impacts of climate change, seasonal migration has become increasingly marred by acts of violence such as cattle theft, crop destruction, sexual assault, and even murder (Bah 2021).

Displacement

For several decades, multiple countries in Central Africa have been affected by displacement. Humanitarian crises in Chad, the CAR, Cameroon and the DRC have led to the internal and regional displacement of people. Over 90 per cent of refugees and asylum seekers from Central Africa are based in three countries: the DRC, Chad and Cameroon (UN DESA 2020). In addition, Chad has experienced the influx of migrants from around the region, many of whom attempt to enter Libya but

are expelled at the border. Chad also hosts returnees fleeing insecurity in northern Nigeria, as well as returnees and refugees fleeing inter-communal clashes in Sudan and the crisis in the CAR (IOM 2023). In mid-2023, the DRC had the largest population of IDPs (an estimated 6.2 million people) on the African continent, in addition to the more than 520,000 refugees hosted in the country. Meanwhile, other Central African countries with forcibly displaced persons include Cameroon (2.2 million IDPs and 469,000 refugees), Chad (381,000 IDPs and 715,000 refugees) and the CAR (488,000 IDPs and 31,000 refugees) (UNHCR 2023a).

Natural hazard-induced disasters, particularly droughts, storms, flooding and landslides, cause high levels of internal displacement in Central Africa. In 2020, the rainy seasons in countries such as Cameroon and the DRC were exceptionally intense and prolonged, flooding areas already affected by violence or other disasters, and consequently triggering secondary displacements. In the DRC, the number of people internally displaced due to natural hazard induced disasters increased from about 230,000 in 2019 to almost 900,000 in 2021 (IDMC 2023). In the Republic of the Congo, between late 2019 and January 2020, heavy rains led to severe flooding and landslides in Brazzaville, which affected nearly 50,000 people and resulted in widespread damage to infrastructure. In Gabon, between November and December 2019, the start of the rainy season was marked by severe flooding in the province of Moyen-Ogooué, while vast areas of Port-Gentil, the second largest city and an important hub for industries, was flooded in June 2020 (UNOCA 2022). Similarly, in Burundi, weather-related hazards including rains, strong winds, flooding and landslides internally displaced 87,000 people in 2021, an increase from 51,000 people in 2020 (IDMC 2023). Another example of climate-induced displacement can be found in the DRC and Burundi around Lake Tanganyika, where a rapid rise in the water level killed dozens of people, displaced thousands more and caused extensive damage to infrastructure along the shores (Davies 2021; Johri 2022).

People forcibly displaced by extreme and sudden climate shocks often become more vulnerable to food and livelihood insecurity, as well as discrimination and marginalisation. This negative cycle also makes people more vulnerable to harmful coping mechanisms such as criminality and enrolment into armed groups (Amakrane et al. 2023). Many Central African countries already host high numbers of refugees or IDPs, as a result of conflict and disasters caused by natural hazards. When climate and environmental pressures increase, these populations are often the first to suffer from the consequences, leading to food and livelihood insecurity. However, host communities are often equally vulnerable, especially when natural resources are scarce due to demographic pressures caused by mass displacement. Under such circumstances, competition can escalate into conflicts around access to livelihoods and natural resources, but also regarding aid and development resources – including food distributions, especially when they are not fairly distributed between displaced persons and the host population (Vinke et al. 2023).

Rural-urban migration and borderlands

Central African countries have some of the fastest growing populations in the world and urbanisation is expected to increase rapidly. Rural-urban migration patterns are already placing severe pressure on infrastructure, public services and people's livelihoods, with urban centres in Central Africa suffering from overpopulation. As climate change risks exacerbate these challenges, migration can also indirectly contribute to more poverty and marginalisation in urban centres, as well as increase urban crime and political instability (UNDESA 2022b).

Similarly, borderlands across Central Africa have become hotspots for climate migration, both as areas of out-migration in response to climate disruption and in terms of in-migration. The Great Lakes region, which spans the borders of the DRC, Burundi, Rwanda and Uganda, is already a dense cluster of migration and displacement, and climate change will likely draw a large number of additional arrivals. In the DRC, climate impacts are likely to drive substantial movements away from low-lying and flood-prone areas in the west, with people moving towards the borders with Rwanda and Uganda in the eastern highlands, and Lubumbashi in the south (Amakrane et al. 2023). However, as urban centres struggle to cope with increased demographic pressures, this migration poses serious risks to human security. For instance, the population of Bukavu in eastern DRC is projected to double by 2030 and triple by 2050, compared to 2016 estimations. However, physical and topographical conditions limit further expansion, and newcomers often tend to build and reside in areas that are not suitable for construction, exposing themselves to a high risk of landslides and flooding (Muhaya et al. 2022).

The borderlands between the CAR, Chad and Cameroon are specific hotspots for climate-induced migration and related insecurity. Many nomadic pastoralists lost their herds through a combination of droughts and conflicts with sedentary communities over shared transboundary habitat, pastures and water bodies (Sayan et al. 2020). In the Far North of Cameroon, in and around the Waza National Park, nomadic pastoralists have for generations migrated to the Waza-Logone flood plain, mostly coexisting peacefully with local farming communities. Traditional authorities from the region have established strong ties with nomadic pastoralists, attributing them grazing lands and even allowing them to settle more permanently and engage in agropastoral activities. However, with increased climatic and environmental pressures, fertile land has become extremely scarce, resulting into conflicts between local farmers, sedentary agropastoralists, transhumant pastoralists and wildlife. Increased climate variability and unpredictability further aggravates this as nomadic pastoralists often extend their stay beyond the season. With land and conservation efforts under pressure, authorities have called into question the established rules and practices (Huchon et al. 2020).

LOSS OF BIODIVERSITY AND ENVIRONMENTAL DEGRADATION INTENSIFIES HUMAN INSECURITY AND VIOLENT CONFLICT, AND VICE VERSA

Insecurity and violent conflict in Central Africa are deeply intertwined with and negatively affect the natural environment, including regarding conservation efforts, human-wildlife relations and extractive industries. These dynamics threaten the last net carbon sink in the world, the Congo Basin Rainforest. While these linkages are often less investigated in Central Africa, the natural environment can be considered both a driver of and a silent victim of armed conflict.

The effects of violent conflict on the natural environment

Violent conflicts have major direct and indirect negative impacts on ecosystems. For example, the use of weapons and military material damages ecosystems. Conflicts also reduce community and state conservation capacities, and lead to an increase in environmental crimes such as poaching, illegal deforestation and mining (Hillert 2023). Conflicts can directly lead to air, water and soil pollution, as well as the deliberate destruction of the environment and the use of natural resources as weapons of conflict. Conflict also hinders natural resource management and environmental protection, facilitating environmental crimes, such as poaching, and illegal logging and mining (Rüttinger et al. 2022). Areas that experience armed conflict and instability generally also count a higher number threatened fauna and flora (IUCN 2021).

Because of the role that environmental crimes and illegal resource extraction play in conflict economies, environmental defenders are often considered targets. This is especially of concern in the DRC, the African country with the highest number of attacks on environmental defenders. In 2020, at least 15 environmental defenders were killed in the country (Business and Human Rights Resource Centre 2021), including eight rangers working in Virunga National Park (Global Witness 2021). Indigenous community members are often victims of violence, which is particularly worrying given their generally positive role in conservation efforts. Evidence also suggests that nature and biodiversity degrade at a slower pace on indigenous lands (IPBES 2019).

These dynamics threaten critical ecosystems, such as the Lake Chad and Congo basins, which are both vital for livelihoods in the region. The latter, as one of the last remaining net carbon sinks in the world, is crucial for global climate mitigation efforts (Barbier and Burgess 2021). Climate change and environmental degradation pose a serious threat to the Congo Basin rainforest, as the impact of climate change combined with direct, human-made environmental pressures damages the ability of the forest to absorb CO2, which in turn drives further climate change (UNOCA 2022). Finally, long-term restoration projects, environmental research and the promotion of ecotourism are hindered by the conflict, resource exploitation and poverty-driven encroachment (Vinke et al. 2023).

Conservation conflicts

Central Africans often perceive protected areas as spaces that unnecessarily exclude human activities and do not generate any benefits for the communities living within or near them. Indeed, when protected areas generate economic activities, local populations rarely enjoy the benefits. Without buy-in from local communities, protected areas can become spaces of frustration and contestation (Tchoumba et al. 2021). Environmental conservation efforts in Central Africa have been plagued by human rights abuses and violations of ecoguards, park rangers and environmental officers against local and indigenous communities. Allegations have included beatings and physical violence

carried out by ecoguards in Boumba Bek, Nki and Lobeke national parks in southeastern Cameroon as early as 2008. Similarly, in the Salonga National Park in the DRC, investigations carried out in 2019 identified widespread allegations of extremely grave abuses perpetrated by ecoguards and Congolese army personnel, including multiple murders, rapes, torture and beatings (WWF 2022). Internationally funded and trained park guards in the DRC's Kahuzi-Biega National Park have reportedly killed, raped and terrorised indigenous Batwa living on their ancestral lands inside the park (Flummerfelt 2022).

Closely linked to human rights abuses and violations in Central Africa is the relatively recent phenomenon of "green militarisation," which refers to the use of military and paramilitary actors and approaches for conservation. This is especially visible in and around protected areas that are confronted with environmental crimes, such as poaching and illegal resource extraction (Lunstrum 2014). Collaborations between environmental actors and armed forces, as seen in the DRC and CAR, have fostered a convergence between environmental and security governance, often contributing to protected areas becoming contested spaces of violent conflict (Kujirakwinja et al. 2010; Lombard 2015). The Congo's Virunga National Park, which is located in the already conflict-ridden North-Kivu province, is an example of a conservation-stabilisation approach, with the DRC army and park rangers collaborating closely to expel armed groups and criminals from the park. However, research suggests that strict law enforcement, repression and an overly militarised approach to conservation might have the opposite effect, and fuel rather than mitigate the dynamics feeding armed mobilisation and violent competition over natural resources (Verweijen and Marijnen 2018).

Human-wildlife conflicts

Another growing climate security challenge are human-wildlife conflicts, with incidents becoming more frequent, serious and widespread across Africa and particularly in Central Africa. In the past, most human-wildlife conflict research on the African continent focused on Southern and Eastern Africa. Nonetheless, human-wildlife conflict is a key issue in many Central African countries as well, occurring in both savanna and forest areas (Breuer and Ngama 2020). Such conflicts are often driven by demographic pressures, climate change and human-made environmental stressors, such as agricultural expansion, infrastructure development, deforestation, pollution, poaching and other losses of biodiversity (Nyhus 2016; IUCN 2022).

The role of climate change is often underappreciated, although evidence suggests it is a critical amplifier of human-wildlife competition for space, water and food, as it exacerbates resource scarcity for both humans and wildlife, altering human and animal behaviours and distributions, and increasing potentially violent human-wildlife encounters (Abrahms et al. 2023). Changes in biodiversity, temperature or rainfall patterns can push both humans and animals into harmful or conflict-promoting coping mechanisms. For example, in Lopé National Park in Gabon, research suggests that a significant decline in fruiting due to climate change led to a decrease in the capacity of the ecosystem to support the fruit-dependent elephant population, pushing elephants out of the wood (Bush et al. 2020).

While there are numerous forms of human-wildlife conflicts, such as livestock predation by large carnivores, the most prevalent conflicts in Central Africa involve forest elephants, which have occurred for decades in countries such as the Republic of the Congo, Gabon, Cameroon, the DRC and the CAR (Tchamba and Foguekem 2012; Terada et al. 2021). Various types of violence between humans and forest elephants occur, including hunting, poaching and traditional killings, as seen among various indigenous communities such as the Baka and Aka tribes (Agam and Barkai 2018).

In the 1990s, Central Africa created more and more protected areas and increased measures of conservation, which also resulted in more elephants living closer to human settlements. The development of infrastructure and roads, immigration and expansion of people into forest lands, high poaching intensity, and an increase in farming activities have resulted in elephants migrating out of unsafe habitats, heightening the likelihood of confrontations with humans. New security issues have emerged with elephants raiding crops in farmlands and villages close to protected areas, destroying food stores and water sources, and directly threatening human life. Impacts on humans include crop loss, property destruction, and injury and death, as well as more hidden consequences such as loss of livelihoods, and increased expenditures and workload (Breuer and Ngama 2020). Furthermore, the increase in hostile encounters has pushed human

and elephant behaviour towards more hostility and aggression, fuelling a negative conflict spiral (Breuer et al. 2016; Tyukavina et al. 2018).

An important consequence of human-elephant conflicts in Central Africa is how it affects conservation and protection efforts more broadly. Losses and grievances associated with living with elephants can fuel resistance against conservation efforts, and in some cases even violent conflict between local communities, and park rangers and environmental officers. This is especially a risk if local communities not only fear damage caused by elephants, but also consider conservation as non-beneficial for local livelihoods, for example, if regulations limit options for agricultural production (Terada et al. 2021). Finally, forest communities often perceive their rights to be treated inferior to the protection of elephants, a perception that has worsened due to numerous cases of human rights violations against forest communities under the pretext of conservation work – an issue that has plagued Central Africa for decades (WWF 2022).

Responses and good practices

The climate-conflict nexus is often considered a new topic in Central Africa, especially in comparison with neighbouring Western Africa and Eastern Africa. Nonetheless, the topic is emerging as a key priority area for Central African countries and for regional cooperation. Even though Central Africa has a less developed framework and established discourse on climate security, it is integrated throughout several initiatives at the regional, national and local levels.

Regional approaches

The links between climate change, peace and security in Central Africa have been recognised by several regional actors. In 2018 and again in 2019, the UN Security Council requested the UNOCA to take into consideration climate change among various factors affecting the stability of Central Africa (S/PRST/2018/17 and S/PRST/2019/10). In 2019, ECCAS member states requested in a ministerial declaration that the UNOCA and UNEP support efforts in the region to address the impact of climate change on peace and security (UNOCA 2022).

Some of the key intergovernmental actors working on climate-related security issues in the region include ECCAS, as well as more thematically focused initiatives such as the Central African Forests Commission (COMIFAC), the Congo Basin Forest Partnership (CBFP) and the Youth Network for Central African Forests. The Network of Central African Protected Areas was created in 2000 to support Central African countries conserve natural resources through protected areas. However, the activities of the initiative have ceased in recent years. The Lake Chad Basin Commission (LCBC) includes Central African countries such as Cameroon, the CAR and Chad.[31] Under the umbrella of COMIFAC, several partnership initiatives focusing on environmental conservation, climate adaptation, resilience-building and human development have been launched. Of note is the Conference on Dense and Moist Forest Ecosystems of Central Africa, launched in 1996 as the Brazzaville Process, which aims to provide a platform for dialogue and collaboration on the sustainable management of forestry resources (COMIFAC 2005).

Knowledge and governance of transhumance-related security issues in Central Africa, especially in comparison to Western and Central Africa, has remained underdeveloped with regard to spatial, ecological, political and socioeconomic dynamics. This is especially the case when linked with the effects of climate change (Huchon et al. 2020). However, in recent years, transhumance has increasingly become a topic for regional cooperation. In 2019, Chad hosted the first International Conference of Ministers on Transboundary Transhumance, which resulted in the N'Djamena Declaration. An international agreement around nine commitments for Western and Central African countries to improve cooperation around transhumance (CBFP 2019). A second conference of ministers on transhumance, protected areas and natural resources, development, peace, and security was held in Yaoundé, Cameroon, in July 2023. The conference focused on the operationalisation of international agreements, such as cross-border agreements, setting up transnational coordination mechanisms, and developing country action and investment plans (CBFP 2023). These promising developments were facilitated or initiated by regional organisations including CBFP, ECCAS and COMIFAC. However, due to the absence of land-use plans and limitations in terms of institutional capacities, many of these initiatives face enormous implementation challenges (Huchon et al. 2020).

31 The activities of the LCBC are covered in the Western Africa chapter and the section on transboundary water issues.

For countries with a history of conflict, environmental conservation is often an easy-to-agree-upon common objective for peacebuilding that is less sensitive than, for instance, accessing high-value resources. The Greater Virunga Transboundary Collaboration – a conservation agreement between Virunga National Park in the DRC, Volcanoes National Park in Rwanda and Mgahinga Gorilla National Park in Uganda – has resulted in several conservation successes, with environmental peacebuilding playing a key part in this. Conflict-sensitive bottom-up approaches included shared agreements on landscape management, community conservation, tourism development and law enforcement (Refisch and Jensen 2016). Due to international collaboration and trust building around the conservation of mountain gorillas through the transboundary secretariat, the three countries are now also working on broader, shared environmental risks. For example, a history of violent conflicts between fishers in the DRC and Uganda led to a decision to include fisheries in the Transboundary Strategic Plan. In addition, the Greater Virunga Transboundary Collaboration plays a key role as a platform and intergovernmental facilitator for discussing contentious issues between the three countries, such as the transboundary exploitation of natural resources. Therefore, it remains a rare platform of engagement between countries that have historically had tense relations (Refisch 2022). Despite some positive outcomes, conservation efforts in Virunga National Park have led to the justification and financing of militarised approaches to protect revenues and goals, while simultaneously concealing defence interests in protecting national borders (Trogisch and Fletcher 2022). Similarly, the militarisation of nature conservation in Virunga has enabled elites to benefit from unauthorised exploitation of natural resources within the park borders (Marijnen 2017; Verweijen and Marijnen 2018).

In March 2023, the sixth edition of the One Planet Summit, entitled One Forest Summit, was held in Libreville, Gabon. Twenty countries representing the major forest basins throughout the world gathered to discuss the conservation and sustainable management of tropical forests, including of the Congo Basin, recognised as a critical factor in maintaining peace and stability in Central Africa. A key outcome was the creation of a EUR 100 million fund to invest in so-called positive conservation partnerships and a mechanism for compensating exemplary forested countries through biodiversity certificate. In addition, the fund aims to create 10 million jobs in activities related to sustainable forest management, and value chains that benefit local and indigenous communities (FDA 2023).

Central Africa still has significant gaps in terms of data gathering and analytical capacities to inform decision-making. Some projects aim specifically to strengthen evidence generation to inform conservation efforts and environmental peacebuilding. One initiative is Project Canopy, which works with governments, development organisations, international and local non-profits to identify which opportunities may have the greatest impact. Project Canopy is a non-profit organisation that takes a data- and technology-driven approach to conservation, applying machine-learning to satellite imaginary, identifying deforestation (by type) in real time, and investigating how environmental science can be aligned with law and policymaking. By providing decision-makers with the data and analytics they need, the project aims to improve conservation outcomes and increase funding for conservation efforts in the Congo Basin (Project Canopy 2023). In addition, the UNOCA has engaged with the Innovation Cell of the UN Department of Political and Peacebuilding Affairs to initiate a geospatial dashboard project and conflict modelling prototypes to create the UNOCA Climate Security Dashboard for use by desk officers, in-situ practitioners and decision-makers. The dashboard leverages environmentally purposed remote-sensing (satellite imagery) data with the mission to predict and prevent conflict, and enable self-reliant peacebuilding and peacekeeping (UNOCA 2023).

ECCAS is engaged in the development of a conflict-sensitive regional strategy on climate change and resilient development, and the completion of a regional protocol on transhumance, with the support of UNOCA and other partners. The overarching objective of these initiatives is to guide ECCAS member states and other stakeholders on the conceptualisation and implementation of collective measures to address the subregional impacts of climate change, and advance sustainable social and economic development (UNOCA 2023).

In addition, UNOCA and numerous other UN entities have initiated the establishment of a UN Working Group on Climate Change, Biodiversity, Security, Transhumance, Finance and Development in Central Africa. UNOCA continues to implement a cross-regional project on farmer-herder dynamics in Central and Western Africa in collaboration with

UNOWAS and the Office of the Special Coordinator for Development in the Sahel. This includes the establishment of a community of practice and the development of a handbook gathering good practices identified in the DRC, Cameroon, the CAR, Chad, Burkina Faso, Benin and the Gambia (UNOCA 2023).

National approaches

Some national initiatives focus on linking conservation with climate resilience. For example, in the Mai-Ndombé province of the DRC, tropical rainforest covers over 80 per cent of the land area, but the past few decades have witnessed heavy deforestation rates, mainly due to slash-and-burn agricultural practices and overexploitation of forestry resources, including for charcoal production. In response, the government of the DRC and World Bank signed an agreement on the purchase of 10 million tonnes of CO2, which the DRC authorities aim to achieve through the implementation Mai-Ndombé PIREDD project. Through the National REDD+ Fund portfolio,[32] the DRC hopes to reduce CO2 emissions by 27.7 million tonnes and at the same time improve livelihoods for 150,000 people from the area. The project illustrates how carbon credits can directly support conservation efforts and land use planning, climate-smart agricultural practices, the sustainable management of forestry resources and a reduction in the use of unsustainable energy sources (Central African Forest Initiative 2023).

Law enforcement and regulation have proven effective ways to reduce the negative effects of natural resource exploitation on the environment, especially in and around conservation areas. In the Trinationale Dja-Odzala-Minkébéand and Sangha Tri-National complexes, Gabon has been one of the most active countries in addressing the issue of illegal mining. In 2011 and 2014, Gabonese authorities removed thousands of illegal gold miners from the park. However, without socioeconomic alternatives for miners or a legal framework in place, such measures often remain insufficient to address underlying issues such as poor climate resilience and livelihood insecurity. Linking regulation with livelihood opportunities for communities can allow ecosystems to recover, while also improving living conditions and earnings of miners, and ensuring that national economies receive their due (Tchoumba et al. 2021).

One of the unique characteristics of Gabon is that it still has a large, well-preserved forest ecosystem, estimated to cover 88 per cent of its surface area. This exceptional natural heritage constitutes a major asset because of its carbon sequestration capability estimated at several hundred million tonnes of CO2 per year, which the country plans to commercialise (Tan 2021). The DRC, which is home to the majority of the Congo Basin rainforest, considers itself a "solution country," with the government aiming to link climate action, including adaptation, mitigation and resilience measures, with environmental protection and development (UN 2021). In the Republic of the Congo, the National Reforestation Program illustrates a government desire to diversify the national economy by establishing one million hectares of forestry and agroforestry plantations in collaboration with public and private partners. By signing a landmark agreement with the World Bank's Forest Carbon Partnership Facility in 2021, the Republic of the Congo became one of the first countries in Africa to test REDD+ at scale, focusing on reducing emissions from deforestation and forest degradation, and increasing carbon sequestration. The programme includes an inclusive benefit sharing plan, developed through extensive stakeholder consultations at different levels to ensure that community members and indigenous peoples, and local beneficiaries that depend on forests for their livelihoods are recognised and rewarded for their role in reducing emissions (World Bank 2021f).

Local approaches

Central Africa hosts a wide range of actors and initiatives that focus on building climate resilience and peace at the subregional and local levels. Programmes and projects often focus on thematic areas, such as transhumance, conservation, energy and climate-resilient livelihoods.

In the Salamat, Sila and Ouaddaï provinces of Chad, the UN country team is working to strengthen resilience among communities affected by herder-farmer conflicts, particularly by strengthening social cohesion between pastoralists and farmers, and between pastoral communities. This includes supporting local and traditional committees to prevent conflicts and promote peace, as well as mediating between farmers and herders over

32 Countries established the REDD+ framework to protect forests as part of the Paris Agreement. REDD stands for reducing emissions from deforestation and forest degradation in developing countries. The "+" stands for additional forest-related activities that protect the climate, namely sustainable management of forests, and the conservation and enhancement of forest carbon stocks. Under the REDD+ framework of activities, countries can receive results-based payments for emission reductions when they reduce deforestation.

natural resource management, and facilitating local justice mechanisms to address grievances and manage conflicts (FAO et al. n.d.). Similarly, in the northwestern provinces of the CAR, organisations such as the FAO and the UN Population Fund (UNFPA) implemented a programme to support transhumance management, and foster intercommunal dialogue between farmers and herders, with the objective of improving inter-group perceptions, and changing attitudes and behaviours (FAO and UNFPA 2020).

Transhumant pastoralists are too often seen as a source of insecurity, and not enough as an essential line of defence against armed groups and criminal networks. They are often the first victims of armed groups, but given their access to remote areas they can play a vital role in monitoring and providing vital information to security actors. In the binational BSB Yamoussa complex, a protected area established in 2011 through a partnership between Chad and Cameroun, which includes the Sena-Oura and Bouba-Ndjida national parks, several studies have been undertaken to better map different dimensions of transhumance in the area. These studies informed a consultation process involving different actors to reconcile points of view and guide future cross-border interventions. By establishing positive relationships with pastoral groups through conservation efforts and natural resource management, they have contributed to addressing issues of poaching and illegal resource exploitation (Huchon et al. 2020).

The UNPBF has numerous projects that focus on the climate-conflict nexus in Central Africa. One initiative worth mentioning is the Kibira Peace programme. The programme leverages blended finance to support joint peacebuilding and conservation interventions that target the drivers of conflict and instability associated with the lack of protection for the Kibira National Park in Burundi. The programme supports the Burundian government in deploying a force of rangers and ecoguards managed by the National Park Authority, a REDD+ strategy aimed at reducing drivers of deforestation, accessing carbon market, providing alternative livelihood models that generate co-benefits for communities, and fostering durable conservation and peace (UNCDF 2023).

One as yet underdeveloped response area in Central Africa includes the linkages between green energy and peace. However, some innovative projects have looked into the peace benefits of renewable energy. For example, an evaluation conducted by Energy Peace Partners in Goma in eastern DRC concluded that overall levels of peace were significantly higher in a neighbourhood that enjoyed street lightening powered by green energy compared to a neighbourhood with similar characteristics but lacked public lighting and widespread access to electricity. Along the same lines, the neighbourhood with street lighting showed heightened sense of security and feelings of safety, especially among women and girls (Energy Peace Partners 2022).

There are several examples of how conservation efforts can integrate climate adaptation and peacebuilding objectives at the very local level. For instance, in the Likouala Department of Northern Congo, the *Association des Jeunes pour l'éducation et la Sauvegarde des Éléphants au Congo* (AJSEC) aims to foster alternative income opportunities for local and indigenous communities with an emphasis on elephant poachers. By providing opportunities in agroforestry and beekeeping, the project helps to mitigate human-elephant conflicts that are highly prevalent in the region. Training and working with young forest hunters on environmental conservation enables the AJSEC to gain a deeper understanding of conflict drivers and opportunities to address existing risks, as well as develop more tailored approaches (Breuer and Ngama 2020). Based on lessons learned from a project implemented by the *Institut de Recherches Agronomiques et Forestières of the Centre National de la Recherche Scientifique et Technologique* in Gabon, beekeeping not only provides opportunities for alternative income generation, beehives can also directly protect plantations from crop-raiding elephants (Ngama et al. 2016).

Another example of how climate and environmental action, which can be directly linked not only with human development, but also with peace and security, can be found in Yobé-Sangha Prefecture in southwestern CAR. The Dzanga-Sangha Protected Areas (DSPA) complex encompasses a multi-use area, the Dzanga-Sangha Special Dense Forest Reserve and Dzanga Ndoki National Park. The DSPA has known relative peace and stability, despite the vast majority of the CAR being affected by insecurity and violent conflict. The DSPA's professional, well-trained rangers combined with the area's critical role in bolstering the local economy has contributed to this stable socioeconomic and political environment. Specific reasons for its success include support for community welfare and livelihoods, as well as health care and educa-

tion. For example, the DSPA runs a human rights centre for indigenous people, provides free medical services and job opportunities, and protects local livelihood systems by regulating multi-use areas. Inclusive management principles have provided historically marginalised indigenous peoples greater voice in the management of their land and resources (WWF 2022).

Similarly, within the Espace TRIDOM Interzone Congo area in the Republic of the Congo, the government has focused its efforts on empowering local communities to engage in free, prior and informed consent regarding conservation efforts. This has included the establishment of a community insurance system for human-wildlife conflict and a multi-stakeholder platform for natural resource management, composed of local communities, indigenous peoples, members of the private sector and government representatives. These initiatives have helped to maximise conservation efforts, while at the same time investing in human development, and peace and stability in the region (WWF 2022).

Addressing the human-wildlife conflicts occurring in many areas of Central Africa means linking conservation efforts to climate change as well as peacebuilding, since climate change is an increasingly important driver of human-wildlife conflicts (Abrahms et al. 2023). A diverse range of measures exist to address various elements of these conflicts, including reducing crop loss and ensuring income safety, developing technical solutions that focus on physical and spatial solutions, and promoting approaches to increase the willingness of local communities to tolerate and co-exist with wildlife (Breuer and Ngama 2020). Conservation and protection efforts reduce the risk of human-wildlife conflicts when they are supported by local communities, and, most critically, interwoven in local livelihoods and ecosystem services that benefit affected people, for example, by diversifying income resources (Terada et al. 2021). The integration of different administrative levels, and collaboration among different actors and stakeholders is key, including local knowledge and practices, and cultural relationships between people and elephants (Hoare 2015; Parathian et al. 2018). Protection and conservation efforts are, therefore, most effective when they focus on land-use planning, community conservation and participation, and integrate scenarios of climate change, population growth, human and wildlife mobility, and industrial expansion (König et al. 2020).

Congo Rainforest Basin: The only remaining carbon sink under threat

The Congo Basin is home to the second-largest tropical rainforest on Earth.[33] It is one of the most important wilderness and biodiversity areas left on the planet. At 500 million acres, it spans six Central African countries in the Equatorial Afrotropics: Cameroon, the CAR, the DRC, the Republic of the Congo, Equatorial Guinea and Gabon (WWF 2023). However, the Congo Basin's transitional eco-regions, including the northern, southern and western Congolese forest-savanna mosaics, extend well beyond the six core countries of the Congo rainforest into Angola in Southern Africa; South Sudan, Rwanda and Uganda in Eastern Africa; and Nigeria in Western Africa (One Earth 2023).

For tens of millennia, people have resided in the Congo Basin. Presently, this diverse ecosystem sustains over 75 million people, providing food, medicine, water, materials and shelter. Moreover, the rainfall produced by the forest supports an additional 300 million rural Africans, extending to regions as distant as the Sahel and the Ethiopian highlands (White et al. 2021). Most of the Congo Basin's population continue to rely extensively on the forest for sustenance and essential resources, which serve as a supplementary source alongside agriculture (WWF 2023).
The Congo Basin is not only a significant biodiversity hotspot, but also one of the world's most important carbon sinks. It is estimated to absorb about four per cent of global CO2 emissions and thus constitutes a crucial line of defence against catastrophic climate change. With the intense deforestation of the Amazon, the Congo Basin rainforest is the only remaining net carbon sink in the world. Moreover, the Congo Basin is home to the world's largest tropical peatlands. The peat swamp forest of the Congo Basin stores around 29 billion tonnes of CO2 – approximately equivalent to three years' worth of global GHG emissions – while the basin as a whole absorbs nearly 1.5 billion tonnes of CO2 per year (UNEP 2023).

However, the Congo Basin is under increasing pressure. The forest edges of the forest-savanna mosaic bear the brunt of human impacts, along with the banks of the larger navigable rivers, including the Congo and Ubangi rivers (WWF 2023). One of the key issues threatening the Congo Basin is deforestation, which can (in addition to biodiversity loss) lead to losses in livelihoods for local populations. Furthermore, deforestation can severely affect the climate equilibrium. For example, various models indicate that loss of tree cover will likely increase ground temperatures and lead to a reduction in rainfall. Further deforestation of the Congo Basin could severely affect the regional climate long term, as well as climates in neighbouring regions (Itsoua et al. 2021). Deforestation rates in many areas of Central Africa are among the highest in the world. The DRC, for example, has an estimated deforestation rate of 0.83 per cent per year, ranking just behind Brazil and ahead of Indonesia in terms of net forest loss for the period 2010–2020 (FAO 2020).[34]

Conflict plays an important role in the dynamics of environmental degradation in the Congo Basin. Many of the Congo Basin countries have been trapped in decades-long cycles of violence, including most notably the DRC, South Sudan, the CAR and Cameroon. This violence has primarily been driven by competition over natural

resources, such as fertile land, minerals and forestry. Indeed, the intensive exploitation of forest resources by non-indigenous people and poor governance have led to increased competition between communities, which threaten the future of the Congo Basin (WWF 2023).

Climate impacts and conflict converge in dangerous ways in the Congo Basin, creating a destructive feedback loop of increasing environmental degradation and conflict. Some of the key climate-related security risks include:

1. The proliferation of armed and criminal groups

In several Congo Basin countries, armed groups focus on illegally exploiting natural resources, and maintain close links with transnational organised criminal networks involved in large-scale smuggling and money laundering (UNEP 2015a). The proliferation of armed groups in Central Africa is already a severe threat to human security and stability in the region, especially in areas where state authority is absent, weak, causing harm and actively contributing to instability. Climate change and environmental degradation exacerbate existing vulnerabilities, and facilitate the rise and growth of armed groups through two mechanisms. First, armed groups proliferate and can operate more easily in fragile and conflict-affected environments where the state has little to no authority and lacks legitimacy. The weakening of governance due to climate change can provide opportunities to actors seeking to undermine state authority. Second, livelihood insecurity caused by, among other factors, climate change makes people more vulnerable to recruitment into armed groups (Nett and Rüttinger 2016).

2. Conflict as a driver of environmental degradation

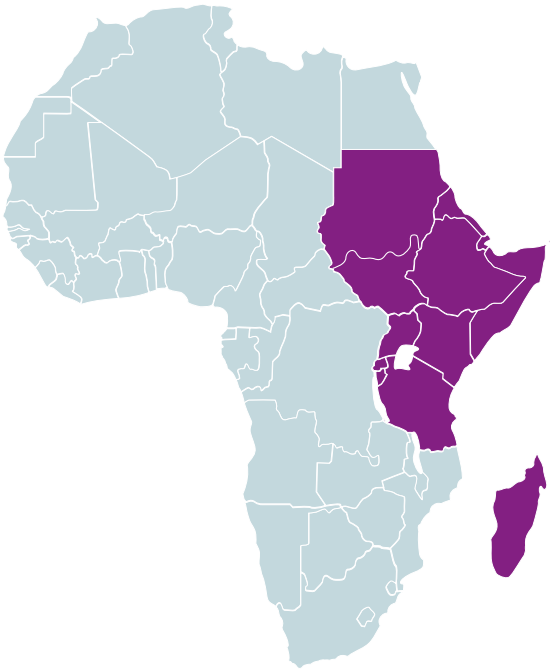
Climate change and environmental degradation can drive violent conflict in various ways. However, at the same time, conflict itself has major negative impacts on ecosystems. For example, the use of weapons and military material damages ecosystems. In addition, conflict reduces community and state conservation capacities, and leads to an increase in environmental crimes such as poaching, illegal deforestation and mining (Hillert 2023). Long-term forestry projects, environmental research and the promotion of ecotourism are hindered by the many localised conflicts, resource exploitation as well as poverty-driven encroachment in the Congo Basin (Vinke et al. 2023).

3. The conservation-conflict nexus

The various environmental conservation efforts occurring in the Congo Basin, particularly with regard to protected areas and national parks, can be a source of tension and even violent conflict, especially when perceived as unjust or harmful by local communities dependent on these ecosystems for their livelihoods. Rent-seeking behaviour among environmental protection officers and security forces has led to severe human right abuses and violations of local communities, which has fuelled grievances around conservation. Conflicts around conservation areas involve not only local communities, park rangers and security forces, but also armed groups that penetrate the area to illegally exploit natural resources (Tchoumba et al. 2021). Finally, Central Africa faces severe risks around human-wildlife conflicts, which are driven by climate change, environmental degradation and conservation efforts (Nyhus 2016; IUCN 2022).

33 After the Amazon.
34 Net forest loss here includes all types of forests, dry and humid.

Eastern Africa



Summary

KEY CLIMATE IMPACTS

Temperature: Air temperatures across Eastern Africa are likely to rise by 1.7–3.9°C by 2080 relative to the pre-industrial period. The largest temperature rise is expected to occur in northern Sudan and northern Kenya, with a comparatively lower temperature rise across large areas of Uganda, southern Kenya, and along the coasts of Kenya, Somalia and Tanzania.

Precipitation*: Precipitation projections are much less certain than those for temperature and vary across Eastern Africa depending on the emissions scenario. Overall, projections indicate an increase in amounts across northern and central Eastern Africa, and a decrease towards the south. In terms of heavy precipitation events, the number of days with such events is projected to increase, particularly in Uganda and southern South Sudan.

Sea level rise: By 2080, sea levels are projected to rise by around 35 cm (RCP2.6) and 43 cm (RCP6.0) on average across the entire Eastern Africa coastline, compared to the year 2000. The coastlines of southern Somalia in particular, although also Kenya and Tanzania are at high risk of rising sea levels.

Flooding*: Projections of flooding are subject to high levels of modelling uncertainty, owing to the uncertainty of future precipitation projections. Nevertheless, projections for Eastern Africa under RCP6.0 indicate an increase in the share of urban areas and roads at the national level that are exposed to river flooding.

Droughts*: Drought projections for Eastern Africa are subject to large uncertainties, but indicate a general increase in drought conditions. Soil moisture and potential evapotranspiration are two important indicators that are used to measure drought conditions. Under RCP2.6 and RCP6.0, annual mean soil moisture for a soil depth up to 1 m show a decrease of 0.6 per cent and 0.3 per cent by 2080 compared to the year 2000, respectively, albeit with large year-to-year variability and modelling uncertainty.

Cyclones: More intense tropical storms and cyclones are projected for the southern region of Eastern Africa in general and Madagascar in particular. This increase in cyclone intensity is projected to come with increased heavy precipitation events.

* Climate projections with high uncertainty need to be interpreted with great caution. Please refer to the Annex for an explanation of uncertainty in climate projections.

CLIMATE SECURITY PATHWAYS IN EASTERN AFRICA

Pathway 1: Competition over natural resources

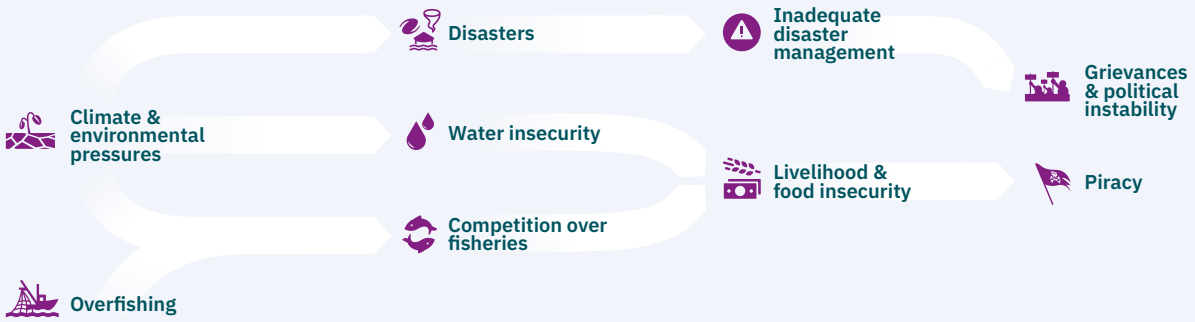
Across Eastern Africa, competition over natural resources has been one of the major drivers behind the region's conflicts. This competition, particularly over water, land and forests, stems from changes in the availability of and access to resources. Competition can arise from both resource scarcity and abundance, and is driven by various socioeconomic and governance-related factors, along with climate-related impacts and other environmental challenges..

Pathway 2: Livelihood and food insecurity

The livelihood and food security of many communities in Eastern Africa are highly dependent on climate-sensitive sectors. Disruptions to these sectors can deepen economic hardships, particularly youth unemployment, and contribute to broader public discontent and more organised crime.

Efforts to address livelihood insecurities, if not done in a climate- and conflict-sensitive manner, can weaken livelihood strategies further and lock communities in a vicious cycle of vulnerability and insecurity.

Pathway 3: Coastal and maritime security

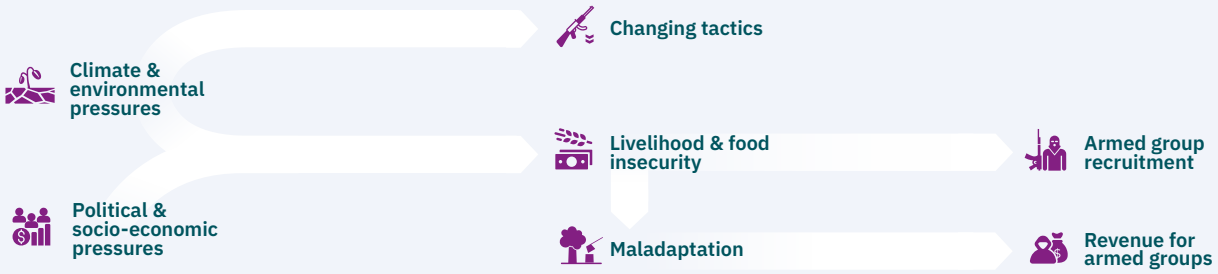


Coastal and island communities across Eastern Africa are particularly vulnerable to the impacts of climate change. Slow and rapid onset events, such as rising sea levels and storm surges, directly threaten their very safety and integrity. They also face challenges to their economic and food security due to the compounding impacts of human-made and environmental factors that affect marine ecosystems, including the intrusion of industrial fishing fleets.

Pathway 4: Changing mobility patterns

Populations in Eastern Africa move for various reasons. For many, including pastoralists, it is an adaptation strategy to cope with periods of shocks and stresses. Climate change increasingly influences where, when and for how long people move. In general, climate change is amplifying and altering existing migration trends, particularly rural-urban migration and cross-border migration. In some cases, migration can increase the pressure on resources and services in receiving areas, heighten competition, and stir tensions between host and migrant communities.

Pathway 5: Exploitation by armed groups



Climate impacts are increasingly shaping the operational environment of armed groups in Eastern Africa. Armed groups in the region actively exploit conditions of food insecurity, loss of livelihoods, and political and inter-community grievances for recruitment and support. The extent of their activities depends on prevailing climatic and environmental conditions that can either hinder or ease their operations, as well as on the existence and profitability of economic activities that provide them with financial support.

Context

GEOGRAPHY

The Eastern Africa region[35] consists of 14 countries: Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Mauritius, Rwanda, Seychelles, Somalia, South Sudan, Sudan, Tanzania and Uganda. It comprises several agroecological zones with specific temperature and moisture regimes. The region's climate ranges from warm arid in the northwestern and eastern plains to humid warm tropics in the plateau and on island states to cool arid-humid conditions in high altitude areas (see Figure 20) (Binder et al. 2023). In some countries, arid and semi-arid lands make up a large share of total land area. In Kenya, the share is over 80 per cent (Nkonya et al. 2018). The regional climate is largely shaped by the diverse topography, characterised by the East African Rift Valley[36] and the East African Highlands[37] (Binder et al. 2023). A large area of Eastern Africa, located towards the northeast of the region, and facing the Red Sea and Indian Ocean, is collectively known as the Horn of Africa.

At present, mean annual precipitation amounts range from over 2,000 mm in southwestern Ethiopia to less than 250 mm in the arid regions of Djibouti, Eritrea, Ethiopia, Kenya, Somalia and Sudan (Camberlin 2014). The El Niño-Southern Oscillation and Indian Ocean Dipole strongly influence precipitation levels across the region. El Niño conditions are typically associated with wetter short rains, while La Niña conditions are linked with drier short rains (Palmer et al. 2023).

The region is rich in natural resources, many of which straddle across several countries and regions. Given their transboundary nature, many of these resources have historically been the source of geopolitical tensions, although they also provide opportunities for cooperation. This includes Africa's longest river, the Nile, which consists of two major tributaries (i.e. the Blue Nile and White

35 This report uses the African Union's classification system for geographic regions (https://au.int/en/member_states/countryprofiles2).
36 The East African Rift Valley is part of the Great Rift Valley, which stretches 6,000 km from northern Syria to the south of Mozambique. Its geological activity created the highest mountains and deepest lakes in Africa (Binder et al. 2023).
37 The East African Highlands include the Ethiopian highlands to the north; the Kenyan highlands, which are fringed by Africa's highest mountains, Mount Kibo (Kilimanjaro) (5,895 m) in Tanzania and Mount Kenya (5,199 m); and the Western Rift Mountains, which stretch from western Uganda to southern Tanzania (Binder et al. 2023).

Nile) and flows towards Egypt where it enters the Mediterranean Sea. Its catchment area comprises almost 3.4 million km³ (10 per cent of Africa's total area), and provides the population in the Nile Valley with water and fertile ground for agriculture (Nashwan and Shahid 2019; Binder et al. 2023). Another important river basin is the Turkana Basin, which spans an area of around 131,000 km² across northern Kenya and southern Ethiopia. The basin is dominated by the alkaline Lake Turkana, which is primarily fed by the Omo River (Feibel 2011). The African Great Lakes comprise a series of lakes in and around the East African Rift Valley, and include some of the largest lakes and freshwater bodies on the African continent, including Lake Victoria and Lake Tanganyika (Camberlin 2014; Binder et al. 2023). Other important lakes include Lake Malawi, Lake Turkana, Lake Albert, Lake Kivu and Lake Edward.

SOCIOECONOMIC CONTEXT

Eastern Africa's level of economic development varies between countries, with Kenya being one of the region's largest economies. The COVID-19 pandemic severely affected economic growth and exacerbated income inequality and poverty rates across the region, although some countries have recorded strong recovery, most notably Kenya, Seychelles, Rwanda and Uganda (UNECA 2022). However, for some countries, namely Somalia, South Sudan and Sudan, recovery rates are hampered by ongoing political instability (AfDB 2022b).

Agriculture and pastoralism are the dominant activities for many communities across Eastern Africa, employing as much as 80 per cent of the population in some countries (e.g. Eritrea, Ethiopia and Rwanda) (Hunt et al. 2019). In South Sudan, approximately 95 per cent of the population depend on rainfed agriculture, pastoralism and animal husbandry for their livelihoods (NUPI and SIPRI 2021). Across the region, agriculture's contribution to GDP is also substantial. In Somalia, for example, livestock production is estimated to account for around 61 per cent of GDP in 2018 (Hunt et al. 2019).

Moreover, coastal and inland lake communities throughout Eastern Africa are highly reliant on fisheries for food security and employment (Thoya et al. 2022). Estimates for the Great Lakes region indicate that the fisheries and aquaculture sectors account for four per cent of GDP in the region. In

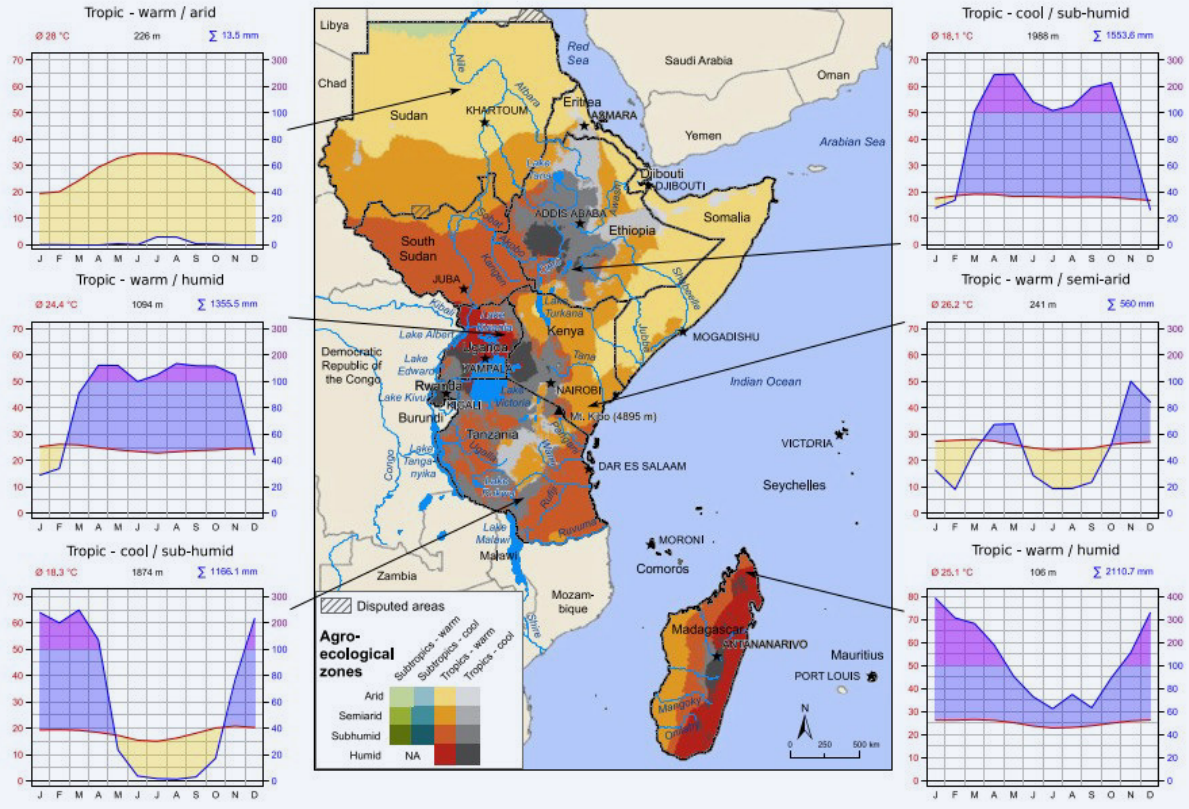


Figure 20: Map of Eastern Africa showing agroecological zones, and location-specific examples of annual temperature (red lines) and precipitation regimes (blue lines) (Binder et al. 2023)

terms of food security, certain fish species such as the Mukene (Rastrineobola argenttea) are important sources of minerals for populations living in the region, whose grain-based diets largely lack these minerals (Chimatiro et al. 2021). In Mauritius, the fisheries sector contributes around one per cent of GDP, with fish products contributing around 19 per cent of national exports (Ministry of Blue Economy, Marine Resources, Fisheries and Shipping, Mauritius n.d.). Small-scale artisanal fisheries are particularly important. In the Comoros and Mauritius, they account for 80 per cent and 30 per cent of the total catch, respectively (Belhabib et al. 2019).

Imports dominate Eastern Africa's overall trade balance, particularly food and agricultural products, as the region is not self-sufficient in producing most of its basic food commodities. In fact, food imports have been increasing in recent decades. In Ethiopia, Kenya and Tanzania, food imports rose by 1,000 per cent, 300 per cent and 122 per cent, respectively, between 1998 and 2018 – a trend that is likely to increase in the future (AU and OECD 2022).

DEMOGRAPHICS AND MOBILITY

As of 2021, the population of Eastern Africa stood at over 405 million (UNDESA 2022b) and is growing at an annual rate of 2.3 per cent since 2010 (IGAD 2021). The region has a long history of mobility, driven by various factors including economic opportunities, conflict and natural hazard-induced disasters (IOM 2020b). Eastern Africa is home to a large number of IDPs. In 2021, there were approximately 12.4 million IDPs in the Horn of Africa and Great Lakes regions (UNECA 2022).

International migration, including intra- and inter-regional, as well as inter-continental migration, is an important trend in Eastern Africa, as the region is simultaneously an origin, transit and destination for migrants and refugees. In many areas of Eastern Africa, the number of recorded regular international migrants more than doubled between 2010 and 2019 (IGAD 2021). Irregular migration (i.e. the unauthorised movement of people across borders) is a widely recorded phenomenon, as is the case with the southern route between Eastern Africa and Southern Africa (IOM 2022b). Moreover, rural-urban migration trends are prevalent across the region, particularly in Kenya and Tanzania (Clement et al. 2021)

Mobility, particularly circular migration, is an essential adaptation strategy to cope with shocks and stresses for communities across Eastern Africa (IOM et al. 2022). For many countries of origin in Eastern Africa, remittances from international emigrants play a vital role in their economies, although official statistics on remittance inflows are usually low, likely because migrants use informal channels to send money home (IGAD 2021). For Tanzania, internal migration has been linked to poverty reduction and improved welfare through remittances and in-kind transfers (Clement et al. 2021). In border areas, cross-border mobility is essential for cross-border trade, and in maintaining transboundary socioeconomic and cultural ties (IGAD 2018). Pastoralists are especially dependent on mobility to cope with environmental hardship and growing climate variability (Idris 2018).

PEACE AND SECURITY

At the time of writing, Eastern Africa is experiencing a number of devastating conflicts that are presenting major security challenges to the region. To a large extent, these have been triggered by ethnic and resource-driven communal conflicts, and have been exploited by armed groups and political elites. In addition, conflicts have been intertwined with organised criminal activities, including the sale of weapons and piracy.

Three major conflicts illustrate many of the historical security challenges facing the region. The armed conflict between the Sudanese Armed Forces (SAF) and Rapid Support Forces (RSF) in Sudan, which broke out in April 2023, can be traced back to the regime of former president Omar al-Bashir, which contributed to inter-communal frictions and the creation of a network of patronage in the country's security sector. Reports also indicate that both rival forces are recruiting young people based on ethnic and tribal affiliations (Foong et al. 2020b; Ali et al. 2023).

In Somalia, a lack of effective central governance following the collapse of the Siad Barre regime in the early 1990s, coupled with periods of severe droughts that devastated pastoralist livelihoods, led to a civil war that is still ongoing, most recently between Al-Shabaab and counter-insurgency operations led by the Somali federal government (Maystadt and Ecker 2014; ACLED 2023).[38]

38 For an overview of the multiple environmental, socioeconomic and political factors that led to these armed conflicts, see https://climate-diplomacy.org/case-studies/civil-war-darfur-sudan (for Sudan) and https://climate-diplomacy.org/case-studies/droughts-livestock-prices-and-armed-conflict-somalia (for Somalia).

In the Tigray region of Ethiopia, violent armed conflict between the federal government and the Tigray People's Liberation Front between 2020 and 2022 resulted in around 600,000 casualties. In 2021 alone, the conflict internally displaced an estimated 5.1 million people, with millions more fleeing to neighbouring Sudan. The conflict can be traced back to historical inter-ethnic and political divisions, and has seen the involvement of troops from Eritrea and other regional militias. While an agreement to cease hostilities was signed in November 2022, concerns remain over the long-term effectiveness of the peace deal to end violence in the region (Center for Preventive Action 2023; Pilling and Schipani 2023).

Areas of Eastern Africa are facing major humanitarian crises, related to conflicts, droughts, and external shocks. Recent global shocks such as the COVID-19 pandemic and the war in Ukraine have disrupted the region's food supply, driven up food prices, and worsened food insecurity (Ayanlade and Radeny 2020; WFP 2022). While externally and internally driven conflicts and humanitarian crises continue to challenge Eastern Africa's peace prospects, the region has some of the strongest strategies, policies and mechanisms to address climate-related security risks. These are covered in greater depth in the Eastern African response and good practices section.

Climate change and impacts[39,40]

AIR TEMPERATURES

Temperatures across Eastern Africa have been on the rise in recent decades. Depending on the season, mean annual temperatures rose by 0.7–1.0°C during the period 1973–2013. At present, average annual temperatures range from 11.6°C to 30.7°C, with lower temperatures recorded in the region's high altitudes, and higher temperatures in the Sahel and Saharan deserts, as well as in southern Somalia and northern Kenya (Binder et al. 2023). In areas of the Horn of Africa, this has led to a sharp increase in the number of heatwaves and a higher transmission rate of pathogens, such as malaria (IGAD 2022d).

Air temperatures across Eastern Africa are likely to rise by 1.7–3.9°C by 2080 relative to the pre-industrial period. The largest temperature rise is expected to occur in northern Sudan and northern Kenya, with a comparatively lower temperature rise across large areas of Uganda, southern Kenya, and along the coasts of Kenya, Somalia and Tanzania (see Figure 21) (Binder et al. 2023).

In line with these temperature projections, the annual number of very hot days[41] is projected to rise with high certainty. Under RCP6.0, large areas of Somalia, eastern Ethiopia and northeast Kenya

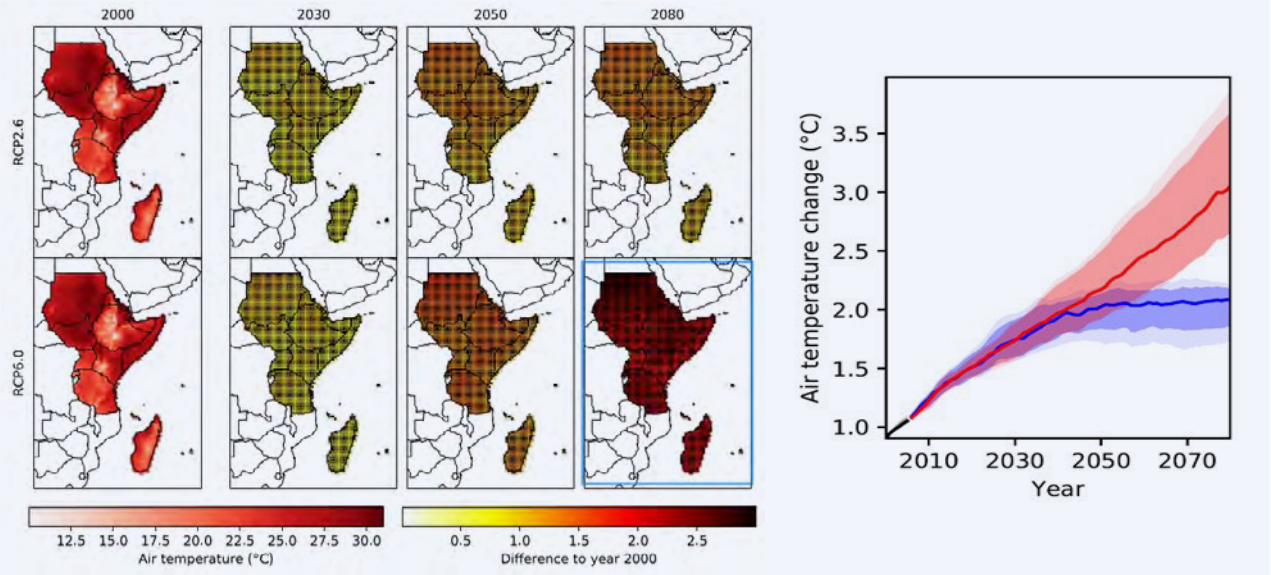


Figure 21: left, regional air temperature projections for Eastern Africa for different GHG emissions scenarios; right, air temperature projections for Eastern Africa for different GHG emissions scenarios compared to the year 2000 (Binder et al. 2023)

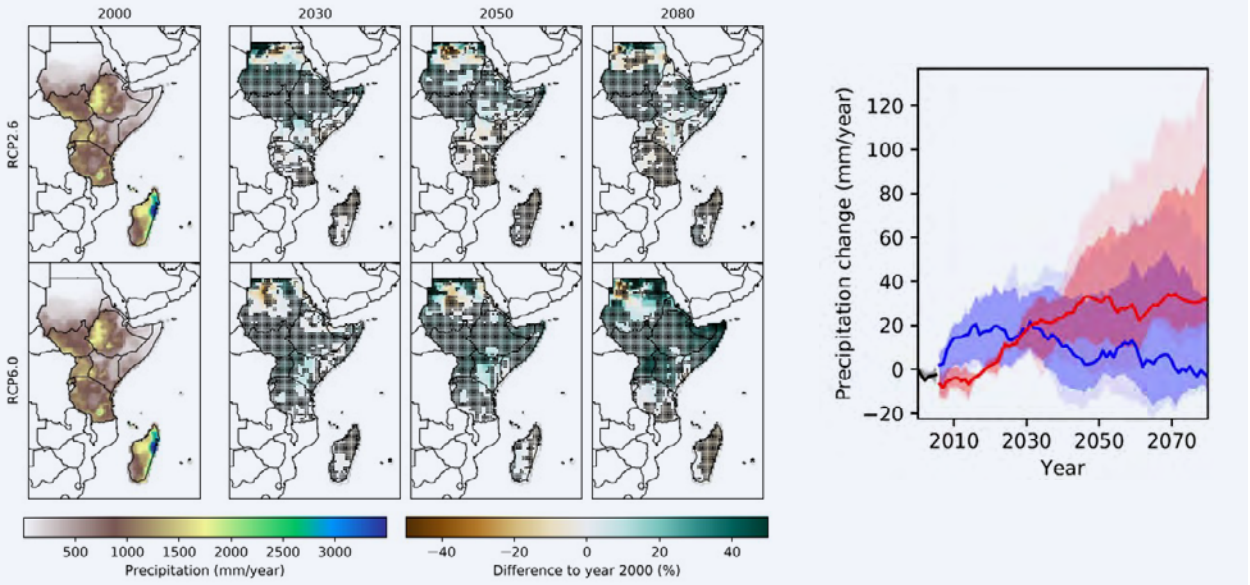


Figure 22: left, regional projections of annual mean precipitation for Eastern Africa for different GHG emissions scenarios, compared to the year 2000; right, mean precipitation projections for Eastern Africa for different GHG emissions scenarios compared to the year 2000 (Binder et al. 2023)

are projected to experience up to 66 more very hot days annually by 2030 and 165 days by 2080 (Binder et al. 2023). In some Eastern African cities, including Kampala (Uganda), projections estimate a 2,000-fold increase in exposure to dangerous heat (i.e. over 40.6°C) by 2090, compared to 1985–2005, assuming high population growth and high future GHG emissions (RCP8.5) (Rohat et al. 2019).

PRECIPITATION

Precipitation trends vary across Eastern Africa, depending on the season. Since the 1980s, precipitation has been decreasing during the "long rains" (March–May) over the Horn of Africa, although this decrease has recovered more recently. Meanwhile, during the "short rains" (October–December), precipitation has increased since the 1960s (Binder et al. 2023). In northern areas of the region, where there is one rainy season (June–September), precipitation has decreased since the 1960s and remained relatively low since then (Masson-Delmotte et al. 2021).

Precipitation projections are much less certain than those for temperature and vary across Eastern Africa depending on the emissions scenario. By 2030, compared to the year 2000, precipitation will likely increase by 7–38 mm per year under RCP2.6 and by 7–29 mm per year under RCP6.0, although projections for the latter scenario come with high uncertainties (Binder et al. 2023).

Overall, projections indicate an increase in the amount of precipitation across northern and central Eastern Africa, and a decrease towards the south. A wetting trend is expected particularly in the medium-to-long term under RCP6.0, with the highest increases across large regions of the Horn of Africa, but also in Kenya and Uganda. Meanwhile, the south of Tanzania and most areas of Madagascar will see a decrease in precipitation under all scenarios. An exception to this pattern is the north of Sudan, where both sharp increases and sharp decreases are projected, depending on the area and scenario used (see Figure 22) (Binder et al. 2023).

In terms of heavy precipitation events, the number of days with such events is projected to increase, particularly in Uganda and southern South Sudan (Binder et al. 2023). Projections of the impacts of global warming on the El Niño-Southern Oscillation and Indian Ocean Dipole remain uncertain. However, regardless of the trend, the associated rainfall extremes that come with the El Niño-Southern Oscillation and Indian Ocean Dipole are likely to become more severe due to an intensification of hydrological cycles (Palmer et al. 2023).

39 Please refer to the Annex for guidance on how to read the plots and for an explanation of the concept of uncertainty in climate projections.
40 The summary of the key climate impacts in this section is based on: Binder L. 2022. Climate Change in East Africa. Berlin: Potsdam Institute for Climate Impact Research.
41 Very hot days are defined as days with a daily maximum temperature above 35°C.

SEA LEVEL RISE

Coastal and ocean systems are important for the economies and livelihoods of Eastern African countries located off the coasts of the Red Sea, the Gulf of Aden and the Indian Ocean. Thus, sea level rise poses an immediate challenge, as rising sea levels can cause saline intrusion in coastal waterways and groundwater reservoirs, rendering water unusable for domestic use and harming biodiversity (Binder et al. 2023). Moreover, rising sea levels are generally associated with an increased risk of coastal flooding, especially in low-lying coastal areas (Richardson et al. 2022). Assessments show that Djibouti, the Seychelles and Comoros have an especially high risk of coastal flooding (GFDRR 2022).

By 2080, sea levels are projected to rise by around 35 cm (RCP2.6) and 43 cm (RCP6.0) on average over the entire Eastern Africa coastline, compared to the year 2000 (see Figure 23). The coastlines of Southern Somalia in particular, although also Kenya and Tanzania are at high risk of rising sea levels and associated impacts (El-Shahat et al. 2021).
In terms of costs, by 2050, sea level rise-induced damages in Dar es Salaam (Tanzania) are estimated to amount to USD 880 million under RCP2.6 and USD 1.36 billion under RCP8.5 (IPCC 2022).

FLOODING

Many areas of Eastern Africa are considered prone to flooding. An analysis of flooding between 1990 and 2014 showed that Ethiopia, Kenya, Somalia and Tanzania were among the most flood-prone and flood-affected countries across the continent (Li C et al. 2016). In Kenya, heavy rains and subsequent flash flooding and landslides in late 2019 affected over 160,000 people, displacing over 30,000 people, and killing 132 people and 26,000 livestock (ECHO 2019). More recently, in 2020, heavy precipitation and severe flooding in the north of the region, particularly Ethiopia, Sudan and South Sudan, affected more than 3.6 million people (UN OCHA 2020).

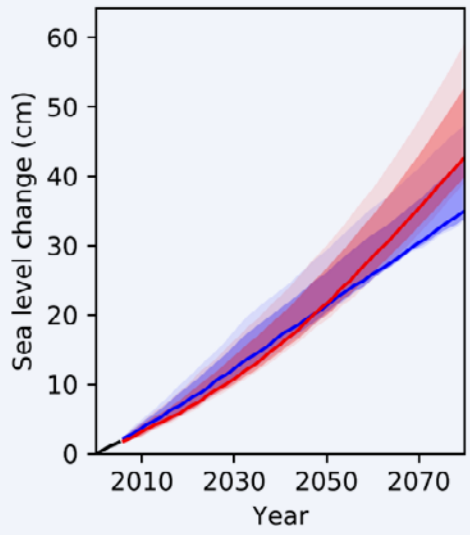


Figure 23: Projections for sea level rise, averaged over Eastern Africa's coastline for different GHG emission scenarios (blue line for RCP2.6 and red line for RCP6.0), compared to the year 2000 (Binder et al. 2023)

Projections of flooding are subject to high levels of modelling uncertainty, owing to the uncertainty of future precipitation projections. Nevertheless, projections for Eastern Africa under RCP6.0 indicate an increase in the proportion of urban areas and roads at the national level exposed to river flooding (Binder et al. 2023).

In the Great Lakes region, more intense precipitation events are likely to increase the risk of pluvial (rainfall-induced) flooding (Ranasinghe et al. 2021; Richardson et al. 2022). Meanwhile, increased precipitation and interannual variability could lead to increased streamflow variabilities across the Blue Nile Basin, with an associated rise in flooding. Certainty over these changes is, however, low due to the uncertainty of future projections of precipitation amounts and their spatial distribution (Ranasinghe et al. 2021; IPCC 2022).

DROUGHTS

Eastern Africa has witnessed some of the most devastating drought events that have led to severe food insecurity, water shortages, agricultural and livestock losses, and acute humanitarian crises (IGAD 2022d). In September 2022, five consecutive poor rainy seasons left over seven million people in Somalia in urgent need of assistance to prevent acute malnutrition and hunger-related death (FEWS NET 2022). In southern Madagascar, prolonged droughts devastated the country's food and water security between 2018 and 2022 (De Berry 2023).

Drought projections for Eastern Africa are subject to large uncertainties, but indicate a general increase in drought conditions. Soil moisture and potential evapotranspiration are two important indicators that are used to measure drought conditions. Under RCP2.6 and RCP6.0, annual mean soil moisture for a soil depth up to 1 m show a decrease of 0.6 per cent and 0.3 per cent by 2080, respectively, compared to the year 2000, albeit with large year-to-year variability and modelling uncertainty (Binder et al. 2023).

In terms of potential evapotranspiration, under RCP2.6 and RCP6.0, projections indicate an increase of 3.3 per cent and 5.7 per cent, respectively, across Eastern Africa by 2080, compared to the year 2000. These projections come with a high level of certainty, with the highest percentage increase likely to occur in Madagascar and southern Tanzania (Binder et al. 2023). In general, higher evapotranspiration rates affect groundwater levels and the amount of surface water that is available for agriculture, thereby potentially affecting agriculturally dependent livelihoods over the long term.

CYCLONES

In Eastern Africa, coastal areas and island states in the southwestern Indian Ocean (including Madagascar and Mauritius) are particularly vulnerable to tropical cyclones. In the southern Indian Ocean, the destruction potential of cyclones doubled during the period 1999–2016 compared to 1980–1998 (Vidya et al. 2021). The resulting socioeconomic damages caused by their landfall are particularly devastating. In March 2023, tropical Cyclone Freddy, one of the longest-lasting tropical cyclones of all times, affected more than 250,000 people in Madagascar in terms of food insecurity and humanitarian assistance, as the country was still reeling from the effects of previous cyclones (UN 2022a; WFP 2023).

More intense tropical storms and cyclones are projected for southern areas of Eastern Africa in general and Madagascar in particular. This increase in cyclone intensity is projected to come with increased heavy precipitation events (Seneviratne et al. 2021).

Climate security risk pathways

COMPETITION OVER NATURAL RESOURCES

Across Eastern Africa, competition over natural resources has been one of the major drivers behind the region's conflicts. This competition, particularly over water, land and forests, stems from changes in the availability of and access to resources. Competition can arise from both resource scarcity and abundance, and is driven by various socioeconomic and governance-related factors, along with climate-related impacts and other environmental challenges.

Pastoralism and cattle raiding

Pastoralism has become a major factor behind many communal resource-related conflicts in Eastern Africa. In part, this is due to the enduring legacy of colonial imposition of borders which disrupted traditional transhumance routes, and thereby fostered political competition and resource conflicts within newly formed states (IGAD CEWARN 2022b). Counter to prevailing narratives around natural resource conflicts and the role of pastoralists, the most widespread form of these conflicts in areas of Eastern Africa are not conflicts between farmers and pastoralists but cattle raiding. Historically, it has been a traditional coping mechanism used by pastoralists to make up for livestock losses due to droughts, as well as a cultural practice associated with marriages and social relations (IGAD CEWARN 2022b).

The practice was historically kept under control by shared norms and the conflict-mediating roles of elders and traditional authorities. However, it has increasingly turned violent due to the proliferation of small arms and weapons, as well as politicisation and exploitation by political elites (Idris 2018; IGAD CEWARN 2022b). One example can be seen in South Sudan, where traditional disputes, such as those between the Dinka and Nuer pastoralist groups, have been exacerbated by a large proliferation of heavy weapons and the exploitation of intergroup hostilities by state authorities for political interests (Climate Diplomacy n.d.c). More recently, in some areas, cattle raiding has become a highly commercialised process with a large youth involvement. In some cases, it is tied to transnational organised criminal networks, particularly in border areas, which facilitate the trafficking of livestock across borders to escape tracking and legal action (IGAD CEWARN 2022b; Sax et al. 2022).

Climate change impacts – especially droughts, and their increasing intensity and variability – contribute to the level of violence in cattle raiding. In particular, extreme weather events reduce the reliability and predictability of available water and grazing resources, forcing pastoralists to change grazing routes (van Baalen and Mobjörk 2018; Binder et al. 2023). In turn, changes in grazing routes, coupled with growing human and livestock populations, can increase the likelihood of pastoralists coming into contact with other pastoralist groups, making access to resources highly contested, and exacerbating the frequency and intensity of clashes (Richardson 2011; Yoshida 2013; IGAD CEWARN 2022b). The combined impacts of resource pressures, structural inequality and economic marginalisation have also led to a shift in the purpose of raiding from an adaptation strategy to replenish stocks to an increasingly violent and commercialised enterprise (IGAD CEWARN 2007).

Shifts in pastoralist grazing patterns and routes can also result in clashes with sedentary farmers. This can happen when pastoralists cross farmlands more irregularly or too early during the growing season, thereby increasing the risk of crop damage and clashes with farmers. Conversely, droughts and unfavourable climate conditions can result in crop yields shrinking, forcing farmers to expand cultivation, which may encroach grazing routes. Furthermore, farmer-pastoralist conflicts are often intertwined with tribal and ethnic affiliations, as is the case in areas of Ethiopia and Sudan (Yishak 2019; Foong et al. 2020b).

The role of socioeconomic and governance-related factors in land, water and forest conflicts

In addition to pastoral-related conflicts, there are a number of other conflicts around land, water and forests between different user groups across the region. The conflict risks arising from competition over resources in Eastern Africa is further exacerbated by other interacting socioeconomic factors, including poverty and marginalisation of certain social groups (Dutta Gupta et al. 2021). Eastern Africa's growing population, and the resulting increase in demand for food and agricultural products have been key factors driving cropland expansion, which increased pressures on forests and natural land areas across the region (Berkhout et al. 2021). Such trends can already be seen in several areas of Eastern Africa, such as in the vegetated areas of Mount Kilimanjaro (Misana et al. 2012) and in Madagascar, where deforestation is associated with the expansion of rainfed agriculture to cope with droughts (Desbureaux and Damania 2018). The impacts on forest disproportionately affect forest-dependent livelihoods, particularly those of women who often manage natural resources, and whose livelihoods heavily rely on forest products for fuel, food and medicine (Binder et al. 2023).

The propensity for resource competition to escalate into conflicts hinges upon governance structures and government policies. In particular, property rights and natural resource management rules can reduce the effect of resource scarcity on conflicts. In Ethiopia, land tenure certification is found to significantly reduce the effects of water scarcity on land disputes among farm households (Di Falco et al. 2020). Similarly in Kenya, the presence of both governmental and traditional natural resource use and access rules has been found to reduce the number of violent events in the event of a drought (Linke et al. 2018).

Meanwhile, government policies and interventions for climate adaptation, forest protection, commercial agricultural expansion and economic development can result in large-scale land use changes that affect livelihoods. In particular, region-wide land use change, along with climate-related impacts, could become a new driver of localised conflicts and violence over resources in the region (Abrahams 2021). For example, conflict mitigation policies that seek to settle pastoralist communities and limit mobility are sometimes seen as intervening in pastoralists' way of life, thus limiting the effectiveness of policies in addressing the root causes of conflict (IGAD CEWARN 2022b). The establishment of conservation sites run the risk of inciting conflicts. One such example was the establishment of Mago National Park in South Oro, Ethiopia, in 1978, where planning for the park assumed that the area was "uninhabited" and "free of human activity," when in reality there were already six groups living in and using the area. Since its establishment, encroachments into the park by pastoralists have led to clashes with park authorities, which in some cases have been linked to episodes of drought and loss of land as a result of acquisitions by investors (Yitbarek 2020). Conservation policies can also affect other livelihood activities such as small-scale fisheries, which have in the past led to tensions between local fishing communities and conservation authorities (see Eastern African chapter section on maritime fisheries).

Many of Eastern Africa's conflicts stem from political elites exploiting competition over land. For example, in Rwanda, where 80 per cent of reported disputes at the district level are related to land, many disputes have been frequently manipulated by political elites to serve their own interests (Kanyangara 2016). Evidence suggests that land scarcity was one of the many factors, along with droughts and food shortages, that exacerbated the politically driven inter-ethnic antagonism that ultimately led to the Rwandan genocide of 1994 (Climate Diplomacy n.d.h). Competition over land is further driven by the growing privatisation of land and acquisition by external investors, which has led to tensions between investors and pastoralist communities over land access and use rights (IGAD CEWARN 2021).

Inter-state competition and hydropower development

Competition over natural resources in Eastern Africa extends to the inter-state level, particularly

over transboundary water basins and inland lakes. Tensions between upstream and downstream countries over competing water uses, especially over hydropower development, feature prominently across the region's major river basins, including the Nile and Turkana. The Grand Ethiopian Renaissance Dam (GERD) is one such example (see Transboundary Water box). Hydropower contentions have been observed at Ethiopia's Gilgel Gibe III Dam, the operation of which could jeopardise the livelihoods of downstream farming, fishing and pastoralist groups in both Ethiopia and Kenya who depend on the seasonal water flow of the Omo River. The potential for shrinking water resources could aggravate ongoing tensions between communal groups on both sides of the border (Climate Diplomacy n.d.j).

Inter-state security challenges can be seen in the Juba-Shabelle Basin, shared by upstream Ethiopia, downstream Somalia and, to some extent, Kenya. Water resources in the basin are crucial for regional agriculture, drinking water and hydropower. For Somalia, the basin is known as the country's bread basket, because of the country's reliance on the basin's alluvial plains for irrigation Krampe et al. 2020). Historically, both Ethiopia and Somalia have unilaterally made plans to develop the basin for hydropower and irrigation purposes, which in one instance required intervention and mediation by the World Bank (Salman 2011). While the risk of inter-state conflict is low due to Ethiopia's relative hegemony in terms of its military, economy and diplomatic influence, the impacts of climate change in diminishing river flows and increasing drought frequency could stress water access and availability, disrupt local livelihoods, and trigger inter-state tensions over the basin Krampe et al. 2020).

One aspect that can escalate unilateral use of transboundary water into an inter-state dispute is the lack of data on basin hydrology and water management, as well as the lack of associated information sharing between riparian countries. Such limitations hinder opportunities for riparian countries to sustainably and peacefully cooperate in managing water resource use. This is the case in the Juba and Shabelle river basins, where sparse data on river flow and water use – due in part to limited monitoring capacities, a lack of governance and security concerns in the region – hinder opportunities for joint water resource development and management (FAO SWALIM n.d.).

LIVELIHOOD AND FOOD INSECURITY

The livelihood and food security of many communities in Eastern Africa are highly dependent on climate-sensitive sectors. Disruptions to the productivity and economic viability of these sectors can deepen economic hardships, particularly youth unemployment, and contribute to broader public discontent and more organised crime. Efforts to address livelihood insecurities, if not done in a climate- and conflict-sensitive manner, can weaken livelihood strategies further and lock communities in a vicious cycle of vulnerability and insecurity. These dynamics are strongly linked to global trade dependencies and price shocks, as well as to the other climate security pathways outlined in this chapter.

Pressure on climate-sensitive livelihoods

Agriculture, pastoralism and fisheries play an important part in the livelihoods and food security of many Eastern African communities (see Eastern Africa chapter section on socioeconomic context). At the same time, these sectors are sensitive to extreme weather events and increasingly erratic climatic conditions due to their dependence on climate-sensitive resources, such as water.

Agriculture and livestock productivity are highly vulnerable to changing temperature regimes. High temperatures are one of the leading factors contributing to the growing rate and intensity of land degradation across the region, which has reduced agricultural productivity and income, and worsened food insecurity. Some regions are likely to face a decline in yields due to the higher frequency and intensity of extreme weather events, while other regions could potentially see productivity gains due to higher water availability and more favourable temperatures, particularly in highland areas. Southeastern Sudan, for example, is likely to face a decline in maize yields of up to 32 per cent by 2080 under RCP6.0 (Binder et al. 2023) due to droughts, shorter growing seasons and flooding damaging agricultural land and related infrastructure (Siddig et al. 2018). Meanwhile, eastern Ethiopia is likely to see an increase in maize yields of up to 77 per cent by 2080 under the same scenario (Binder et al. 2023).

In addition to climate change impacts, various other environmental factors can affect agricultural yields. A particular issue in Eastern Africa is pest infestation. For example, in the Karamoja cluster, desert locusts have decimated agricultural yields, including crops that were grown as a form of liveli-

hood diversification, aggravating rural livelihoods that were already severely strained by the COVID-19 pandemic (IGAD CEWARN 2022b). Evidence suggests that outbreaks of inter-communal conflicts in areas of Kenya are linked to desert locust invasions and the resulting destruction of pastures (IGAD CEWARN 2021).

For pastoralists, climate change can have a profound impact on livestock health and productivity. Excessive rainfall, for example, has led to a spike in the incidence of livestock diseases such as Rift Valley Fever, leading to high livestock mortality rates, threatening human health outcomes and prompting export bans, which have severely affected the meat trade in the region in the past (Whitaker et al. 2023).

In areas that are dependent on the blue economy, temperature regimes affect the biodiversity of aquatic ecosystems, with potentially negative impacts on fishing activities (IGAD 2022d). For inland lake fisheries, such as in the Great Lakes region, reduced precipitation and increased droughts can cause lake water temperatures to rise and levels to fluctuate, with negative consequences for the habitat of freshwater species (Lowe et al. 2019; Nyboer et al. 2022). Adding to the pressure on fish stocks are other environmental factors and human interventions. In the Great Lakes region, the introduction of predatory fish species, increased eutrophication, as well as population growth and increasing demand for aquatic resources have contributed to the decline in native fish populations (Nyboer et al. 2022).

The impacts of climate change on climate-sensitive livelihoods also have important gender implications. Because of gendered norms and divisions of labour that are prevalent in many areas of Eastern Africa, women are more heavily and directly dependent on small-scale agriculture and livestock production, which disproportionately places them at greater risk of climate-related impacts (Abebe 2014). For example, intense droughts in Madagascar have led to more reported cases of violence against women, as domestic tasks such as fetching water and preparing meals – tasks which are traditionally done by women – become more difficult to achieve, leading to violent repercussions from male household members (De Berry 2023). In the Great Lakes region, the impacts on fisheries could disproportionately affect women, as women make up around 44 per cent of the regional population engaged in small-scale fisheries, particularly as fish processors and traders (Chimatiro et al. 2021).

Moreover, because of the prevailing patriarchal settings and marginalisation of women in decision-making processes across Eastern Africa, women are often under-represented in resource management (Abebe 2014). Rural women in Eastern Africa, therefore, have weaker capacities in terms of adapting to livelihood and food insecurity compared to men. Conversely, men who have lost economic livelihoods derived from these sectors may resort to using violence against women to reassert their authority in the household (CGIAR 2022b).

Discontent arising from loss of livelihoods, as well as food and nutritional insecurity can undermine people's trust in state authorities, exacerbate ongoing grievances, and trigger social unrest and political instability (Yishak 2019; Belli et al. 2021). There is strong empirical evidence of these links throughout Eastern Africa. In Sudan, a temperature shock significantly raises the risk of civil conflict in areas where pastoralist groups are present, demonstrating the vulnerability of livestock-dependent communities to climate variability and their subsequent participation in violent activities (Maystadt et al. 2014). Similar observations have been made in areas of Kenya, where a high level of agricultural dependence makes it less likely for individuals to leave the region, increasing the likelihood of joining armed groups (Uexkull 2016). There is also empirical evidence from Kenya linking rainfall anomalies with increased malnutrition (measured via the incidences of child stunting) and subsequent cases of violence (CGIAR 2022b).

Conversely, infrastructural damage and livelihood disruptions caused by protracted conflicts impede the access of vulnerable groups to essential services and markets, the latter being an important factor for the economic viability of agricultural and livestock-dependent livelihoods. Moreover, protracted conflicts disrupt food and livestock production capacities, while also disrupting mobility and its potential as an adaptation strategy (CGIAR 2022a). These impacts create a reinforcing feedback loop that further perpetuates livelihood vulnerabilities and food insecurities.

Adaptation and maladaptation

When communities face economic difficulties, whether from climate- or non-climate-related factors, many turn to other forms of livelihood activities to cope with shocks and stresses. Mobility is an essential adaptation strategy in this regard (see also Eastern Africa chapter section on migration). However, communities also resort to other strategies

– known as maladaptation – that may ease their livelihood challenges in the short run but worsen their vulnerabilities over the longer term, while also exacerbating other climate-related security risks, particularly natural resource competition.

One form of maladaptation that has been widely observed in areas of Eastern Africa is charcoal production. The industry has become an important source of energy and economic revenue for many communities affected by conflict, displacement and environmental hardships, such as droughts. However, charcoal production provides a steady source of income for non-state armed groups, such as Al-Shabaab, thus feeding into the insecurity challenges faced in the region (Climate Diplomacy n.d.a; Foong et al. 2020b) (see also Eastern Africa chapter section on armed groups). At the same time, charcoal production is a major driver of deforestation and environmental degradation. Charcoal-associated deforestation is estimated to have caused the loss of around 2.7 per cent of trees in Somalia in just two years between 2011 and 2013 (Bolognesi et al. 2015). In turn, rapid deforestation further exposes rural communities to extreme weather events, creating a vicious cycle of maladaptation and vulnerability (Climate Diplomacy n.d.a). In Madagascar, poverty is driving communities to exploit mangroves – an important ecosystem for marine life and a key natural defence against coastal hazards – for firewood and construction wood as a source of income (Scales and Friess 2019).

Attempts to build up security and protection from violence could also inadvertently worsen environmental conditions and vulnerabilities to climate hazards. In Uganda, some communities fleeing from cattle raids have reportedly cut down trees to erect fences and protective infrastructure to shield themselves from armed attackers, leading to widespread deforestation and further livelihood degradation (GPPAC 2023).

Other forms of negative coping strategies can be found in the Great Lakes region. For example, in Lake Turkana, many pastoral communities that lost their livelihoods due to drought and cattle raiding have turned to fisheries or a mix of pastoralism and fisheries as alternative livelihood strategies. In some cases, this has led to lake communities competing over limited fish stocks, resulting in violent clashes and the theft of fishing equipment, events that typically intensify during dry periods. These impacts can also have important cross-border implications, given that communities and the resources they depend on are spread across borders (Sax et al. 2022).

Similarly, in Lake Victoria, many fishing communities have had to transition to small-scale farming due to declining fish stocks and harsher fisheries regulations imposed by governments. However, the increase in flooding has disrupted their alternative livelihood sources. Many communities have had to revert to fisheries and, in particular, to fish deeper in the lake, increasing the risk of trespassing across international borders, and coming into conflict with neighbouring authorities and pirates (CGIAR 2022a).

Global shocks and high trade dependencies

Food and livelihood security in many areas of Eastern Africa are strongly tied to international trade. On the one hand, Eastern Africa is highly dependent on the import of many staple food products, which makes access to and the affordability of food in the region susceptible to global food price shocks and supply chain disruptions (Whitaker and Steinkraus 2023). At the same time, domestic agricultural production in many Eastern African economies is dependent on oil imports for energy, which leaves agricultural productivity in the region vulnerable to global oil price volatilities and shocks in oil-producing regions (Olamide et al. 2022).

The vulnerability of Eastern Africa's food security to global shocks is evident in light of significant global events in recent years. From a security perspective, food price spikes can have politically destabilising effects in Eastern Africa, in addition to humanitarian impacts. This can be seen during the global food price spikes in 2007–2008 and 2010–2011, which contributed to urban protests in Ethiopia, Madagascar, Somalia and Sudan driven in part by their dependence on food imports (Sneyd et al. 2013). These food price spikes were driven by a number of factors, including extreme weather events and export restrictions. For example, in 2011, Russia experienced a severe drought and heatwave that decimated wheat production. In response, Russia imposed a ban on grain exports that triggered global food price spikes and food insecurity in many import-dependent countries (Climate Diplomacy n.d.g).

Moreover, many Eastern African economies and livelihoods are dependent on access to export markets. In particular, the ability of local communities to diversify livelihoods and build resilience

hinges on their access to markets, which in areas of Eastern Africa are hindered by poor transport infrastructure (Destrijcker, Kyeyune and Dieffenbacher 2023). At the same time, shocks that occur in export markets, whether from climate- or non-climate-related events, can severely affect the livelihoods of those engaged in the agricultural and livestock sectors. A case in point is the COVID-19 pandemic, during which Saudi Arabia, a major importer of Somali livestock, imposed a limit on the number of pilgrims allowed to perform the hajj. As a result, the demand for livestock products from Somalia plummeted, which severely impacted the livelihoods and financial security of many livestock breeders in the country (Faruk and Bearak 2020).

Conversely, a high dependence on international markets for export revenue can drive further environmental degradation at the local level. For example, the increase in international demand for highly prized wood products, such as rosewood and ebony, is feeding into large-scale deforestation in Madagascar. The situation is further exacerbated by limited forestry governance and enforcement in the country (Waeber et al. 2019). In areas of central Kenya, local communities have identified the growing access to international livestock black markets as one of the drivers of the intensification of cattle raiding activities in the area (Medina and Caroli et al. 2022).

COASTAL AND MARITIME SECURITY

Coastal and island communities across Eastern Africa are vulnerable to the impacts of climate change in a number of ways. Slow and rapid onset events such as rising sea levels and storm surges directly threaten people's safety and integrity. People also face challenges to their economic and food security due to the compounding impacts of human-made and environmental factors that affect marine ecosystems, including the intrusion of industrial fishing fleets.

Coastal disaster hazards

Eastern Africa's coastal areas are highly vulnerable to the combined impacts of climate-related hazards and human-made disturbances. Around 22 per cent of its coastline and 3.5 million people face high exposure to coastal hazards (Ballesteros and Esteves 2021), along with many important biodiversity and cultural sites. Coastal flooding and erosion threaten the region's rich diversity of seagrasses, the impacts of which could weaken the natural protection of coastal areas and heighten the risk of flooding, leading to negative social consequences (Vousdoukas et al. 2022).

The impacts are especially high for Eastern Africa's island and small island developing states. Island states in the southern Indian Ocean are generally at higher risk of extreme sea level events compared to continental coastal areas. This is because many of these island states have lower coastal elevation, which exposes them to a greater area of inundation during extreme events (Sreeraj et al. 2022). For example, the Aldabra Atoll, which is part of the Seychelles and the world's second largest coral atoll, could see up to 17 per cent of its land mass exposed to coastal extreme events by the end of the century under a high emissions scenario (Vousdoukas et al. 2022).

Extreme climatic events such as cyclones and storms are a major safety hazard for many coastal areas and island states in Eastern Africa (see Eastern Africa chapter section on cyclones). In addition to the loss of life, these events can cause widespread damage to buildings, and transport and port infrastructure, while also disrupting access to public services, affecting livelihood and food security, and causing significant economic losses (Adewumi et al. 2022). In the case of the Comoros, more than 3,000 homes and nearly 80 per cent of the archipelago's crops were destroyed when tropical Cyclone Kenneth made landfall in April 2019, resulting in food shortages and price spikes, which affected more than a third of its population (IFRC 2020). Indeed, the country's agricultural sector has been identified as one of its most vulnerable economic sectors to projected climate change impacts (Ministry of Agriculture, Fishing, Environment, Tourism and Handcraft, Comoros 2021).

Water security

Climate change could also have negative consequences for water security in Eastern Africa's coastal areas. Land subsidence as a result of rising sea levels leads to saltwater intrusion into coastal aquifers, an issue that is further exacerbated by droughts and erratic rainfalls that reduce groundwater recharge (Idowu and Lasisi 2020). This is the case, for example, for several coastal communities in Tanzania that depend on coastal rivers as a source of potable water. Coastal rivers, however, are facing increasing salinisation due to rising sea levels, leaking salt into aquifers and wells, which poses a threat to the water security of communities dependent on the rivers (Makoye 2013).

For Eastern Africa's small island states, the impacts of climate change on water security are particularly pronounced. Mauritius, for example, is already

considered moderately vulnerable to water insecurity, with water availability per capita just over the critical water-stress threshold of 1,000 m3 per year for the period 2000–2015. Considering the projected impacts of rising sea levels and the resulting intrusion of saltwater, water availability is expected to shrink to below 1,000 m3 (Boojhawon and Surroop 2021).

The negative consequences of sea level rise and other climate-related events are particularly high in coastal cities, where rapid population growth increases the number of people at risk to hazards. This is especially the case for major coastal urban centres such as Dar es Salaam and Mombasa (Ballesteros and Esteves 2021). While coastal cities continue to be an attractive livelihood option for inland communities affected by environmental and security problems (see Eastern Africa chapter section on migration), displacement out of urban areas, driven by rising sea levels and storm surges, could become a growing trend that warrants attention (Clement et al. 2021).

Pressure on fish stocks

Climate change is likely to have negative consequences on the livelihoods and food security of coastal and island communities across Eastern Africa that are dependent on fisheries as a source of income and essential nutrients (Belhabib et al. 2019). Warmer sea surface temperatures and ocean acidification affect the health of Eastern Africa's coral reefs, which act as important habitats for marine species but could shrink by up to 90 per cent under a 2°C increase in global warming (Binder et al. 2023).

Adding to the pressure on fish stocks are other environmental factors and human-made interventions. This includes overfishing by local fishers (UNDP 2023c), as well as the increase in demand driven by the migration of inland communities affected by droughts and conflict towards coastal areas (Belhabib et al. 2019). In some coastal areas, port development is negatively affecting the integrity and water quality of fish habitats, such as coral reefs and mangroves, thus affecting the small-scale fishing activities of coastal communities (Thoya et al. 2022). The growing pressure on limited fish stocks increases poverty and food insecurity within coastal communities, and heightens competition and tensions between migrant and non-migrant fishers (Belhabib et al. 2019).

Marine conservation sites can help to combat the decline in fish stocks and aquatic biodiversity. However, their establishment, if crudely implemented, can run the risk of disrupting small-scale fisheries and causing frictions with local communities. Such incidences have occurred across Eastern Africa. One example is the establishment of the Mafia Island Marine Park in Tanzania, which disrupted local livelihood activities, resulting in protests and violation of regulations by local fishers (Climate Diplomacy n.d.d).

The impacts on fisheries, whether from climatic, socioeconomic or security-related factors, could disproportionately affect women, given that women occupy important roles in the sector. In the Comoros, women have long been involved in harvesting marine species at low tide, selling half of their catch for income and keeping the rest for household consumption (Harper et al. 2013). In areas of Tanzania, women are engaged in harvesting small fish, seaweed and octopus. However, their roles in the sector are largely overlooked and are increasingly being displaced by men due to growing international demand for local aquatic resources (Porter et al. 2008).

Industrial fishing fleets and piracy

One important factor driving the decline in fish stocks is the intrusion of large-scale fishing fleets, many of which are foreign and illegal, into maritime zones that are primarily reserved for artisanal small-scale fisheries. While some maritime zones, such as those around Somalia and Eritrea, have restrictions in place that ban fishing by foreign vessels, foreign vessel incursions have continued to occur due in part to limited governance capacities to monitor coastal waters and enforce fisheries regulations. The resulting increase in competition and conflict with small-scale fisheries has threatened local livelihoods and food security, while also creating high levels of frustration among small-scale fishers (Belhabib et al. 2019).

The increase in industrial fishing vessel intrusions have also contributed to the emergence of and rise in piracy in the region (Belhabib et al. 2019). Following the droughts in Somalia in 2008, many drought- and poverty-stricken pastoralists turned to piracy as a source of income, with the number of pirate attacks on illegal foreign fishing vessels increasing at around the same time. While the number of attacks has declined considerably since 2010 following the consolidation of the federal government's authority and international military

support, the threat of piracy remains as climate impacts continue to undermine livelihoods (Climate Diplomacy n.d.i).

CHANGING MOBILITY PATTERNS

Populations in Eastern Africa move for various reasons. For many, including pastoralists, it is an adaptation strategy to cope with periods of shocks and stresses. For others, it provides an important escape from conflict, and economic and political instability. Climate change increasingly influences where, when and for how long people move by making environmental conditions harsher and less predictable. In general, climate change is amplifying and altering existing migration trends, particularly rural-urban migration and cross-border migration, with differential impacts based on people's socioeconomic status. Some estimates project that approximately 41 million people could be displaced by climate-related impacts within countries in the region by 2050 (Amakrane et al. 2023) (see also Figure 24 internal climate mobility hotspots).[42] In some cases, migration can increase the pressure on resources and services in receiving areas, heightening competition, and stirring tensions between host and migrant communities.

Pressure on resources and services

Climate change is a growing driver of forced migration in Eastern Africa (IOM 2020b), and can

Internal climate mobility hotspots areas in East Africa showing also current locations of refugee and internally displaced person camps

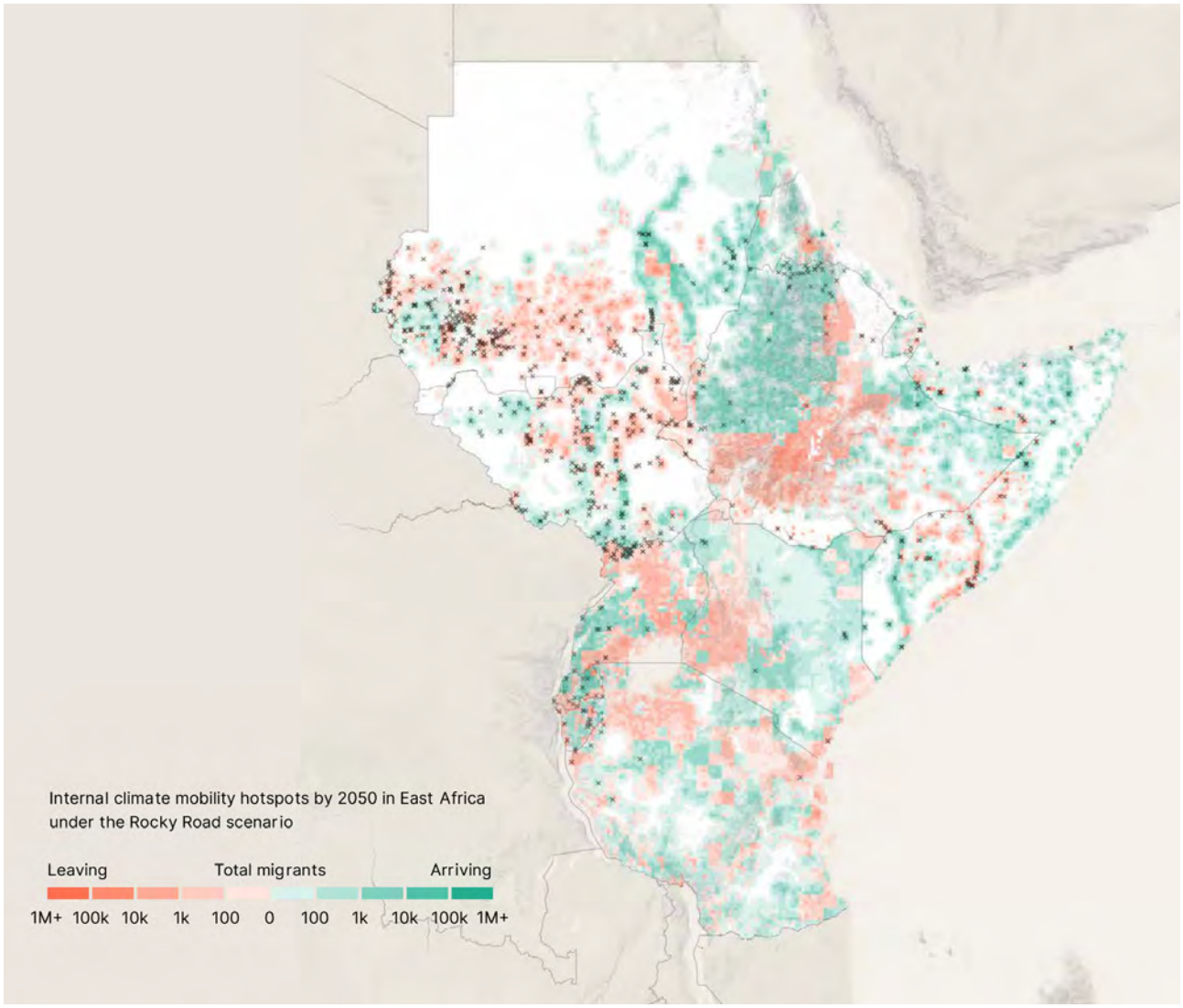


Figure 24: Internal climate mobility hotspots in Eastern Africa, showing current locations of refugee and IDP camps (Amakrane et al. 2023)

heighten conflict and security risks arising from mobility in a number of ways. It can make the availability of water and grazing resources less reliable and predictable, causing pastoralists to change grazing routes, which can amplify clashes with other pastoralists and farmers. Similarly, climate-induced migration of inland communities to coastal areas, a trend which is expected to persist in many coastal areas (see Figure 24 internal climate mobility hotspots), can increase competition over limited fish stocks (see Eastern Africa chapter section on maritime fisheries). Droughts can drive populations to areas with more favourable conditions for agriculture, leading to competition over cultivable land between migrant and resident populations. In the Great Lakes region, Lake Victoria is set to become a climate in-migration hotspot as early as 2030 due to its more favourable environmental conditions for agriculture. However, the area suffers from high poverty rates, and limited infrastructure and service provision, all of which could worsen as the population grows (Clement et al. 2021).

Competition and conflict between host and migrant communities are especially pronounced if tensions fall along ethnic lines, which can exacerbate historical inter-ethnic grievances (van Baalen and Mobjörk 2018). Host-migrant tensions can arise when certain groups perceive unequal access to services. For example, a survey in Kenya found that individuals who were displaced due to climatic events were more likely to participate in social movements, particularly when there was insufficient provision of and access to aid and services (Koubi et al. 2021).

Rural-urban migration

Rural-urban migration trends are prevalent across Eastern Africa, as urban centres are widely perceived to be economic hubs that provide more livelihood opportunities than rural areas (IOM et al. 2022), particularly in non-agricultural sectors such as retail, construction and services (Clement et al. 2021). The impacts of climate change on rural food and livelihood security will likely feed into this trend, which could over the long run create additional stress on infrastructure and services in urban areas (IOM et al. 2022). Moreover, a rise in migration to urban areas can trigger anti-migrant sentiments among host urban communities, particularly if host communities perceive migrants to be receiving more social welfare benefits from international organisations. In addition, host communities may attribute social problems such as rising urban crime rates to migrant groups without substantive evidence (Agwanda 2022).

Growing urban populations, partly driven by rural-urban migration, can amplify the economic and social damages caused by climate-related extreme events in urban areas. For example, Dar es Salaam, one of Eastern Africa's largest and fastest growing cities, is highly vulnerable to flooding, and its associated risks to infrastructure and assets (World Bank 2017a). Flood impacts are further amplified by the limited access of residents to essential services and the high levels of water pollution in the city's river systems, thus creating a number of health risks (Turpie et al. 2016).

In addition to rural-urban migration, out-migration from urban coastal areas could increase as a result of climate-related impacts in coastal zones. Between 2020 and 2050, approximately 750,000 people are projected to migrate out of Eastern Africa's coastal zones, driven by rising sea levels and associated flooding, as well as vulnerabilities associated with population growth and rapid coastal development (IPCC 2022).

International migration

Mobility in many areas of Eastern Africa is characterised by international, cross-border migration. This is particularly the case in border areas where pastoralists often cross borders in search of water and grazing resources (IGAD 2018). Elsewhere, international migration is an essential adaptation strategy for those seeking better employment opportunities beyond the borders of their respective countries.

Localised climate-related impacts on climate-sensitive activities and food security can increase the pressure on people to move across borders and to other regions for better livelihoods. Increasingly difficult conditions at home may even push more people to pursue irregular forms of migration, which exposes them to exploitation, human trafficking and smuggling (IOM 2022c). Moreover, climatic shocks and extreme weather events exacerbate existing resource disputes and sociopolitical tensions that can lead to conflicts and violence in countries of origin, reinforcing internal and cross-border displacement, and migration trends (IGAD 2022d).

Conversely, efforts to tighten border security can restrict cross-border migration as a key liveli-

42 This projection assumes a "rocky road" scenario in which global emissions are high and global warming is at least 2°C by 2050, as well as low levels of cooperation, high population growth, limited economic expansion and low educational attainment.

hood strategy to cope with adverse environmental conditions at home. In particular, the securitisation of borders hinders mobility, threatening the livelihoods of borderland communities that are dependent on pastoralism and cross-border trade (IGAD 2018). For pastoralists in particular, a combination of strict border controls, protracted conflicts and ineffective tenure policies hamper the ability of pastoralists to migrate across borders in search of water and grazing resources (CGIAR 2022a; IGAD 2022d).

Differential impacts of migration

The decision to migrate hinges on a number of socioeconomic aspects that can either push individuals to leave, deter them from moving or pull them towards certain areas. Wealth is an important factor in this regard. For example, in Tanzania, men from wealthier households with more assets such as land are found to have a better chance of migrating in the event of a temperature shock (Hirvonen 2016). This stands in contrast to lower-income households where the likelihood of migrating is significantly lower due to financial constraints and limited assets (Clement et al. 2021). In the worst case, this can lead to situations where certain population groups are not able to move, trapping them in a vicious cycle of climate vulnerability and livelihood insecurity (Clement et al. 2021). In some cases, potential migrants who need to move and have the economic assets to do so may be unwilling to move for cultural or social reasons, which inadvertently aggravates their vulnerabilities (IOM et al. 2022).

Gender is an important aspect that affects climate-related migration decisions and outcomes in Eastern Africa. In particular, women often lack the required resources to migrate. Notably, such resources include not only economic assets, but also social networks and information. Furthermore, social norms and cultural beliefs in the region, such as the prevailing belief that women are primarily responsible for childcare and reproductive responsibilities, often hinder women's ability to move. Thus, women and children are often left behind to face the impacts of climate change at the place of origin. Adding to the pressures they face is the fact that women also have to work the household farm in addition to caring for their families at home (Abebe 2014), increasing the security risks to their livelihoods. The higher likelihood of men moving out of rural farming households further contributes to a "feminisation of agriculture" in which women and girls are left behind to manage household farms (Caroli et al. 2022).

When women and children are able to migrate, they may not experience the same economic and livelihood opportunities, and security that migration offers to men. Instead, women and children often face greater risk of sexual and GBV en route or at their destination, and are more likely to be targeted by human traffickers, worsening their socioeconomic vulnerability. For example, studies have shown that young girls and women from rural areas of Ethiopia who move to bigger cities are often subjected to long working hours and low paying jobs in the informal sector due to a lack of education or skills, which they are unable to acquire because of gendered differences in access to schools, education and training opportunities (Abebe 2014). In Madagascar, women who migrated within and out of the country as a result of the droughts between 2018 and 2022 reported facing higher risks of gender-based discrimination and violence, including human trafficking (De Berry 2023). Similar experiences have been recorded among Eastern African migrants in other regions, such as the Middle East (Sultan and Mlowezi 2019).

Mobility in Eastern Africa has a strong generational aspect, with young people comprising a large proportion of migrants. In 2019, migrants aged 15–35 years made up more than a third of international migrants in the regional labour force (IGAD 2021). In areas of Kenya, out-migration rates from both rural and urban areas are highest for young adults (Clement et al. 2021). Such trends could disproportionately expose young people to potential risks en route or at the destination, while at the same time leaving a disproportionate number of dependents, including older people, to face livelihood risks at home (HelpAge International 2022).

EXPLOITATION BY ARMED GROUPS

Climate impacts are increasingly shaping the operational environment of armed groups in Eastern Africa. Armed groups in the region actively exploit conditions of food insecurity, loss of livelihoods, and political and inter-community grievances for recruitment and support. The extent of their activities depends on prevailing climatic and environmental conditions, which can either hinder or ease their operations, as well as on the existence and profitability of economic activities that provide them with financial support.

Exploitation of livelihood and food insecurity

In Eastern Africa, the impacts of climate change are worsening livelihood conditions and reducing income, which can contribute to more people join-

ing armed groups due to decreasing opportunity costs (van Baalen and Mobjörk 2018). While recruitment into armed groups is a complex phenomenon that is driven by a range of factors, including identity, religion, social and political marginalisation, as well as negative experiences with state security forces, it is also happening against the backdrop of increasing economic hardship and financial incentives that these groups offer. For example, in Somalia, Al-Shabaab offers cash incentives and other benefits to recruit fighters facing poverty and a lack of economic opportunities (Maystadt and Ecker 2014). Similar examples can be found in Sudan where armed groups have capitalised on weak state legitimacy, growing public grievances and inter-ethnic divisions (Foong et al. 2020b), as well as in Kenya where a combination of climate vulnerability, poverty and marginalisation makes certain communities more susceptible to recruitment by bandits (CGIAR 2022a).

Gender is an important factor in the recruitment process of armed groups in Eastern Africa. For men, joining armed groups is sometimes seen as a way to live up to social expectations of masculinity, particularly in the context of widespread unemployment and limited education opportunities (Saferworld 2014). For women, their involvement in armed group activities, whether passive or active, can partly be attributed to social protections that such groups offer, particularly to marginalised women in areas with limited access to justice (ICG 2019). For community-based armed groups, women play important roles in providing logistic and recruitment support. In some cases, women also participate in armed violence (Matfess 2020). Recruitment into armed groups is seen as a means for men to enhance their marriage prospective, and vice versa for parents to improve their financial, social and security status through their daughters' marriage to members of armed groups (ICG 2019). Young people are especially vulnerable to recruitment by armed groups. Young people who stay behind in rural areas, partly because they may not have the resources to leave in search for better livelihood opportunities elsewhere, can grow discontented with their poor education and employment access making individuals vulnerable to recruitment by armed groups who offer economic incentives (CGIAR 2022b). This is especially the case for young pastoralists who, because of the diminishing economic prospects of pastoralism and rising hunger driven in part by harsher climatic conditions, choose to leave their traditional pastoral roles behind and join armed groups (IGAD CEWARN 2022b). The likeliness of participating in armed group activities and violence is especially high for young people who face high levels of political exclusion and injustice (IGAD CEWARN 2023).

Refugee camps in areas of Eastern Africa, particularly those located in border areas, are also key targets for many armed groups in the region. This is due to the dense conditions in border camps, the lack of employment opportunities faced by refugees, and the flow of aid into camps which are often informally taxed by armed groups (Camarena 2023). Moreover, armed groups as well as organised criminal networks often exploit the region's porous borders and weak state control over border areas, enabling these groups to operate at the transnational level (IGAD 2018).

Revenue for armed groups

Across Eastern Africa, extreme wet conditions and an abundance of resources are linked with increases in communal conflicts due to the opportunities such conditions provide for rent-seeking behaviour and recruitment of people to participate in violence (Raleigh and Kniveton 2012). In Somalia, the shift towards charcoal production has increased the revenue base of armed groups such as Al-Shabaab by as much as USD 38 million to USD 56 million annually (Climate Diplomacy n.d.a). Through taxation of charcoal and other natural resources, armed groups have been able to consolidate their power and influence, aggravating conflict and security risks in the region (Whitaker and Steinkraus 2023).

A similar situation can be found in Sudan, where artisanal gold mining has become an important source of revenue for the Rapid Support Forces. At the same time, gold mining has undermined the resilience of local communities to environmental degradation, while also contributing to health problems due to the use of toxic substances during the extraction of gold (Foong et al. 2020b).

Tactical considerations

Where, when and how armed groups initiate attacks depend on a number of economic and environmental factors that offer more tactical advantages. Rainfall variability, for example, can affect the operations and tactical decisions of armed groups. Wetter conditions have been found to enable better camouflage and raiding opportunities, while drier conditions ease movement and improve logistics (van Baalen and Mobjörk 2018). Evidence of this has been found in Uganda, where

the timing of rainfall events significantly influences when conflict actors decide to act (Carter and Veale 2015). In areas around the Ethiopian-Kenyan border, droughts have been identified as a trigger for armed groups to attack water supply points (Peña-Ramos et al. 2022).

The influence of climate change impacts on strategic and tactical decision-making apply to peacekeeping operations. Climate-related hazards such as flooding and sandstorms can reduce the mobility and combat performance of peacekeeping troops (Krampe 2021), necessitating peacekeeping missions to anticipate climate-related events. In the aftermath of South Sudan's catastrophic floods in recent years, UNMISS has been preparing for future rainy seasons, particularly focusing on personnel training and equipment provision (Mandoreba 2023).

Responses and good practices

Compared to other regions across the African continent, Eastern Africa has some of the strongest strategies, policies and mechanisms to prevent and respond to climate-related security risks. This stems from a long history of recognition and understanding of these risks by governments, policymakers and other key decision-makers in the region.

In this section, interventions that seek to address climate-related security risks in Eastern Africa are presented in three parts: (1) regional approaches, (2) national approaches and (3) community-level initiatives.

REGIONAL APPROACHES

Eastern Africa is one of the most advanced regions on the African continent in terms of regional cooperation on matters related to climate change and security. Countries in Eastern Africa are members of a number of international and regional organisations and mechanisms that seek to promote economic, political, social and cultural integration across the region. Several of these organisations and mechanisms are at the forefront of bridging the climate security gap in their mandates and strategies.

The United Nations

Several UN bodies and missions working on peacebuilding and security in Eastern Africa have begun to incorporate elements of climate-sensitivity into their operational structures. In particular, the UNSOM stands out as one of the world's first climate-sensitive political missions. This is reflected in the UN Security Council Resolution 2408, which recognises "the adverse effects of climate change, ecological changes and natural hazard-induced disasters among other factors on the stability of Somalia," and emphasises "the need for adequate risk assessments and risk management strategies" (UNSC 2018).

In 2020, an environmental and climate security adviser was deployed to UNSOM, enhancing the mission's work on climate security. The adviser's work centres on three pillars: (1) mainstreaming environment and climate across UNSOM's mandated areas of work; (2) coordinating the work of climate actors (including other UN agencies, funds, programmes, government actors and NGOs) through a "triple-nexus" approach that spans development, humanitarian and peacebuilding issues; and (3) supporting the federal government of Somalia to develop, fund and coordinate climate action plans and policies (Hodder 2021; Russo 2022).

According to interviews with UN agency staff conducted by Russo (2022), the UNSOM adviser has achieved notable successes. Notably, the adviser has supported the programmes of other UN and governmental bodies in sustainable flood management, alternative livelihoods to charcoal production, climate-adaptive displacement and sustainable fisheries. However, the adviser faces a number of challenges, including financial and organisational constraints. For example, it is funded by extra-budgetary contributions that are only secured on a year-to-year basis, which limits its ability to plan for the long term and ensure continuity in its work (Russo 2022).

In addition to UNSOM, the UNMISS has its own climate and security adviser, and assessments conducted by its joint mission analysis centre frequently consider climate-related security risks (Sarfati 2022). Furthermore, the Office of the Special Envoy for the Horn of Africa has a climate security adviser who, in close cooperation with other UN agencies and regional organisations such as the IGAD and African Union, coordinates the implementation of sustainable natural resource management and climate resilience initiatives in the region.

The UNPBF has several projects in Eastern Africa focusing on the climate-conflict nexus. For example, in South Sudan, several UN agencies (e.g. the FAO, IOM and UNWOMEN) are working together

on a project in Bor, Pibor and Malakal to promote local solutions for building climate resilience, and advance peace and stability. The project is centred around three resilience capacities, which include absorptive capacities to anticipate and plan for climate shocks, as well as adaptive and transformative capacities. The latter aims to create sustainable structures to respond to stressors and shocks peacefully (Peacebuilding Fund 2023).

BOX 1:
TACKLING FOOD INSECURITY THROUGH PEACE

The Fighting Food Crises along the Humanitarian-Development-Peace Nexus Coalition aims to "contribute to ending hunger through pursuing peace and unleashing the potential of sustainable food systems to enhance the prospects for peace" (Global Network Against Food Crises n.d.). Launched by the UN Food Systems Summit in September 2021, the coalition is a partnership involving several international and regional organisations, NGOs, research centres, and UN member states, including two from Eastern Africa (Ethiopia and Sudan). The coalition conducts food security hotspot analyses and high-level forums that seek to address challenges associated with the climate-peace-security nexus (Global Network Against Food Crises n.d.).

The Intergovernmental Authority on Development (IGAD)

According to the IGAD's regional strategy for 2021–2025, regional economic cooperation and integration constitute one of the IGAD's main pillars of intervention, along with food security, sustainable resource management, and peace and security (IGAD 2020a). As such, the IGAD is well-positioned to mobilise political will and facilitate cooperation in addressing shared conflict and climate risks, particularly through its specialised institutions that have climate risk analysis and conflict prevention mandates.

The IGAD's work on assessing climate, peace and security-related risks are led by: (1) the Conflict Early Warning and Response Mechanism (CEWARN), which analyses and shares information related to violent conflict, and develops case scenarios and formulates response options; and (2) the IGAD Climate Prediction and Applications Center (ICPAC), which offers climate services, including information-sharing, forecasting and early warnings; and (3) the IGAD Centre for Pastoral Area and Livestock Development (ICPALD), which is mandated to establish links with CEWARN and the ICPAC in its work to support pastoralist livelihood development, and livestock and dryland management and development (ICPALD n.d; IGAD CEWARN n.d; IGAD 2022d).

There is a high level of collaboration between the IGAD's specialised institutions and their respective mandates reflect the strong climate-conflict links of their work. For example, since its establishment in 2000, CEWARN's mandate, structure and early warning indicators have been broadened to include climate and environment (IGAD 2022d). A 2022 study on the climate-conflict nexus in the IGAD region exemplifies this. Using both CEWARN and ICPAC data, the study identifies several climate-related factors, including vegetation and natural hazard-induced disasters, as top predictors of conflict outcomes in the region (IGAD CEWARN 2022a).

The IGAD's specialised institutions work closely with regional and international partners to address specific thematic areas in the climate security field. Together with the FAO, the ICPAC co-chairs the Food Security and Nutrition Working Group to provide early warning analysis on food security, and a platform to collectively address issues facing policy and interventions on food security (ICPAC n.d.). The ICPAC also hosts the IGAD Disaster Operation Centre, jointly established by the African Union, UNDRR and IGAD. The centre plays a key role in multi-hazard monitoring and early warning analysis for extreme weather events, pests and food insecurity in the region. In addition, the centre is connected to the AU Continental Situation Room for Disaster Risk Reduction (UNDRR 2021).

The IGAD has achieved several notable successes in addressing some of Eastern Africa's most pressing climate-related security challenges. Following the devastating droughts of 2010–2011, the IGAD established the IGAD Drought Disaster Resilience and Sustainability Initiative (IDDRSI) to strengthen the IGAD's overall regional strategy on drought resilience. One of its priority intervention areas is peacebuilding, and conflict prevention and resolution for drought-prone communities, particularly those in cross-border areas (IGAD 2013). However, there is a need to extend the IDDRSI's approach towards addressing broader climate security chal-

43 Input provided during the regional consultation on climate security in Eastern Africa, hosted by adelphi and the IGAD in Nairobi on 5 May 2023.

lenges, and other socioeconomic and political factors that affect climate security risks, particularly those pertaining to development issues.[43]
In the Karamoja cluster, the IGAD has been instrumental in bridging the climate-conflict gap and in engaging with local stakeholders in the process. The IGAD's Cross Border Development Facilitation Unit facilitates cross-border dialogue in the cluster, while also developing cross-border bankable resilience projects with high community involvement (IGAD n.d.a).

Recognising the value of mobility for many livelihoods in Eastern Africa, IGAD member states endorsed the Protocol on Free Movement of Persons in the IGAD Region in February 2020. The protocol seeks to enable orderly cross-border mobility and migration in the aftermath of disasters, while also supporting regional integration and development. In addition, the protocol guarantees citizens the right of free movement between, and residence and employment in any member state. The protocol thus contributes to the development of a more coordinated and protection-centred response to disasters, focusing on enabling people to move in response to natural hazards. IGAD will continue working with IGAD countries and partner organisations on its implementation (IGAD 2020b).
Similarly, for natural resources such as land, IGAD is implementing the IGAD Land Governance Project, which aims to address issues among its member states surrounding land policy and governance (IGAD n.d.b). For aquatic and maritime environments, IGAD member states endorsed the IGAD Blue Economy Strategy (2021–2025) in April 2022, which seeks to strengthen regional cooperation and integration in addressing some of the key challenges faced by the blue economy (IGAD 2022c).[44]

The IGAD's work on climate security was further strengthened following the 48th Ordinary Session of IGAD Council of Ministers in November 2022. During the session, the council established the regional Climate Security Coordination Mechanism, which aims to build the capacity of member states to "anticipate, prevent and mitigate the outset of climate-induced conflict and displacement" (IGAD 2022a).[45] Experts have noted that stakeholder and policy-level discussions on addressing core climate-related security challenges have become more focused and targeted thanks to the mechanism. Furthermore, experts note that, through the mechanism, the IGAD – together with international organisations such as the African Union and United Nations – is able to jointly address the climate, peace and security priorities of IGAD member states, based on the complementarity and comparative advantages of their respective mandates.[46]
In 2022, the IGAD launched its Regional Climate Change Strategy and Action Plan for 2023–2030. Among other things, the document identifies climate-sensitive sectors, security, displacement, gender and young people as priority areas. The document also provides a detailed implementation plan, with the ICPAC leading its implementation and coordination (IGAD 2022b).

The East African Community (EAC)[47]
The EAC aims to strengthen "economic, political, social and cultural integration" across its member states, and has several semi-autonomous institutions that are directly mandated to improve transboundary natural resource management (AU 2021). These are (1) the Lake Victoria Basin Commission (LVBC), which aims to coordinate sustainable development and management in the Lake Victoria Basin among its five member states including Burundi, Kenya, Rwanda, Tanzania and Uganda (LVBC n.d.b); and (2) the Lake Victoria Fisheries Organization (LVFO), which is responsible for managing and developing fisheries and aquaculture resources in the region, specifically between Burundi, Kenya, Tanzania and Uganda (LVFO n.d.a).

Both the LVBC and LVFO have made headway in fostering cooperation on resource management through several regional projects and programmes. The LVBC's Integrated Water Resource Management (IWRM) programme aims to build an integrated IWRM strategy for the entire basin, while also addressing water quality issues in the lake through close collaboration with its member states (LVBC n.d.a). On the other hand, the LVFO has supported the establishment of community-based structures for the sustainable management of fisheries and aquaculture resources, including beach management units (LVFO n.d.b).

The EAC has a long history of providing an enabling environment for mobility across its member states, dating back to the Treaty for East African Cooperation that was signed between Kenya, Uganda and Tanzania in 1967, which ensured the free movement of people within the region (UNECA n.d.a). With regards to climate-induced migration, IGAD and EAC member states signed the Kampala Ministerial Declaration on Migration, Environment and Climate Change in July 2022. The declaration calls for countries to work together to address the risks associated with climate-induced migration, includ-

ing rural-urban migration. It also calls for the establishment of an inter-ministerial working group on climate change, environment and migration, and the development of an associated implementation plan. To provide a more supportive environment for migrants and displaced people, the declaration calls for deeper engagement with multilateral development banks and financial institutions to extend funding for countries hosting migrants and displaced people (Government of the Republic of Uganda et al. 2022).

The Horn of Africa Initiative (HoAI)

The HoAI was established with the aim of deepening regional cooperation and integration on development in the Horn of Africa, specifically between Djibouti, Eritrea, Ethiopia, Kenya, Somalia, South Sudan and Sudan. One of its four pillars focuses on building resilience to climate change impacts and other shocks (e.g. conflict and displacement) in the region's borderland areas (HoAI n.d.b). Projects under this pillar have a strong transboundary, regional cooperation focus. For example, projects that aim to promote resilience in borderlands include activities that enhance social cohesion, knowledge exchange and dialogue between communities (HoAI 2022). Moreover, through several programmes funded by the World Bank, the HoAI aims to strengthen food system resilience and water security in the region (HoAI n.d.a).

The Consultative Group for International Agriculture Research (CGIAR)

The CGIAR has a very active presence in Eastern Africa through its well-developed portfolio of projects and tools focusing on the links between climate and security in the region. A key milestone was the launch of the Climate Security Observatory (CSO) in May 2023.[48] The CSO is an evidence-based decision-making support tool that uses a mixed-method approach to explore the climate-conflict link, identify the most vulnerable areas and groups to climate-related security risks, and assess what actions need to be undertaken to address the risks. One of the distinguishing features of the CSO is its innovative approach that places a strong emphasis on the user, in particular, by streamlining evidence on climate security links to support policymakers in developing climate- and conflict-sensitive solutions (Kluckner and Liebig 2023).

The CGIAR has developed the Climate Security Sensitiveness Scoring Tool (CSST), which assesses the conflict-sensitivity of climate adaptation interventions, such as climate-smart agricultural practices and participatory rangeland management in pilot areas. The CSST has been piloted in several villages in Kenya, and provides important recommendations for policymakers to improve conflict-sensitiveness and peace responsiveness of climate action programmes (Sarzana, Melgar, Laderach and Pacillo 2022; Sarzana, Melgar and Meddings et al. 2022).

Furthermore, the CGIAR has within its network a number of research centres based in Eastern Africa that are dedicated to specific topics related to climate security. The Alliance of Biodiversity and the International Center for Tropical Agriculture (CIAT) host the CGIAR FOCUS Climate Security Team, which actively leads climate security activities in Eastern Africa. Co-hosted by Kenya and Ethiopia, the International Livestock Research Institute focuses on addressing food and livelihood security through its extensive work on livestock research. Other relevant institutions include the World Agroforestry, which is based in Kenya and works closely with the Center for International Forestry Research to explore the links between climate change, livelihoods, and the forestry and agroforestry sector (Destrijcker and Foong et al. 2023).

The Drylands Learning and Capacity Building Initiative (DLCI)

Working specifically on dryland management in the Horn of Africa, the DLCI (previously known as the Regional Learning and Advocacy Programme) includes conflict sensitivity as part of its mandate to support community-centred policy and practices of dryland management (DLCI n.d.).

The DLCI's work on resource-related conflict management in the region has achieved a number of tangible results at the community level. One example relates to the violent conflict over land competition – a dispute that dates back to 1992 – between the Rendille, Gabra and Borana groups in Marsabit county, Kenya, in June 2020. Since July 2020, the DLCI has facilitated inter- and intra-ethnic meetings, and inter-generational dialogues to build sustainable peace and cohesion (Mokku 2020).

44 The IGAD Blue Economy Strategy (2021–2025) can be downloaded here: https://igad.int/wp-content/uploads/2022/03/IGAD-Blue-Strategy-Draft.pdf.
45 The decision was endorsed by IGAD heads of state in June 2023 (ICPAC 2023b).
46 Input provided during the regional consultation on climate security in Eastern Africa, hosted by adelphi and the IGAD in Nairobi on 5 May 2023.
47 Overview of the EAC: https://www.eac.int/overview-of-eac.
48 For more information on the CSO see: https://cso.cgiar.org.

BOX 2:
COOPERATION ON COASTAL SECURITY

Countries in Eastern Africa have made considerable progress in shoring up maritime security through enhanced regional and international cooperation. For example, the decline in the number of pirate attacks along Eastern Africa's coasts can be attributed to improved security measures resulting from international cooperation with Eastern African coastal countries (Belhabib et al. 2019).

In terms of fisheries, countries in Eastern Africa, including several island states, are actively cooperating to safeguard fish stocks from illegal fishing operators. A notable cooperation in this regard is Fish-i Africa, a partnership involving eight countries in the Western Indian Ocean (Comoros, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, Somalia, and Tanzania), regional organisations and international experts that aims to tackle illegal fishing in the region. Through a task force, the partnership enhances regional cooperation on timely access to and sharing of information on illegal fishing operators, which has led to more targeted and effective enforcement actions (Stop Illegal Fishing n.d.).

NATIONAL LEVEL POLICIES AND STRATEGIES

At the national level, countries in Eastern Africa have implemented policies and strategies that aim to address the drivers of climate-related security risks. These initiatives have been developed through close collaboration between the national governments of each country, and regional and international organisations such as the United Nations. This section provides an overview of some examples.

Gender inclusivity

In September 2022, the federal government of Somalia launched its National Action Plan (NAP) for the implementation of the Somali Women's Charter and UN Security Council Resolution 1325. The NAP aims to enhance the inclusion and participation of Somali women in peacebuilding and decision-making at all levels, recognising the security issues faced by Somali women, including those related to climate change, GBV and access to justice. Based on the NAP, five of Somalia's federal states are in the process of developing and launching their own respective local action plans (UN Women 2023).

Climate-sensitive livelihoods

Recognising the cultural and economic importance of pastoralism for many rural livelihoods, as well as the role pastoralism plays in many of Eastern Africa's conflicts, the government of Kenya has a dedicated parliamentary group composed of pastoralists. The Pastoralist Parliamentary Group was established in 1998 to provide a collective voice for pastoralists on issues relating to security and economic livelihoods in the parliament (FAO n.d.). Since its establishment, the parliamentary group has been active in the parliament and has ensured that governmental policies are geared towards ensuring equitable support for pastoralists, particularly in terms of access to water and markets.[49]

For small island states in Eastern Africa where marine and coastal resources are the backbone of their economies and livelihoods, there is a strong degree of integration of climate resilience-building strategies in policies pertaining to the blue economy. For example, the Seychelles launched the Blue Economy Strategic Policy Framework and Roadmap for 2018–2030, which seeks to integrate the island state's approach to ocean-based sustainable development, with economic diversification and food security being among its strategic priorities for action and investment (SMSP 2018). While climate resilience features prominently in its policies, implementation is limited due to its status as a high-income country,[50] which limits its access to necessary aid and funding. In turn, this limits the country's capacity to effectively monitor and manage marine resources, and thus respond to the impacts of climate change.[51]

Climate-conflict sensitivity

The government of Kenya has already implemented a number of policies and strategies on climate, environment and food security that understand and acknowledge climate-related security risks and the conditions under which such risks emerge. Strategies related to development and disaster risk reduction are particularly well-advanced in terms of overall coherence and awareness of climate security links. However, peace, security and gender-related policies have limited sensitivity to climate security risks. Moreover, Kenya's policies and strategies remain limited in terms of implementing climate security-sensitive programming that explicitly aim to address and prevent such risks (Schapendonk et al. 2022).

The government of Uganda is increasingly embedding aspects of livelihood resilience and grassroots engagement in its responses to conflict and security issues. Learning from past limitations in addressing conflict and violence in the Karamoja cluster, which were heavily focused on coercive militaristic disarmament campaigns, the government launched the Karamoja Integrated Disarmament and Development Programme (KIDDP) in 2006. Among its measures, the KIDDP worked closely with civil society and inter-governmental organisations in the region to support the provision of basic social services, alternative livelihood means, and conflict management and peacebuilding processes alongside disarmament activities. Importantly, the KIDDP began to include a wide range of non-state actors to improve coordination and foster community trust in state interventions (Kachope 2021).

Human health

National level climate policies in Eastern Africa are increasingly recognising the importance of human health considerations in addressing climate-related impacts. The government of Kenya has created the National Climate Change Action Plan, which includes a commitment to enhance knowledge of climate-related impacts on mental health, and incorporate mental health considerations into programmes and policies on climate change. Similarly, the government of Rwanda has launched the National Climate and Environment Fund, which supports programmes that provide community-based psychosocial support networks to enhance mental health and well-being. Through its nationally determined contributions, the government of South Sudan is aiming to strengthen the climate resilience of its health systems, and to better understand the links between human health and climate change (ICPAC 2023a).

Conservation and resilience

Environmental conservation can often be a good entry-point for socioeconomic development, building climate resilience, and preventing or resolving conflicts around natural resources. In Rwanda, Volcanoes National Park applied tourism revenue sharing to integrate wildlife conservation with rural development. Through this programme, tourism revenues are directly or indirectly channelled to residents who live adjacent to protected areas. Despite existing challenges, this approach can help to create mutual benefits and build local support for conservation (Munanura et al. 2016).

COMMUNITY-LEVEL INITIATIVES

Community-level initiatives have historically played important roles in conflict mediation, peacebuilding and resource management in many areas of Eastern Africa. Given the very localised impacts of climate-related events on climate-sensitive livelihoods, community-level interventions continue to be an important factor in ensuring climate-related security challenges are effectively addressed in the region.

In Eastern Africa and especially in the Horn of Africa, community-level adaptation initiatives can be broadly placed into one or more of the following four categories: (1) holistic approaches that incorporate aspects of early warning, environmental protection, conflict management and prevention, and livelihood resilience; (2) resource management approaches that are centred on governance, peacebuilding and early warning; (3) environmental rehabilitation and enhancement (e.g. reforestation); and (4) approaches that strengthen livelihood resilience (e.g. enhancing agricultural productivity and market access) (UNDP 2023c).

Integrated responses

Due to the multidimensional and multicausal character of climate insecurity, integrated responses, for example, that combine livelihood opportunities with social cohesion and peace objectives appear to offer more promise for building climate resilience (Kurtz and Elsamahi 2023). Projects that focus solely on creating employment opportunities, for instance, are found to have limited impact on peace more broadly (Brück et al. 2021). An analysis of USAID programs that focus on peacebuilding, climate change, and environmental issues in the Horn of Africa found that integrated approaches, such as combining livelihood support with social cohesion, have consistently improved people's ability to manage conflicts and cope with climate-related shocks (USAID 2020). A project implemented in Uganda's West Nile region supported refugees to broker land-sharing agreements with local farmers to engage in agroforestry, which helped to boost agricultural production and generate revenue for both stakeholders. In addition, the project helped to counter environmental degradation, and

49 Input provided during the regional consultation on climate security in Eastern Africa, hosted by adelphi and the IGAD in Nairobi on 5 May 2023.
50 Income level as defined by the World Bank: https://data.worldbank.org/country/SC.
51 Input provided during the regional consultation on climate security in Southern Africa, hosted by adelphi and the SADC in Gaborone on 7 June 2023.

appeared to improve social cohesion and peaceful coexistence between refugees and host communities (Destrijcker, Kyeyune and Dieffenbacher 2023). Finally, research on integrated peacebuilding programming[52] on the border of Kenya and Uganda suggests that such interventions contribute to enhanced access to water and pasture for pastoralists, which helps pastoralists prevent and cope with livestock losses during periods of drought (Carson et al. 2021; Kurtz and Elsamahi 2023).

Research conducted in southern Ethiopia has shown that peacebuilding initiatives[53] have contributed significantly to the resilience of pastoralist groups in the face of drought by enabling mobility and resource access (Kurtz and Elsamahi 2023). Furthermore, the research found that enabling pastoralists to have greater freedom of movement and access to natural resources made them less likely to rely on distressful coping mechanisms – including violent competition – in response to extreme drought and more likely to employ peaceful adaptive capacities, compared to groups without such access (Kurtz and Scarborough 2012). Similarly, evidence from the Abyei Administrative Area, a contested zone located on the central border between South Sudan and Sudan, indicates that implementing community-based animal health veterinary services within an agricultural livelihood support strategy played a pivotal role in enhancing community relationships and maintaining peace. Increased dialogue between clashing groups over natural resources resulted in a local peace accord that improved access to shared grazing zones and water access (FAO 2017b).

Civil society groups

Civil society groups are making important contributions to early warning and early response systems across Eastern Africa. Such support has largely come through formal and informal networks, such as the East African Civil Society Organizations' Forum (EACSOF) (GPPAC 2022).[54] For example, in Kenya, civil society organisations are an integral part of the country's conflict early warning and response strategy. For example, religious councils and local peace committees in Kenya have been instrumental in providing essential early warning information, as well as filling governance gaps where the state's presence and capacity to provide services are limited (Babatunde Amao et al. 2014).

Civil society groups play important roles in natural resource management in Eastern Africa. In particular, a number of community-led initiatives are leading the way in ensuring that communities are at the forefront in managing key climate-sensitive resources such as forests, land, water and marine ecosystems, while at the same time ensuring that communities are effectively engaged in conflict mediation and peacebuilding processes (see Box 3: Northern Rangelands Trust).

For example, water resource users associations have been established in areas of Kenya with the aim of regulating water use, conserving water resources, and mediating and mitigating water-related conflicts, with strong stakeholder involvement, including of water users and riparian landowners (UNDP 2023c). In the Great Lakes region, beach management units have been set up to strengthen community participation in the sustainable management of fisheries, and to enhance social cohesion and collective action (Vaccaro I et al. 2013; Nyboer et al. 2022). Some beach management units have worked closely with women and young people to enhance reproductive health, family planning and economic opportunities, while simultaneously promoting sustainable lake resource management (Pathfinder International 2018).

In coastal areas, locally managed marine areas known as tengefus have been established to conserve marine and coastal biodiversity and habitats, while enhancing sustainable livelihoods, and ensuring secure and collective tenure of marine resources by coastal communities. Tengefus have helped diversify coastal livelihoods by supporting activities that are in line with marine conservation principles (e.g. ecotourism, coral farming and rehabilitation), and have been successful in restoring fish populations and coastal habitats (UNDP 2023c).

Many civil society organisations, however, face challenges in terms of inadequate institutional and technical capacities, and financial resources to ensure the timeliness and effectiveness of their work (Babatunde Amao et al. 2014). The beach management units in the Great Lakes region, for example, were initially successful in enhancing adaptation and addressing aspects of illegal fishing; however, the effectiveness and legitimacy of some beach management units have waned due to corruption, management issues, a lack of sustained engagement and insufficient funding (Nyboer et al. 2022).

In addition, peacebuilding concepts are rarely included in resilience programming and alterna-

tive livelihood generation initiatives at the community level across the region. One notable exemption is the participatory biosphere management plan for the Majang Forest Reserve in Ethiopia. The programme previously had a peacebuilding component, which participants saw as an important factor that improved the programme's overall results, particularly in developing dialogue and mutual understanding between community groups (UNDP 2023c). This example highlights the need for community-based adaptation and development initiatives to fully incorporate and institutionalise peacebuilding components in their programming.

BOX 3:
NORTHERN RANGELANDS TRUST (NRT)

The NRT is a community-based organisation that aims to develop community-led conservancies in the northern and coastal regions of Kenya and Uganda. Specifically, the NRT aims to enhance livelihoods, build peace, and conserve landscapes and wildlife by promoting community-led efforts to sustainably manage natural resources, including forests, land, river and marine ecosystems (NRT n.d.). The NRT has made important achievements in collecting data on weather conditions, conflict incidents and vegetation conditions, while also building peace, devoting considerable efforts to involve women and young people as peace ambassadors, and ensuring continuity and local ownership of resource management processes (UNDP 2023c).

Traditional authorities and cultural norms

Traditional authorities have historically played an important role in managing and mediating cattle rustling activities (Idris 2018). Across Kenya, empirical studies show how local conflict resolution mechanisms have kept the risk of inter-group violence to very low levels (Ide et al. 2014; Linke et al. 2015; van Baalen and Mobjörk 2018). In the lower Omo region of Ethiopia, some pastoralist groups have been able to reduce the risk of conflict over grazing land through negotiations and interplays between individual actors in the absence of formal resource-based rules (Tadie and Fischer 2017). In South Sudan, church-based organisations have played an instrumental role in conflict resolution and peacebuilding between pastoralist groups, such as the Dinka, Murle and Nuer, by providing a space for dialogue and reconciliation between groups (Climate Diplomacy n.d.c).

Moreover, local cultural norms influence how potential conflicts are mitigated or addressed. In areas of Eastern Africa, particularly where Islam is practised, mutual trust and shared understanding of cultural norms prohibit people from committing crimes and violence. These norms are well-understood by local communities and have been incorporated in several peacebuilding initiatives in the region. For example, the Wajir Peace and Development Committee, based in the Wajir District in Kenya, incorporates traditional Islamic mechanisms and values in its conflict resolution initiatives, and has made notable achievements in monitoring tensions and preventing violence in the district, while also raising awareness of women's contribution to peacebuilding in communities (Lado Tonlieu 2021).

There is evidence showing that indigenous customs are instrumental in maintaining the health and integrity of natural landscapes, and thereby conserving natural resources such as forests. Examples include the Tepeth and Pokot societies in Uganda, where strict adherence to traditional resource management practices has kept the forests they inhabit in relatively good condition. Similarly, along Kenya's coasts, where Kaya elders retain an active role in resource management, tree growth and overall environmental conditions remain healthy (UNDP 2023c).

Private sector

In Eastern Africa, the private sector has significantly contributed to climate adaptation by providing adaptive climate services, including agricultural extension services and livestock insurances. In areas of Eastern Africa, private agents and NGOs providing agricultural input and extension services have been able to reach more farmers than formal providers (Nkonya et al. 2018). In Uganda, for example, private insurance providers are enabling barley farmers to access agricultural insurance services more quickly and at lower costs through digital tools, with major barley purchasers such as Nile Breweries covering the upfront insurance costs and deducting the fee from farmers' crop payments at the end of the season (GSMA 2020).

There are examples across Eastern Africa where the private sector has contributed towards enhancing climate resilience of climate-sensitive livelihoods through interventions along the value chain. For example, East African Breweries Limited in Kenya has developed a new type of beer

that provides small-scale cereal producers with direct access to a market for more climate-resilient crops (Gannon et al. 2020).

Financial institutions are empowering the private sector to take a more active role in climate action. The Kenya Commercial Bank (KCB) is accredited to the Green Climate Fund to boost private sector access to green financing in Kenya (KCB n.d.). In Rwanda, the Rwanda Green Climate Fund enables the private sector to access funds for climate change adaptation and mitigation at interest rates below market rates in an effort to strengthen private sector engagement in climate action (Rwanda Green Fund n.d.).

BOX 4:
THE KARAMOJA CLUSTER

The Karamoja cluster, a region shared by pastoralist and agropastoralist communities in Ethiopia, Kenya, South Sudan and Uganda, provides an example of how civil society groups and traditional authorities have played important conflict-mediating roles. In Kenya, "peace caravans" have made headways in promoting dialogue and solutions to conflict, while also lobbying for state-sponsored development and peacebuilding (Okumu 2013). Councils of elders have traditionally mediated conflicts between pastoralist groups by determining the terms of conflict settlement and compensation, and mutual natural resource management, such as grazing rights. However, the role of these councils has diminished due to the proliferation of arms and weapons, which has led to an escalation in violence, especially cattle raiding, as well as incoherent land tenure institutions (Climate Diplomacy n.d.b).

Community peace rituals also play an important role in enabling communities in Karamoja to coexist peacefully. For example, lactating mothers from the Jie and Dodoth communities sometimes exchange their infants for breastfeeding, which analysts have found can sustain long-term peace between the communities (IGAD CEWARN 2022b).

Although women have an integral role to play in the conflicts in Karamoja through, for example, the provision of intelligence and supplies for cattle raiders, women are largely excluded from and have no direct role in formal or informal conflict resolution and peacebuilding processes. Recent observations, however, suggest that this may change, as women are starting to take on more prominent roles as conveners of conflict resolution dialogue and counselling – roles that were previously reserved for traditional male leaders (UNDP 2022b).

Although intermittent clashes and thefts still occur, the Karamoja cluster is relatively free from deadly violent cattle raids, owing to the recognition and active implementation of climate-sensitivity and grassroot support in security interventions (Kachope 2021).

Sahel: A region under pressure

Geographical and climatic conditions
While definitions vary, the Sahel can be described as a transitional region located between the Sahara Desert to the north and the tropical savannahs to the south (OSCDS and UNHCR 2022). It spans from the Atlantic Ocean in the west to the Red Sea in the east, and covers a number of countries that are part of Western, Central and Eastern Africa. Common definitions include Senegal, Mauritania, Mali, Burkina Faso, Niger, Nigeria, Chad, Sudan, Eritrea, Ethiopia and Djibouti as Sahelian states.

An escalating cycle of insurgency and counter-terrorism operations has destabilised the security situation in the Sahel. In 2023, the Central Sahel suffered the highest number of conflict fatalities in recent years (Luengo-Cabrera 2023). Separatist and, more recently, Islamist armed groups are being fought by military-dominated governments and, occasionally, foreign actors such as the Russian Wagner mercenary group. This cycle of violence has strongly affected the civilian population (Puig Cepero et al. 2021). The conflicts have largely centred on Burkina Faso, Mali and Niger, but have started to spill over into Western African littoral countries such as Côte d'Ivoire and Benin (ACLED 2022). Following the destabilisation of Sudan, the eastern Sahel is also under increasing pressure.
Current trends and future projections for the Sahel indicate an increase in rainfall variability, rising temperatures, and the growing severity and frequency of extreme weather events, namely droughts and flooding (Puig Cepero et al. 2021). Rising temperatures add to already high temperatures, increasing the number of very hot days above 35°C (IPCC 2022). Population and economic growth across the Sahel are driving increased land use, including deforestation. Despite these developments, areas of the Sahel have seen increased wetting and greening conditions after the heavy droughts of the 1980s (Nagarajan 2022). However, uncertainty regarding these models and particularly precipitation projections is high, and it is unclear if the positive gains in vegetation growth will be countered by rapid population growth, overgrazing and other human-made interventions (Puig Cepero et al. 2021).

Climate security risks
In terms of climate-related security risks, there are a number of common risks that are shared across the Sahel region:

1. Livelihood insecurity and natural resource conflicts: Livelihoods and resource access and availability across the Sahel are highly sensitive to the impacts of climate change. Most countries in the Sahel are characterised by low levels of economic diversification, with climate-sensitive sectors such as agriculture and pastoralism being the dominant economic activities (UNECA 2019). Today, conflicts over natural resources – in particular land and water, but also forests and fisheries – are a major security challenge in the region.

2. Armed groups are actively exploiting climate security risks: Areas of the Sahel have been a hotspot of activity by violent Islamist groups such as Al-Qaeda and Boko Haram. Armed groups are actively exploiting climate change-induced state weaknesses and livelihood insecurities, among other things, to provide economic incentives that foster grievances against the state and strengthen their own position (DeConing and Krampe 2021).

3. Maladaptation: In the face of deteriorating livelihoods, communities across the Sahel are trying to adapt. Some adaptive strategies, however, bring their own risks. For example, in Sudan, many IDPs as well as pastoralist groups, facing poverty and lack of employment, have resorted to charcoal production (UNEP and HCENR 2020), resulting in deforestation and renewed conflicts as timber exploitation encroaches upon new areas (Foong et al. 2020a). Similarly, artisanal gold mining across the region provides an important livelihood, but also contributes to the financing of armed groups from Mali to Sudan (Waal 2019).

4. Migration: Human mobility, particularly seasonal and circular migration, is an important coping strategy for many Sahelian communities in times of economic and environmental stress. However, displacement and irregular migration in response to changing environmental conditions and violence are significant challenges that sometimes further aggravate local resource competition and strengthen armed groups when they facilitate human trafficking through the Sahel.

Regional responses

Recognising the converging risks posed by climate impacts and conflict on security and development in the Sahel, states in the region, the United Nations and international partners have established a number of initiatives and specialised bodies dedicated to addressing these challenges.

- The **UNISS** was established in 2013 and operationalised in 2018 through the **UN Sahel Support Plan**, with the aim of bringing greater coherence, coordination and efficiency to the collective responses to crises in the Sahel. UNISS hosts the Sahel Predictive Analytics project, initiated by the UN High Commissioner for Refugees (UNHCR) in 2019, to guide data sharing, preparedness and evidence-based decision-making related to climate security in the Sahel (OSCDS and UNHCR 2022).

- The **UN Special Coordinator for Development in the Sahel**, appointed by the UN secretary general, leads collective and integrated efforts across the Sahel to scale up development in the region. The Office of Special Co-ordinator for Development in the Sahel (OSCDS) is responsible for leading collective efforts, including financing, to implement the UNISS.

- The **Permanent Interstate Committee for Drought Control in the Sahel (Comité permanent inter-État de lutte contre la sécheresse au Sahel, CILSS)**, along with its regional centre Aghrymet, is an early warning initiative specialised in providing climate forecasts, surveys and training. This includes climate forecasts and predictions, and the monitoring of agriculture and herding, which help farmers prepare for extreme weather events. Both institutions conduct hydrological and ecosystem surveys to track ecosystem evolution and degradation.

- The **G5 Sahel** is an institutional framework between the five Sahel countries, namely Burkina Faso, Chad, Mali, Mauritania and Niger. It was founded in 2014 and sits in Mauritania. It coordinates development policies and security matters.

- The **Sahel Alliance**: In July 2017, France, Germany and the European Union announced the launch of the Sahel Alliance to respond to G5 needs and increase coordination between partners for the implementation of assistance and projects. The founding members were joined by the World Bank, the African Development Bank, the UNDP and other countries.[55]

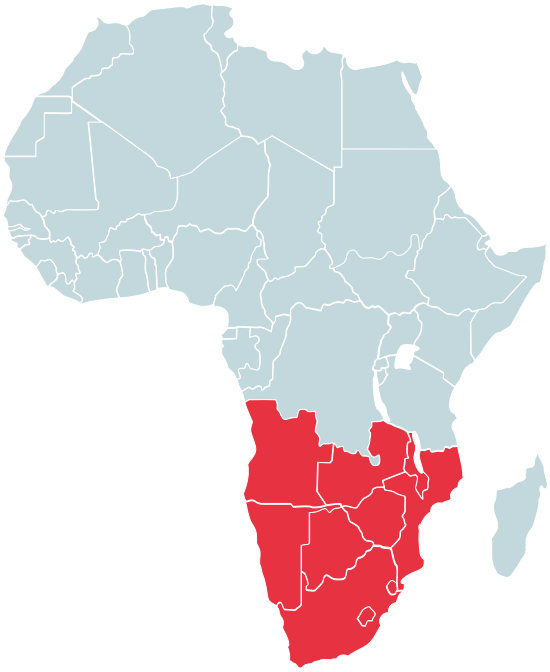
- The **Great Green Wall (GGW) of the Sahara and the Sahel** is an AU project to combat desertification across the Sahel, which, among other things, contributes to climate change mitigation and adaptation (UNCCD 2020). Launched in 2007, the reforested area is supposed to stretch 7,000 km, but only a small percentage of these plans have been achieved so far (Bove 2021; Gravesen and Funder 2022; Mutanda Dougherty 2023). Nonetheless, the initiative provides a valuable impetus and important lessons learned (see page 33 for a more detailed discussion).

In recent years, several Sahelian countries,

including Mali, Burkina Faso, Chad and Niger, experienced a series of military coups that started to shift the intra-regional and geopolitical relations in the Sahel. Following international condemnation and sanctions, the three military-led governments of Burkina Faso, Mali and Niger quit ECOWAS, citing their intent to better counter terrorists in their countries and severties with Western countries active in the region (Dini-Osman 2024). These developments have weakened regional cooperative efforts around international security, which consequently poses a threat to cross-border security that can worsen existing humanitarian crises, food insecurity, transnational crime and environmental hazards (Dan Suleiman 2023).

55 The Sahel Alliance: https://www.alliance-sahel.org/en/sahel-alliance/

Southern Africa



Summary

KEY CLIMATE IMPACTS

Temperature: The air temperature over Southern Africa is projected to rise with high certainty by between 1.9°C and 2.2°C under a low emissions scenario (RCP2.6), and between 2.9°C and 4.1°C under a high emissions scenario (RCP6) by 2080 relative to 1876. The highest values are projected for Botswana, eastern Namibia and the north of South Africa. The Kalahari region will experience the highest rises, while coastal areas will be less affected.

Precipitation*: Overall mean annual rainfall has decreased in the Western Cape and areas of South Africa, while increasing in Namibia, Botswana and southern Angola. Future precipitation projections for Southern Africa show a high degree of uncertainty and vary across the region depending on the emissions scenario. However, southwest and central regions, as well as areas of Zimbabwe and Mozambique, are expected to become drier. Meanwhile, there will be increased precipitation in the southeast.

Sea level rise: Between 1993 and 2021, sea levels rose faster than the global average along Southern Africa's coasts. Projections indicate higher rises under RCP6.0, threatening Mozambique in particular. It is estimated the median increase in sea level rise across the entire coastline of Southern Africa will be around 35.9 cm under RCP2.6 and over 43 cm under RCP6.0 by 2080. However, the uncertainty around the magnitude increases with time.

Flooding*: Exposure to flooding in Mozambique, Botswana and Malawi has increased. At the same time, droughts, both agricultural and meteorological, have become more frequent. Projections of flooding are subject to high modelling uncertainty due to the uncertainty of future precipitation projections. However, median projections for Southern Africa indicate an increased exposure of national roads to river flooding at least once a year under RCP6.0, with the range likely widening from 0.08–0.16 per cent in 2000 to 0.10–0.24 per cent in 2080.

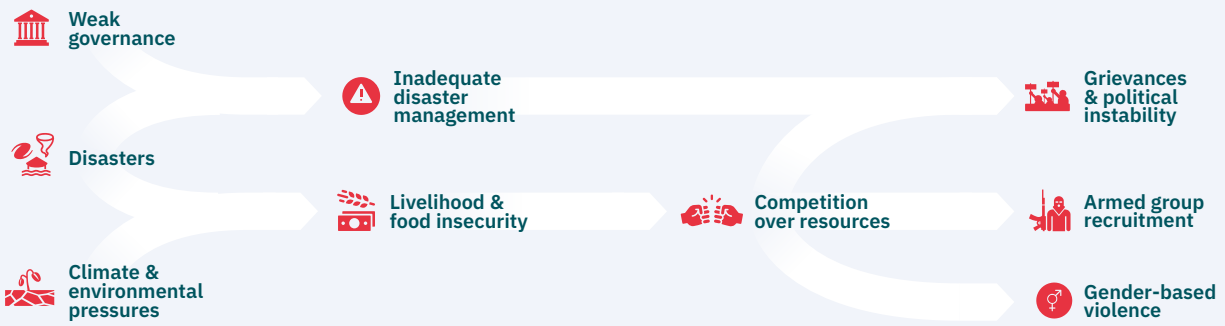
Droughts*: Drought projections for Southern Africa are subject to significant uncertainties, but indicate a general increase in drought conditions. Soil moisture and potential evapotranspiration are two important indicators for measuring drought conditions. Annual mean soil moisture for a soil depth up to 1 m shows a decrease of 3.2 per cent under RCP2.6 and 3.8 per cent under RCP6.0 by 2080, compared to the year 2000. Under RCP6.0, potential evapotranspiration is projected to increase by 8.3 per cent in 2080, compared to the year 2000. Albeit with large year-to-year variability and modelling uncertainty.

Cyclones: Tropical cyclones regularly hit southeastern Africa, causing rainfall and flooding. Rising ocean temperatures have intensified cyclones. While quantifying future impacts remain challenging, cyclones that make landfall are projected to increase in intensity, potentially causing significant damage, particularly in central and northern Mozambique.

* Climate projections with high uncertainty need to be interpreted with great caution. Please refer to the Annex for an explanation of uncertainty in climate projections.

CLIMATE SECURITY PATHWAYS IN SOUTHERN AFRICA

Pathway 1: More frequent weather induced disasters compound root causes of instability



Southern Africa is one of Africa's most disaster-prone regions and the frequency of natural hazard-induced disasters is increasing due to climate change. Population growth, unplanned urbanisation, inadequate governance and infrastructure, and uncoordinated early warning systems make the region more vulnerable to weather-related disasters. In turn, this increases the risk of livelihood and food insecurity, which drives social unrest, political instability and violent competition over resources. Disasters decrease social cohesion as state services are strained, development is hindered and health conditions worsen without effective state responses. In addition, there is an increase in GBV, which is a particular risk for women and girls in the aftermath of disasters.

Pathway 2: Climate risks and conflict impact human mobility

Climate change will increasingly affect human mobility in Southern Africa. Climate impacts are accelerating economic migration from rural to urban areas as well as rural-rural migration. At the same time, climate impacts drive displacement, with particularly larger-scale, unregulated and unmanaged movements exacerbating security risks. For example, the influx of rural young migrants into fragile urban areas strains resources, exacerbating poverty, inequality and social instability. Moreover, discrimination, xenophobia and violence against migrants are growing concerns in the region.

Pathway 3: Land and water access and use conflicts

Land tenure and use, and water management conflicts have long existed in Southern Africa, and climate change is increasingly affecting existing conflict dynamics and contributing to new ones. These conflicts are driven by various socioeconomic and governance-related factors, such as colonial legacies and disputes over land ownership. Land use conflicts exist between conservation, extractive activities, industrialised food production and communal subsistence agriculture. Similarly, population growth, climate-induced water scarcity and poor law enforcement of industrial activities that cause pollution exacerbate regional, national and local water conflicts. In urban areas, corruption and inadequate infrastructure contribute to social tensions and protests.

Pathway 4: Weak governance of high-value natural resources

Southern Africa's natural resource wealth presents economic opportunities but also poses risks. Weak governance, climate impacts and the transition to a low-carbon economy can escalate conflicts around mining. Abundant mineral deposits promise a green energy transition, but corruption, unequal distribution and ecosystem degradation fuel social tensions. Southern Africa's transition to a low-carbon economy entails risks such as job losses and governance challenges. Increased demand for minerals may compromise protected areas, while the governance of natural resources requires clarity to manage climate security risks effectively. Stranded assets and financial losses are also concerning, as the world moves away from fossil fuels, potentially impacting oil and gas projects and investments.

Context

GEOGRAPHY

The Southern Africa region comprises 10 countries: Angola, Botswana, Eswatini, Lesotho, Malawi, Mozambique, Namibia, South Africa, Zambia and Zimbabwe.[56] Southern Africa is a region rich in biodiversity and natural resources. The region extends south of the extensive Congo River Basin and comprises a narrow coastal plain along the South Atlantic Ocean to the west and the Indian Ocean to the east. A steeply rising inland plateau, the Great Escarpment, extends in a horseshoe shape from Angola to the Mozambique-Zimbabwe border, separating the coastal areas from the interior highlands. The highest peak in the region (3,482 m above sea level) is Thabana Ntlenyana in the Drakensberg Mountains in Lesotho. The interior of Southern Africa mainly consists of hilly plateaus. In the north of Namibia, on the border with Angola, lies the extremely dry Namib Desert, which in the south merges into the dry Kalahari Savanna (Binder 2023).

The region comprises several diverse agroecological zones with specific temperature and moisture regimes. These divide most of the region along different latitudes, which move in a north-south direction from a tropical sub-humid to a sub-tropic arid climate. A significant area of Zimbabwe, northern Zambia and Malawi, and the north of Angola are characterised by sub-humid, warm conditions. Southwards, aridity increases along the regions of the hot Namib Desert and the Kalahari, covering large areas of Namibia, Botswana, and the border areas between Zimbabwe, Mozambique and South Africa. An arid sub-tropical climate prevails across most of South Africa,

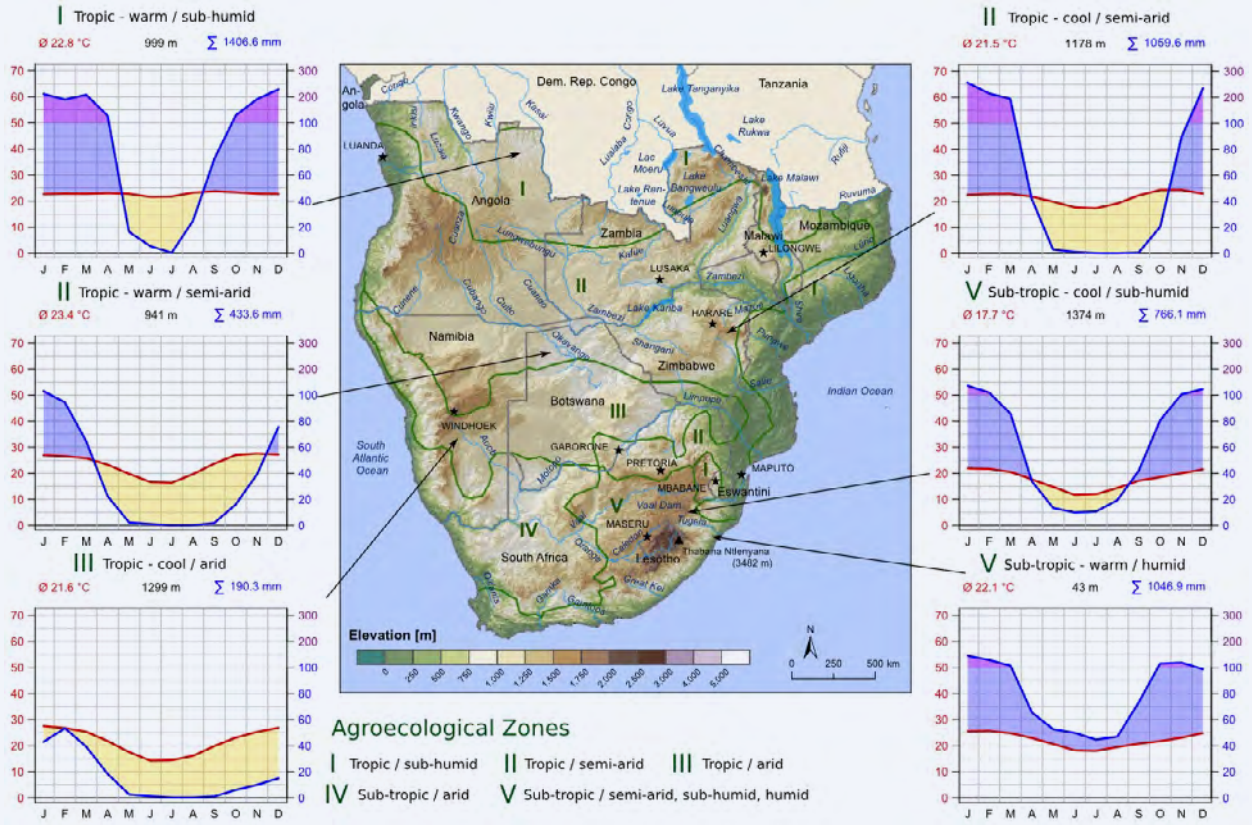


Figure 25: Topographic map of Southern Africa with existing precipitation regimes and agroecological zones (Binder 2023)

56 This report uses the African Union's classification system for geographic regions (https://au.int/en/member_states/countryprofiles2).

and in southern Namibia and Botswana, with humidity increasing towards the south. The south of South Africa, including the Western Cape, is characterised by sub-tropical semi-arid to sub-humid zones. Exceptions to these changes along the latitude are in the east, where average annual precipitation is much higher and regions of high elevation predominate. While a tropical semi-arid climate prevails in northeastern South Africa and the very southeast of Botswana, including Pretoria and Gaborone, a sub-tropic semi-arid to humid climate can be found in the mountainous southeast (Binder 2023).

The southern plateau covers much of Southern Africa. Most of the plateau is flat or rolling grassland, and used for crops and pastures. Southern Africa is home to several river systems, with the Zambezi River the most prominent. The 3,500 km Zambezi River plays a critical role for socio-economic life in Southern African. There are 128 million people living in the eight countries surrounding the Zambezi River Basin. They rely on the river as a vital source of food and water, both directly and indirectly (Swain et al. 2011).

SOCIOECONOMIC CONTEXT

Between 1990 and 2019, the combined GDP of Southern African countries more than doubled from USD 324 billion to USD 678 billion (ISS 2023a). In 2019, Southern Africa had the third highest regional GDP on the continent, behind Northern Africa with a regional GDP of USD 900.3 billion and Western Africa with a regional GDP of USD 816.4 billion. In 2043, Southern Africa is forecast to have the second lowest regional GDP on the continent (USD 1,257.9 billion), almost twice as large as in 2019. Within Southern Africa, the sizes of the economies are heterogeneous (AfDB 2019b).

The service sector is the main economic driver in Southern Africa, contributing to about 60 per cent of GDP in most economies in the region. South Africa is the largest contributor to this sector accounting for 67 per cent, followed by Angola and Zambia with 14 per cent and four per cent, respectively. Mining and quarrying constitute the second most significant sector, accounting for 14.4 per cent of the region's combined GDP (AfDB 2019b). This sector includes extracting minerals, precious metals, oil and gas. Angola, South Africa and Botswana significantly contribute to this sector with substantial oil, gold and diamond production. Zimbabwe is a significant producer of platinum and Mozambique exports gas. Agriculture, manufacturing, transport and tourism comprise 35 per cent of the regions' economy (UNCTAD 2021; AfDB 2023b).

South Africa is the region's largest economy, valued at USD 503.7 billion, and accounts for 74.2 per cent of the regional economy. Nevertheless, South Africa's economy has struggled since 2022 with sluggish growth, surging inflation and soaring unemployment. These difficulties have been exacerbated by devastating floods, which claimed many lives and caused extensive damage, including to Durban's largest port (Sheefeni 2022). The next largest, even if significantly smaller, economies are Zambia at USD 35.4 billion, Mozambique at USD 23.5 billion and Botswana at USD 23 billion (ISS 2023a). These countries are classified as low or medium in terms of human development, with Mozambique, Malawi and Lesotho considered the lowest in the region (UNDP 2022a). Nonetheless, poverty and economic inequality within and between Southern African countries remain the biggest challenge in the region. Almost 60 per cent of the region's residents live below the poverty line of USD 1.90 per day. Women, young people, and social and ethnic minorities are especially at risk of exclusion and poverty (Swain et al. 2011).

In terms of gender inequality, many Southern African countries score low in global comparisons, with particularly Malawi and Angola among the worst performers globally. However, some countries perform very well, such as Namibia, which ranks sixth. Other countries perform better in certain sub-indexes. For example, Botswana and Zambia have reduced the gender gap for workers in senior positions and achieved greater parity in estimated earned income. Lesotho, Botswana and Namibia are the region's highest-ranked countries for educational attainment (WEF 2023).

POLITICAL INTEGRATION

The most important regional mechanism is the SADC, which was founded in 1980. It is one of eight regional organisations in Africa under the umbrella of the African Union. Following the end of apartheid and the emergence of a new democratic state in South Africa, new common objectives were defined with the establishment of the SADC in 1992. Currently, the SADC has 16 member states,[57] which comprise almost 300 million people. Its objectives include monitoring political, economic, social and cultural developments in the member states.[58]

Another important organisation is the Common Market for Eastern and Southern Africa (COMESA), established in December 1994. COMESA comprises 21 member states, with a combined population of over 583 million, a combined GDP of USD 805 billion and global trade in goods value of USD 324 billion. Its primary goal is to create a robust economic trading bloc to surmount individual state barriers, emphasising regional integration for economic prosperity. In addition, COMESA places importance on fostering peace and security in the region (COMESA 2023). Similarly, the Southern African Customs Union (SACU) is a group of five countries in Southern Africa: Botswana, Eswatini, Lesotho, Namibia and South Africa. The primary aim of the SACU is to maintain the free flow of goods among its member states. To achieve this, the SACU has established a common external and excise tariff within its customs area (SACU 2023).

DEMOGRAPHICS AND MOBILITY

Southern Africa is a multi-ethnic region, with more than 16 ethnic groups predominately speaking Bantu languages (Silverstein 1968; Sengupta et al. 2021). As of mid-2020, the region had an estimated population of 363.2 million people and 6.4 million international migrants. A few countries serve as the economic pillars of the region, which explains high-level mobility defined by an array of trajectories, which encompasses short-term cross-border movements, circular movements and permanent migration (UNDESA 2022b). Southern African countries are both sources and destinations for migrants. In 2017, 53 per cent of out-migrants lived outside the region (UNCTAD 2018).

In Southern Africa, migration is predominantly motivated by the pursuit of employment and economic prosperity. Studies reveal that the majority of skilled migrants originate from countries outside the region, specifically Kenya and Uganda. South Africa's industries that require specialised skills, including finance, education, and information technology, are particularly attractive to migrants, and the country has the largest migrant population in the region. Additionally, highly skilled labourers from neighbouring countries, particularly Zimbabwe and Zambia, relocate to South Africa to work in education and information technology (Carciotto 2020). The country affected the most by forced displacement is Mozambique, which hosts more than 30,000 refugees, while more than one million people remain internally displaced due to violence and the devastating impacts of climate change (UNHCR 2022).

PEACE AND SECURITY

Southern Africa is regarded as the most peaceful and stable region in Africa. Nevertheless, the region continues to be affected by various forms of violence driven by racial and cultural polarisation, and different trends of marginalisation (Piccolino 2016). Many of the present challenges are related to past wars and conflicts. More than 20 years after the resolution of these conflicts, politics in South Africa, Mozambique, Zimbabwe, Angola and Namibia are still dominated by the liberation movement organisations that were the protagonists of past conflicts (Southall 2013).

The biggest ongoing conflict in the region began in Mozambique in 2017. The violent insurgency in the north threatens the lives and livelihoods of vulnerable populations, forcing people to flee to the neighbouring countries of South Africa and Malawi. The conflict is situated in the region of Cabo Delgado. The main drivers of which are inequities between areas in the country and weak natural resource governance. The armed extremist insurgents have exploited the lack of economic opportunities for vulnerable populations and their local grievances (Pirio et al. 2019). Two regional multi-lateral operations have been launched in Mozambique to support the government. First, on 23 June 2021, the SADC established the SADC Mission in Mozambique (SADC 2021). Second, since July 2021, around 1,000 troops from Rwanda have entered Cabo Delgado, operating under a bilateral agreement with Maputo, Mozambique, to secure the Afungi peninsula (ICG 2022).

57 Angola, Botswana, Comoros, the DRC, Eswatini (Swaziland), Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, the United Republic of Tanzania, Zambia and Zimbabwe.
58 The SADC extends beyond the AU definition of Southern Africa to include the DRC, Madagascar, Comoros, Mauritius, Seychelles and Tanzania.

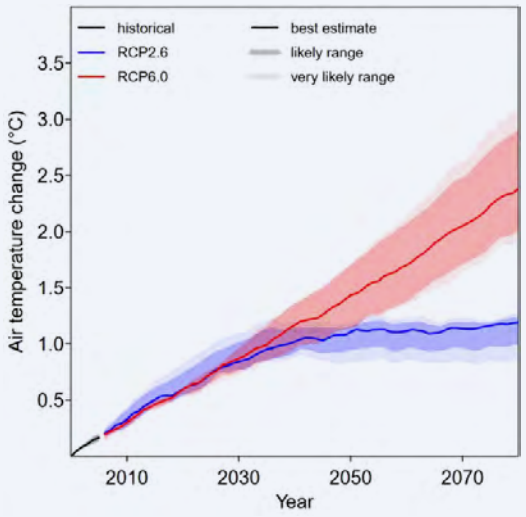


Figure 26: Air temperature projections for Southern Africa for different GHG emissions scenarios compared to the year 2000 (Binder 2023)

Climate change and impacts[59,60]

AIR TEMPERATURE

Between 1961 and 2015, mean annual air temperatures over Southern Africa increased by between 1.04°C and 1.44°C. A rise in very hot days has been observed over the last four decades, while cold extremes have declined in frequency (IPCC 2022).

Compared to the year 2000, future air temperature increases will affect the entire region with high certainty. According to the low emissions scenario RCP2.6, the air temperature will very likely increase by 1.8–2.1°C by 2030 and 1.9–2.2°C by 2080, compared to pre-industrial levels. The median temperature increase will be approximately 1.9°C by 2030, 2.1°C by 2050 and 2.2°C by 2080. On the other hand, under RCP6.0, the air temperature will increase by 1.7–1.9°C by 2030 and 2.9–4.1°C by 2080 (very likely range) (Binder 2023). The median temperature increase will be

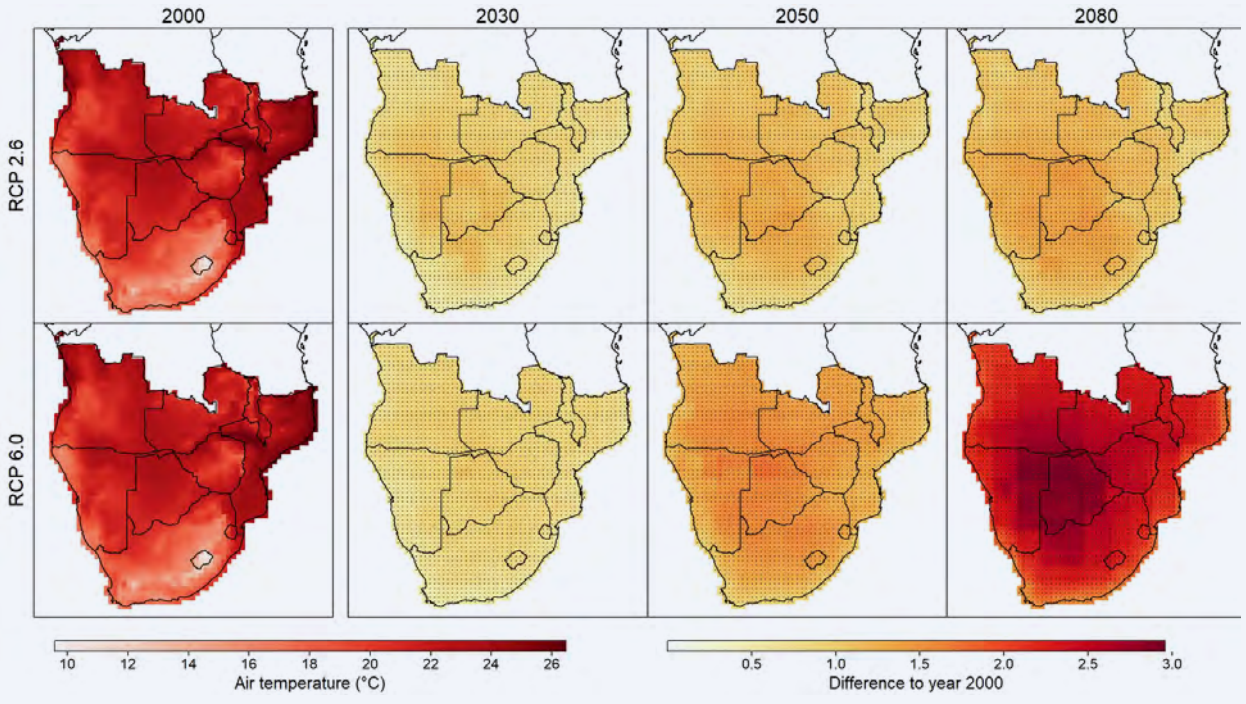


Figure 27: Air temperature projections for Southern Africa for different GHG emissions scenarios (regional variations) (Binder 2023)

1.9°C by 2030, 2.4°C by 2050 and 3.4°C by 2080 (see Figure 27). The magnitude compared to the year 2000 will vary, with the highest long-term rises in the dry Kalahari Savanna. According to the projections, Botswana is expected to experience the highest increase in average temperatures under RCP6.0, with temperatures rising to 2.9°C by 2080. In addition, eastern Namibia and the northern region of South Africa are likely to experience similar temperature increases. However, coastal regions are expected to have comparatively smaller temperature increases (see Figure 27).

In line with rising mean annual temperatures, the annual number of very hot days (with a daily maximum temperature above 35°C) is also projected to rise (see Figure 28). In some regions, especially in the Kalahari, but also in northern Angola, and on the border between Zimbabwe and Botswana, where very hot days are already common, a sharp increase is expected. In contrast, many mountainous regions, including those of Lesotho, Angola, Mozambique, Malawi, Namibia, South Africa and Zimbabwe, and coastal regions will be much less affected. Very hot days will rise substantially more under RCP6.0 than under RCP2.6 in the long run. The strongest increases are again expected in the north of Angola, assuming medium-to-high future emissions, with up to 122 additional very hot days expected by 2080 (Binder 2023).

Higher heat stress poses a risk to the population's ability to live and work (Andrews et al. 2018). Research has found that even under a 1.5°C compatible pathway, children born in 2000 in Southern Africa will be exposed to three to four times more heatwaves than people born in 1960. A 2.4°C warming increases this exposure to five to nine times more heatwaves. At the same time, cold-related mortality rates in some higher altitude regions such as Lesotho are expected to decline as temperatures rise (IPCC 2022).

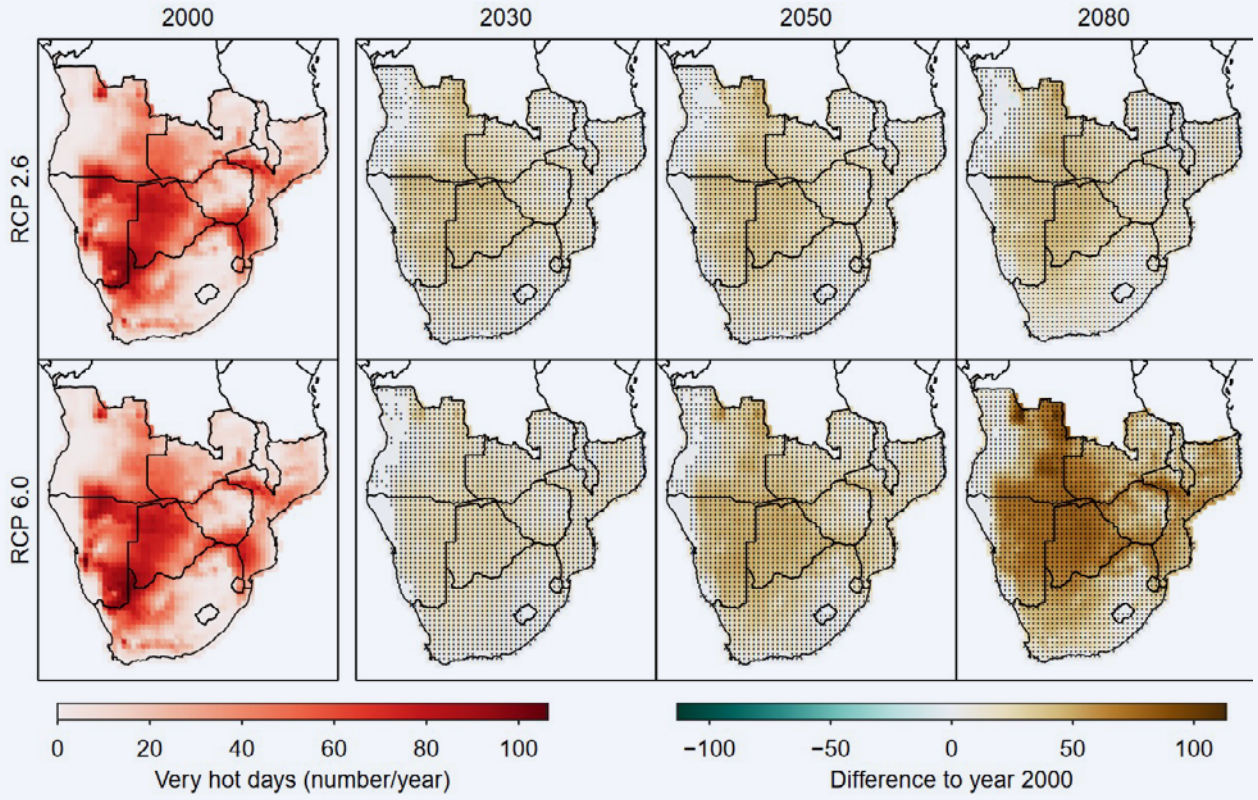


Figure 28: Projection of very hot days for Southern Africa for different GHG emissions scenarios (regional variations) (Binder 2023)

59 Please refer to the Annex for guidance on how to read the plots and an explanation of the concept of uncertainty in climate projections.
60 The summary of the key climate impacts in this section is based on: Binder L. 2022. Current and future climate impacts Southern Africa. Berlin: Potsdam Institute for Climate Impact Research.

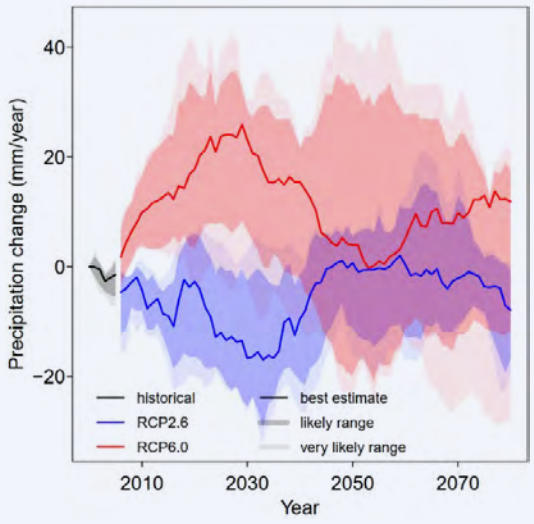


Figure 29: Annual mean precipitation projections for Southern Africa for different GHG emissions scenarios, compared to the year 2000 (Binder 2023)

PRECIPITATION

Since the 1960s, mean annual rainfall has decreased over the Western Cape and in the far east of South Africa. In contrast, in areas of Namibia, Botswana and southern Angola, precipitation increased from 128 mm to 256 mm between 1980 and 2015. At the same time, heavy precipitation events have intensified (Binder 2023).

Precipitation projections for Southern Africa are highly uncertain and differ significantly depending on the emissions scenarios, which show opposing trends (Binder 2023). Under RCP6.0, median precipitation changes amount to an increase of 23 mm by 2030 and 12 mm by 2080 (best estimates), compared to the year 2000. As the map plot shows, regionally explicit precipitation projections are subject to high uncertainties, and vary widely by scenario and time scale (see Figure 30). Overall, the already dry southwest and the central region are projected to become drier under all scenarios, with the same projected for most of Zimbabwe and Mozambique. An extreme decrease in precipitation is projected over the Western Cape of South Africa. In contrast, precipitation will increase over the southeast, including in Lesotho, Eswatini and eastern South Africa. The other regions show a mixed picture.

SEA LEVEL RISE

Between 1993 and 2021, sea levels have been rising at a rate of almost 3.8 mm per year along the

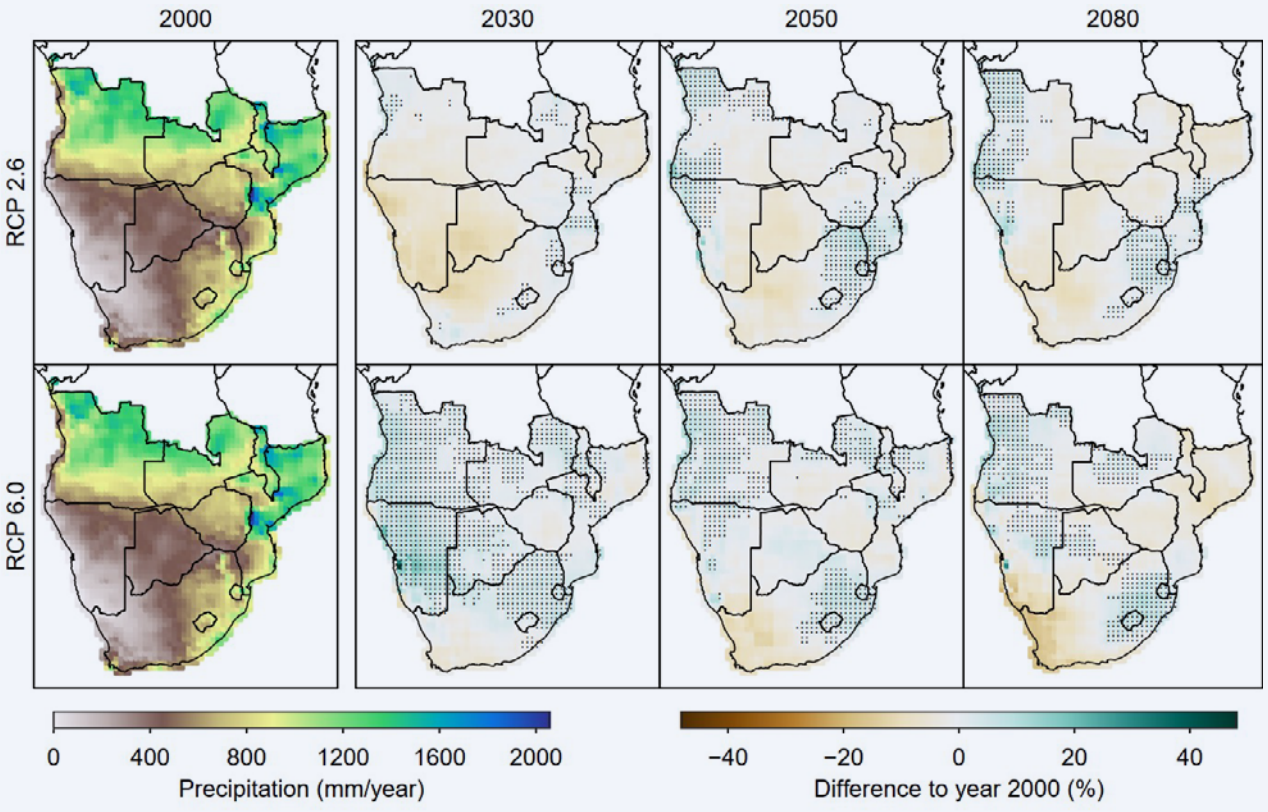


Figure 30: Precipitation projections for Southern Africa for different GHG emissions scenarios (regional variations) (Binder 2023)

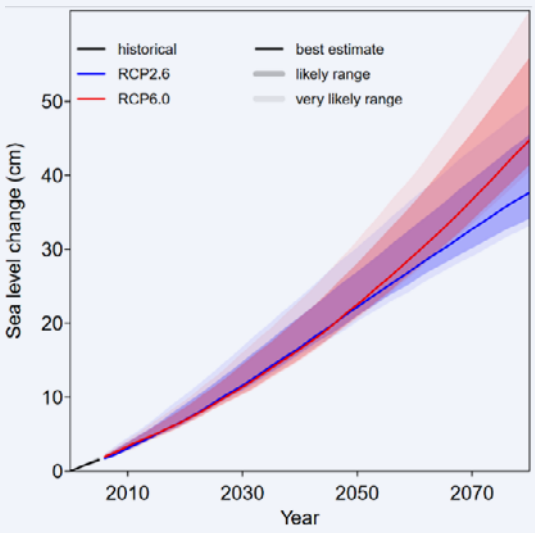


Figure 31: Annual mean sea level change projections around Southern Africa for different GHG emissions scenarios, compared to the year 2000 (Binder 2023)

western coasts of South Africa and over 3.9 mm per year in the southern Indian Ocean (along the eastern shores of Mozambique and South Africa). These rates exceed the global mean sea level rise of 3.3 mm per year (WMO 2021).

Projected sea level rise is a major concern for Southern Africa's coastline. According to the data, the median increase in sea level rise is expected to be around 11.4 cm by 2030 and 35.9 cm by 2080 under RCP2.6, compared to the year 2000 (Binder 2023) (see Figure 31). The median sea level rise under RCP6.0 will increase to around 11 cm by 2030. However, over the long term, the median increase will be much higher under RCP6.0, amounting to over 43 cm by 2080. It is important to note that the uncertainty around the magnitude of these increases grows with time. The rise in sea levels significantly threatens coastal communities and economies. It can cause saline intrusion in coastal waterways and groundwater reservoirs, rendering water unusable for domestic use and harming biodiversity (Binder 2023).

FLOODING AND DROUGHTS

In Mozambique, Botswana and Malawi, people's exposure to flooding is estimated to have increased by more than 50 per cent between 2000 and 2015 (IFAB 2022). Agricultural and meteorological droughts have increased by 2.5 to three events per decade between 1961 and 2016 (Spinoni et al. 2019). In Southern Africa, according to median estimates, there is an expected rise in the likelihood of national roads being affected by river floods under RCP6.0 (Binder 2023).

Projections for river flooding in the region are limited. For the Middle Zambezi River Basin on the border of Zimbabwe, Zambia and Mozambique, an area prone to flooding, projections indicate that peak flows will decrease under various climate change scenarios compared to the baseline period of 1988–2018, consistent with the projected decrease in rainfall (GFDRR n.d.).

In addition, Southern Africa will become a global drought hotspot under 1.5°C and 2°C global warming scenarios (Liu W et al. 2018). There is an increasing trend in potential evapotranspiration throughout Southern Africa. Under RCP6.0, potential evapotranspiration is projected to increase by 2.7 per cent in 2030 and 8.3 per cent in 2080, compared to the year 2000. Countries such as Botswana, Namibia and South Africa, which already have high rates of potential evapotranspiration, will have the highest absolute rates by the end of the century. Malawi and Mozambique will experience the highest percentage increases. The increase in evapotranspiration will impact the supply of water and the amount of surface water available for agriculture (Binder 2023). Under a high emissions scenario (RCP8.5), the duration of meteorological droughts is projected to double from around two months between 1950 and 2014 to around four months in the second half of the 21st century (Ukkola et al. 2020).

TROPICAL CYCLONES

The southeastern coast of Africa is regularly hit by tropical cyclones, which also bring significant rainfall and flooding to Mozambique, Zimbabwe and South Africa. Rising ocean temperatures increased the intensity and duration of cyclones over southeastern Africa between 1999 and 2016, compared to 1980–1998 (Vidya et al. 2021). Mozambique, which is particularly strongly affected, is hit by an average of 1.5 cyclones per season, with the cyclone season lasting from October to April (Mucova et al. 2021).

Due to the high degree of random variability, it is difficult to quantify the future effects of climate change on tropical cyclones (Masson-Delmotte et al. 2021). Nevertheless, cyclones that make landfall are projected to increase in intensity, with potentially highly damaging impacts. For central and northern Mozambique, where cyclones are already particularly destructive, some research suggests cyclones will not only become more intense, but also more frequent, though uncertainty regarding these projections is high (IPCC 2022).

Climate security risk pathways

MORE FREQUENT WEATHER INDUCED DISASTERS COMPOUND ROOT CAUSES OF INSTABILITY

Southern Africa is one of Africa's most disaster-prone regions, and the frequency of natural hazard-induced disasters is increasing due to climate change. Population growth, unplanned urbanisation, inadequate governance and infrastructure, and uncoordinated early warning systems make the region more vulnerable to weather-related disasters. In turn, this increases the risk of livelihood and food insecurity, which drives social unrest, political instability and violent competition over resources. Ineffective state responses to disasters also decrease social cohesion as public services are strained, development is hindered and health conditions are worsened. In addition, there is an increase in GBV, which particularly affects women and girls in the aftermath of such disasters.

Social unrest after disasters

The combined pressures of increasing weather-induced disasters, marginalisation, poverty and the costly impacts on the economy and infrastructure increase social tensions, especially when governments cannot adequately respond to humanitarian emergencies. When aid distribution is uneven or ineffective due to, for example, corruption and garnering political mileage, it can exacerbate a sense of injustice and marginalisation, contributing to grievances and social unrest.

Southern Africa is one of Africa's most disaster-prone regions and the frequency of natural hazard-induced disasters is increasing due to climate change (IPCC 2021). The southeastern coast of Africa is regularly hit by tropical cyclones, which bring significant rainfall and flooding to Mozambique, Malawi, Zimbabwe and South Africa. In Mozambique and Zimbabwe, weather-related disasters have contributed to social unrest and sparked protests. For example, following Cyclone Idai in 2019, affected populations were left without enough food, energy and water (Madurga Lopez et al. 2021). Affected communities complained that humanitarian assistance was insufficient, reconstruction efforts needed to be expedited and international aid was often held for too long in central government agencies or inadequately distributed to the local areas (Deutsche Welle 2019).

Similarly, in Malawi, international aid was affected by a financial corruption scandal, which undermined donor confidence in the government's disaster response and generated social unrest (Radha Adhikari et al. 2019). In South Africa's Bhambayi township, residents protested against being removed from temporary shelters after their homes were destroyed in floods. The government's slow response fuelled anger, with protesters demanding the restoration of services and alternative housing (Gustin 2022).

Disasters compound human security issues and root causes of conflict

Extreme weather events – together with other factors such as the COVID-19 pandemic, high international fuel prices and macroeconomic instability – affect food security in the region (SADC 2022). Food insecurity and price shocks can serve as powerful structural drivers, and triggers of instability and social unrest, particularly in communities highly dependent on agricultural livelihoods and where grievances against governments already exist (Raleigh et al. 2015; Morales-Muñoz et al. 2020).

For example, climate-induced food insecurity in Bulawayo and Matabeleland in the north of Zimbabwe has been shown to have far-reaching consequences, including an alarming rise in the likelihood of engaging in violent acts (Maphosa 2022). Matabeleland is home to a mosaic of ethnic minorities that have experienced structural marginalisation. As drought frequency and intensity increases, vulnerabilities also intensify, aggravating grievances and social unrest in the area, and pushing local communities to engage in natural resource disputes and protest (Madurga Lopez et al. 2021; Ferre Garcia et al. 2023). Similarly, in Angola in 2012, escalating food prices combined with unresolved land rights issues, corruption and rural poverty sparked widespread protests (SADC 2019). In Zambia, the interaction between climate impacts, constrained employment prospects, poverty and economic instability has contributed to an increase in crime and the vulnerability of local communities. Crimes such as sexual abuse, and the theft of livestock and crops have been found as maladaptive responses that rise due to the weakened livelihood options of pastoralist and agricultural populations (Medina and Belli et al. 2022; Caroli 2023; Medina et al. 2023).

Cyclones and droughts have exacerbated other human security issues in southern Angola, northern Namibia and southern Zambia (IFRC 2021). In southern Zambia, for example, droughts coupled with unsustainable monocultural practices have negatively affected agricultural production and

exacerbated food insecurity (Caroli 2023; Sax et al. 2023). Various studies across the region have identified increased security incidents, including the theft of stock and general insecurity on farms, during periods of drought. These incidents were closely associated with heightened unemployment, hunger and compromised livelihoods, which in turn hindered the capacity of households to cope effectively with the effects of water stress (Akpalu 2005; Kamara et al. 2018). In addition, other studies have identified a series of government failures in resilience building. These include slow responses in providing security measures to protect against farm attacks and stock theft (especially during periods of drought), poor service delivery, insufficient and delayed drought relief, a lack of training, and inadequate early warning information (van Riet 2012; Bahta et al. 2016). For example, in Zimbabwe, drought shock has been associated with an increased propensity for people to experience violence around water points, with a higher probability according to the severity of the drought (Chigusiwa et al. 2023).

Disasters put pressure on state services, and weaken the ability of public institutions to solve structural development problems and root causes of conflict, such as inequality, marginalisation and poverty. For example, northern Mozambique is structurally marginalised. Consequently, inequality, poverty, youth unemployment and political exclusion are driving recruitment into religious extremist groups (Ewi et al. 2022). These dynamics are further compounded by increased weather-induced disasters, which exacerbates the region's fragility and provides an opportunity for extremist groups to exploit the situation to gain a foothold in the area (Meek and Nene 2021). As climate hazards destroy important infrastructure, humanitarian actors face difficulties accessing affected areas and insurgent groups exploit the situation to act as alternative service providers. Furthermore, extreme weather events destroy crops, aggravating food insecurity (UNHCR 2022).

After a naturally induced disaster, governments often need to redirect funds from education and health care to support emergency responses and reconstruction efforts. In general, the cost associated with weather-induced disasters to infrastructure and economic sectors slows development pathways. According to the African Development Bank, weather-related disasters will likely reduce the combined GDP of Southern Africa by 10 per cent per year by 2050 (Baarsch et al. 2019).

Gender-based violence

GBV is a significant security risk during and after disasters. Natural hazard-induced disasters and displacement particularly affect rural young people and women. In displacement situations, women often face an increased risk of abuse (sexual and physical), GBV, trafficking and human rights violations (IOM et al. 2022). Drought shock-induced water point violence significantly affects women and girls more than men and boys (Chigusiwa et al. 2023). A comprehensive study found that women residing in Southern African regions severely affected by drought faced an elevated risk of enduring physical and sexual violence perpetrated by their intimate partners compared to women in non-drought areas (Epstein et al. 2020). Further evidence from Namibia indicates that in communities grappling with food scarcity due to drought, five out of eight women resorted to transactional sex to provide for their families (IFRC 2015). With communities frequently affected by droughts leading to food insecurity, young girls are at greater risk of sexual abuse, partner violence and teenage pregnancy. For example, in Mozambique, during periods of drought, young girls have reported instances of older men offering gifts in exchange for sex as they engage in long journeys to collect water far from their homes (CARE International 2017).

Early warning and disaster risk reduction challenges

The effectiveness of early warning action is compromised by a lack of communication channels and trust in information providers, especially the government, as well as inadequate community involvement. Rural and marginalised communities often lack access to mobile networks, excluding them from modern early warning systems. In addition, individuals' confidence in the government significantly impacts their responses and actions during crises. In certain instances, people place greater faith in traditional local authorities, such as healers and indigenous leaders, than in the government. Without trust and active community inclusion, early warning systems often fail to mobilise and engage individuals effectively, hindering timely and appropriate responses to potential hazards or emergencies, such evidenced by the recent emergency associated with Cyclone Freddy in Malawi.[61]

61 As discussed during the ACRA consultation in Southern Africa in 2023.

The differences between Mozambique and Malawi's responses to Cyclone Freddy in 2023, and their respective outcomes, illustrate the vital importance of building trust in government for early warning systems. While in Mozambique fatalities were reduced by adhering to government instructions to evacuate and take shelter, in Malawi prevention alerts were not taken sufficiently seriously, significantly increasing the death toll. In the first few weeks, Mozambique recorded 76 deaths, a relatively low toll compared to previous disasters, while at least 447 people were killed in Malawi (Phiri et al. 2023).

Lack of finance for adaptation

Finance flows targeting adaptation in Southern Africa fall billions of U.S. dollars short of even the lowest cost estimates. In 2019, Mozambique and Zimbabwe were among the 10 most affected countries in the world by climate change-related hazards, with the frequency of tropical cyclones and droughts increasing (Germanwatch 2021). Southern African countries require approximately USD 727 million annually to meet the costs of adaptation efforts. However, according to the African Development Bank, the financing gap for adaptation initiatives in the region amounts to approximately 60–70 per cent (UNEP 2013; AfDB 2019a).

CLIMATE RISKS AND CONFLICT IMPACT HUMAN MOBILITY

Climate change will increasingly affect human mobility in Southern Africa. By 2050, the region is expected to host 86 million climate change migrants, primarily due to decreased crop productivity and water shortages (WFP 2021a). Climate impacts are accelerating economic migration from rural to urban areas, as well as rural-rural migration and displacement. In particular, larger-scale, unregulated and unmanaged migration can drive security risks. For example, the influx of rural young migrants to fragile urban areas strains resources, exacerbating poverty, inequality and social instability. Moreover, discrimination, xenophobia and violence against migrants are growing concerns in the region. As women primarily carry the burden of responsibility for agricultural livelihoods and family caregiving, climate security risks disproportionately affect displaced women and girls.

Migration as adaptation

Economic opportunities are the main driver of migration in Southern Africa. People are primarily migrating within countries and within the region in search of better access to education, employment and basic services (Ncube 2010; Maviza 2020). This kind of migration is partly driven by climate change impacts. For example, the migration of farmers and youngsters to cities is often used as an adaptation strategy to cope with increasing climate impacts and livelihood insecurity in rural areas. It can lead to better access to education, health care and income-generating activities (Ncube and Gómez 2015), as well as open new economic prospects and networking opportunities (Simatele D and Simatele M 2015).

Within the region, South Africa, Botswana and Namibia are the main destinations of choice (Moyo 2020). The region has some of Africa's most significant bilateral migration corridors, with the Zimbabwe-South Africa corridor (1.3 million people per year) and the Mozambique-South Africa corridor (1.2 million people per year) among the oldest and most frequented (UN OCHA 2022). Both corridors are characterised by irregular mobility (Mlambo 2010; Maviza 2020; Ndlovu and Landau 2020). South Africa has historically been the main migration destination in the region, particularly for skilled and unskilled Africans looking for work in the mining, farming and service sectors. Oil-rich Angola is also a hub for international migrants, particularly from countries with similar cultural links, such as Cabo Verde, and São Tomé and Príncipe. In Mozambique, skilled migrants are employed in extractive industries and education (IOM Migration Data Portal 2023).

According to the Africa Climate Mobility initiative, cross-border mobility between neighbouring countries in the SADC region will significantly increase due to climate change. By 2050, between 200,000 to 800,000 individuals in total are projected to migrate between neighbouring countries in the SADC region. At the country level, based on climate impacts, Zimbabwe, Malawi and Zambia may experience the most significant rise in out-migration. At the same time, South Africa, Zimbabwe, Mozambique and Botswana are forecast to experience the most significant increase in climate-induced in-migration. For example, Zimbabwe, which is expected to have better weather conditions, may become a significant country of origin. In the region, better crop production conditions are linked to increased outward mobility from the countries involved. Higher crop yields enable individuals to gather the necessary resources for longer-distance, cross-border migration (Amakrane et al. 2023) (see Figure 32).

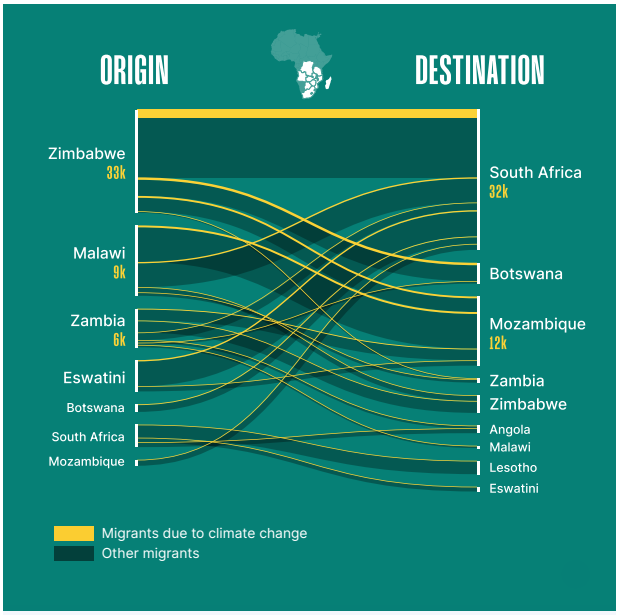


Figure 32: Number of migrants by origin and destination in Southern Africa (Amakrane et al. 2023)

Climate-driven displacement

Climate change impacts have driven the displacement of people through weather-related disasters. Recent data reveals that more than half a million people in Southern Africa had been displaced due to climate-related factors by 2022 and this trend is continuing to increase (IOM 2022a). In the first quarter of 2023, Southern Africa was hit by three tropical cyclones and two tropical storms, resulting in the loss of over 890 lives and forcing 696,000 people to flee their homes. The most significant impact was caused by Tropical Storm Ana, which struck Madagascar, Malawi, Mozambique and Zimbabwe in January 2023. Malawi was the hardest hit by these consecutive storms, with Storm Ana causing significant damage to homes and displacing more than 196,000 people across 16 districts in southern areas of the country (UN OCHA 2022).

Conflict-driven displacement and climate impacts compound security risks

Conflict is a significant driver of displacement in the region, particularly in northern Mozambique, where over a million people were internally displaced as of 2022. Most recently, violence in Cabo Delgado and the neighbouring province of Nampula reignited in the second half of 2022, triggering 283,000 people to move (IDMC 2022). In terms of security risks, mismanaged migration can contribute to tensions in receiving areas, sparking competition over livelihoods and natural resources. This situation is further exacerbated by climate change impacts, which creates a vicious cycle (Ndlovu and Landau 2020).

In northern Mozambique, a prolonged crisis coupled with mismanagement of displacement caused by conflicts and climate impacts has led to conflicts over land tenure. This is particularly evident when the land of displaced individuals is occupied by others or when displaced individuals move onto land belonging to another host community that is struggling with existing livelihood insecurities caused by extreme weather (Julian Quan and Natalie Rose Dyer 2008; Sturridge et al. 2022; Nhamirre et al. 2023). In Mozambique, fishers who now live as IDPs around Macomia often try to fish in their former areas of Quissanga, Mucojo or Quiterajo. This has led to clashes between IDPs, new occupants and host communities (Institute for Justice and Reconciliation 2021).

The insecurity caused by climate change impacts and the fears of terrorist attacks in the region complicate the situation, posing further challenges in dealing with humanitarian assistance for IDPs (Ewi et al. 2022) These vulnerable populations with pressing humanitarian needs, often work illegally or participate in informal economic activities and their settlements are typically the most severely impacted when natural hazard-induced disasters occur (IFRC 2020).

Southern Africa hosts a significant number of refugees and other migrants under the category of stateless persons displaced due to conflict or the adverse effects of climate change. For example, Zambia, Zimbabwe and South Africa, among other countries in the region, host refugees and stateless persons with the majority being from Mozambique, the CAR, the DRC, Burundi, Angola and Rwanda (United Nations South Africa 2023). Statelessness is a prevalent challenge for migrants in the region, largely influenced by historical colonial legacies, alterations in borders, migratory patterns, inadequate civil registration infrastructure, and biases rooted in gender, ethnic, and religious discrimination (Manby 2012). In Southern Africa, camps still persist, especially refugee camps, despite a professed move away from encampment policies towards settlement. Refugees and those with a stateless status are among the most vulnerable to climate impacts, which affects the natural resource-based livelihoods of people in refugee camps and exposes many to secondary displacement (Mbiyozo 2019).

Gender shapes risks

Natural hazard-induced disasters and violent displacement particularly affect rural young people

and women, who often face greater risk of abuse, GBV, trafficking and human rights violations in situations of displacement (IOM et al. 2022). Climate-related security risks affect women in Southern Africa more than men, as women are primary caregivers, and responsible for food and fuel. Climate-induced resource scarcity makes their duties harder and many resort to irregular migration (Mwaba 2023). Female migrants using irregular routes between Zimbabwe and Botswana, for example, face greater risks, as the men who assist them may violate their rights (Matose et al. 2022).

As displaced families move to unfamiliar areas, young people often experience educational disruptions, social isolation and loss of opportunities. Gender also intersects with norms, race and power relations further shaping the experiences of women, young people and sexually diverse people in migrant communities (Mbiyozo 2022). During flooding and drought in Mozambique, Malawi and Zimbabwe, displaced women and girls reported higher levels of GBV (IFRC 2015). Migrants are often compelled to work in irregular economies. This is especially true for women who are forced to work in roles that are below their skill-levels and training, concentrated in unregulated, unskilled and undervalued sectors. In many cases, women are left to shoulder household duties and family care responsibilities. Similarly, sexually diverse people in situations of displacement are often pressured to take up sex work or are victims of targeted attacks (Mbiyozo 2022).

Rural-urban migration

Rural-urban migration is by far the largest mobility pattern in Southern Africa. Climate change impacts are intensifying these movements, further straining rural livelihoods. At the same time, cities pull people and especially young people with the promise of better access to education, employment and basic services. In addition, there has been a significant rise in the number of refugees and irregular, economic migrants arriving in Southern African cities from the Horn of Africa. These migrants often face challenges meeting basic needs and accessing essential services during their journeys (IFRC 2022b). Moreover, they often settle in densely populated areas on the outskirts of cities and struggle to integrate into the formal economy, creating tensions with already impoverished host communities (Mbiyozo 2022).

Pressures in cities are increasing as urban populations increase. It is estimated that an additional 24 million people will live in urban areas by 2050 (Le Roux 2021). Much of this growth will occur informally on unregulated and highly risk-exposed vacant land (Le Roux and Napier 2022). The lack of comprehensive urban planning and limited capacities to absorb growing population pressures contribute to more vulnerable infrastructure and communities exposed to climate change impacts. Capital cities in Southern Africa are highly vulnerable to climate change. Half of the region's cities are projected to experience increased flooding by mid-century (Engelbrecht 2022). Among the biggest threats is the collapse of water provisions and sanitation in urban areas, as exemplified by water insecurity in Cape Town, Johannesburg and Durban (Prins et al. 2022). A three-year drought in Cape Metropole, which started in 2015, and peaked between mid-2017 and mid-2018 when dam levels hovered between 15 per cent and 30 per cent of total capacity, resulted in severe water restrictions (City of Cape Town 2018; ISS 2023b).

The increase in informal economic activities and non-traditional employment in urban areas has increased security concerns. This has contributed to existing inequalities in urban spaces, with limited resources such as housing, water and electricity, and economic opportunities becoming more competitive (Carciotto 2020). As cities grow, governments struggle to provide public services, and challenges around inequality and exclusion increase. These dynamics often mirror and intersect with histories of exclusion and segregation. For example, in South Africa, townships are the primary receptors of migrant populations. Following apartheid, the government started public housing programmes, and expanded clean water and electricity infrastructure. However, the only available land for housing programmes was on the outskirts of cities, unintentionally reproducing the particular dynamics of segregation, exacerbating poverty and marginalisation, and contributing to high crime rates (Turok et al. 2021).

Xenophobia and discrimination

The increasing demographic pressure caused by augmented migration has led to the rise of urban social movements embracing nationalism, which sometimes turn into protests and violence (Engelbrecht 2022; Mongale 2022). In this context, migrants are often seen as competitors for scarce jobs, health care and housing, which contributes to xenophobia, discrimination and, in some cases, violence against migrants (Mbiyozo 2022). There have been xenophobic attacks in South Africa since

2008, mainly targeting foreign nationals from Bangladesh, Pakistan, Somalia, Ethiopia, Nigeria, Zimbabwe and Mozambique (Norman and Collin 2022).

More recently, in Angola and South Africa, there is an emerging trend of violent anti-migrant campaigns, sometimes reinforced by senior politicians, which have resulted in shop lootings, vandalism, mob justice meted out against alleged criminals and the murder of immigrants (Cinini and Mkhize 2021). An illustration of this phenomenon is the so-called Operation Dudula in Durban, South Africa, a breakaway faction of the Put South Africans First movement. Initially, the movement's main objective was to prioritise the needs of ordinary South Africans in response to public dissatisfaction with a faltering government (Myeni 2022). However, the campaign has been used to mobilise violent protests, vigilante violence, target migrant-owned homes and businesses, and murder foreign nationals. The primary targets are low-income Africans, southeast Asians, women, sexually diverse people and low-skilled workers (UN 2022b).

Rural to rural migration

Various factors, including the impact of climate change, drive rural-rural migration dynamics in Southern Africa. Climate hazards such as droughts, flash floods and unpredictable rainfall patterns have reduced crop yields. This has resulted in food insecurity and high unemployment in rural Southern African communities. These communities are often pushed to migrate with their livestock to neighbouring regions with sufficient grasslands and water or seek employment opportunities in the mining sector (Mpandeli et al. 2020).

Traditionally perceived as a potential source of income and employment, the mining sector attracts migrants from rural areas looking to escape livelihood insecurity and climate change impacts. In Zimbabwe, prolonged droughts and hotter temperatures increase the migration of young and single women from large families to nearby localities (Mudefi et al. 2019). In Zambia, climate impacts in the southern province, where the effects of climate change on agricultural production are most profound, have led to rural-rural migration as farmers seek new fertile land in northern and western areas of the country (Caroli 2023; Medina et al. 2023). Similarly, some rural groups have migrated between Zambia and Zimbabwe in search of opportunities in the mining sector, which has led to heightened vulnerability in both countries. As a result, people have resorted to seeking livelihood opportunities mainly in illegal, unregulated or abandoned small mining sites, contributing to the growth of criminal networks (Sax et al. 2023). Illegal mining is a major contributor to land degradation, and the contamination of underground and overland water sources due to the use of harmful mining chemicals such as mercury. This has polluted water, causing health issues for humans and animals, and contaminating crops (Brown et al. 2012; Ncube-Phiri et al. 2015). Moreover, climate change can further intensify the vulnerability of mining communities, as extreme weather events may disrupt mining operations and negatively impact livelihoods (Moyo and Phiri 2023).

Another climate security risk is the negative impact of rural out-migration on agricultural production and food security. When people leave rural areas, there is a decrease in agricultural labour and knowledge, resulting in lower productivity and reliance on external food sources. For example, many Zimbabweans have left their home areas due to food insecurity and migrated to the neighbouring region of Messina in South Africa to work in the agricultural sector. This has affected food production due to the lack of rural labour, and increased competition between migrants and local South African farmers working in the fields (Scheen 2011). These rural-rural migration dynamics have also contributed to an increase in the proliferation of small arms and light weapons in Zimbabwe. Zimbabwean returnees from South Africa are trafficking small arms and light weapons linked to stockpiles used by the former apartheid regime in South Africa. This connection has resulted in an increase in armed violence and robbery in Zimbabwe (Global Organized Crime Index 2023). Meanwhile, in urban areas, the demand for food is high, while agricultural resources are limited, which leads to higher food prices and food insecurity (Mpandeli et al. 2020).

LAND AND WATER ACCESS AND USE CONFLICTS

Land tenure and use, and water management conflicts have long existed in Southern Africa, and climate change is increasingly affecting existing conflicts dynamics and contributing to new ones. These conflicts are driven by various socioeconomic and governance-related factors, such as colonial legacies and disputes over land ownership. Land use conflicts exist between conservation,

extractive activities, industrialised food production and communal subsistence agriculture. Similarly, population growth, climate-induced water scarcity and poor law enforcement of industrial activities that cause pollution exacerbate regional, national and local water conflicts. In urban areas, corruption and inadequate infrastructure contribute to social tensions and protests.

Land tenure governance, access and use

Southern Africa has a complex history of conflicts over land. Inequalities relating to land use and access are one of the primary reasons for conflicts in the region. These inequalities are often the legacy of colonial policies, with land reform remaining a central challenge that has compounded political tensions and conflicts between white, land-owning elites and majority black populations with limited land ownership (Ngubane 2018). Climate change amplifies these challenges through its negative impacts on natural resources. Competing development visions put pressure on land, leading to desertification, displacement and unsustainable practices (IPCC 2019). Furthermore, insecure land tenure, ineffective governance, unequal access and a lack of community involvement worsen environmental degradation and climate vulnerability, fuelling land access and use conflicts.

Land tenure and use conflicts can be tracked in Zimbabwe, South Africa and Namibia following independence, where land reform gained prominence, challenging land tenure governance systems. Two separate systems of land tenure, shaped by colonial legacies of race, have emerged. These systems divide land administration along racial lines, perpetuating privilege for white and emerging black elites, while leaving vulnerable farmers behind. The mainly white-owned, commercial, large-scale farms received minimum regulation because of the power contained in the freehold title to land. In contrast, in communal areas declared as state land, stronger regulations were imposed with tighter land use restrictions for small holder farmers. This has resulted in different environmental and land use standards between large-scale commercial farms and small holdings, affecting the way climate change has impacted vulnerability in the region (Moyo 2005).

Land occupations in Zimbabwe led to the initiation of a land reform programme in 2000. The reform resulted in conflicts between commercial farmers and rural communities over land, which led to environmental degradation and soil erosion. The land reform programme involved the government redistributing land from commercial, predominantly white, farmers to rural, predominantly black, communities in an attempt to address historical inequalities. Although the land reform expanded the base of economic participation, the lack of proper planning and support for the new landowners, coupled with political and economic instability, led to inadequate farming practices, an increase in poaching in private farms that the owners abandoned, overgrazing of the newly acquired land and a decline in environmental stewardship. In turn, this led to environmental degradation and soil erosion (Moyo 2005). The changing climate and extreme weather events, including droughts and flooding, have exacerbated the situation, affecting the food security and livelihoods of communities, and challenging sustainable climate adaptation strategies (Mkodzongi and Lawrence 2019; Scoones et al. 2019; Spierenburg 2021; Mambondiyani 2022).

Climate change and disasters have led to land tenure conflicts in rural KwaZulu-Natal, South Africa. These conflicts involve local organisations that manage land, and disputes between locals and displaced individuals affected by climate change (Majeke 2005). Farm dwellers are especially vulnerable to the impacts of climate change, which affects the commercial farm enterprises they depend on for both wage labour and residence rights. This creates a complex scenario that is mediated by post-apartheid agrarian dynamics (Hornby et al. 2018).

Insufficient community involvement in decision-making processes related to land and resource management and climate adaptation can lead to grievances and conflicts. When communities are marginalised and excluded from decision-making, their rights and interests are often disregarded, resulting in a lack of incentives to invest in sustainable land use practices (Clover and Eriksen 2009). This further exacerbates environmental degradation and can fuel conflicts over access to and control over valuable land and resources (Msangi 2007; Scoones et al. 2019). For example, in the Zambezia province of Mozambique, disputes have arisen from policies labelled as climate-smart, which some critics see as a form of land grabbing. These policies allow foreign investors to acquire land for conservation efforts, forest plantations and biofuel production. However, some people fear that these top-down policies, designed by international organisations,

may not consider the needs of Mozambique's rural communities, which rely heavily on access to forest resources and arable land (Bruna and Mbanze 2023).

Similarly, maladaptation practices put rural landscapes at risk as they are often associated with negative environmental impacts such as deforestation that further stress ecosystems and reduce resilience to climate change. In Zambia, for example, deforestation is a main factor affecting climate conditions, agricultural production, heat stress and flooding (Caroli 2023). A livelihood diversification strategy that is a common maladaptation practice is excessive deforestation for charcoal production. Felling trees for charcoal production accelerates soil erosion and desertification, further compounding the loss of livelihood and jeopardising the human security of Zambian communities (Medina et al. 2023). In Matabeleland South in Zimbabwe, there is a concerning trend towards dense woodland cover loss. This loss is attributable to a combination of increased human activities, such as small-scale and illegal gold mining, and the adverse effects of climate change and variability (Maviza and Ahmed 2020). Although there are no violent conflicts in these countries, without immediate remedial action to reverse the observed negative trends in land use/land cover, adverse socioeconomic, hydrological and ecological consequences may be experienced, with the potential for conflict over scarce land resources.

Land use conflicts from conservation efforts

Land conflicts arise in the context of conservation efforts. The region has significant biodiversity-rich ecosystems, woodlands and grasslands, and is home to wildlife that attract visitors from around the world and support an industry of land-based ecotourism. Conflicts often emerge around protected areas over the traditional use of natural resources, such as fishing and hunting. In Mozambique, a national wildlife policy has been adopted, which aims to "conserve, utilise and develop forest and wildlife resources to gain social, ecological and economic benefits for present and future generations of Mozambicans." However, in practice, local communities have received only a small proportion of the revenues generated by protected areas (Musavengane and Leonard 2022). Moreover, in the Gilé National Reserve in Mozambique, although the reserve has implemented environmental projects without expropriating land, tensions have arisen around land use as some rural households have limited access to the reserve. These households derive up to 50 per cent of their food and income from forest resources, and some claim that they have not been adequately compensated for their losses (Neef et al. 2023). This has created tensions between local communities and national authorities.

Southern Africa has experienced a surge in conflicts between humans and wildlife, which the effects of climate change have exacerbated. Due to the lack of adequate grazing land and water sources, animals have been forced to migrate closer to human settlements. For example, this is an issue in the Namibian portion of the Kavango-Zambezi Transfrontier Conservation Area, impacting local communities' livelihoods. A study of selected mammal species reveals that conflicts have intensified due to population growth and large mammal species' re-colonising previously uninhabited areas. Although conservation efforts have helped increase specific animal populations, their distribution is now more limited than when wildlife numbers were lower, which could negatively impact ecosystem resilience (Stoldt et al. 2020). Similarly, human-wildlife conflicts have been observed in Zimbabwe's Save Valley Conservancy, particularly between farmers resettled in protected areas, and lions, hyenas, elephants and crocodiles. Changing land use from wildlife ranching to farming and disputes over land ownership are the main drivers of conflict. More established inhabitants have shown greater inclination towards peaceful co-existence with species than more recent settlers (Makumbe et al. 2022).

Regional water conflicts

Water disputes over shared rivers are rising due to climate change affecting freshwater availability, weak governance and inadequate management practices (Zikhali 2019). Water is central to Southern Africa's development. Yet, water availability is under pressure from climate impacts, industrial pollution, and increased demand driven by population growth and agricultural expansion. Furthermore, water scarcity is a particular challenge given Southern Africa's is mainly arid or semi-arid (Zikhali 2019). Countries such as South Africa, Namibia, Zimbabwe and Angola are experiencing severe water stress issues. As a result, water conflicts are on the rise in Southern Africa (Zikhali 2019).

Around 70 per cent of available freshwater resources in the region are shared. The distribution of water resources in Southern Africa exhibits

spatial and temporal disparities, with ample water availability observed in northern and eastern areas of the region, while limited water resources are found in southwestern areas (Binder 2023). The challenges related to the management of the Zambezi River Basin exemplify conflicts that may emanate from cooperative water management (Petersen-Perlman 2016). When examining the spatial distribution of water resources between the riparian countries of the Zambezi River Basin, it is apparent that Zambia possesses a significantly larger share compared to other neighbouring countries. The disparities in water availability can impact the economic, social and environmental development, and an asymmetry in resource allocation can give rise to tensions between riparian countries (Zikhali 2019; Ferre Garcia et al. 2023; Sax et al. 2023).

Although water has historically been a source of cooperation rather than conflict in Southern Africa (Southern Africa Consultation in Climate Security 2023),[62] the increasing frequency and severity of droughts have sparked tensions. Transboundary disputes over shared rivers and lakes have been recorded along the Zambezi, Chobe, Orange and Limpopo rivers. Countries such as Zambia, Zimbabwe, Mozambique and Angola often conflict over fair water distribution for agriculture, energy production and domestic use (Seyuba and Ferré Garcia 2022). These disputes have sometimes escalated into diplomatic tensions. For example, the Chobe River, which flows through Botswana, Namibia and Zambia, has been a source of conflict between these countries. Despite Botswana being recognised as the owner of Sedudu Island, located in the middle of the river, declining water levels caused by droughts have forced Namibian fishers to cross into Botswanan territory. This has resulted in rising tensions and even shootings (Kings 2016).

Another case is the Orange-Senqu Basin, which is shared between the four Southern African countries of Lesotho, South Africa, Namibia and Botswana (Blumstein 2017). South Africa uses over 90 per cent of the water resources in upstream areas for agricultural production, and industrial and domestic consumption. Meanwhile, Namibia and Lesotho rely on the Orange-Senqu River's water resources for irrigated crop production, mining (Namibia), hydropower and water sales (Lesotho). The conflict arises from Namibia's concerns about the transboundary water management project's negative impact on water flow in the basin. The disapproval echoes the sentiment that South Africa disproportionately benefits from the current management of the Orange-Senqu system, disadvantaging downstream countries. Climatic change threatens livelihood opportunities and the river ecosystem, with crop and livestock water requirements increasing due to rising temperatures and evapotranspiration. Small farmers with limited resources are vulnerable to yield and financial losses. Flooding may worsen soil erosion and lead to loss of agricultural land and siltation of dams (Blumstein 2017).

At the national level, industrial and commercial activities significantly contribute to water conflicts. Mining operations, for instance, require substantial water resources, putting them in direct competition with local communities and the agricultural sector. The pollution and contamination of water sources from industrial activities further worsen conflicts and pose environmental risks. These conflicts not only threaten the availability of water for various sectors, but also undermine the overall sustainability of water resources. An illustrative example is the Muene River in Mozambique. The country has complained to the SADC about contaminated water flowing downstream from mining operations in South Africa, which is harming biodiversity and reducing fish stocks. Moreover, droughts have aggravated the situation by concentrating pollution levels in rivers, leading to health problems such as cholera for local populations. The polluted water has also harmed wildlife in Kruger National Park in South Africa, one of the largest wildlife sanctuaries in Africa (Kings 2016).

Local water conflicts

At the local level, water conflicts emerge due to competing needs within communities and economic sectors. In rural areas, tensions frequently arise between rural communities, who require access to water resources for irrigation, food production, livestock watering or mining. The combination of limited water sources and climate change-induced droughts exacerbates these conflicts, contributing to water rights and usage disputes. In some cases, these disputes escalate into violence and displace people, compounding the social and economic hardships affected communities face.

In Zambia, for example, water-related competition is common (Zikhali 2019; Sax et al. 2023). Tensions within and between communities primarily emerge in relation to access to water sources. During drought periods, when existing water

sources are scarce and many dry out, the pressure on remaining water sources intensifies. Access to water points is frequently controlled by local elites who impose restrictions on the utilisation of water, which intensifies the vulnerability of marginalised groups. It is crucial to note that conflicts can also arise at newly constructed boreholes, where local power relations are contested (Sax et al. 2023).

In Zimbabwe, water scarcity and quality pose risks to climate security, with Bulawayo and Matabeleland North the most affected areas due to extreme climate variability. The pollution of water resources, including sediments from artisanal mining and agriculture, as well as pathogens from wastewater and industrial discharges, exacerbate water quality problems in the country (Davis and Hirji 2014; Madurga Lopez et al. 2021). The lack of water supply in Bulawayo is a major concern, with government inaction and disputes with local authorities over water supply exacerbating the situation (Swain et al. 2011).

In urban areas of Southern Africa, water conflicts persist due to climate impacts, increased demand and inadequate water infrastructure. These issues disproportionately affect marginalised communities (Rusca et al. 2023). Furthermore, the unequal distribution of water resources generates social tensions, and can even trigger protests and civil unrest as communities strive to secure their water needs. For example, deficiencies in the flood management systems of townships in the Durban area have led to protests against the municipality's perceived failure to restore power and water services quickly after flooding in 2022 (Africa News 2022). In addition, the recent cholera outbreak in the region and particularly in South Africa has highlighted government failures in ensuring access to clean water, proper waste management and safe sanitation practices (World Health Organization 2022).

WEAK GOVERNANCE OF HIGH-VALUE NATURAL RESOURCES

Southern Africa possesses abundant high-value natural resources that present both opportunities and risks. Weak governance of natural resources in the region, in combination with climate change impacts and the development of a low-carbon economy, may drive conflict dynamics. The region's mineral deposits, including platinum, lithium, nickel and cobalt, hold the potential for economic growth and supply critical minerals for the green energy transition. However, corruption, ecosystem deterioration and insufficient benefit-sharing have led to social conflicts, while climate change affects mining sites and exacerbates competition for water and land resources. Conflicts between mining companies and communities, as well as disputes over water access are already common. Transitioning to a low-carbon economy introduces risks such as job losses, social tensions and governance challenges. Increased demand for minerals may compromise protected areas, while the governance of natural resources requires clarity to manage climate security risks effectively. Stranded assets and financial losses are also concerns, as the world moves away from fossil fuels potentially impacting oil and gas projects and investments.

Abundant valuable resources

Southern Africa has an impressive array of mineral deposits. Southern Africa is home to the most extensive platinum reserves globally, alongside other highly prized minerals like gold, copper, and diamonds. Given the quality and scale of these reserves, the region has substantial potential for economic growth and can provide the minerals that are needed for the low-carbon transition (Butts and Thomas 2019). However, to date, the extraction of natural resources has in most countries in the region negatively impacted fragile ecosystems and has yet to result in wealth distribution among citizens that would enable sustainable development (Musavengane and Leonard 2022).

As the industry expands and climate impacts increase, these compounding pressures are likely to increase conflict risks around mining. Today, conflicts between mining companies and communities, and between states and communities around various issues – including negative environmental impacts, land tenure disputes, labour rights, water scarcity and compensation for damages – are common.

Climate change impacts exacerbate mining conflicts

Increased temperatures and fluctuating rainfall patterns pose increasing risks to water security in Southern Africa, with water essential for mining operations. At the same time, many local communities rely on water access for their livelihoods, such as agriculture or ecotourism based on biodiverse ecosystems. Today, disputes and conflicts

62 As discussed during the ACRA Southern Africa regional consultation in 2023.

around water are common in the region. One example of a water-related conflict in Southern Africa concerns the Okavango Delta in Botswana, where mining activities have led to increased water consumption and pollution, impacting the region's ecosystem and the livelihoods of local communities (Darkoh and Mbaiwa 2014; Mosepele et al. 2018). In South Africa, the Waterberg Coalfield has been the site of a protracted conflict between mining companies and local communities over water use and pollution (Ololade 2018; Simpson et al. 2019).

There are concerns about mineral resource extraction in many countries in Southern Africa, including Zimbabwe, Mozambique and Angola, particularly over the violation of indigenous people's rights and mining companies' disregard for environmental regulations, leading to protests and court cases against companies. In Zimbabwe, for example, there have been conflicts around diamond mining in the Marange region, with reports of human rights abuses, environmental degradation and corruption leading to the displacement of thousands of people and the loss of traditional livelihoods (Bruffaerts 2015; Ntlhakana 2015; Howard 2016). Labour conditions are also a flashpoint of conflict. For example, in 2012, workers at the Marikana platinum mine in South Africa went on strike to demand better working conditions and higher wages. The strike turned violent and led to the death of miners, which triggered widespread public outrage and demands for accountability (Onyebukwa 2021).

Mining contributes to larger conflict dynamics

Mining issues can contribute to larger conflict dynamics. Cabo Delgado in Mozambique is the most prominent armed conflict in the region. The conflict demonstrates how weak governance of natural resources provides an opportunity for radical groups to attract impoverished populations by channelling their grievances. Among the root causes of the conflict in northern Mozambique are the discovery of rubies and liquified gas. The government's initiatives aimed at facilitating resource extraction in regions of northern Mozambique, coupled with lingering inequality and the perception of unjust resource distribution, have been exploited by the extremist group Ahlu Sunnah wa-I-Jama'ah (ASWJ) to legitimise its presence. Particularly among the young people, ASWJ has capitalised on this discontent by attempting to provide its own religious education, leading to a surge in the number of young individuals willing to join the Islamist group. Some believed the narrative that adherence to Islamic law would bring about improvements in their circumstances (Pirio et al. 2019; Hamming 2021).

Mozambique aims to become a significant global gas producer and has attracted substantial investment in LNG projects. However, this comes with inherent risks. First, there are concerns about corruption, transparency and due diligence regarding climate change, environmental and social impacts, and human rights (Pirio et al. 2019). Gas projects significantly impact the environment and communities living in areas where gas extraction companies build their LNG plants and related infrastructure. To construct the onshore Afungi LNG park, the industry will relocate 557 households, leaving behind their homes and livelihoods, mainly farming, fishing and tourism. There have been complaints about the lack of opportunities for community participation in previous consultations. Furthermore, local communities are unlikely to benefit from any possible economic gains due to tax evasion, weak governance and corruption (Wensing 2022).

The risks of the green transition

While the green transition offers a lot of opportunities, there are also risks. First, a significant increase in demand for crucial minerals can increase conflicts around mining. Moreover, the green transition can result in a loss of revenue fort countries dependent on the extractive industries, particularly countries that rely on fossil fuels.

One of the risks associated with the green transition is the increasing demand for critical minerals, which – if not appropriately managed – contribute to conflicts around mining. For example, in northern Mozambique, an area rich in graphite, an essential element in manufacturing batteries, there is concern that – following the announcement of investments in Balam – the risks of violence and recruitment may increase. Among other things, there are fears that radical groups may demand a share of the revenue, which may lead to new conflicts (Ewi et al. 2022).

Similarly, concerns have been raised about the potential impact on protected areas and conservation efforts as the demand for minerals for renewable energies rises. South Africa has made commendable efforts to advance environmental protection and conservation. However, the fragmented and uncoordinated implementation of laws

– such as the National Environmental Management Act, and the Mineral Petroleum and Resources Development Act (MPRDA) – has been a significant obstacle. The MPRDA could potentially harm pristine natural areas, while promoting optimal exploitation of environmental resources. Achieving a balance between exploitation and conservation is essential in effectively addressing climate security risks in Southern Africa (Leonard 2020).

Zimbabwe presents an interesting case highlighting the risks of critical mineral extraction. The country has significant lithium reserves, which have attracted miners, including irregular migrants, who target abandoned mines (Diene et al. 2022). There has been an increase in the smuggling of lithium to other countries, which has undermined tax revenues for Zimbabwe (Dana 2023). In addition, previous experiences have shown that extractive industries often generate little economic benefit for local communities, leading to discontent. In turn, this has influenced people's perceptions and attitudes towards new mining enterprises. Recently, protests against mining companies' lack of prior consultation occurred in Kanyandura village in Mudzi District in Mashonaland East province of Zimbabwe, where lithium exploration and extraction activities are planned (All Africa 2023).

In response to the illegal mining of critical minerals such as lithium, a recent law in Zimbabwe requires special permission to export raw lithium ore. The law encourages local processing to generate more revenue and added value for the country, with the government urging foreign companies to establish local processing plants, creating an opportunity for local development. This law is meant to discourage Zimbabwe's small-scale, informal mining activities. Exporters must demonstrate that they have established local manufacturing facilities; otherwise, they must show exceptional circumstances before exporting the commodity. Foreign companies can only export concentrates created by processing the ore. The government of Zimbabwe is urging foreign companies to establish local processing plants, with Chinese companies already doing so to bypass the export ban (Diene et al. 2022; Dana 2023). This has the potential to create opportunities for a more equitable model of distributing added value within the value chain, ensuring that economic benefits from sustainable resource mining for the green transition reach the local communities. However, the law does not include the necessary arrangements to enable local companies to start processing the ore. Furthermore, it is crucial to follow the implementation of the law to ensure efficiency, accountability and transparency within the emerging value chains.

The transition to a low-carbon economy poses challenges related to loss of revenue and stranded assets. High emissions extractive industries, such as oil and gas, have traditionally been a significant source of revenue for many economies in Southern Africa, particularly Angola, Zambia, Zimbabwe, Lesotho, Mozambique and South Africa (Ericsson and Löf 2020). However, as countries strive to reduce their carbon footprint, gas and oil prices are projected to decrease significantly (see Northern Africa chapter). There is a growing risk that new gas and oil investments and infrastructure become stranded assets. International pressure to limit financing for fossil fuel projects can lead to reduced funding for ongoing oil and gas projects (Siyobi 2021). In turn, this can lead to the loss of jobs from extractive industries and, in combination with the sudden loss of jobs created by the impacts of climate change on other sectors such as the agri-food industry, can create social tensions around increased demand for jobs, the lack of alternatives for livelihoods and even climate denialism. Moreover, the loss of revenue can affect government finances, hindering the ability of governments to finance poverty reduction initiatives and vital public services, such as health care and education.

Responses and good practices

Governments, policymakers and other key decision-makers in Southern Africa are aware of the risks caused by climate change and have put in place various strategies, policies and mechanisms to prevent and respond to climate-related security risks. This section presents interventions that seek to address climate security risks in three parts: (1) regional approaches, (2) national approaches and (3) community-level approaches.

REGIONAL APPROACHES

There are a number of regional mechanisms, institutions and initiatives in the fields of early warning for conflict prevention, resilience, disaster risk reduction and water management that are relevant and address climate-related security risks. This section presents a selection of these initiatives.

The SADC Regional Early Warning Centre (REWC) for conflict prevention, management and resolution

The overall objective of the REWC is to strengthen SADC mechanisms for conflict prevention, management and resolution. The REWC was officially launched in 2010, and its main functions are compiling strategic assessments and analysing data collected at the regional level. In addition, the REWC shares information on central issues that threaten the security and stability of Southern Africa, while proposing effective strategies to prevent, counter and manage these potential threats.

The centre focuses mainly on conflict-related data, but is beginning to incorporate information on climate-related factors and collaborate with units focused on reducing disaster risks. However, there is still a need for more detailed and comprehensive integration of climate and conflict data in the early warning centre. A way forward could be to enhance the partnership with locally driven climate security assessments conducted by the Global Partnership for the Prevention of Armed Conflict (GPPAC) local chapters (Moyo and Phiri 2023; Nhamirre et al. 2023).

Resilience and disaster risk reduction regional policies

The SADC Regional Resilience Framework 2020–2030 aligns with international, regional and national initiatives, fostering efforts to prevent climate security risks. The framework takes an integrated approach to sustainable development, disaster risk reduction and climate change adaptation. It is guided by international and regional frameworks, such as the Sendai Framework of Disaster Risk Reduction, AU Agenda 2063 and Agenda 2030. By adopting a strategic resilience-building approach, the framework aims prepare and mitigate against shocks and stressors, and minimise human suffering and economic loss. Furthermore, the framework guides stakeholders in designing and implementing resilience programmes, promoting coherence, and scaling up good practices for greater impact (SADC 2020). The framework supports the realisation of regional development goals, including integration, industrialisation, peace, stability, poverty reduction, wealth creation, and social and economic transformation. It is expected to enhance adaptive capacities, and drive sustainable and equitable development in the SADC region (SADC 2020).

Several SADC member states have introduced policies that recognise the impacts of climate change on agriculture. In addition, there are a number of promising examples of early warning systems, such as the Southern African Regional Climate Outlook Forum, the SADC Regional Vulnerability Assessment and Analysis Programme, and the SADC Disaster Risk Management and Information System. Among other things, these systems provide weather and climate information, which can improve policy planning and intervention. However, various implementation challenges persist. These include a lack of coordination, institutional capacity, financial resources, and information transmission between local, national and regional levels (SADC 2020) (Seyuba and Ferré Garcia 2022).

However, there are gaps in policy implementation including a lack of harmonising early warning indicators of climate and conflict triggers, and joint advocacy and awareness raising around areas of intersection and mutual interest between climate and conflict units. There is also still a gap in identifying and tailoring pathways linking climate change impacts, such as agriculture and livelihoods, to conflicts over natural resources, migration, crime and social unrest.[63]

Regional water management

Transboundary water management in Southern Africa is well-developed. The 14 SADC member states have shown awareness of the potential dangers associated with water issues and have initiated important measures to foster cooperation among shared river courses. In 1995, the 14 members states agreed to integrate and cooperatively manage all shared river basins through the SADC Protocol on Shared Watercourse Systems, in alignment with the SADC goal of mutual economic development through cooperation and integration. The protocol laid out the structure for cross-border water collaboration, encompassing all surface water applications for agricultural, residential, industrial, and navigational purposes. The most important follow-up to the protocol was the establishment of the distinct and dedicated Water Sector Co-ordinating Unit by Council and Summit in 1996 (Böge 2006). In 2000, after a consultation process, the Revised SADC Protocol on Shared Watercourse Systems was signed. It serves as an instrument of international water law for the region and highlights the importance attributed to water by member states through the establishment of river basin management institutions (SADC 2000).

The Regional Strategic Action Plan for Integrated Water Resources Development and Management

was adopted in 1998 by all SADC member states. The plan aims to create conducive conditions for the common management of regional water resources. The plan has since been updated, with current version focusing on the period 2021 to 2025. Subsequently, several bilateral and multilateral institutions – including river basin organisations, such as the Permanent Okavango River Basin Water Commission, the Orange-Senqu River Commission (ORASECOM), the Limpopo Watercourse Commission and the Zambezi Watercourse Commission (ZAMCOM) – have been established to manage shared watercourses (Böge 2006). These river basin organisations represent a significant step forward in transboundary cooperation.

A good practice in Southern Africa is the establishment of groundwater task forces within the framework of river basin arrangements. Countries such as Botswana, Eswatini, South Africa and Zimbabwe have implemented this approach, as evidenced by the ORASECOM and ZAMCOM. These task forces are vital in promoting transboundary water cooperation and including groundwater-related activities in joint body meetings. The river basin organisations ensure that groundwater issues are given due attention, fostering accountability and facilitating the follow-up of decisions made in these forums. This proactive approach strengthens regional collaboration and contributes to Southern Africa's sustainable management of shared water resources (UN Water 2021).

However, transboundary water management in Southern Africa faces significant challenges. Two critical challenges exist in the SADC's transboundary water management: data sharing and management, and financial arrangements. Difficulties in data exchange arise from technical, logistical, and legal and political barriers (GIZ 2016; UN Water 2021). One of the biggest obstacles to transboundary water cooperation is the lack of financial resources for newly established arrangements. For joint bodies and agreements to be successful, countries must be able to cover the basic costs of meetings, staffing and facilities, as well as any additional expenses for monitoring, planning and joint infrastructure projects. Adequate funding is crucial for initiating and supporting the creation of new transboundary water arrangements and river basin organisations (UN Water 2021). For example, at the national level, although the government of Lesotho has put forward structural arrangements for its Department of Water Affairs, which seeks greater responsibility for implementation, the department still needs additional government funding alongside support for its transboundary water management agreements (GIZ 2016).

NATIONAL APPROACHES

In Southern Africa, several countries have taken steps to tackle different drivers of climate security risks. These efforts have been created through partnerships between national governments and multilateral organisations, with the assistance of international development cooperation. This section presents a few examples of innovative national-level approaches from Southern Africa that illustrate steps towards a just energy transition, policies that aim to coordinate different sectors to support populations displaced by climate change and conflict, and national water management programmes that aim to prevent conflicts.

Renewable energy transition: The Just Energy Transition Partnership in Southern Africa advocates leaving coal in the ground

The Just Energy Transition Partnership – consisting of South Africa, France, Germany, the United Kingdom, the United States and the European Union – has announced an ambitious, long-term initiative to support South Africa's decarbonisation efforts. With an initial commitment of USD 8.5 billion, the partnership aims to accelerate the decarbonisation of South Africa's economy, particularly the electricity sector, aligning it with the country's updated emissions goals. The financing will be mobilised through grants, concessional loans, investments, risk-sharing instruments and private sector participation. The partnership is expected to prevent 1–1.5 Gt of emissions over the next 20 years and facilitate South Africa's transition to a low emission, climate-resilient economy (EC 2021).

In line with this endeavour, the Eskom Just Energy Transition Project has been approved by the World Bank. With a funding package of USD 497 million, the project will support the decommissioning of the 56-year-old Komati coal-fired power plant, repurposing the site with 220 MW of renewable energy solutions and 150 MW of batteries. The project aims to create opportunities for workers and communities and, provide a blueprint for a just energy transition in South Africa and beyond (World Bank 2023b).

63 As discussed during the ACRA Southern Africa regional consultation in 2023.

Mozambique's Comprehensive Strategy to Address Internal Displacement Caused by Climate Hazards and Conflict

The National Policy and Strategy for Internal Displacement Management approved in 2021 aims to reduce the impact of disasters and conflicts on the population, and the number of displaced people by improving aid support and coordination. To ensure widespread support, Mozambique formed a national team bringing together numerous sectors, ministries, agencies and disciplines to develop the policy. The team worked closely with displaced individuals, visited resettlement camps, engaged local disaster risk reduction teams, and gained media attention, resulting in swift political commitment and policy approval. The policy focuses on addressing prevention, assistance, protection, resilience building, reintegration and durable solutions for displaced individuals (UNHCR 2022).

At the same time, Mozambique has worked on strengthening the policy's implementation at the local level (UNDRR 2022b). Early successes were seen immediately after Cyclone Freddy hit the east coast of Southern Africa in 2023, with the early warning strategy and relocation of communities preventing a significant death toll compared to neighbouring countries such as Malawi or previous disasters such as Cyclone Idai. Nevertheless, it should be noted that the extent to which these policy actions have successfully been implemented has yet to be determined. Financial capacities and local coordination are critical challenges for policy success. Further research is required to evaluate the implementation of these actions (IFRC 2022a).

Integrated water management and nature-based solutions in Lesotho

Lesotho, known as the water tower of Southern Africa, provides a significant portion of the annual run-off for the Orange-Senqu River, supporting agriculture, industry and households in the region. However, severe land degradation in Lesotho's river catchment areas, the lack of updated regulations and climate change adverse impacts threaten water security and the livelihoods of rural populations. In response, the government of Lesotho has launched the ReNOKA We Are a River programme, which aims to integrate catchment management through a multi-stakeholder approach (Kingdom of Lesotho 2022).

The ReNOKA programme focuses on restoring degraded watersheds through emergency rehabilitation measures, nature-based solutions and catchment management plans. It tackles unsustainable land use patterns and water conflicts, promotes climate resilience, and offers livelihood opportunities for local communities (Southern Africa Consultation in Climate Security 2023). The programme equips resource users and professionals with the necessary skills and knowledge to ensure sustainable land, water and environmental management.

Public awareness and adoption of sustainable behaviours are crucial to reducing catchment degradation, and the programme employs targeted communication approaches, conflict prevention strategies and behavioural insights to promote this. In addition, data and evidence inform decision-making, learning and innovation in integrated catchment management. Providing equitable and inclusive access to clean water and sanitation contributes to the overall well-being of the population by reducing the burden of water collection, minimising the risks of water-related diseases and enhancing human security (Kingdom of Lesotho 2022).

COMMUNITY-LEVEL INITIATIVES

In Southern Africa, many community-based climate security responses have emerged to address the region's challenges. These initiatives showcase the importance of local empowerment and cooperation in fostering climate resilience, although challenges concerning unclear land rights and limited financial resources persist.

Supporting rural resilience

The World Food Programme's R4 Rural Resilience Initiative, implemented in Mozambique, Malawi, Zambia and Zimbabwe, has successfully combined risk management strategies to promote sustainable farming practices and resilience among their poorest farmers. These strategies include nature-based solutions, improved agricultural practices, access to insurance schemes, livelihood diversification, microcredits and savings instruments. Through the R4 initiative, farmers can access crop insurance by engaging in risk reduction activities, which gradually decreases their vulnerability to disasters. In the event of weather-related losses, the insurance compensation prevents farmers from having to resort to desperate measures, such as selling their assets or engaging in illegal activities, and enables faster recovery. This allows farmers to invest in more lucrative enterprises and essential agricultural resources. Monitoring and

evaluation data demonstrate that insured farmers save more and invest significantly in farming activities. The R4 initiative also positively impacts gender equality, empowering women by providing increased access to land, resources and training opportunities. Women are actively involved in decision-making processes related to insurance payouts, with most insured households in the region headed by women (WFP 2021b).

Localised climate security assessments in Zimbabwe and Mozambique

Local solutions play a crucial role in addressing climate security risks, with local ownership a key aspect. Local ownership enhances the sustainability of interventions through multi-stakeholder dialogue. In the Gwanda District, Zimbabwe, local actors – including community members, government representatives, security sector actors, peacebuilders, climate experts and development partners – co-designed an approach and mapped stakeholders, hazards, climate security risks and solutions. The risk assessment fostered open dialogue in a polarised setting. The process led to the recognition and establishment of climate change committees for knowledge transfer and a formal early warning system. Indigenous knowledge systems were integrated into data collection, informing context-specific indicators. Traditional practices such as rain-making ceremonies were recognised and incorporated by the District Development Committee. Such inclusive and participatory approaches strengthen community cohesion and the sustainability of identified solutions (GPPAC 2023; Moyo and Phiri 2023).

Similarly, in Mecufi, Mozambique, local consultation is used to address climate security risks. This practice highlights the importance of stakeholder engagement, community empowerment, and collaborative efforts to tackle climate security challenges at the local level. The approach involves inclusive and participatory design, with diverse stakeholders, such as local communities, government entities and civil society organisations, co-designing the risk assessment. The Mecufi District Government played a vital role in ensuring collaboration between local authorities and communities (Nhamirre et al. 2023).

The risk assessment aimed to strengthen the understanding of climate-related security risks in Mecufi, considering the existing climate change conditions. The engagement of community members, traditional leaders, climate experts and peacebuilders enables the collaborative identification and development of plans to address climate-related security risks. A key lesson has been the importance of integrating formal and informal local authorities. In this case, the project sought permission from not only the governor, but also traditional spiritual leaders, who hold legitimacy among the population, for space in the locality.[64]

This inclusive approach facilitates the collection of relevant information from various sources, and fosters cooperation between government entities, local authorities and communities. However, there is still a gap in the capacities of local stakeholders to integrate various variables, associate vulnerabilities with climate change impacts, and understand how they can lead to conflict (Nhamirre et al. 2023).

Community-based natural resource management in Namibia and Angola

The promising community-based Planned Grazing through Herding (PGH) project was implemented in the remote Kunene Region in Namibia, characterised by arid mountains, climate vulnerability and communal land. The project specifically focused on combining traditional and scientific methods, and gaining support from traditional leaders (UNCCD 2010). In addition to improving rangeland productivity, biodiversity, resilience and livelihood security, a key aim of the project was to improve social cohesion and prevent conflicts. Key lessons learned from the initiative include the importance of motivated herders and effective management of internal conflicts. The success of PGH depended on receiving support from stakeholders, and ensuring the approach was socially and culturally compatible (UNCCD 2010). This kind of valuable practice has been disseminated to other regions.

In southern Angola, the Restoration of Traditional Pastoral Management Forums (RETESA) project initiated by the FAO has implemented an approach to address land degradation and improve local livelihoods among transhumance pastoral communities. Traditional governance and management systems for pastoral resources was abandoned due to conflicts in the last century. Consequently, the RETESA project aimed to revive these systems to reduce land degradation. The approach involved using traditional management

64 As discussed during the ACRA Southern Africa regional consultation in 2023.

practices adapted to modern rangeland management theory (UNCCD 2017).

The project established modern discussion forums called Jangos, which included traditional authorities, community leaders, local administrations, veterinarians, church leaders, NGOs, ranchers and farmers. The Jangos were traditional in nature but adapted to include various stakeholders. The project utilised the Green Negotiated Territorial Development methodology to negotiate and implement six management plans. This approach allowed for rangeland recovery and agricultural practices in the lowlands without conflict with livestock (UNCCD 2017).

The project contributed to the involvement of local communities in decision-making processes related to natural resource management and climate adaptation, and has strengthened local and municipal institutions. Conditions that hindered the approach included unclear land and water rights, and limited financial resources. However, the project collaborated with the Angolan government to improve livestock and herder movement policies. The involvement of stakeholders – including local communities, community-based organisations, sustainable land management specialists, NGOs, private sector representatives and local government – played a crucial role in the approach (UNCCD 2017).

African Island States

African island states are particularly vulnerable to the impacts of climate change due to a combination of high exposure and low adaptive capacities. Their distinct geographies shape the specific risks they face, which stem from increased extreme weather events (in particular tropical storms and hurricanes), limited water and land resources, and vast ocean territories that are home to important yet vulnerable fish populations (e.g. tuna) and marine ecosystems such as coral reefs. The Western Indian Ocean, for example, is home to approximately five per cent of the world's coral reefs, with those around Madagascar, Comoros, Seychelles and the Mascarene islands classified as endangered or critically endangered due to predicted future warming (Obura et al. 2022).

In addition, the combined impacts of rising sea levels and extreme weather events are severely impacting the water, food and economic security of African island states in the short, medium and long term. Between 1993 and 2014, sea level rise for small islands in the Indian Ocean was estimated at 4–6 mm per year, faster than the global average, with the additional sea level rise expected to double the frequency of floods by 2050 (Mycoo et al. 2023).

Disasters

African island states face a high risk of extreme weather events and disasters. These disasters directly impact the safety of islanders, and often lead to loss of life and widespread infrastructure damage. For example, in the aftermath of tropical Cyclone Kenneth making landfall across the Comoros archipelago in April 2019, hundreds of casualties were reported, along with 20,000 displaced people and more than 10,000 houses damaged or destroyed (IFRC 2020). The estimated damage amounted to USD 150 million or 12.5 per cent of Comoros' GDP (IMF 2019). In Madagascar, more than 41,000 houses were damaged and over 299,000 people were impacted when tropical Cyclone Freddy made landfall in February/March 2023 (OCHA 2023). While projected trends for tropical cyclones making landfall across African island states come with high levels of uncertainty, the combined impact of extreme weather events and rising sea levels could raise the frequency of and damage caused by coastal flooding in the future (Mycoo et al. 2023).

Vulnerable population groups are particularly affected by disasters. Women and children often have relatively limited assets and opportunities to move out of hazard zones, while older people, and people with disabilities and chronic illnesses face physical constraints to moving (Binder et al. 2023). In addition, women often face greater risk of GBV in the aftermath of disasters. Moreover, sudden onset events such as tropical cyclones and flooding destroy island health care and judicial infrastructure, which limits people's ability to seek justice when experiencing violence (van Daalen et al. 2022).

Economic vulnerability

Both slow and rapid onset climate-related events pose economic risks, the impacts of which can already be seen today. For São Tomé and Príncipe where sea levels have continuously risen since 1993, flooding associated with a combination of heavy rainfall and sea level rise place a huge pressure on the island state's agricultural productivity, affecting approximately 1.4 per cent of GDP annually (STP 2023). Continued sea level rise also threatens the country's energy infrastructure (Ministry of Public Works, Infrastructures, Natural Resources and the Environment of São Tomé and Príncipe 2019).

Island states' geographies and specific economies shape these risks. Small island states can be understood as large ocean states owing to the fact that, while their landmass is small, they have comparatively large EEZs, which often contain important resources such as fisheries, fossil fuels and minerals. However, this feature presents a number of security challenges to small island states. Changes in the size of EEZs due to sea level rise and land disappearance could trigger legal disputes related to marine resources (Zhang and Veening 2014). At the same time, small island states generally have limited capacities to monitor and control their vast EEZs, leading to increased incursions by

foreign industrial fleets (both legal and illegal) that threaten fish populations, and overall food and livelihood security (IRIS 2023).

In addition, island states often have a narrow economic base, with fisheries and tourism typically comprising important economic sectors. Moreover, islands states are highly vulnerable to climate change impacts. In the Seychelles, the fisheries sector employs 17 per cent of the population (World Bank 2017b), and generated almost USD 400 million from the export of fish and fish products in 2021 alone (FiTI National Multi-Stakeholder Group (MSG) Seychelles 2023). However, the sector is highly vulnerable to increasing ocean temperatures and acidification, as these impacts affect the habitats of key commercial species such as tuna and may push these species outside the Seychelles EEZ after 2050 (UNFCCC 2021). Meanwhile, flooding and extreme weather events impact the Seychelles' vital tourism sector, which relies heavily on thriving and intact beaches, coral reefs, and coastal infrastructure (UNFCCC 2021). Similarly in Mauritius, tourism contributed to nearly 20 per cent of GDP in 2019. However, within 10–15 years, major tourist attractions such as the Mont Choisy beach could be submerged (Dutton 2022).

For small island developing states in general, women comprise a disproportionate share of people who are unemployed or living in poverty. This is because prevailing customary laws and traditional gender roles, such as fetching water for domestic use, impacts their educational and economic opportunities, and health (Gheuens et al. 2019). In the Comoros, women are traditionally involved in harvesting marine catch for both household consumption and for selling (Harper et al. 2013). The impacts of warming sea surface temperatures in reducing the productivity of these activities can affect the important roles women play in sustaining household food security and income.

The need to diversify economies in light of the impacts of climate change could push small island states to pursue other potentially lucrative sectors, such as deep-sea mining within their EEZs, particularly as the global energy transition is driving up demand for minerals. Mauritius, for example, has expressed interest in the sector and is developing a national bill on seabed mining. However, as many uncertainties remain over the ecological impacts of deep-sea mining, such economic pursuits could expose island states to more risks (Iqbal Ahmed Khan 2022).

Many African island states are highly dependent on external development financing to address development gaps. However, accessing such finances, particularly climate financing, is a major challenge as some island states are classified as middle or high-income countries. Hence, they are not eligible for concessional financing and ODA. Experts have highlighted the need for donors and international financial institutions to adopt a vulnerability-based criterion, such as the Multidimensional Vulnerability Index, to assess a country's eligibility for climate financing. Such needs-based approaches are an important step in broadening the scope of development finance schemes available to island states and increasing island states' eligibility for much needed climate financing (UN OHRLLS 2022).

Water, food and energy security

Water, food and energy security are key challenges for African island states. Small island states such as the Comoros often have very restricted water storage capacities due to limited land resources (UNDP 2019). Consequently, water supplies are highly vulnerable to rainfall variability and saltwater intrusion due to flooding and sea level rise. The direct impacts of climate-related sudden-onset events also pose huge risks. While some island states such as the Seychelles have installed desalination plants to cope with water shortages (Ernesta 2019), experts warn that their high energy and maintenance costs are a burden for island states' limited financial and human resources.

For the Seychelles, as with many other African island states, healthy coastal ecosystems, particularly coral reefs, are an important source of revenue for artisanal fisheries and contribute to local food security. They also provide important ecosystem services, such as coastal protection against erosion, climate regulation and water filtration. These coastal ecosystems, and the overall food security and wellbeing of island communities are threatened by both climate-related impacts such as rising sea levels and warming sea surface temperatures, as well

as human disturbances such as coastal development that aggravates coastal erosion (IRIS 2023). In Madagascar, estimates suggest that flooding resulting from tropical Cyclone Freddy affected more than 60,000 ha of cropland. The timing of the tropical cyclone's landfall coincided with the main rice planting season and secondary rice harvest, thus disrupting an important income and food source for many households, with severe repercussions for food and economic security in the longer term (FAO 2023).
At the same time, African island states are generally highly dependent on imports of basic foodstuffs to meet domestic demands. Mauritius, for example, imports approximately 77 per cent of its total food requirements, including of wheat, rice, milk and meat products (Tsakok 2023) and in Cabo Verde domestic food production, which is largely rainfed, only accounts for 10–15 per cent of domestic consumption (Brilhante M et al. 2021). This high dependence on food imports not only exposes small island states to the disruptive impacts of global supply chain shocks, but also creates major health issues. This is because many island states are heavily reliant on processed imported foodstuffs with low nutritional value, which is leading to higher rates of obesity and non-communicable diseases (WHO 2023).

Maritime security

African island states also face a range of maritime security issues that are mainly linked to their geographical location and extensive coastlines, making them attractive targets and transit points for transnational criminal activities. This includes illegal fishing, smuggling and trafficking.

These issues are especially relevant for island states in the Indian Ocean, where illegal, unreported and unregulated fishing is a major maritime security threat. In particular, illegal, unreported and unregulated fishing activities worsen the impacts of climate change on fish populations, as unauthorised fishing vessels tend to target marine reserves and protected areas where fish populations are more abundant (Camurri 2022). These activities not only threaten marine biodiversity and ecosystem resilience, but also exacerbate the economic hardships faced by local fishing populations and the overall food security of island states (Kanodia 2022).

The increase in drug trafficking has also led to a drug addiction problem in several island states. Although comparatively low compared to other continents, drug misuse is a rapidly growing issue for island states such as Cabo Verde and Mauritius (UNODC 2023). In the Seychelles, drug consumption is becoming a "worrying [...] epidemic," as a very high share of the island state's working-age population is estimated to be consuming heroin and cannabis. Evidence also suggests that Seychellois criminal networks are largely in control of drug imports (Global Initiative Against Transnational Organized Crime 2021b).

African island states lie along several transregional human trafficking routes. Mauritius is primarily used as a transit point for trafficking people from Eastern Africa to destinations such as the Middle East. Meanwhile, people trafficked within a country are often forced to work in the textile industry (Global Initiative Against Transnational Organized Crime 2021a). High unemployment rates, triggered by various socioeconomic factors including the COVID-19 pandemic, place low-income households at greater risk of exploitation (mieux+ 2021). Meanwhile, the Seychelles is a country of origin and transit, and a destination for sex and labour trafficking victims who are forced to work as domestic servants, or in the fisheries, agricultural or construction sectors. While the Seychellois government is receiving substantial international support to tackle organised crime, its monitoring and enforcement capacities are overstretched due to the vastness of its maritime territories (Global Initiative Against Transnational Organized Crime 2021b).

Recommendations

Climate-related security risks are increasing across the African continent, particularly around natural resource competition, access to food, water and energy, migration and displacement, and armed groups. At the same time, insecurity and conflict are further driving environmental degradation, and hindering climate change adaptation and mitigation efforts.

In order to break this vicious cycle of increasing climate change, environmental degradation, insecurity and instability ambitious action is needed. This includes, first and foremost, ambitious mitigation action to reduce GHG emissions and keep warming at a minimum following the principle of common but differentiated responsibility. At the same time, efforts to adapt to climate change and directly address climate-related security risks must be massively scaled up. Addressing the links between climate change, peace and security is a key building block for development more broadly, and a stable, peaceful and prosperous continent. The intersection of climate security and development forms a crucial nexus that presents opportunities to solve tensions between environmental stability and socioeconomic progress. The following six recommendations outline key areas that can help to better address climate-related security risks in Africa.

African challenges need African solutions

Climate-related security risks are increasing aWhile there are important commonalities in terms of the climate-related security risks that African countries and societies are facing, the specific ways these risks play out and their dynamics are always highly localised and specific. Histories of conflict, marginalisation, identity, the underlying political economy and power structures, governance structures and institutions, and the behaviour of political, traditional and business leaders are all decisive in translating climate risks into security and conflict risks. These factors are highly contextual and change from region to region, country to country and community to community. This means that to address climate-related security risks the following areas should receive particular attention:

Strengthen analysis, research and data collection: In order to address climate-related security risks, it is imperative to understand local differences and adapt solutions accordingly. There is a need for analysis and research that is highly contextualised. In particular, more research is needed in those regions and on those topics that are under-researched. This includes Northern Africa, Central Africa, Southern Africa, African island states, and transboundary climate-related security risks such as transhumance, environmental conservation, and water and land management. To inform appropriate solutions, African analysis, research and data collection capacities have to be improved to provide more contextualised analysis of climate-related security risks.

Use local and traditional knowledge and institutions: There is a wealth of local and traditional knowledge that should be used to better address climate-related security risks. Communities have been adapting to environmental change for a long time, and have approaches and technologies that are well-suited to the specific local environmental, social and cultural context, particularly concerning conflict and natural resource management. Using local, traditional and indigenous knowledge and institutions are important success factors for climate security interventions and should be a key part of any integrated approach.

Seize the strength of the younger generation: With 70 per cent of the population under 30 years old, Africa has the world's youngest population. This represents a tremendous asset and an opportunity for the continent, which needs to be harnessed. If this generation is ignored and left behind, it will turn into a generation without perspectives and a risk. Yet, if given the right tools,

this generation can be a source of rapid development and innovation. For this to become a reality, education and jobs will be foundational. In order to prevent many of the risks outlined in this report, a strong focus on primary, secondary and tertiary education, and employment opportunities will be a key prevention and resilience strategy. This should include focusing on climate literacy, and green skills and sectors, as well as fostering social and environmental entrepreneurship.

Do not leave African island states behind: African islands states are particularly affected by climate change and face unique risks due to their geography and other factors, such as narrowly based economies. Island states need specifically designed solutions, access to finance and capacity building support. For example, higher-income island states, such as the Seychelles and Mauritius, often do not have access to concessional financing and grants. Capacity building support should include improving maritime security, for example, by enhancing maritime awareness and enforcement capacities; investments in early warning and disaster risk reduction; harnessing the potential of the blue economy and ecosystem-based adaptation; developing an integrated approach to water, food and energy security; and regular dialogues and knowledge-sharing platforms for island states to learn from each other's experiences and best practices in addressing climate-related security risks.

Financing climate security actions

Access to finance will be key to addressing the full breadth of climate-related security risks, and building more resilient and sustainable economies, societies and states in Africa. There are a number of specific areas that need urgent action:

Close the adaptation financing gap: There is a huge need for an overall increase in climate financing for the continent, particularly regarding adaptation. Without water, energy and food security, and climate-resilient livelihoods, peace and stability are hard to achieve. To avoid the worst risks, there is an urgent need to invest in risk prevention and resilience building. This includes better and easier access to finance, investment in absorption capacities, and an international mechanism to address loss and damage. At the same time, as financing is scaled up, it is imperative to use context- and conflict-sensitive approaches to ensure that adaptation action does not produce new conflict risks, and to identify peacebuilding and conflict-prevention co-benefits.

Reach the most vulnerable, conflict affected and fragile contexts: At the moment, the majority of climate and biodiversity financing does not reach the most vulnerable contexts: conflict-affected and fragile countries, and island states. The existing modalities and capacities to manage financing are often not fit for purpose, and need to be adapted and strengthened. Financing for these contexts has to be ramped up and more accessible, while the capacities to manage funds need to be strengthened especially on the country level. One way of addressing some of these challenges would be to promote high-level dialogue between multilateral development banks, and conflict-affected and fragile countries that addresses the financing gap.

Strengthen African financing facilities: To date, African financing facilities have been limited in nature. The African risk facility is an important step in the right direction and needs to be strengthened. In particular, access for countries that face funding problems and the understanding of how the risk facility works on the national level need to be improved. The African Peace Fund could play a pivotal role in addressing climate security risks on the continent, but the fund needs to be urgently operationalised and scaled up.

Provide integrated financing to scale up climate security actions: In addition to a lack of overall climate financing, there is a specific lack of financing instruments for climate security actions. Integrated funding mechanisms such as the UNPBF enable climate security actions by facilitating cooperation between different specialised actors. It is imperative to invest now in projects that build resilience to climate-related security risks. There is a long history of environmental peacebuilding and over the past 10 years a first generation of climate security projects has been implemented across the African continent. With substantial and dedicated funding schemes, these experiences and the emerging good practices documented in this report should be further developed and scaled up. In addition, finance organisations should integrate climate-related security risks across their portfolios.

Institutions, cooperation and capacities for preventive action and resilience building

Climate-related security risks will increase significantly over the coming years and decades. In order to prevent the worst potential outcomes, there is a need to move away from reactive and responsive approaches to more pro-active and anticipatory approaches that focus on prevention and resilience building. In order for this to happen, the following areas could serve as important entry points:

Mainstream climate security in strategies and policies: Climate, peace and security should be fully mainstreamed in all relevant strategic and policy frameworks. While there has been some notable progress in terms of regional frameworks and strategies, this is not the case for national and sub-national strategies and policies. This includes addressing climate security intersections in national adaptation plans, nationally determined contributions, climate change action plans, peace plans, interventions and architectures, defence strategies, stabilisation frameworks, and sectoral policies including water, agriculture and energy.

Continue to strengthen the climate-conflict nexus in early warning and early action: Early warning and early action systems, whether focusing on climate and environment or peace and security, still fail to integrate the climate-conflict nexus. This is the case for early warning systems at the continental level, but also for some at the regional and national levels. Some countries and regions still need to take significant steps in developing and operationalising disaster management plans that include early warning systems, evacuation procedures and emergency response protocols. It is important that such systems draw clear linkages to indirect, cascading risks related to climate change and environmental stress by incorporating a clear set of climate security indicators. Furthermore, such systems must integrate and build upon local institutions, indigenous knowledge and civil society.

Foster cross-sectoral cooperation: Climate-related security risks are systemic and complex risks that span sectors. As such the responses to climate-related security risks have to address the different dimensions of risks. This includes the humanitarian, development, peace and conflict, and adaptation and environment sectors. The goal is to improve operational responses, in particular, by making peacebuilding and conflict prevention climate sensitive, and climate action conflict sensitive. For example, natural resource and livelihood programmes, as well as initiatives that link nature conservation with climate security, can increase resilience to both conflict and climate change. Experiences from integrated peacebuilding and climate change adaptation projects show that there are significant co-benefits when this cooperation is successful. As part of this effort, institutions must provide strong leadership and incentives for cooperation.

Develop and strengthen climate security capacities and institutions: Many organisations across the continent have started to develop dedicated climate security capacities and structures. This needs to continue, and be strengthened and expanded to areas where the biggest gaps exist, particularly on the national and local levels. Organisations need dedicated climate security specialists, and vertical and horizontal cooperation and coordination structures. These initiatives can take various forms. For example, the United Nations has been integrating climate security advisers into their regional offices and peace operations. Meanwhile, in Eastern and Western Africa working groups such as the IGAD Regional Mechanism on Climate and Security, and the Western African Regional Working Group on Climate Change, Security, Environment and Development have been created. In addition, organisations and institutions on all levels should establish clear lines of responsibility and accountability, for example, by designating specific ministries or bodies to take ownership of climate security issues. The institutionalisation of climate security could help organisations such as the African Union, as well as its Regional Economic Communities and Regional Mechanisms, break siloes and harmonise the work of different pillars. To foster these developments, there has to be a strong effort to exchange experiences and training, and build capacity in this area, for example, through an AU-led training facility for climate security.

African cities as transformative force: African cities play a critical role in forging a path to peaceful and more climate resilient societies. They have the potential to be centres of sustainable economic growth, provide better jobs, and access to education and health care. However, if urbanisation is rapid and unplanned, climate and security risks can increase, with the threat that cities will become climate security hotspots. African cities should, therefore, leverage their human capital,

increase efforts to tackle rising inequality and exclusion, and provide an enabling environment for the green transition. A particular focus should be put on improving cross-sectoral cooperation to foster localised solutions that address social, economic, environmental and political challenges in an integrated manner, for example, through inclusive urban planning and development initiatives.

A strong civil society is resilient

Civil society is at the forefront of addressing climate-related security risks. Civil society actors are advocates and catalysts for necessary change, and indispensable partners in building more resilient societies and states, particularly in conflict-affected and fragile contexts. In order to play an effective role in addressing climate-related security risks, the following areas are key:

Build capacities and awareness: While more and more civil society organisations are actively addressing climate-related security risks, many organisations still lack the required expertise and awareness. To enable civil society action, it will be important to raise awareness about why it is important to address climate-related security risks, provide good practices on how to address these risks, and finance training and capacity building. This also requires allowing civil society to participate in relevant policy decisions, rather than rely on top-down policymaking. Strengthening civil society's climate security capacities will be pivotal in filling the action gap on these risks at the local level.

Partner for implementation: Civil society organisations often possess tremendous experience in implementing projects in challenging environments, networks and implementation structures to deliver results, and local contextual knowledge and analytical capacities that are important for developing effective interventions. Building on these strengths, implementation partnerships that address climate security risks should be scaled up to ensure delivery on the ground.

Protection for those on the frontlines of climate security risks: Environmental defenders and human rights activists are key for addressing climate-related security risks, but they are too often the target of attacks and human rights abuses. They need more engagement, awareness and protection mechanisms. This includes prioritising investments in safeguarding, empowering and building the capacity of environmental defenders.

Engage the private sector: As shown throughout this report, the private sector can be a risk multiplier, but also a powerful lever to build more resilient states and societies. Civil society can be an important partner to ensure that corporate misconduct is identified and monitored. In partnerships with the private sector, civil society can also help to enable the private sector to play a positive role in addressing climate-related security risks, for example, by ensuring that infrastructure developments are conflict- and climate-sensitive, and have real benefits for local communities.

Intersectionality is key to addressing vulnerability

The most vulnerable are the most affected by climate-related security risks. Gender, socioeconomic status, ethnicity, age, disability and sexual orientation combine and shape risks on an individual level. In order to ensure that the most vulnerable are reached, the following areas of action are key:

Understand differences: It all starts with having the knowledge and understanding how different individuals are affected by and experience risk. Still too often data disaggregated by gender and other identify factors is not available, which makes it impossible to understand the scale of the challenge and measure improvements. Thus, it is imperative that, when data is collected, it is disaggregated by gender, age and other factors that shape risk and resilience. In addition, climate security assessments need to critically reflect these factors and use an intersectional research lens. Climate security action needs to be tailored to also include the most vulnerable.

Ensure broad inclusivity: The notion of inclusive participation has to be expanded. Often the participation of groups such as women or young people is done through selective processes, which result in the participation of representatives with higher socioeconomic status and educational attainment, and urban backgrounds. To effectively address climate-related security risks, it is important to broaden participation and ensure that the voices of the most marginalised participate in the decision-making process from policies to projects on

the ground. This includes programmes to empower and enable effective participation, develop leadership skills, and create inclusive platforms.

Focus on the most marginalised and vulnerable: Climate security action needs to focus on the most marginalised and vulnerable. This means that actions should be targeted towards women, young people, people with disabilities, LGBTQ+ individuals, indigenous peoples, and other minority groups that are socially, economically and politically marginalised, ensuring that interventions are inclusive and specifically address the root causes of marginalisation. This includes harnessing the potential of women and young people in natural resource and conflict management, providing specific livelihood and resilience support, and addressing the specific protection needs of the most vulnerable in times of disaster.

Address gender-based violence: GBV is a climate security risk. In situations of displacement and disasters, there is a higher protection need. The same is true for situations and communities that face multiple converging pressures. This means that action on GBV needs to be integrated across climate security programming and scaled up. This includes improving the legal, social and physical protection of women and girls on the move.

No justice, no peace

Addressing climate-related security risks is closely linked to ensuring climate justice. Africa is globally one of the worst affected regions in terms of climate impacts, conflicts and associated interlinkages, while being one of the least responsible regions in terms of contributing to climate change. This injustice needs to be addressed. In terms of climate-related security risks, this includes the following:

Amplify and unify African voices: While some African countries have used the international stage to underline the urgent need to act on climate-related security risks, Africa's collective voice has not reached the level it should be at. A common position on climate, peace and security could be one key step in this regard. In addition, joint African diplomatic initiatives and capacities to urgently address climate-related security risks should be developed.

Ensure a just transition: There is a risk that African regions will lag behind in the global transition towards greener and more sustainable technologies. The continent boasts significant resources such as green hydrogen and critical minerals, as well as human capital potential, which could fuel not only a global, but also Africa's own transition. African countries and international partners need to ensure that there is sufficient investment in Africa to finance the green transition, and enable equal opportunities for growth and development. This includes developing local value chains for green technologies to avoid African countries simply exporting valuable raw materials to the rest of the world.

Foster environmental justice: Climate-related security risks have to be addressed through an environmental justice approach. This includes recognising the human right to a clean, healthy and sustainable environment, as well as promoting the realisation of environmental protection and restoration through a rights-based approach. Moreover, this should include integrating conservation efforts with ecosystem services, local livelihoods, and conflict prevention and resolution.

Reduce external risks: Climate-related security risks are shaped by policies that are devised by countries outside of the African continent. As such non-African countries have the responsibility to ensure that key policies on food, migration, corruption, mineral and development cooperation are climate security sensitive and do not exacerbate risks on the African continent.

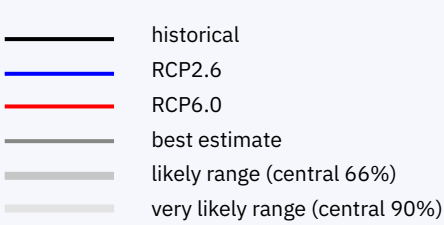
Annex

How to read the plots

The maps and plots included in this report provide an overview of projected climate change parameters and related sector-specific impacts in African regions until 2080 under two different climate change scenarios (RCPs). RCP2.6 represents a low emissions scenario that aims to keep global warming below 2°C above pre-industrial temperatures, while RCP6.0 represents a medium-to-high emissions scenario. Projections are provided up to 2080, with each year showing the mean value of a 31-year period.[65]

The **line plots** show climate impact projections averaged over the whole country, with the blue colour representing the RCP2.6 scenario and the red colour representing the RCP6.0 scenario. While the lines depict the best estimate (representing the multi-model median of 10 climate models), the shaded areas represent the likely range (strongly shaded area) and the very likely range (lightly shaded area), indicating the range of model agreement of at least 66 per cent and 90 per cent of all model projections, respectively.

How to read the plots



The **map plots** display regionally explicit climate information under RCP2.6 and RCP6.0, in a spatial resolution of approximately 50 x 50 km. While the leftmost column represents the baseline period as found in the model data, the other three columns represent future projections in comparison to that baseline period. The colour values depict the multi-model median of the underlying models at each grid cell. The presence of a dot means that at least 75 per cent of the models agree on the sign of change depicted for the specific grid cell and scenario (i.e. whether an increase or a decrease can be expected). Conversely, the absence of a dot represents the lack of model agreement on the predicted change.

UNCERTAINTIES IN CLIMATE CHANGE PROJECTIONS

It is important to acknowledge that uncertainties are always part of climate change projections. Uncertainties arise from a variety of factors, including natural variabilities, uncertainties in GHG emissions scenarios and differences in the models use. Consequently, no future (climate change) projection comes without some level of uncertainty. The levels of (un)certainties, however, differ. We present the results of 10 different global models. To indicate the (un)certainty of the projections, we consider model agreement. The more these models agree the higher the certainty, the more they disagree the lower the certainty. For example, if different models project a similar result under the same scenario, the projected changes demonstrate low levels of uncertainty. However, if the models project very different changes (in terms of range and even direction) under the same scenario, then the projections are uncertain.

Line plots and map plots depict uncertainty differently and cannot be compared. The line plots indicate the level of certainty through the shaded areas, depicting the likely (central 66 per cent) and very likely (central 90 per cent) range of all model projections. Generally, the smaller the shaded areas, the more certain the projections. The map plots depict the level of certainty through the presence or absence of dots. If dots are present, at least 75 per cent of all models agree on the direction of change or, in other words, on an increasing or a decreasing trend. If the dots are absent in a specific region or scenario, then model agreement within this specific region and scenario is below 75 per cent.

To simplify the interpretation of the projections, all line plots and map plots that are subject to high levels of uncertainty are marked with a symbol ( ).

This does not imply that these plots have no informational value, but rather draws attention to the limitations of such projections for future planning. Consequently, they should be very carefully interpreted when they are used for planning measures. In the case of high uncertainty, additional information will be provided on how to interpret the data.

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