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CENTER ON
ADAPTATION

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Climate Adaptation and Security in the Sahel and Horn of Africa



BODHI
GLOBAL ANALYSIS

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Acronyms

Acronyms	Definitions
AAAP	Africa Adaptation Acceleration Program
AfDB	African Development Bank
ARF	Africa Resilience Forum
AU	African Union
AUPSC	African Union Peace and Security Council
CILSS	Permanent Interstate Committee for Drought Control in the Sahel
COP	Conference of the Parties (UNFCCC)
CPSA	Climate, Peace, and Security Advisor
ECOWAS	Economic Community of West African States
EBA	Ecosystem-based Adaptation
EM-DAT	Emergency Events Database
FAO	Food and Agriculture Organization
FDI	Foreign Direct Investment
FMNR	Farmer-Managed Natural Regeneration
GCA	Global Center on Adaptation
GDI	Gender Development Index
GIS	Geographic Information Systems
HoA	Horn of Africa
ICPAC	IGAD Climate Prediction and Applications Centre
IDDRSI	IGAD Drought Disaster Resilience and Sustainability Initiative
IGAD	Intergovernmental Authority on Development
IIAG	Ibrahim Index of African Governance
IOM	International Organization for Migration
JOSP	Jowhar Off-Stream Storage Programme
KII	Key Informant Interview
MPI	Multidimensional Poverty Index
NAP	National Adaptation Plan
ND-GAIN	Notre Dame Global Adaptation Initiative
NGO	Non-Governmental Organization
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
ODA	Official Development Assistance
ODF	Official Development Finance
OECD	Organisation for Economic Co-operation and Development
OPHI	Oxford Poverty and Human Development Initiative
PC	Principal Component
PCA	Principal Component Analysis
PCR	Principal Component Regression
PiN	People in Need
REI	Resilient Economies Index
SIPRI	Stockholm International Peace Research Institute
UCDP	Uppsala Conflict Data Program
UN/AU	United Nations / African Union
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNOAU	United Nations Office to the African Union
UNOWAS	United Nations Office for West Africa and the Sahel
WFP	World Food Programme
WORLD	WORLD Policy Analysis Center

Glossary

Climate Adaptation

Adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects. It involves changes in processes, practices, and structures to mitigate potential damages or capitalize on opportunities associated with climate change. In this report, adaptation is understood not only as a climate response but also as a strategic investment in stability and human security.

Adaptation as a Security Investment

A framing advanced by the Global Center on Adaptation that positions adaptation as a proactive investment in stability. It emphasises how well-targeted adaptation measures such as resilient infrastructure, climate-smart livelihoods, early warning systems, and inclusive governance can reduce the drivers of fragility and insecurity, and generate peace dividends in fragile and conflict-affected settings.

Climate Peace and Security Nexus

The interaction between climate change impacts, peace, and security outcomes. Climate change is not treated as a direct cause of conflict, but as a risk multiplier that compounds existing social, economic, and political vulnerabilities, particularly in contexts of weak governance and inequality.

Conflict Dynamics

The interaction of structural drivers, proximate triggers, actors, and conflict management mechanisms that shape how tensions evolve over time. Climate variability and resource stress can influence these dynamics by intensifying competition over livelihoods, land, water, and mobility corridors, particularly where institutions are weak or exclusionary.

Fragility

A condition characterised by weak or exclusionary governance, limited institutional capacity, and high exposure to shocks. In fragile and conflict-affected settings, climate impacts are more likely to translate into insecurity where coping and adaptive capacities are low.

Human Security

A people-centred understanding of security that extends beyond the absence of violence to include protection from threats to livelihoods, dignity, and well-being. Climate impacts undermine human security by exacerbating food and water insecurity, displacement, and inequality. Strengthening adaptive capacity is therefore integral to preventing climate-related instability.

Locally Led Adaptation

Adaptation approaches that emphasise local ownership, participation, and decision-making in the design and implementation of climate responses. Evidence highlighted in this report shows that locally led and participatory adaptation initiatives are more likely to strengthen resilience, cooperation, and peace-positive outcomes in fragile contexts.

Resilience

The capacity of households, communities, institutions, and systems to anticipate, absorb, recover from, and adapt to shocks and stresses, while maintaining essential functions. In this report, resilience is closely linked to governance quality, inclusion, and social cohesion.

Risk Multiplier

A factor that intensifies existing vulnerabilities, grievances, or governance weaknesses, increasing the likelihood that climate shocks translate into insecurity or conflict. Climate change functions as a risk multiplier rather than a deterministic driver of violence.

Security

Understood broadly to include societal stability, institutional legitimacy, and the ability of states and communities to manage shocks peacefully. This framing aligns with AU and UN approaches that integrate peace, development, and human security.

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Foreword

Climate shocks, deepening droughts, degraded land and shrinking water resources are displacing communities, heightening tensions, and undermining stability across the Sahel and Horn of Africa.

This new GCA–Bodhi report shows that, against the backdrop of an intensifying global climate crisis, for the Sahel and the Horn of Africa, adaptation is now a core security imperative. In several regions of Africa, local resilience, climate-smart agriculture, early-warning systems, and community-driven solutions are already preventing crises and protecting lives.

If climate impacts in Africa can lead to livelihood erosion, community destabilization, conflicts over resources and promote instability with strategic and transboundary ramifications — as insights from this report point to — then directing part of NATO members' new security-related expenditure envelope toward climate adaptation in fragile regions of the Sahel and Horn of Africa is both strategic and necessary. Adaptation finance should count as a security-related investment, a recommendation that is particularly relevant when development and climate finance are facing setbacks.

The report's findings highlight that in Africa, adaptation investments in resilient infrastructure, early-warning systems, and climate-smart livelihoods are also strategic security measures. Failure to invest in adaptation on the continent risks wider instability — from rising displacement to disrupted trade and mounting geopolitical tensions.

This report demonstrates that climate adaptation reduces risk, strengthens stability, and safeguards development gains. We present it with urgency and conviction — calling on international partners to give due consideration to climate and adaptation in peace and security responses.

Across the Sahel and the Horn of Africa, climate change has become one of the most destabilizing forces of our time. Floods that sweep away harvests, droughts that last for years, and the steady degradation of land and water are no longer episodic shocks—they are the structural drivers of fragility, displacement, and insecurity. These regions have become the world's clearest demonstration that climate resilience and human security are now inseparable.

This report provides new insights on what African communities have known for years: when climate shocks intensify, so do the pressures that push families from their homes, strain relations between herders and farmers, and disrupt the economic systems on which millions depend. It shows plainly that climate impacts do not occur in a vacuum. They interact with governance challenges, public services limitations, and existing inequalities, creating a combustible mix that can fuel instability and threaten regional and international security.

Yet the findings of this report also reveal a profound opportunity. Where adaptation is deployed early—where countries invest in drought-resilient agriculture, restore degraded land, strengthen early-warning systems, and empower local communities and institutions—tensions fall, cooperation increases, and populations can better withstand shocks — before they escalate into crises. Adaptation is, in the focus regions of this report, a first line of defense.

The evidence is clear: **adaptation is not only a development priority—it is a strategic security investment.** The cost of inaction is rising displacement, conflicts, and insecurity, deepening poverty, the erosion of state authority, and the widening of geopolitical fault lines. The benefits of action

are stable communities, functioning markets, and strengthened institutions capable of managing climate pressures peacefully.

This report arrives at a pivotal moment. As international partners reassess security spending and resilience commitments, the data presented here make a compelling case for a new approach: one in which a portion of global security-related expenditure—particularly within alliances such as NATO—is directed toward climate adaptation in fragile regions of Africa. When droughts, floods, and resource scarcity can trigger instability with cross-border and even global repercussions, investing in adaptation is not charity; it is preventive diplomacy at scale, and it delivers returns measured in stability, reduced displacement, and stronger regional cooperation.

For Africa, this is a matter of urgency —and of sovereignty. For the international community, it is a matter of enlightened self-interest. As this report demonstrates, adaptation is one of the most effective tools we have to reduce fragility, protect development gains, and safeguard peace.

We present this report with a shared conviction: **the world must recognize climate adaptation as integral to global peace and security.** And we do so with confidence, because the solutions are already being built by African communities—from the floodplains of Somalia to the drylands of the Sahel—who are proving every day that resilience is possible when resources, governance, and partnerships align.

We call on governments, multilateral institutions, and security actors to act on the evidence before us. The stakes are high, but the path forward is clear. Investing in adaptation today is an investment in stability tomorrow.



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Executive Summary

While climate impacts are not typically viewed as a direct cause of conflict, in fragile regions they can and do act as an important risk multiplier, compounding existing vulnerabilities and deepening grievances.¹ When climate pressures or shocks intersect with governance shortcomings, limited institutional capacities and persistent inequalities, they can trigger escalation of—and reinforce—existing social tensions, instability, and lead to erosion of confidence in institutions and to civil and political unrest.^{2,3}

The Sahel and the Horn of Africa (HoA) are among the world's most climate-exposed and fragile regions—where recurrent droughts, floods, temperature extremes, and erratic rainfall variability undermine the livelihoods of one of the lowest-income population regions of the world, in turn acting as a driver of displacement and increasing competition over arable land and limited water resources.⁴ For example, in Somalia and South Sudan, cycles of drought and flooding are driving large-scale movements of people, generating disputes over access to water, grazing land, and humanitarian aid. Similar dynamics are observed in parts of the Sahel, including Niger and Mali, where recurrent droughts, pasture degradation, and competition over natural resources have intensified tensions between pastoralist and farming communities.⁵ This report examines how these dynamics unfold across the Sahel and Horn of Africa and how adaptation can and is contributing to reduce the pressures that drive fragility and insecurity.

Framing adaptation as a critical component for security investments, this study explores how adaptation is not solely for mediating climate risks, but also for dismantling structural drivers of instability. This conceptualization positions adaptation investments in infrastructure, early warning systems and climate-smart livelihoods as strategic peace and security measures. Conversely, underinvestment in adaptation on the African continent, risks cascading consequences for regional and international security through migration pressures, disrupted trade, and geopolitical instability, among others.^{6,7}

The study has sought to analyse statistical evidence and qualitative insights to better understand how adaptation contributes to peace and stability. The analysis covers 18 countries across the Sahel and the Horn of Africa, combining quantitative, spatial and qualitative methods to identify where and how adaptation can be positioned as a security investment.

1. In the discourse surrounding the climate-security nexus, the multiplier effects of climate change have been widely recognized, see: United Nations Secretary-General. 2009. Climate change and its possible security implications: Report of the Secretary-General, A/64/350, 11 September 2009, p. 1., where the use of the concept of "threat multiplier" is set out by the UNGA and United Nations (2019). "Climate change recognized as 'threat multiplier', UN Security Council debates its impact on peace." 25 January, 2019

2. United Nations. (2021). Addressing the impacts of climate change on peace and security. <https://dppa.un.org/en/addressing-impact-of-climate-change-peace-and-security>

3. World Bank. (2025). Fragile and Conflict-Affected Situations. Intertwined Crises, Multiple Vulnerabilities. <https://openknowledge.worldbank.org/server/api/core/bitstreams/35bb4b31-e9b0-4a1e-8c6c-df4336558673/content>

4. For the purposes of this study, the geopolitical categories of the Sahel and HoA operationalised in this report are those accepted by the United Nations by the United Nations Integrated Strategy for the Sahel (UNISS), defined as the members of the Intergovernmental Authority on Development (IGAD), and the United Nations Climate, Peace and Security Hub for the Horn of Africa respectively. While there are discrepancies in the usage of the Sahel and HoA, the countries outlined in footnote 2 are encompassed in these two UN definitions, with the exception of Sudan, which suspended its IGAD membership in January of 2024.

5. Tony Blair Institute for Global Change, 'From Crisis to Conflict: Climate Change and Violent Extremism in the Sahel'.

6. HORN International Institute. (2023). Policy Brief: Climate Change, Migration, and Security in the Horn of Africa. <https://horninstitute.org/wp-content/uploads/2023/09/Climate-Change-Migration-and-Security-in-the-Horn-of-Africa-Issue-27-1.pdf>

7. GCA (2022). State and Trends in Adaptation Report 2021: How Adaptation Can Make Africa Safer, Greener and More Prosperous in a Warming World. https://gca.org/wp-content/uploads/2022/07/GCA_STA_2021_Complete_low-res.pdf

Analytical Approach and Data

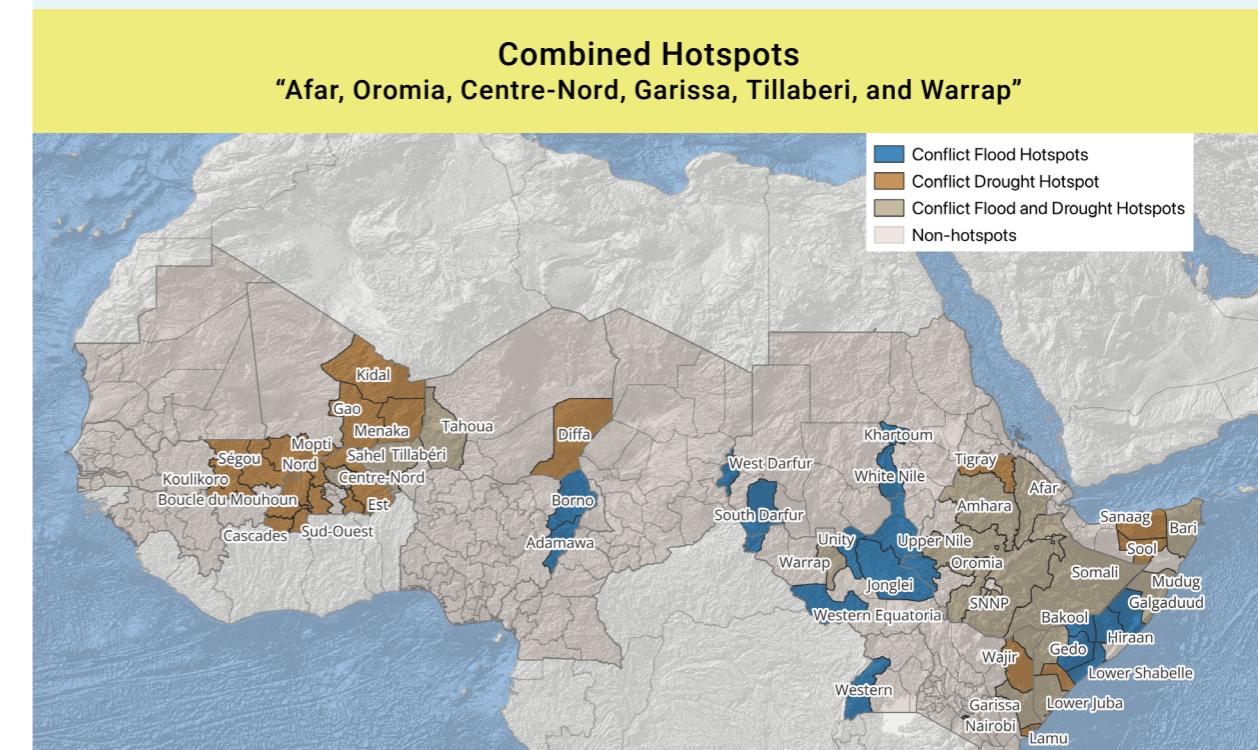
In terms of the study's methods, the research team compiled comprehensive climate, conflict and adaptation datasets for 2020-2024 and conducted Principal Component Analysis and Principal Component Regression to examine correlations between extreme weather events, socio-economic vulnerability and conflict incidents. Geographical Information Systems were used to map conflict-climate hotspots, while expert interviews and desk reviews provided contextual explanations and case examples. Three main research questions guided the analysis:

- **Climate-Security Nexus:** How climate impacts (e.g. rainfall variability, droughts, floods) relate to conflict dynamics.
- **Adaptation as a security investment:** how adaptation policies and investments influence peace and stability outcomes.
- **Policy and institutional framing:** how regional and continental frameworks link adaptation, peace and security and where coordination gaps remain.

KEY FINDINGS

Looking at the **climate-security nexus** across both regions, floods and droughts are the climate hazards most consistently associated with conflict incidents, whereas storms show a negative correlation. This suggests that prolonged drought and flood stress, rather than short-lived events, drive instability. Conflict-climate hotspots identified through GIS analysis include:

- **Conflict-Flood:** Centre-Nord (Burkina Faso), Afar and Oromia (Ethiopia), Garissa (Kenya), Tillaberi (Niger), Borno (Nigeria), and South Darfur (Sudan).
- **Conflict-Drought:** Boucle du Mouhoun (Burkina Faso), Afar (Ethiopia), Mandera (Kenya), Gao (Mali).



Evidence reviewed suggests socio-economic vulnerability and limited coping capacities can amplify climate-related insecurity. Based on principal component regression using 22 variables from 17 datasets, areas with higher numbers of people in need, large rural populations, and higher INFORM Risk Index scores are more prone to conflict. At the same time, greater foreign investment correlates with lower conflict incidence, reflecting the stabilizing effects of economic opportunity. Governance and institutional strength, therefore, determine whether climate shocks translate into insecurity, more than the magnitude of the shocks themselves. An analysis of the [Resilient Economies Index – Africa \(REI\)](#) data reveals that countries with higher conflict prevalence will tend to have a less resilient GDP, highlighting the risk of compounding the negative impacts of conflicts on the national economy when climate disasters happen.

The analysis of this report further demonstrated that different types of **adaptation investments**—from sectoral measures (economic, agricultural, infrastructural, social) to institutional and economic reforms—can reduce insecurity and strengthen resilience. The findings show that when adaptation includes institutional and economic measures, such as improved governance capacity, economic readiness, and increased foreign direct investment, conflict intensity tends to be lower. These measures enhance communities' coping capacity and overall stability. This pattern echoes regional priorities articulated by IGAD, which frame investments in livelihoods, governance capacity, and adaptive institutions as central peacebuilding strategies in the Horn of Africa. The qualitative analysis also revealed that community-led initiatives across the Sahel and the Horn of Africa further illustrated how adaptation generates peace dividends:

- Water management programs in Mauritania, Niger, and Chad consistently show reductions in local conflict reports when communities jointly manage water points and grazing access.
- The Jowhar Off-Stream Storage Program in Somalia demonstrates how pairing flood control infrastructure with strengthened local governance and women's cooperatives has turned irrigation canals into locally recognized "peace corridors."
- Ecosystem and rangeland restoration in Kenya's Laikipia and Somalia's Afgoye corridor combine reforestation and solar-powered irrigation with shared resource management systems, helping reduce tensions between herders and farmers.
- Women and youth-led initiatives in Mali, Mauritania, and Lake Chad show how linking market gardening, microfinance groups, and land-restoration efforts contributes to conflict prevention and supports community-level mediation.

These examples strongly indicate that adaptation can yield dividends for peace and stability when designed in a participatory way with due consideration to equity for beneficiaries, and rooted in local governance systems. Conversely, the research found evidence that adaptation projects that overlook inclusion and local power dynamics risk reinforcing tensions, especially around water and land access. This finding aligns with IGAD's Climate Adaptation Strategy and Disaster Risk Management Framework, which emphasizes inclusive and community-led models, such as co-managed water points and local irrigation schemes, alongside broader socio-economic and institutional reforms. At the same time, adaptation outcomes in fragile contexts are shaped by wider structural constraints, including limited public absorption capacity, donor compliance rules, and short funding horizons. These factors often shift delivery outside national systems, reducing opportunities for long-term institutional strengthening. Addressing these barriers is essential for adaptation to meaningfully contribute to peace dividends. These patterns are consistent with regional



priorities articulated through IGAD-led frameworks, including the Drought Disaster Resilience and Sustainability Initiative (IDDRSI), which emphasizes pastoral and rangeland systems, community-led water management, and locally grounded governance as core components of climate resilience and stability.

At the **policy level**, adaptation is increasingly recognized as a conflict prevention and risk reduction strategy. The African Union's Climate, Peace and Security Policy Framework and IGAD's Climate Adaptation Strategy (2023-2030) integrate adaptation into continental and regional peacebuilding agendas. The African Development Bank has similarly embedded climate considerations in its fragility and resilience strategy. This report aligns with these frameworks by translating high-level commitments into empirical evidence on how adaptation investments can reduce fragility and generate stability dividends in fragile and conflict-affected contexts.

National Adaptation Plans (NAPs) are emerging as key instruments linking adaptation with peacebuilding. Somalia and South Sudan's NAPs explicitly address conflict sensitivity and local peace, while Nigeria and Burkina Faso have incorporated conflict-sensitive indicators and peace committees. However, several countries still face coordination and implementation gaps, with limited capacity and fragmented governance undermining delivery. The analysis of the REI Africa findings shows that conflicts do not necessarily impede the policy development process; rather, it was the focus on military spending that was a stronger indicator of gaps in adaptation policy, indicating that the prioritization of military action in government attention, rather than the prevalence of conflict itself, may detract from climate-related policy-making efforts. Regional cooperation remains essential. Mechanisms such as IGAD's CEWARN and CILSS strengthen early warning and cross-border drought resilience but remain under-resourced and unevenly implemented.

At the global level, the International Climate Regime under the UNFCCC and the UN Secretary-General's New Agenda for Peace remain important avenues to position adaptation as a global security and finance priority.^{8,9} The upcoming UN General Assembly processes provide opportunities to strengthen how global adaptation frameworks capture governance, resilience, and fragility, without relying solely on physical measures of progress. In line with broader Global Climate Action, this includes recognizing the role of non-Party stakeholders such as local governments, civil society and the private sector in driving an "all of society" approach to stability and resilience in fragile contexts.¹⁰

Conclusions and Recommendations

The findings confirm that **climate-security links are clear but context-specific**. Floods and droughts are consistently associated with higher conflict incidence across the Sahel and Horn of Africa. Where vulnerability is high and coping or adaptive capacity is weak, climate shocks are more likely to translate into security risks. Locally led adaptation plays a critical role in strengthening community resilience and social cohesion, enabling local institutions to manage these shocks before they escalate into instability. The nature of the impact depends less on the hazard itself than on the governance and preparedness systems in place.

8. United Nations. (2024). COP29 Climate and Peace | Climate Security Mechanism. <https://www.un.org/climatesecuritymechanism/en/cop29-climate-and-peace>.

9. United Nations. (2024). United Nations Framework Convention on Climate Change (UNFCCC) and Climate, Peace and Security | Climate Security Mechanism. <https://www.un.org/climatesecuritymechanism/en/united-nations-framework-convention-climate-change-unfc-cc-and-climate-peace-and-security>.

10. UNFCCC (2025). Climate Action | UNFCCC. <https://unfccc.int/climate-action>.

Migration reflects both the immediate pressures created by climate shocks and the deeper structural weaknesses in adaptive capacity. Climate-related displacement and mobility are reshaping local economies and resource pressures. In contexts with inclusive governance and shared resource management, mobility can serve as an adaptive strategy—where institutions are weak, it amplifies fragility and competition, with the potential to destabilize wider regions through spillover effects on resources, markets, and security. In the Horn of Africa, this includes recognizing pastoral mobility and cross-border cooperation as core adaptation dimensions, consistent with IGAD policy instruments such as the Transhumance Protocol and the Kampala Declaration on Climate, Migration, and Environment.

Governance and capacity shape outcomes more than climate hazards alone. Countries and regions with higher coping capacity, inclusive governance and economic readiness experience fewer conflict incidents. Where governance is weak which could be due to shortcomings in public processes, services or institutions, even small shocks are capable of triggering instability reverberations. In given contexts, **adaptation can deliver dividends in stability when locally led**. Community-based water and land management, ecosystem restoration, and livelihood diversification reduce tensions and strengthen cooperation because they empower people, enhance ownership, and reduce pressure on natural resources when designed and governed locally. Further examples illustrating how this operates systematically are provided in subsequent sections.

Economic resilience is foundational to stability. Both the Sahel and the Horn of Africa depend heavily on climate-sensitive sectors such as agriculture (especially rain-fed), livestock, and fisheries. Repeated shocks to these systems continue to erode incomes, employment, and local markets. Building adaptive economic systems is therefore essential to reducing fragility and enabling sustainable peace.

Regional platforms are pivotal for scaling resilience. Institutions such as IGAD, ECOWAS, and the African Union provide critical coordination and early warning functions but require sustained investment and political support to fully deliver on their mandated work scopes. **Bridging the planning-implementation gap** is equally important. Bridging this gap through accessible finance, coherent governance, and stronger delivery systems is key to translating National Adaptation Plans and climate strategies into tangible conflict attenuation and peace outcomes. The recommendations identify specific entry points to advance this agenda:

- **Integrate governance and stability into adaptation planning and measurement:** Governments and negotiators should ensure that governance, inclusion, and institutional stability are reflected in adaptation metrics and reporting processes, rather than focusing solely on physical infrastructure. Practitioners can contribute by generating evidence and frameworks that help fragile and conflict-affected countries define adaptation success in ways that also capture livelihood security and reduced fragility.
- **Finance governance and local coordination as adaptation priorities:** Multilateral and bilateral donors should invest not only in infrastructure but also in the governance systems that sustain it, such as local coordination, mediation, and dispute resolution. Support should target local institutions managing resource competition, reintegration of displaced populations, and adaptive migration.
- **Scale up locally driven adaptation:** Governments and partners should expand locally led adaptation initiatives that strengthen social cohesion and reduce conflict risks. Documenting and sharing examples from the Sahel and Horn of Africa can help embed peace-positive adaptation in finance pipelines and policy dialogues.
- **Strengthen regional cooperation and early warning systems:** Regional organizations, including IGAD and CILSS, should enhance data sharing, early warning, and cross-border drought resilience. Partners can build on initiatives such as the World Meteorological Organisation's Early Warnings for All to expand investment in cross-border resilience corridors.
- **Track the peace and governance benefits of adaptation:** Governments and finance institutions should measure how adaptation contributes to stability, equity, and governance outcomes. This could include the development of dedicated tracking tools to assess climate-peace co-benefits.

Background and Purpose



Study Background

The Sahel and the Horn of Africa (HoA) are regions of heightened climate-security exposure: recurrent droughts, floods, temperature extremes, and variable rainfall patterns are degrading livelihoods, driving displacement, and intensifying competition over land, water, and mobility corridors. These environmental stressors intersect with weak governance and persistent inequalities, creating a volatile environment where climate shocks more readily cascade into violent conflict and instability.¹¹

Climate change may not be seen as a direct cause of conflict, but has often been characterized as a risk multiplier that compounds existing vulnerabilities, fuels grievances, and erodes already fragile institutions.¹² Recent critical work has emphasized that these interlinkages are not linear but are continuously recomposed through governance practices, security discourses, and local power relations.¹³ For policy and practice, this necessitates a shift towards a more nuanced understanding of how climate risks intersect with fragility and insecurity in dynamic ways.

Against this backdrop, the Global Center on Adaptation (GCA) is advancing a framing of adaptation as a security-related investment. Earlier approaches (e.g., Global Center on Adaptation, 2022) called for security-sensitive adaptation to ensure climate actions do no harm in fragile and conflict-affected contexts. Building on this, the current framing expands further, positioning adaptation as a valuable investment that not only addresses climate risks but that can also reduce or contain drivers of instability. The world's front lines are no longer only defined by borders or armies, but by the capacity of societies to withstand floods, droughts, and displacement and other direct consequences of climate-related pressures in an overheating planetary environment. In regions such as the Sahel and the Horn of Africa, extreme weather intersects with acute governance challenges and deep-seated inequalities, amplifying fragility and fueling conflict risks.¹⁴

A practical illustration comes from Bankilaré, Niger, where the rainy season has become increasingly erratic, with longer dry spells and more intense rainfall. These changes threaten soil, forests, and biodiversity, and directly undermine rural livelihoods. The area is also affected by insecurity: armed attacks have displaced thousands of people and disrupted access to schools and health facilities. Climate stress risks intensifying competition over land and natural resources, particularly amid political instability and regional sanctions. In response, UNDP, together with government and local partners, has supported community-based natural resource management and measures to strengthen local adaptive capacity. Evaluations of these interventions show improvements in sustainable resource use, livelihood resilience, and local cooperation, illustrating how adaptation efforts can contribute to climate resilience, peace, and social stability.¹⁵ In addition, GCA's research highlights both the vast adaptation finance gap in Africa and the outsized dividends from well-targeted adaptation investments in fragile settings, such as job creation, livelihood stabilization, and strengthened institutional resilience.¹⁶

The interplay of climate-security factors are both transnational and are also of concern beyond the continent. Underinvestment in adaptation in Africa risks cascading consequences for international

11. UNDP et al., CSM Progress 2024 | Climate Security Mechanism (2025).

12. In the discourse surrounding the climate-security nexus, the multiplier effects of climate change have been widely recognized, see: United Nations Secretary-General. 2009. Climate change and its possible security implications: Report of the Secretary-General, A/64/350, 11 September 2009, p. 1, where the use of the concept of "threat multiplier" is set out by the UNGA and United Nations (2019). "Climate change recognized as 'threat multiplier', UN Security Council debates its impact on peace." 25 January, 2019.

13. Delf Rothe et al., 'Recomposing the Climate-Security Nexus: A Conceptual Introduction', *Geoforum* 159 (February 2025): 104195.

14. Of the 18 countries considered for this study, 13 rank in the bottom half of the continent on the Ibrahim Index of African Governance.

15. UNDP, Climate resilience can be a catalyst for peace and prosperity in the Sahel - Burkina Faso | ReliefWeb. (2023).

16. Global Center on Adaptation, State and Trends in Adaptation Report 2022, no. 9789083293370 (GCA, 2022).

security, through disrupted trade, migration pressures, food system shocks, and geopolitical instability.^{17,18} Conversely, investing in adaptation offers international dividends: it can strengthen resilience, reduce risks of conflict spillover, and contribute to a more stable global security environment. If even a fraction of the new resilience budgets announced by alliances such as NATO were directed toward adaptation partnerships in Africa, the global dividends could be substantial, such as through reduced migration pressures and the stabilizing and reversal of community and livelihood erosion.

Building on this framing, this report generated statistical evidence and case studies to demonstrate how adaptation can and should be positioned as a peace and security investment, not only for the Sahel and Horn of Africa but also for global stability. The approach taken looks at climate-related factors as they connect to socio-economic and governance issues of interest, rather than looking at observed or projected climate changes and their influence. In this study, the research team included the following countries in the analysis:

- **Sahel:** Senegal, Gambia, Mauritania, Guinea, Mali, Burkina Faso, Niger, Chad, Cameroon and Nigeria
- **Horn of Africa:** Djibouti, Ethiopia, Eritrea, Kenya, Somalia, South Sudan, Sudan and Uganda¹⁹

Each of these countries is characterised by a unique set of economic and governance characteristics, so that these two regions are not to be considered as a monolith. Nonetheless, this group of countries faces common challenges related to conflict over resources and climate-related challenges. In addition, the transboundary nature of climate impacts, particularly shared river basins and aquifers,²⁰ where upstream water management decisions shape downstream livelihoods and security, further warrants a regional approach. Pastoral nomadic communities such as the Fulani people span many countries of the considered regions.

Desk Review Summary

The framing of climate, peace, and security has evolved from viewing climate change solely as a threat multiplier to recognizing adaptation as a peace dividend in fragile settings. While earlier narratives emphasized climate stress as a trigger for instability, recent analyses highlight climate adaptation's potential to generate social and governance co-benefits.²¹ The UN has also highlighted that progress on many of the SDGs depends on advances in climate change mitigation and adaptation, and vice versa.²²

Recent literature consistently frames climate change as a threat multiplier that exacerbates existing fragility, inequality, and governance weaknesses rather than acting as a direct cause of conflict, particularly in fragile and conflict-affected settings.^{23,24} Climate-related shocks—especially water scarcity, droughts, floods, and food insecurity—intensify competition over natural resources, undermine livelihoods, and heighten social and political tensions, increasing the risk of instability and violence.^{25,26,27} A substantial body of research on the water–climate–conflict nexus demonstrates that climate impacts compound existing water security challenges, with water systems acting as critical transmission pathways between climate stress and conflict dynamics.^{28,29} Evidence from West Africa and highly fragile contexts such as the Western Sahel and the West Bank and Gaza shows that climate variability interacts with weak institutions, policy choices, and pre-existing vulnerabilities, contributing to farmer–herder conflicts, forced migration, and food and water insecurity.^{30,31,32} These pressures drive displacement, strain social cohesion, and erode adaptive capacity, reinforcing a vicious cycle of high climate exposure and low resilience in conflict-affected countries.^{33,34,35} At the same time, emerging evidence suggests that conflict-sensitive adaptation—particularly inclusive water governance and integrated climate–development–peacebuilding approaches—can mitigate risks and generate peace dividends by addressing shared resource challenges and strengthening institutional resilience.^{36,37,38}

Against this backdrop, adaptation refers to adjusting systems, livelihoods, and institutions to manage climate risks, while resilience is a society's capacity to absorb shocks and recover.³⁹ In fragile and conflict-affected settings, such as can be found in the Sahel and the Horn of Africa, these concepts

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21. Joshua W Busby, 'Beyond Internal Conflict: The Emergent Practice of Climate Security', *Journal of Peace Research* 58, no. 1 (2021): 186–94.
22. United Nations, Synergy Solutions for Climate and SDG Action: Bridging the Ambition Gap for the Future We Want. REPORT ON STRENGTHENING THE EVIDENCE BASE | SECOND EDITION 2024 (2024).
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33. Global Center on Adaptation. (2021b). State and trends in adaptation 2021: Climate, conflict and migration. Global Center on Adaptation.
34. Global Center on Adaptation. (2022). State and trends in adaptation 2022: Security. Global Center on Adaptation.
35. International Monetary Fund. (2023, August 24). Climate challenges in fragile and conflict-affected states (IMF Staff Climate Note). International Monetary Fund.
36. World Bank. (2023). The climate change and conflict nexus in West Africa: A new approach for operationally relevant vulnerability assessments. World Bank.
37. Global Center on Adaptation. (2021a). State and trends in adaptation 2021: Water. Global Center on Adaptation.
38. Global Center on Adaptation. (2022). State and trends in adaptation 2022: Security. Global Center on Adaptation.
39. IPCC, 2022. Sixth Assessment Report (AR6), Working Group II – Glossary.

interact closely with one another. When governance is weak, climate shocks amplify social and economic vulnerabilities; conversely, participatory adaptation can enhance local governance, reduce inequality, and build social cohesion.⁴⁰

Evidence shows that adaptation initiatives can achieve positive outcomes in conflict-affected areas when they consider local governance and power dynamics. When this responsiveness is absent, and strategies focus mainly on technical or infrastructural solutions, experiences from regions outside government control show that critical social and political dynamics are often overlooked. This oversight can reproduce or even worsen existing inequalities and tensions.⁴¹ Conversely, adaptation initiatives designed through participatory processes and aimed at equitable access to resources tend to strengthen resilience, trust and social stability.⁴²

Within the climate, peace and security nexus, the Horn of Africa and the Sahel have received heightened attention due to being deeply affected by extreme weather linked to climate change. Moreover, existing conflicts across both regions exacerbate the effects of climate stressors, as families and communities face multiple security threats. Resource scarcity has become a flashpoint for herder-farmer conflicts, with erratic rainfall increasing rivalry over resources—particularly water—and exacerbate conflict.

To combat this, at the policy level, adaptation is increasingly recognized as a conflict prevention and risk reduction strategy. The African Union's Climate, Peace and Security Policy Framework puts adaptation within its continental peace and development agenda, while IGAD's Climate Adaptation Strategy (2023-2030) commits to linking climate resilience with regional security cooperation. Similarly, the African Union Climate Change and Resilient Development Strategy and Action Plan (2022-2032) also alluded to the fact that climate change is a threat multiplier in the context of conflict and human security and how strengthening governance and policies can help in addressing the climate and conflict nexus, and provided priority interventions to address this challenge.⁴³ Moreover, the African Union Peace and Security Council (AUPSC) has advanced a Common African Position on Climate Peace, while the African Development Bank (AfDB) has similarly integrated climate into its fragility and resilience strategy, underscoring that adaptation is central to reducing conflict risk.⁴⁴

In the Horn of Africa, this policy architecture is further complemented by IGAD-endorsed instruments that explicitly link climate adaptation, mobility, and peace. The IGAD Transhumance Protocol (2021) provides a regional framework for managing cross-border livestock mobility as a means of reducing resource-based conflict under increasing climate stress.⁴⁵ Similarly, the Kampala Declaration on Climate, Migration, and Environment (KDMECC) recognizes climate-induced mobility as an adaptation strategy and calls for coordinated, rights-based responses across borders.⁴⁶

Emerging alongside these global and regional frameworks, National Adaptation Plans (NAPs) are increasingly framed as key vehicles for aligning adaptation with peacebuilding efforts. According to the NAP Global Network guidance (Crawford et al., 2023), conflict-sensitive NAPs enable governments to address shared drivers of fragility and climate risk through inclusive, locally driven planning. The guidance notes that adaptation and peacebuilding require similar enabling factors - strong leadership, conflict-sensitive data systems, inclusive governance and equitable financing and that "conflict-sensitive NAPs" are becoming practical instruments for bridging adaptation and stability agendas.

Despite this progress, important evidence gaps remain. There is limited longitudinal research on how adaptation influences peace over time, and there is little data linking adaptation finance to stability outcomes.⁴⁷ Few monitoring frameworks include governance or social cohesion indicators and national adaptation planning often lacks systematic conflict sensitivity.⁴⁸ Strengthening evidence and practice in these areas will be key to ensuring that adaptation contributes not only to resilience but also to support lasting peace in fragile contexts.

40. Frans Schapendonk, Conflict Sensitive Adaptation Governance (CSAG): Towards a Theoretical Framework for Integrating Climate, Peace, and Security into Adaptation Policy (CGIAR, 2024).

41. Karen Meijer and Ann-Sophie Bohle, Climate Change Adaptation in Areas Beyond Government Control: Opportunities and Limitations (SIPRI, 2024).

42. Farah Hegazi and Seyuba, The Social Side of Climate Change Adaptation: Reducing Conflict Risk (SIPRI, 2022); UNDP, Mapping of Climate Security Adaptations at Community Level in the Horn of Africa | Climate Security Mechanism (2023).

43. AU. (2022). African Union Climate Change and Resilient Development Strategy and Action Plan (2022-2032). <https://au.int/en/documents/20220628/african-union-climate-change-and-resilient-development-strategy-and-action-plan>.

44. African Development Bank, 'Bank Group's Strategy for Addressing Fragility and Building Resilience in Africa', March 2022.

45. IGAD. (2020). IGAD Protocol on Transhumance. <https://icpald.org/wp-content/uploads/2021/06/IGAD-PROTOCOL-ON-TRANSHUMANCE-Final-Endorsed-Version.pdf>.

46. IOM. (2024). Kampala Ministerial Declaration on Migration, Environment and Climate Change. <https://ehsa.iom.int/kampala-ministerial-declaration-migration-environment-and-climate-change>.

47. Alec Crawford et al., Peace, Conflict, and National Adaptation Plan (NAP) Processes (2023).

48. Schapendonk, Conflict Sensitive Adaptation Governance (CSAG): Towards a Theoretical Framework for Integrating Climate, Peace, and Security into Adaptation Policy.

Analytical Approach



Overview of Data and Methodology

The research team compiled comprehensive data on climate change, security and conflict, and adaptation. This included the number of conflict events in each region, the prevalence and risk of climate hazards, foreign defense investments, patterns of humanitarian intervention, and other relevant indicators. Datasets included temporal and geographic dimensions and were compiled in Excel format. The primary focus was on data from 2020-2024, with the aim of obtaining information down to the first subnational administrative level in each country to enable comparative statistical analysis. An overview of the datasets is provided in the [Annexes](#).

Using the datasets, the research team conducted statistical analyses and developed participatory case studies to address the following research questions:

- **Climate-Security Nexus**

- What are the strongest statistical relationships between climate impacts (e.g. rainfall variability, droughts, floods) and conflict or security dynamics in the Sahel and Horn of Africa?
- How are conflict-climate linkages distributed geographically across the Sahel and Horn of Africa?
- Which contextual factors—such as marginalization, gender inequality, or institutional trust—amplify or mitigate climate-related security risks?

- **Adaptation as a Climate Peace and Security Investment**

- In what ways have adaptation policies, investments, and practices influenced peace and security outcomes in the Sahel and Horn?
- Under what conditions have adaptation measures (e.g. drought-resilient agriculture, ecosystem restoration, climate-smart livelihoods) demonstrably reduced insecurity or strengthened social cohesion?
- What lessons from these experiences can inform the design and scaling of adaptation as a security investment within Africa and globally?

- **Policy and Institutional Framing (integrated across sections)**

- How do regional and continental policy frameworks (e.g. AU, AfDB, IGAD) frame the relationship between adaptation, peace, and security, and where do coordination gaps remain?

Conflict-Climate Mapping and Statistical Analysis

As part of the study, the team used Geographical Information Systems (GIS) to map climate hazard events and conflict incidents, identifying key conflict-climate hotspots across the Sahel and the Horn of Africa. This GIS analysis is particularly important, because it enables the identification of climate-conflict hotspots using spatial data, making complex relationships easier to visualize. Moreover, the use of GIS maps enhances accessibility and understanding for stakeholders, allowing them to clearly observe and interpret geographic patterns of conflict and climate risks. The team focused on major climate hazards, such as droughts and floods.

Furthermore, the research team produced statistical evidence using Principal Component Analysis (PCA) and Principal Component Regression (PCR) to examine the links between conflict events, climate change impacts, and adaptation. The dependent variable was the number of conflict events in each region⁴⁹, while several independent variables were examined, including the frequency of extreme weather events⁵⁰, demographic factors, the number of people in need (PiN) per location, military expenditure, foreign climate investment, and other related indicators. Python was used for data processing, with libraries such as Pandas and NumPy, while Scikit-learn was applied for statistical analyses, including data standardization and model testing. The [data preprocessing](#) procedure and details of the [PCA and PCR](#) are presented in the Annexes.

Gaps and Limitations

- Many global datasets have coverage limitations (e.g. specific countries or years) or reporting biases, particularly in the Sahel and Horn of Africa. To address this, the team aimed to obtain data down to the first level of subnational administrative divisions in each country. Where this was unavailable, country-level indicator values were used. The focus was on data from 2020 to 2024, and where data for certain years were missing, the most recent available values were used as substitutes. Lastly, where data for some Sahel or Horn of Africa countries were missing, the team substituted the values with the same-year averages of other countries in the region for statistical analysis.
- Conflict data may be highly detailed, while adaptation policy or climate datasets are typically annual and at the country level, leading to spatial and temporal mismatches. In addition, many adaptation datasets capture policy announcements or intentions rather than actual implementation or effectiveness.
- Both climate and conflict data face limitations in establishing causality; instead, the focus is on identifying correlations and trends of influence, with previous studies suggesting up to 20 per cent explanatory power.⁵¹
- Extreme weather events are not strictly exogenous, and adaptation policies may respond to conflict risk or climate stress, therefore, caution is needed when determining causal effects.
- The research team made efforts to include data on climate adaptation efforts. However, most datasets lacked enough detail for use in statistical analysis. For example, the team initially intended to use the Climate Adaptation Data from the WORLD Policy Analysis Center (WORLD), which provides numbers on 1) Adaptation and Groundwork, and 2) Policy Recommendations. This dataset was ultimately excluded, however, as it was outdated, covering the period from 2009 to 2012.
- The research team does not assume that conflict-climate risks are linear. The statistical model identified correlations rather than direct causation, using PCA and PCR. Although the team employed a regression test, it was applied to principal components, and our goal was to explore the relationships among conflict, climate, and adaptation efforts, not to establish causal effects. The team does not assume that any of these factors exerts a linear influence on conflict. In addition, the team addressed temporal and spatial variation by using subnational data and by complementing the quantitative analysis with contextual case studies. The statistical tests were intended to illustrate broader patterns observed in the target regions.

49. Extracted from UCDP GED

50. Extracted from EM-DAT - Emergency Events Database

51. Mach et al., Climate as a Risk Factor for Armed Conflict | Nature (2019).



Findings



Statistical Test Results

Table 1: Principle Component Analysis Output

Principle Component	Eigenvalue	Variation (%)	Cumulative Variation (%)
PC1	3.04	19.0%	19.0%
PC2	2.36	14.7%	33.7%
PC3	1.48	9.3%	43.0%
PC4	1.29	8.0%	51.0%
PC5	1.21	7.6%	58.6%
PC6	1.16	7.3%	65.9%
PC7	0.90	5.6%	71.5%
PC8	0.84	5.2%	76.7%
PC9	0.75	4.7%	81.4%

The research team conducted PCA to identify principal components (PCs) for regression analysis. The method helped identify patterns and relationships in the data by creating new summary variables, known as PCs. Each PC combines several related factors from the original dataset into a single score, thereby reducing repetition and highlighting the most important patterns. By looking at how much each original variable contributes to each PC, we can see which factors are most influential in shaping the main trends. To limit the number of principal components (PCs), the research team applied the following thresholds, as outlined in [the data sources and methods](#):

- Cumulative variation threshold: 80.0 per cent (or greater)
- Eigenvalue threshold: 1 (or greater)

As a result, the first six PCs were selected for further analysis. Among these, the first two PCs, which explained 19.0 per cent and 14.7 per cent of the variance, respectively, were analyzed in greater detail due to their relatively large contribution compared with the other components.

The six PCs were constituted of the following variables, as described in the table below:

Table 2: PCs with relevant variables

Variable	Description	PC1	PC2	PC3	PC4	PC5	PC6
INFORM_risk	Global, open-source risk assessment for humanitarian crises and disasters (with three dimensions: hazard and exposure, vulnerability, and lack of coping capacity)	0.4520	-	-	-	-	-
people_in_need	Number of people in need	0.3784	-	-	-	-	-
rural_population	National rural population	0.3705	-	-	-	-	-
foreign_invest	Net inflows of investment made to acquire a lasting management interest, typically 10 per cent or more of voting stock, in an enterprise operating in an economy other than that of the investor	-0.3614	-	-	0.4614	-	-
gender-devel	Subnational Gender Development Index	-	0.4328	-	-	-	-
odf_total_net	Official Development Finance total net	-	0.3437	-	-	-	-
female_pop	Female population at the ADM1 level	-	0.3073	-	-	-	-
military_spending	Military expenditure by country as a percentage of government spending	-	-0.4018	-	-	-	-
mpi	Subnational Multidimensional Poverty Index	-	-0.4227	-	-	-	-
ipc_food_insecurity	Proportion of IPC4 and IPC5	-	-	0.5036	-	-	-
nd_readiness	ND-GAIN Readiness index (economic readiness, governance readiness, and social readiness)	-	-	0.4622	0.3029	-	-
c_drought	Number of drought events	-	-	0.3616	-	0.6323	-
lpi	National livestock production index	-	-	-0.3647	-	-	0.4675
rfh_avg	Annual Sum of Rainfall Long-term Average	-	-	-0.3663	0.3750	-	-0.4044
c_flood	Number of flood events	-	-	-	0.4741	-	0.3439
c_strom	Number of storm events	-	-	-	-	-0.3044	-0.4516

Following this, the team conducted a regression analysis using the PCs to examine their relationship with the number of conflicts in each region. The table below presents the results of this analysis.

Table 3: Principal Component Regression (PCR) Method Output

Principal Component Regression Results (n=1,340)				
Dep. Variable	conflict_count	R-squared		0.226
Prob (F-statistics)	3.20e-68	Adj. R-squared		0.221
Parameter	Coefficients Value	Std. Error	t-value	Pr(> t)
Intercept	10.589	0.932	11.359	0.000
PC1	3.776	0.535	7.061	0.000
PC2	2.891	0.607	4.764	0.000
PC3	1.362	0.766	1.779	0.076
PC4	6.308	0.822	7.677	0.000
PC5	6.515	0.848	7.687	0.000
PC6	-1.298	0.864	-1.502	0.133
PC7	1.455	0.981	0.484	0.138
PC8	-9.971	1.017	-9.803	0.000
PC9	-10.480	1.078	-9.720	0.000

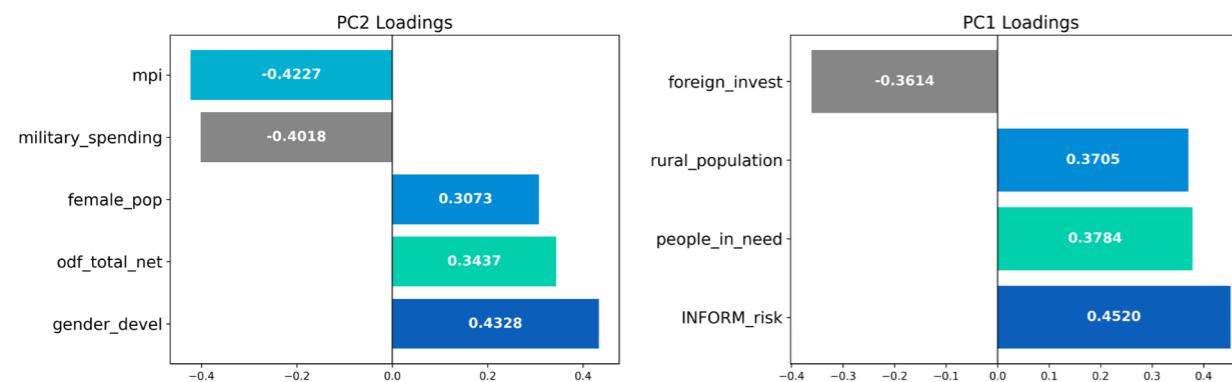
The model shows an R-squared value of 0.226 (Table 3), indicating that approximately 22.6 per cent of the variability in the dependent variable (conflict incidents) is explained by the principal components used as predictors. Although the explanatory power is lower than 20 per cent⁵², the research team considers it acceptable. Nonetheless, this R-squared highlights unexplained variability, suggesting that other unobserved factors may also contribute to conflict-climate dynamics.

The intercept is 10.589, with a robust t-value of 11.359, confirming its significance. The first five PCs have positive coefficients (3.776, 2.891, 1.362, 6.308, 6.515), indicating that higher scores on these components are associated with an increase in conflict incidents.⁵³ **In contrast, PC6, with a coefficient of -1.298**, suggests an inverse relationship with conflict.⁵⁴ It is important to note that two PCs (PC3 and PC6) were excluded from further analysis, as they were not statistically significant at the 5 per cent level.

52. Previous climate-conflict studies suggest an explanatory power of up to 20 per cent.

53. For example, a one-unit increase in PC1 is associated with an increase of approximately 3.8 conflict incidents.

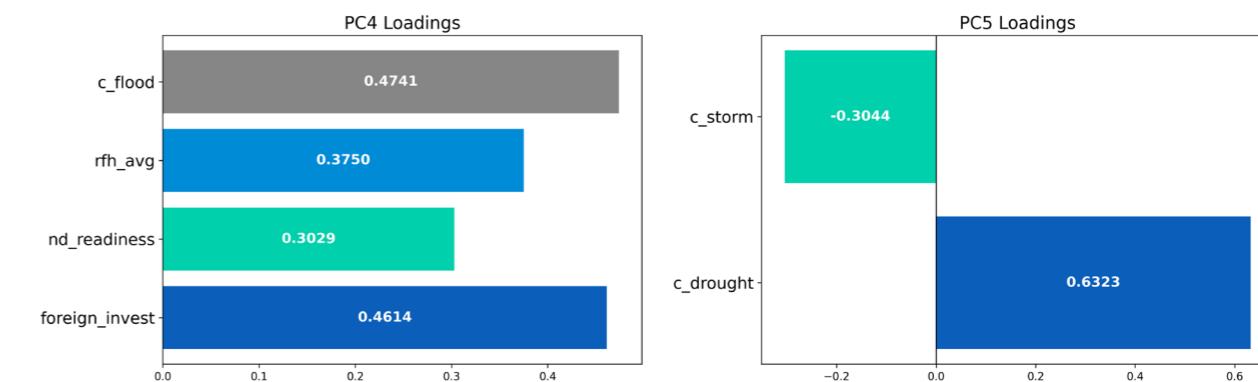
54. For example, a one-unit increase in PC6 is associated with a decrease of around 1.3 conflict incidents.

Figure 1: Loading Values for PC1 and PC2

The research team examined the loadings of variables in PC1, PC2, PC4, and PC5. A loading indicates the extent to which a variable contributes to a PC. Only variables with loadings greater than ± 0.30 were considered, as a cut-off of 0.30 is recommended when the sample size exceeds 350.⁵⁵ A positive loading indicates that a variable contributes, to some degree, to the principal component, whereas a negative loading indicates that the variable contributes in the opposite direction. The larger the relative magnitude of a loading, the more important the variable is to the principal component.

PC1 reflects socio-economic vulnerability and coping capacity. It mainly consists of four variables. Three variables—'INFORM_risk', 'people_in_need', and 'rural_population'—show positive loadings, while 'foreign_invest' shows a negative loading. **Given that PC1 has a positive coefficient value of 3.766, this suggests that regions with larger rural populations, a greater number of people in need, and higher overall INFORM Risk Index⁵⁶ scores tend to experience more conflict incidents. Conversely, regions with higher levels of foreign direct investment tend to have fewer conflict incidents.**

PC2 captures governance and gender-development dynamics. Five variables primarily influence it. Three variables—'female_pop', 'odf_total_net', and 'gender-devel'—show positive loadings, while 'military_spending' and 'mpi' show negative loadings. The positive coefficient of 2.891 indicates that **regions with stronger gender development indicators and higher levels of official development finance tend to report more conflict incidents, possibly reflecting better reporting capacity and more international engagement in volatile settings.⁵⁷ In contrast, higher military expenditure and poverty levels are associated with fewer reported incidents, which may point to stabilizing effects of security spending or underreporting in poorer or more fragile regions.**

Figure 2: Loading Values for PC4 and PC5

PC4 captures hydro-climatic stress interacting with institutional and economic readiness. It includes four variables—'c_flood', 'rfh_avg', 'nd_readiness', and 'foreign_invest'—all with positive loadings and a positive coefficient of 6.308. **This suggests that regions experiencing higher rainfall and more frequent floods also report more conflict incidents.** Notably, higher levels of economic governance and social readiness appear to increase conflict incidents in this model, rather than reduce them. Unlike PC1, foreign direct investment shows positive loadings in PC4.

PC5 represents extreme-weather exposure and is primarily influenced by two variables. The prevalence of drought (c_drought) shows a positive loading, while the prevalence of storms (c_storm) shows a negative loading, with PC5 having a positive coefficient of 6.515. **These results indicate that higher drought prevalence tends to increase the number of conflict incidents, whereas higher storm prevalence is associated with a decrease in conflict incidents—possibly because storms are shorter, more localized events that often prompt humanitarian response and cooperation, temporarily reducing tensions.**

Climate-Security Nexus

Research Question 1.1: What are the strongest statistical relationships between climate impacts and conflict or security dynamics in the Sahel and Horn of Africa?

As shown in the [statistical test results](#), the analysis finds that floods and droughts are the two climate hazards most consistently associated with conflict incidents across the Sahel and Horn of Africa. In PC4, floods show positive loadings, and in PC5, droughts also show positive loadings. The annual sum of long-term average rainfall similarly demonstrates positive loadings in PC4. Both components have positive coefficients for conflict incidents, indicating that higher flood and drought frequency, and to some extent, rainfall variability, are statistically linked to greater conflict occurrence.

Meanwhile, storms exhibit a negative association with conflict in PC5, suggesting that areas experiencing more frequent storms tend to record fewer conflict events. A possible interpretation of these findings is that they reflect the different nature of storm impacts—short, localized, and often met with humanitarian response—compared to the more prolonged cumulative stress of floods and droughts. Further studies would be required to further confirm or refine this interpretation. Overall, the findings confirm that climate variability influences conflict dynamics differently depending on the type and duration of the hazard.

55. Joseph F. Hair (Jr.) and Joseph F. Hair, Multivariate Data Analysis (Prentice Hall, 2010).

56. The INFORM Risk Index is a global, open-source risk assessment tool for humanitarian crises and disasters. It comprises three dimensions: hazard and exposure, vulnerability, and lack of coping capacity. The index is highly relevant to this study, as it assesses regional exposure to hazards, people's vulnerability, and coping capacity.

57. In the case of ODF, caution is required in interpretation, as higher allocations may reflect higher assessed needs in the region.

Research Question 1.2: How are conflict-climate linkages distributed geographically across the Sahel and Horn of Africa?

This section identifies the main conflict-climate hotspots across the Sahel and Horn of Africa, highlighting areas where environmental stress, socio-economic vulnerability, and conflict incidence coincide. While no separate statistical models were run by region, the spatial overlay analysis provides insight into geographic concentrations of risk and helps inform where adaptation investments could have the greatest stabilizing impact. The conflict-climate hotspots pictured in Figure 3 overlay areas of conflict with flood and drought hotspots in the region.

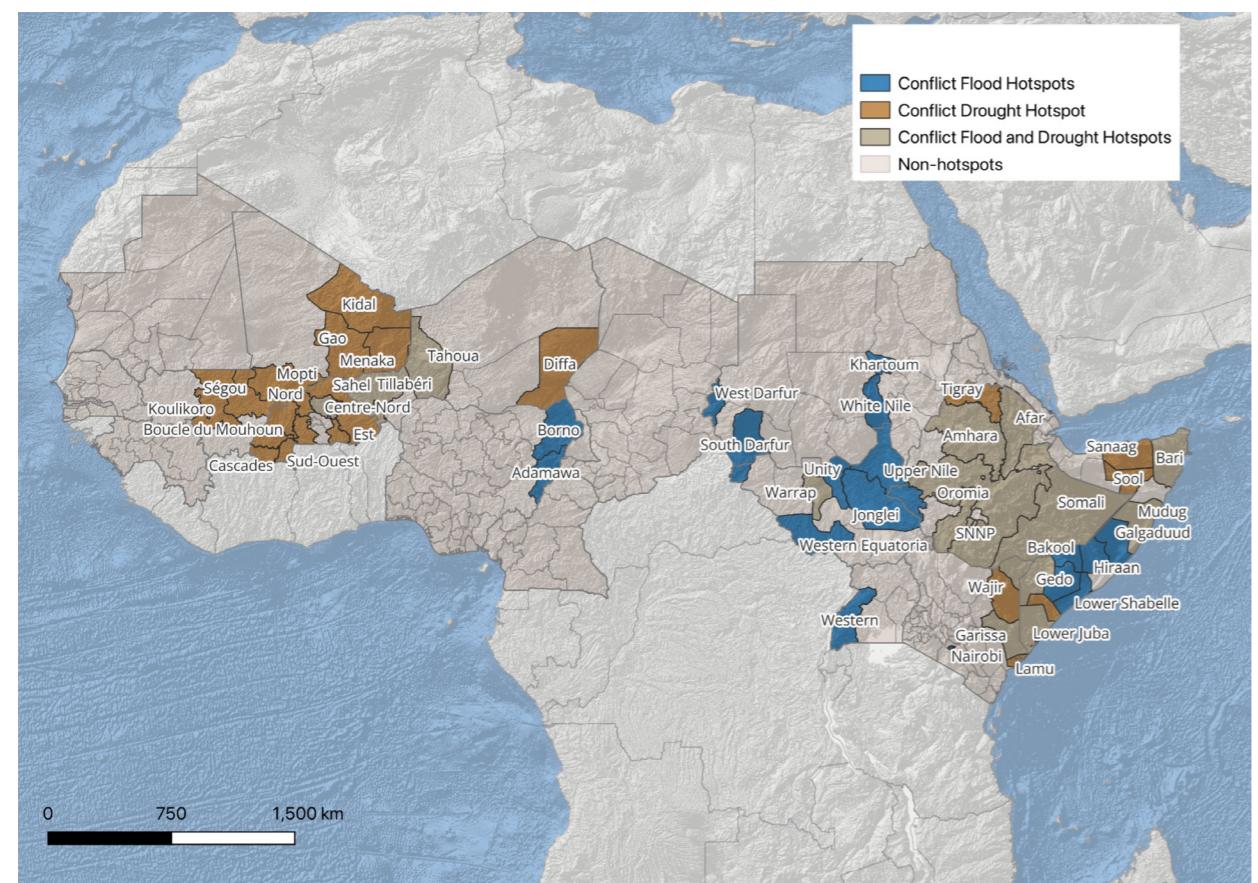


Figure 3: Conflict-Climate Overlap Hotspots in the Sahel and the Horn of Africa

The research team identified several priority regions that were highly affected by both conflict and climate events. The team classified conflict hotspots as areas that experienced at least seven conflict incidents over the past five years, while flood and drought hotspots were classified as regions that recorded at least three flood events and one or more drought events⁵⁸ during the same period.

Conflict-Flood Hotspots: Centre-Nord (Burkina Faso), Afar, Amhara, Gambela, Oromia, SNNP, Somali (Ethiopia), Garissa, Mandera, Nairobi (Kenya), Tillaberi, Tahoua (Niger), Adamawa, Borno (Nigeria), Khartoum, South Darfur, West Darfur, White Nile (Sudan), Bakool, Bari, Bay, Galgaduud, Gedo, Hiraan, Lower Juba, Lower Shabelle, Mudug (Somalia), Jonglei, Unity, Upper Nile, Warrap, Western Equatoria (South Sudan), and Western (Uganda).

Conflict-Drought Hotspots: Boucle du Mouhoun, Cascades, Centre-Est, Centre-Nord, Centre-Ouest, Est, Hauts-Bassins, Nord, Sahel, Sud-Ouest (Burkina Faso), Afar, Amhara, Oromia, SNNP, Somali, Tigray

58. The team found that among the conflict hotspots, a maximum of two drought events occurred.

(Ethiopia), Garissa, Lamu, Mandera, Wajir (Kenya), Koulikoro, Segou, Mopti, Gao, Kidal, Menaka (Mali), Tillaberi, Tahoua, Diffa (Niger), Bari, Gedo, Lower Juba, Middle Juba, Mudug, Sanaag, Sool (Somalia), and Warrap (South Sudan).

Conflict-Climate Hotspots: Centre-Nord (Burkina Faso), Afar, Amhara, Oromia, SNNP, Somali (Ethiopia), Garissa, Mandera (Kenya), Tillaberi, Tahoua (Niger), Bari, Gedo, Lower Juba, Mudug (Somalia), and Warrap (South Sudan).

The Conflict Climate Hotspots refer to regions that have experienced both extreme floods and drought events. These areas face high vulnerability due to insecurity combined with the impacts of climate change and therefore should be prioritized for adaptation investments that build resilience and reduce risk.

Several of these hotspots are cross border in nature, including the Lake Chad Basin and the Mandera Triangle in the Horn of Africa. In such areas, climate shocks interact with different governance systems, parallel resource regulations, fragmented jurisdiction over rangelands or water sources, and inconsistent enforcement across borders. These factors can heighten tensions, particularly where communities move across borders in search of pasture or water during periods of drought or displacement after floods. This indicates that adaptation strategies need to consider transboundary dynamics, ranging from simple data sharing to strengthen cross-border early warning systems in the short-term to joint implementation of large transboundary infrastructure projects in the long-term, and promote regional rather than only national approaches.⁵⁹

Research Question 1.3: Which contextual factors amplify or mitigate climate-related security risks?

The quantitative results show that areas with **greater socio-economic vulnerability and weaker coping capacity tend to experience more climate-related insecurity**. In the analysis, regions with a higher number of people in need and larger rural populations were more likely to experience conflict incidents. This suggests that when communities are poorer or have fewer resources to adapt to climate impacts, tensions and conflict risks increase. In 2024, UN OCHA estimated that nearly 300 million people worldwide would require humanitarian assistance and protection due to conflicts, climate events, and other drivers⁶⁰. In East and Southern Africa, an estimated 74.1 million people needed humanitarian aid, while in West and Central Africa, 65.1 million people required support⁶¹. A large proportion of people in need are refugees or internally displaced persons (IDPs). A high number of people in need may therefore also reflect the presence of displaced populations and migration dynamics, which can intensify local pressures on land, water, and basic services. Within this context, the results suggest that socio-economic vulnerability is statistically associated with increased conflict.

In addition, higher INFORM Risk Index scores are correlated with more conflict incidents in PC1. Because this index combines hazards, exposure and coping capacity, the result indicates that limited institutional and social resilience, rather than climate hazards alone, tends to amplify security risks. Conversely, foreign investment shows a negative loading, suggesting that greater economic opportunity and investment stability may reduce vulnerability to climate-related insecurity.

A complementary analysis based on the recently published GCA REI⁶² explored relationships between conflict prevalence at the national level (incidences per capita) and Index performance. The findings show that for the two observed regions, economies with higher conflict prevalence tend to have a higher share of their GDP exposed to climate impacts. Conflict hotspots such as Niger, Burkina Faso,

59. Mulli 2024; Okpara and Yunus 2025

60. 'Global Humanitarian Overview 2024 [EN/AR/FR/ES] | OCHA'

61. 'Global Humanitarian Overview 2024 [EN/AR/FR/ES] | OCHA'

62. This Index evaluates the climate resilience of African economies across three dimensions: economy, policy and finance.

Ethiopia, Sudan or Somalia are all qualified in the Index as having the highest shares of exposed GDP on the continent. This highlights the risk of compounding the negative impacts of conflicts on the economy when climate disasters happen. Within PC2, higher MPI values are associated with fewer conflict incidents, whereas higher female populations or higher Gender Development Index (GDI) values appear to be correlated with increased security risks. The research team interpreted these results cautiously, as countries with higher GDI scores may also have better monitoring systems and more transparent reporting. Conversely, high-poverty contexts may experience underreporting. Furthermore, since PC2 explains only 14.7 per cent of the variation and the analysis is based on PCA and PCR, these correlations should be interpreted as statistical artefacts rather than evidence of causality. Overall, the analysis does not provide sufficient empirical support to challenge the well-established association between gender inequality and insecurity in the Sahel and Horn regions. From a theoretical standpoint, the broader evidence base indicates the opposite relationship: higher gender equality, captureded through lower GDI scores, tends to be associated with increased conflict risk and slower recovery.⁶³

Overall, the quantitative findings point to migration dynamics, rural exposure, socio-economic vulnerability and limited coping capacity as key factors associated with higher conflict incidence. These correlations highlight how climate impacts interact with existing fragility and governance challenges, rather than acting as direct triggers of violence.

Building on these patterns, the desk review and interviews with key experts on climate adaptation and security shed further light on the mechanisms through which these contextual factors shape climate-related insecurity. While pathways vary slightly between the Sahel and the Horn of Africa, the key mechanisms remain the same: environmental degradation and livelihood decline, displacement and social fragmentation, and governance fragility in the face of accelerating climate stress.

Across both regions, the convergence of climate stress, livelihood decline and weak governance is transforming the security landscape. Rising temperatures, erratic rainfall, and land degradation are eroding the foundations of rural economies, while state institutions struggle to respond. What were once manageable seasonal pressures are now driving displacement, localized violence, and deepening mistrust between communities and authorities.

Environmental Degradation and Livelihood Pressures

Reduced rainfall, recurrent droughts and land degradation are undermining both agriculture and pastoralism as key livelihoods. In the Sahel, the shrinking of arable and grazing land has intensified competition between herders and farmers, particularly in Mali, Niger, and Burkina Faso.⁶⁴ As one expert explained, "The same hectare of land now sustains half the livestock it did twenty years ago. This scarcity reshapes social contracts between herders and farmers".⁶⁵

Similarly, in the Horn, repeated droughts, such as the 2020-2023 drought, the worst in four decades, have wiped out millions of livestock and displaced entire communities.⁶⁶ Ethiopia's Somali Region, northern Kenya, and South Sudan's floodplains show similar dynamics. As one regional expert noted, "Every drought now acts as a conflict trigger because the social systems that absorbed shocks have collapsed".⁶⁷

63. Buvinic Philip Mayra Lourdes,Casabonne, Ursula,Das Gupta, Monica,Verwimp, 'Violent Conflict and Gender Inequality : An Overview'.

64. Tony Blair Institute for Global Change, 'From Crisis to Conflict: Climate Change and Violent Extremism in the Sahel'.

65. KII 7.

66. International Crisis Group, Fighting Climate Change in Somalia's Conflict Zones | International Crisis Group (2024).

67. KII 1.

Displacement and Social Fragmentation

Climate-induced displacement is eroding community networks and heightening tensions over already scarce resources. In Mauritania, over 100,000 Malian refugees place additional strain on local water systems, and host-refugee tensions often mirror pre-existing ethnic divides.⁶⁸ Likewise, in Somalia and South Sudan, cycles of drought and flooding are driving large-scale movements of people, generating disputes over access to water, grazing land, and humanitarian aid.

However, across both regions, local peace committees and cross-border initiatives, often supported by humanitarian and development actors, have emerged as important mechanisms for mediating water- and land-related conflicts, as seen in Bassikounou (Mauritania)⁶⁹ and along the Ethiopia-Kenya borderlands.

Governance Fragility and Adaptation Deficits

Weak governance, limited decentralization, and overlapping institutional mandates continue to undermine coordination between climate and peace initiatives. In the Sahel, environmental stress amplifies perceptions of state neglect; as one expert observed, "Environmental stress magnifies political mistrust; when resources fail, people judge the state by its absence".⁷⁰

In the Horn, fragmented authority persists, particularly in Somalia, where Al-Shabaab controls rural areas, and in Ethiopia, where uneven federal-regional coordination constrains effective adaptation planning and resource allocation. Many local governments lack the capacity to manage adaptation funds or enforce natural resource agreements, leaving communities reliant on external assistance.

Transboundary and Cross-Border Dynamics

The interconnected nature of ecological systems links both regions through shared transboundary challenges. River basins such as the Niger, Nile, and Juba-Shabelle are emerging as critical flashpoints, where upstream environmental management decisions shape downstream security and livelihoods. In the Horn, flooding and siltation in Ethiopia's upper Shabelle Basin affect livelihoods downstream in Somalia.

At the same time, in the Sahel, shifting migration routes and resource corridors have regional implications for stability. Mechanisms such as IGAD's CEWARN, ICPAC and the G5 Sahel framework provide regional coordination and early warning, but all remain under-resourced to translate forecasts into localized, preventive action.



68. Action Against Hunger, Mauritania: Responding to the Humanitarian Needs of Malian Refugees and Host Communities. (2024), KII 5.

69. Action Against Hunger, Mauritania: Responding to the Humanitarian Needs of Malian Refugees and Host Communities. 2024.

70. KII 3.

Adaptation as a Climate, Peace, and Security Investment

Research Question 2.1: In what ways have adaptation policies, investments, and practices influenced peace and security outcomes in the Sahel and Horn?

The quantitative results indicate that **regions with stronger adaptation-related investments tend to experience fewer security risks**. As shown in the [statistical test results](#), some adaptation efforts, economic and public spending such as foreign direct investment (FDI) in infrastructure, agriculture, or renewable energy, and government expenditure to maintain stability and essential services - are linked to lower levels of conflict. These types of investments are considered adaptation efforts because they strengthen societies' ability to cope with climate shocks and related stresses by creating jobs, improving access to basic services, and building infrastructure that reduces vulnerability to droughts, floods, or food insecurity. In fragile areas, such investments can also stabilize livelihoods and reduce competition over scarce resources, thereby lowering the risk of conflict.

The OECD has noted that expanding the FDI Qualities Indicators to include climate adaptation would help capture how both public and private funds contribute to building resilience. This reflects a growing recognition that adaptation is not limited to environmental projects, and also includes economic and institutional measures that enable communities to absorb shocks and recover more quickly.⁷¹

The desk research found evidence indicating that in fragile regions, increased government spending on stability and security, particularly in fragile regions, can correlate with reduced conflict intensity. Specifically, a 1 per cent rise in military spending as a share of GDP was associated with a 0.012 percentage-point drop in conflict intensity.⁷² While military expenditure is not in itself a form of adaptation finance, in settings of active conflict, reductions in violence can create the enabling conditions needed for humanitarian actors, civil society, and local governments to implement adaptation and resilience initiatives.

In practical terms, this means that adaptation often depends on broader investments that build resilience such as strengthening infrastructure, improving governance, and expanding economic opportunities. These measures indirectly reduce security risks by improving people's ability to manage shocks and by making states more capable of responding to crises.

The relationship between FDI, state expenditure, and conflict reduction likely reflects broader structural conditions, such as improved economic stability, infrastructure investment, and governance capacity, rather than a direct adaptation-to-peace mechanism. However, these associations support the view that adaptation investments can enhance resilience by strengthening coping mechanisms and institutional capacity. As seen earlier in the correlation between INFORM Risk Index scores and conflict incidents, improving coping capacity may help reduce security risks. Therefore, adaptation can indeed be considered a form of security investment, contributing to resilience through economic and infrastructure investments, as well as by improving preparedness for security and climate-related challenges.

Research Question 2.2: Under what conditions have adaptation measures demonstrably reduced insecurity or strengthened social cohesion?

Findings under this question draw from the desk review and expert interviews conducted across the Sahel and Horn of Africa. The evidence highlights a range of locally led adaptation measures that have contributed to stability, reduced conflict, and strengthened social cohesion. The examples below illustrate the conditions under which such interventions have produced demonstrable peace dividends.

Community-Based Water Management

In Mauritania, Niger, and Chad, small-scale water infrastructure projects, dykes, retention basins, and solar-powered pumps demonstrate tangible peace dividends. According to one NGO, "where we manage water collectively, conflict indicators drop. Water is social glue".⁷³ These systems often double as peace platforms, where communities negotiate maintenance and access rules.

The Jowhar Off-Stream Storage Program (JOSP) along Somalia's Shabelle River aims to reduce flood risk for 1.5 million people through improved water storage and irrigation, reflecting the country's growing investment in large-scale climate adaptation. Recurrent floods and Al-Shabaab's sabotage of dykes have displaced thousands and destroyed farmland, creating recurring flashpoints between communities, authorities, and armed actors. In response, the program pairs engineering works with community-based governance. Water committees, women's cooperatives, and youth groups will manage rehabilitated canals and riverbanks and apply nature-based solutions to upkeep the water system rehabilitation.⁷⁴ Funded by the UK and implemented by the FAO, in partnership with UNEP, IOM, UN Habitat, UNIDO, World Vision International and Somali authorities, JOSP demonstrates both the promise and fragility of major adaptation infrastructure: success depends on long-term maintenance, local ownership, and political stability. According to local facilitators, each rehabilitated canal has become a "peace corridor," reducing resource disputes and opening dialogue between officials and communities in previously contested areas.⁷⁵ By reducing triggers for local conflict and strengthening channels for dialogue in areas where armed groups have historically exploited grievances, the approach shows how infrastructure rehabilitation, when paired with participatory governance, can deliver both resilience and security gains.

Agro-Pastoral and Ecosystem Restoration

Across the central Sahel, NGOs and local cooperatives have introduced climate-smart agriculture, drought-resistant seeds, half-moon bunds, and assisted natural regeneration. Yet as one researcher observed, "these practices only work when communities own them; when they come as projects, they fade".⁷⁶ His study on environmental peacebuilding in the Sahel found that adaptation succeeds where dialogue precedes technology.

UNEP's Global EbA Dialogue (2023) identifies the Horn as a key site for nature-based adaptation. Projects in Kenya's Laikipia and Somalia's Afgoye corridor integrate rangeland restoration, reforestation, and livelihood diversification. These ecosystem-based adaptation efforts restore degraded ecosystems while rebuilding social capital through cooperative resource management. However, scaling remains a challenge, with three main barriers emerging: limited finance (73 per cent of practitioners cite this), weak local capacity, and fragmented governance. Strengthening community institutions and devolved finance is critical to making EBA a pillar of peacebuilding.

71. 'Climate Adaptation Investment Framework', OECD, 13 November 2024.

72. Idrissa Aladji AYA, 'Effectiveness of Military Spending in Reducing the Intensity of Armed Conflict in Sub-Saharan Africa', Oxford Economic Papers 77, no. 3 (2025): 637–52.

73. KII 1.

74. KII 4, KII 6.

75. KII 4, KII 6.

76. KII 3.

In Laikipia, Kenya, joint rangeland management initiatives have shown promising peace dividends. Rangeland co-management committees that bring herders and farmers together, supported by NGOs and the county government, have contributed to reduced cattle-raiding and more effective dialogue platforms. Similarly, in Somalia and Ethiopia, solar irrigation and sand dam projects have fostered collaboration among rival clans, demonstrating how shared resource management can reduce tensions and build practical cooperation.⁷⁷

Women and Youth-led Initiatives

Women's associations in northern Mali and Mauritania have become key actors in market-gardening and micro-finance initiatives that link income generation with local conflict mediation and prevention.⁷⁸ These cooperatives not only strengthen women's economic agency but also position them as trusted brokers in community dialogue processes. In the Lake Chad basin, youth groups trained in land restoration and irrigation system maintenance have provided viable alternatives to joining armed groups. In several areas, former fighters are now integrated into local maintenance brigades, contributing labor to communal infrastructure rather than to conflict.⁷⁹

In Mogadishu, the IOM-supported seed bank and tree nursery initiative at City University is uniting clans through climate adaptation, preserving indigenous seeds, training women and youth in sustainable agriculture, and creating shared spaces for cooperation rather than competition over scarce land and water.⁸⁰

Research Question 2.3: What lessons from these experiences can inform the design and scaling of adaptation as a security investment within Africa and globally?

Findings under this question draw on the desk review and expert interviews conducted across both the Sahel and the Horn of Africa. Together, they offer insights into how adaptation can be designed and scaled as an effective security investment by outlining key principles, institutional arrangements, and contextual factors that underpin success.

Community Ownership and Indigenous Knowledge

The Sahel's converging crisis demands integrated and locally grounded responses. Climate security initiatives across the region have yielded valuable insights into what works and what does not when designing interventions to build resilience, reduce conflict, and promote stability. Effective climate security programming begins with community ownership. Practitioners find that projects co-designed with local actors, rather than imposed from outside, are more likely to endure and adapt over time.

Indigenous knowledge systems, including traditional land management and seasonal migration practices, offer proven resilience strategies that should be embedded into formal adaptation frameworks. Such findings underline the need to contextualize adaptation efforts and knowledge, as externally developed operational and conceptual models often fail to resonate with local realities.⁸¹

Community-level evidence from the Horn of Africa confirms these findings. In Laikipia, Kenya, joint rangeland management between herders and farmers has reduced cattle-raiding incidents. In Somalia and Ethiopia, solar irrigation and sand dam projects have fostered collaboration among rival clans. Locally led

77. KII 6.

78. KII 6.

79. KII 5 and 7.

80. IOM, 'Seeds of Recovery: Somali-Led Solutions at a Turning Point | IOM Storyteller', accessed 29 October 2025.

81. KII 1 and KII 3

regeneration in northern Kenya through farmer-managed natural regeneration (FMNR), supported by World Vision (2022), has restored degraded rangelands, improved water retention, and rebuilt social cohesion through inclusive committees that combine tenure security with landscape restoration. In Somalia, adaptation projects have revealed that if water governance structures exclude certain clans or gender groups, new infrastructure can become a flashpoint. One expert explained that it is about land ownership and power dynamics. As soon as one clan has more interest or power over another, it can create conflict.⁸²

Integration Across Sectors

Moreover, climate security cannot be siloed. Programming that links climate adaptation and mitigation with peacebuilding, governance reform, and socio-economic development has shown greater effectiveness in fragile contexts by reducing conflict, strengthening social cohesion and building trust.⁸³

Socio-economic integration into adaptation projects is equally critical. Initiatives that address unemployment, inflation, and poverty alongside environmental goals are more likely to gain community support and deliver tangible benefits.⁸⁴

Climate-proofing stabilization programming, such as investing in resilient infrastructure and renewable energy, can reduce competition over resources and prevent future conflict. Climate-security interventions should align short-term stabilization with long-term resilience goals, serving as strategic exit pathways for broader peacebuilding programs.⁸⁵

The JOSP also illustrates the importance of integrating sectors within adaptation efforts. By linking flood control, irrigation rehabilitation, and local resource management, the programme has helped farmers and pastoralists cooperate more effectively, reducing tensions and strengthening local governance arrangements. These kinds of integrated investments build trust, support livelihood stability, and show how adaptation can reinforce both resilience and governance outcomes.⁸⁶

Governance, Coordination, and Institutional Capacity

Inclusive and decentralized governance structures are essential for managing climate-related risks. Transparent dispute resolution mechanisms and participatory institutions help reduce grievances and improve resilience.⁸⁷ However, weak institutional capacity and fragmented coordination, particularly between environment and security ministries or between international actors, remain significant barriers. Political engagement is a prerequisite for sustainability.⁸⁸ Without the support of local authorities, projects face access constraints and implementation delays. Yet, military-led governments further complicate engagement. Frequent personnel turnover and lack of institutional continuity undermine long-term collaboration and project momentum. Coordination is often informal and relationship-based, rather than structured and systemic, while funding cuts induced by broader political dynamics hamper climate security efforts.⁸⁹

82. KII 4.

83. T.S. Akinyetun et al., 'Heated Environment, Armed People: Between "Climate Change Conflict" and "Fragility Conflict" in the Sahel', Journal of Asian and African Studies, n.d.

84. KII 1.

85. UNDP, Climate, Peace and Security in Stabilization Contexts in the Sahel: Advancing Stabilization Efforts through Climate, Peace and Security Solutions. (UNDP, 2025).

86. KII 4, KII 6.

87. Akinyetun et al., 'Heated Environment, Armed People: Between "Climate Change Conflict" and "Fragility Conflict" in the Sahel'; UNDP, Climate, Peace and Security in Stabilization Contexts in the Sahel: Advancing Stabilization Efforts through Climate, Peace and Security Solutions.

88. UNDP, Climate, Peace and Security in Stabilization Contexts in the Sahel: Advancing Stabilization Efforts through Climate, Peace and Security Solutions (UNDP, 2025), KII 2.

89. KII 1.

At the same time, the Horn of Africa experience demonstrates that adaptation can also generate tensions when governance or inclusion is weak. In early JOSP phases, the lack of balanced clan representation in water committees made new infrastructure a potential flashpoint—ownership and power dynamics are always the trigger, one interviewee explained. To address this, UNEP and FAO mainstreamed conflict sensitivity into design, adding indicators for dispute resolution and equitable benefit-sharing.⁹⁰

Regional Cooperation and Cross-Border Mechanisms

Regional cooperation offers a rare point of consensus. Climate and security risks transcend borders, prompting collaboration even amid political divides. Frameworks such as ECOWAS and the Bamako Declaration, along with transboundary projects such as Liptako-Gourma, have strengthened migration management, agricultural resilience, and cross-border dialogue. Shared climate risks have become a unifying agenda, illustrated by joint participation in COP30 preparations,⁹¹ and have helped rebuild trust between Sahelian governments and international partners, even where formal coordination remains limited.⁹² Research has emphasized how climate security provides key pathways for engagement by rebuilding trust between Sahelian governments and Western actors.⁹³

Regional coordination is also advancing in the Horn. IGAD's drought-resilience agenda (IDDRSI) has strengthened early warning cooperation and cross-border resource-sharing in Kenya and Ethiopia.⁹⁴ Interviewees confirmed that these systems are operational now, not just aspirational, particularly through IGAD's Climate Prediction and Applications Centre and the CEWARN mechanism, which links early warning to early action.⁹⁵

Financing and Inclusion

Access to funding remains a critical constraint. Blended financing that combines climate and peacebuilding resources can enhance impact, particularly in fragile settings. However, donor reluctance, especially in politically unstable contexts, often stalls promising initiatives.⁹⁶

Finally, youth and women's engagement in climate adaptation and peacebuilding strengthens social cohesion and resilience. Tailored capacity building across stakeholder groups is essential to ensure adequate understanding and action.⁹⁷ Inclusive livelihood programs and access to education are critical to addressing vulnerabilities, particularly among women and girls.

90. KII 4.

91. KII 2

92. European Institute of Peace and TrustWorks Global., Environmental Peacemaking in Liptako Gourma: A Mapping of Issues and Initiatives. (2023).

93. G. Lagrange, The Missing Climate Factor: Why European Military Interventions in Niger Have Failed, 2025.

94. IGAD, IDDRSI Conducts Regional Field Mission in Ethiopia. (2025).

95. KII 4.

96. KII 2

97. KII 1 and KII 2



Policy and Institutional Framing

Research Question 3.1: How do regional and continental policy frameworks frame the relationship between adaptation, peace, and security, and where do coordination gaps remain?

At the policy level, adaptation is increasingly recognized as a conflict prevention and risk reduction strategy. The UN Climate Security Mechanism works to integrate climate and peace analysis across UN operations, integrating adaptation measures where relevant. The African Union's Climate, Peace and Security Policy Framework, together with the African Union Climate Change and Resilient Development Strategy and Action Plan (2022-2032),⁹⁸ situates adaptation within its continental peace and development agenda, while IGAD's Climate Adaptation Strategy (2023-2030) commits to linking climate resilience with regional security cooperation.⁹⁹ These regional frameworks also align with the Marrakech Partnership for Global Climate Action, which provides the UNFCCC platform for engaging both state and non-state actors in advancing climate-resilient peacebuilding. These frameworks signal a paradigm shift from reactive responses to climate-related security risks to proactively harnessing adaptation as a foundation for peace and resilience.

The African Union Peace and Security Council (AUPSC) has advanced a Common African Position on Climate Peace and, explicitly integrating climate change into security frameworks to tackle challenges exacerbated by climate change, recognizing Africa's need for climate finance while calling on wealthier nations, many of which are significant polluters, to make affordable financing available. This continentally aligned framing is important, as it positions adaptation not only as a technical response but as a strategic investment in peace and security.¹⁰⁰

The African Development Bank (AfDB) has similarly integrated climate into its fragility and resilience strategy, underscoring that adaptation is central to reducing conflict risk.¹⁰¹ In line with the strategy, the AfDB also convenes the Africa Resilience Forum (ARF) every two years, bringing together governments, civil society, and international partners. Past editions of the ARF have focused on security, COVID-19, climate change and migration, while this year's forum, the 6th edition, discussed peace financing in an increasingly volatile development aid landscape.¹⁰² African actors, including the AU, AfDB, and GCA, are advocating for adaptation finance to be treated not as aid but as justice and prevention funding. As noted in the Addis Ababa Declaration, climate finance "must be scaled up, predictable and transparent", and prioritized for fragile and conflict-affected contexts.¹⁰³

National Adaptation Plans & Regional Security Frameworks

NAPs are increasingly recognized as key vehicles for aligning adaptation with peacebuilding. According to the NAP Global Network guidance,¹⁰⁴ conflict-sensitive NAPs enable governments to reduce shared drivers of fragility and climate risk through inclusive, locally driven planning.

The guidance highlights that adaptation and peacebuilding share similar enabling factors, strong leadership, conflict-sensitive data systems, inclusive governance, and equitable financing and that conflict-sensitive NAPs are emerging as instruments to bridge adaptation and stability agendas.

98. AU. (2022). African Union Climate Change and Resilient Development Strategy and Action Plan (2022-2032). <https://au.int/en/documents/20220628/african-union-climate-change-and-resilient-development-strategy-and-action-plan>.

99. IGAD. (2023). The IGAD Climate Adaptation Strategy (2023-2030). <https://igad.int/download/the-igad-climate-adaptation-strategy-2023-2030/>.

100. Backenberg, 'Opinion: Why Africa's Voice on Climate and Conflict Matters More than Ever'.

101. African Development Bank, 'Bank Group's Strategy for Addressing Fragility and Building Resilience in Africa'.

102. African Development Bank, 'ARF 2025 - Africa Resilience Forum', Text, African Development Bank Group, African Development Bank Group, 26 September 2025.

103. African Union, Addis Ababa Declaration on Media, Climate, Peace, Security, and Justice (2025).

104. Crawford et al., Peace, Conflict, and National Adaptation Plan (NAP) Processes.



Together, these mechanisms illustrate how Africa is embedding climate action within its evolving security architecture. In parallel, at the continental level, a CPSA embedded in the UN Office to the African Union (UNOAU) is working with the AUPSC to mainstream climate-security into its peace and security architecture and to foster stronger AU-UN collaboration.¹⁰⁵

In the Horn of Africa, some governments see adaptation as key to stabilizing their countries. Between 2020 and 2025, Somalia, South Sudan, Kenya, Ethiopia, and Sudan have developed NAPs with UNFCCC support. Only Somalia and South Sudan's NAPs explicitly address conflict sensitivity and local peace. Most NAPs are still aspirational—Somalia and Kenya have climate finance frameworks, but their success depends on international support. Kenya and Somalia show strong community participation, as do Ethiopia and Sudan.

The climate-security strategies for the Sahel in 2023-2024 indicate a change: adaptation is now prioritized as essential for governance and peace, beyond just environmental concerns. Nigeria's 2024 NAP incorporates conflict-sensitive indicators. Burkina Faso's 2025 NAP includes local peace committees that enhance community participation. However, gaps still exist. Mali and Mauritania must turn their strategies into concrete NAPs. Additionally, Chad and Senegal need improved coordination between their adaptation efforts and security agencies.

The complementary analysis of GCA REI findings reveals that the prevalence of conflicts itself does not necessarily predict impediments to the policy formulation process: indeed, countries like Burkina Faso or Niger, while hosting conflict hotspots, also are examples of pioneers in adaptation policy continent-wide according to the Index. On the other hand, a strong negative relationship was found between the level of military spending per capita and the country's performance on the policy dimension of the Index. This is further reflected particularly in the Horn of Africa, where the three studied countries with the highest military spending per capita—Djibouti, Eritrea, Somalia—are also earning a "foundational" performance on their adaptation policy. While many complex factors interplay to shape the conditions for successful policy-making, these findings indicate that it may be the prioritization of military action in government attention, rather than the prevalence of conflict itself, that could detract from climate-related policy-making efforts.

At the global level, the United Nations Secretary-General's New Agenda for Peace (2023) explicitly identifies climate, peace, and security as urgent and interconnected priorities. At COP30 in Belém, progress was made on the adaptation agenda, though results were mixed. The final mutirão decision called for at least a tripling of adaptation finance by 2035, but did not specify a baseline year, and it reaffirmed the goal of doubling adaptation finance by 2025. The decision did not establish a roadmap for a fossil fuel phase-out. Parties also adopted the first indicators for the Global Goal on Adaptation and introduced new workstreams, including the Global Implementation Accelerator and the Belém Mission 1.5, to support the implementation of NDCs and NAPs. While the decision does not directly reference fragility or conflict-affected settings, its emphasis on scaling adaptation finance and strengthening institutional capacity has clear implications for stability in vulnerable regions.^{106,107} In parallel, climate-peace and security considerations were advanced through a series of dedicated initiatives around COP30, including the Baku Call on Climate Action for Peace, Relief, and Recovery,¹⁰⁸ the Baku Climate and Peace Action Hub, and the Baku Hub Annual High-Level Dialogue on Climate and Peace¹⁰⁹, which issued a communiqué highlighting the need to better integrate peace, recovery,

105. UNDP et al., CSM Progress Report 2024 | Climate Security Mechanism.

106. Natalia Alayza and Gaia Larsen, How to Reach \$300 Billion – and the Full \$1.3 Trillion – Under the New Climate Finance Goal, 20 February 2025.

107. UNFCCC, Ad Hoc Work Programme on the New Collective Quantified Goal on Climate Finance. Report by the Co-Chairs | UNFCCC.

108. UNFCCC. (2024). Call on Climate Action for Peace, Relief and Recovery. <https://unfccc.int/documents/642246>.

109. UNFCCC. (2025). Concept note and agenda, Baku High-level Dialogue. <https://unfccc.int/documents/652927>.

and adaptation agendas. While these processes were not formally reflected in COP30 negotiated outcomes, they signal growing political momentum to embed climate-peace considerations alongside adaptation and finance discussions.

Taken together, these global, continental, and regional policy frameworks reflect a growing recognition of climate adaptation as a peace and security investment. This report aligns with the African Union's Agenda 2063 and the AU Climate, Peace and Security Policy Framework by translating these policy commitments into empirical evidence on how adaptation investments can reduce fragility and conflict risks. Rather than duplicating existing strategies or Peace and Security Council processes, the analysis focuses on identifying operational entry points where adaptation finance, governance reform, and locally led implementation can reinforce ongoing AU and REC-led peacebuilding and resilience efforts in fragile and conflict-affected contexts.

Across policy frameworks, evidence increasingly shows that adaptation outcomes depend not only on technical investments but also on who participates in decision-making and who benefits. In the Sahel and the Horn of Africa, exclusion of women, youth, pastoralists, or persons living with disabilities can exacerbate grievances and undermine adaptation effectiveness. Integrating gender, youth inclusion, disability, and inequality considerations into adaptation governance is therefore central to delivering both resilience and stability.

Conclusion and Recommendations



This study set out to explore how climate adaptation policies, investments, and practices shape peace and security outcomes in the Sahel and Horn of Africa. The combined statistical analysis, desk reviews, and expert interviews show that while climate change is not a direct cause of conflict, it amplifies existing vulnerabilities and governance issues. At the same time, well-designed adaptation efforts, particularly those that are locally led and inclusive, can help reduce tensions, strengthen institutions, and build the foundations for stability. The following section summarizes the key takeaways and proposes practical recommendations to advance adaptation as a security investment in Africa and beyond.

Key Takeaways

Climate-security links are clear but context-specific.

Floods and droughts are consistently associated with higher conflict incidence across the Sahel and Horn of Africa. Where vulnerability is high and coping or adaptive capacity is weak, climate shocks are more likely to translate into security risks. Locally led adaptation plays a critical role in strengthening community resilience and social cohesion, enabling local institutions to manage these shocks before they escalate into instability.¹¹⁰ The nature of the impact depends less on the hazard itself than on the governance and preparedness systems in place.

Displacement often reflects both the immediate impacts of climate shocks and deeper weaknesses in adaptive capacity, highlighting areas where support for resilience needs to be strengthened.

Climate-induced displacement and mobility are reshaping local economies, resource pressures, and social contracts. In contexts with inclusive governance and shared resource management, mobility can serve as an adaptive strategy. Where institutions are weak, however, it amplifies fragility and competition, with the potential to destabilize wider regions through spillover effects on resources, markets, and security. Systemic climate-related impacts, such as sustained drought together with other compounding impacts (extreme heat, shock flooding, land degradation), when reverberating across fragile regions, can accelerate corrosive processes that erode the ability of communities and territories to accommodate populations, contributing to migratory pressures.

Governance and capacity shape outcomes more than climate hazards alone.

Countries and regions with higher coping capacity, inclusive governance, and economic readiness experience fewer conflict incidents. Where governance is weak, even small shocks trigger instability.

Adaptation can deliver stability dividends when locally led.

Community-based water and land management, ecosystem restoration, and livelihood diversification reduce tensions and strengthen cooperation when designed and governed locally.

Economic resilience is foundational to stability.

Both regions depend heavily on climate-sensitive sectors such as agriculture, livestock, and fisheries. Repeated shocks to these systems continue to erode incomes, employment, and local markets. Building adaptive economic systems is therefore essential to reducing fragility.

¹¹⁰ Adaptation Fund. (2020). Local Leadership in Adaptation Finance: Learning from Locally-led Action in Adaptation Fund Projects and Programmes. <https://api.knack.com/v1/applications/5b23f04fd240aa37e01fa362/download/asset/65d8eaf6e77e8d002768be6b/local-leadershipinadaptationfinancepublication1.pdf>

Regional platforms are pivotal for scaling resilience.

Institutions such as IGAD, ECOWAS, and the African Union provide critical coordination and early warning functions but require sustained investment and political support, and matching robust government capabilities, to deliver their full potential for enhancing resilience down to community level.

Bridging the planning implementation gap.

Africa's adaptation deficit lies not only in the volume of finance but in how resources are structured and deployed, a trend seen across Africa in the GCA's REI. Bridging this gap through accessible and sustainable finance, coherent governance, and stronger delivery systems is key to translating National Adaptation Plans and climate strategies into tangible, peace-positive outcomes. Foreign security-related expenditure offers a new avenue with potential for bridging financing gaps to mutual transnational benefit for financier and beneficiary alike.

Actionable Recommendations

To support decision-making across continental, regional, and national levels, the recommendations below are organized by an indicative time horizon. While implementation pathways will vary by context, this structure distinguishes short-term actions, medium-term measures requiring stronger coordination, and longer-term structural reforms needed to embed adaptation as a security investment.

Short-term actions (0-2 years)

- **Integrate governance and stability into adaptation planning and global policy alignment.**

Governments and international partners working on post-GGA policy alignment and the Belém-to-Addis roadmap should ensure that adaptation metrics and reporting processes reflect the outcomes identified in this study, particularly improvements in governance capacity, inclusion, livelihood security, and reduced conflict risk. Adaptation practitioners and technical partners can support this by generating evidence and policy guidance that help fragile and conflict-affected countries assess adaptation success beyond physical infrastructure, linking it to observed gains in stability, resilience, and social cohesion.

- **Track the peace and governance benefits of adaptation.**

Climate finance institutions and governments should measure the extent to which adaptation contributes to stability, equity, and governance outcomes. This could include the development of tracking tools monitoring climate-peace co-benefits. Such a tool could monitor how adaptation contributes to governance quality, equity, and security outcomes, creating an evidence base to inform adaptation finance and programming, providing an evidence base for climate-security investments and adaptive governance systems. The goal would be to produce analytical briefs demonstrating early evidence of peace and governance benefits in fragile settings.¹¹¹

- **Leverage security-related expenditures for win-win security benefits through adaptation.**

The clear linkages between both climate-related impacts and adaptive capacities and conflict as outlined in this report and numerous other studies provide a strong basis for the link between adaptation and conflict attenuation and reduction. The contribution of governance challenges, marginal socio-economic conditions and existing conflict across the regions of the Horn of Africa

111. Global Center on Adaptation. (2025b). Resilience Economies Index.

and Sahel—uniquely fragile conflict-prone regions—to enhancing exposure and vulnerability to climate impacts, likewise reinforces the criticality of adaptation needs. Adaptation investments specifically targeted to particularly conflict-affected or prone and climate-threatened communities in these fragile regions of Africa will yield conflict reduction and peace benefits with reasonable confidence, especially where investments have been locally designed and led, and are well anchored within community structures. Such investments will also contribute to limiting transboundary effects which can be felt beyond these regions and even beyond Africa, highlighting the strategic value and mutual benefit of investing. Given recent setbacks to traditional development aid and climate adaptation finance¹¹² - with the OECD projecting a 9 to 17% drop to ODA in 2025¹¹³ – leveraging on synergies with security-related expenditure would be of heightened value and significance.

Medium-term actions (3-5 years)

- **Finance governance and local coordination as key adaptation priorities.**

Multilateral development banks, climate funds, and bilateral donors should allocate resources not only to infrastructure but also to the governance systems that sustain adaptation investment, such as local coordination, mediation, and dispute resolution. Given that both the Sahel and the Horn of Africa rely on climate-sensitive sectors, financing should also support local institutions in managing resource competition, reintegration of displaced populations, and adaptive migration. Adaptation practitioners can strengthen this agenda by identifying and documenting examples of community initiatives that link adaptation and social cohesion (e.g. Niger's pastoral corridors, Somalia's peace committees).

- **Support locally driven adaptation efforts that promote peace.**

Partners can help national governments scale up locally led adaptation initiatives that strengthen social cohesion and reduce conflict risks. Practitioners and researchers can contribute by documenting and disseminating evidence from the Sahel and the Horn of Africa, helping donors and governments integrate peace-positive adaptation approaches into international finance pipelines and policy dialogues. A practical next step could include joint technical workshops or learning exchanges to align data-sharing and identify scalable adaptation-stability investments.

Long-term structural reforms (5+ years)

- **Strengthen regional cooperation and early warning systems.**

Regional organizations, including the Intergovernmental Authority on Development (IGAD) and the Permanent Interstate Committee for Drought Control in the Sahel (CILSS), should enhance data sharing, early warning systems, and cross-border drought resilience. Adaptation partners can leverage existing initiatives such as the World Meteorological Organization's "Early Warnings for All" to facilitate knowledge exchange and investment in cross-border resilience corridors linking Sahelian and Horn of Africa states. These mechanisms are particularly critical where shared river basins, grazing routes, and migration flows intersect with climate risks and insecurity.

Across all recommendations, inclusion is a critical enabling condition. Adaptation initiatives that do not meaningfully include women, youth, pastoralist groups, and persons living with disabilities risk reinforcing inequality and conflict dynamics. Conversely, inclusive and locally led approaches strengthen legitimacy, social cohesion, and the peace dividends of adaptation investments.

112. Global Center on Adaptation. (2025a). Adaptation Finance Flows to Africa – State and Future Trends.

113. OECD. (2025). Cuts in official development assistance – OECD projections for 2025 and the near term. https://www.oecd.org/en/publications/2025/06/cuts-in-official-development-assistance_e161f0c5/full-report.html

Annexes

Data Sources and Methods

Overview of Datasets

Table 4: Overview of datasets

Dataset	Key Indicators	Type of Data
UCDP Georeferenced Event Dataset (UCDP GED) + UCDP datasets	<ul style="list-style-type: none"> Type of organised violence (state-based, non-state, one-sided violence) Number of events (incidents of conflict) Fatalities per event and aggregated by time period Actors (government, non-state groups, external actors) Dyads (conflict parties in interaction) Geographic coordinates (latitude/longitude for each event, down to the admin 1 or 2 level) Event date (daily coding, enabling time-series analysis), etc 	Public
UN OCHA - Humanitarian Needs	<ul style="list-style-type: none"> Number of people in need 	Public
UN OCHA - Subnational Administrative Boundaries	<ul style="list-style-type: none"> Admin 0 Level Code and Name Admin 1 Level Code and Name Admin 2 Level Code and Name Admin 3 Level Code and Name Admin 4 Level Code and Name 	Public
SIPRI - Military Expenditure Database	<ul style="list-style-type: none"> Military expenditure by country as percentage of gross domestic product Military expenditure by country as percentage of government spending 	Public
WORLD Policy Analysis Center (WORLD) - Climate Adaptation Data	<ul style="list-style-type: none"> Global Adaptation and Groundwork Policy Recommendations 	Public
EM-DAT - Emergency Events Database	<ul style="list-style-type: none"> Hazards and Disasters (Flood, Storm, Drought, Earthquake) 	Public
IPC - Acute Food Insecurity Country Data	<ul style="list-style-type: none"> Proportion of IPC4 and IPC5 	Public
OCHA - Global Subnational Population Statistics	<ul style="list-style-type: none"> Female Population Male Population 	Public
Ibrahim Index of African Governance (IIAG)	<ul style="list-style-type: none"> Rule of Law & Justice 	Public
Global Data Lab	<ul style="list-style-type: none"> Subnational Gender Development Index 	Public
WFP - Rainfall Indicators at Subnational Level	<ul style="list-style-type: none"> Annual Sum of Rainfall Long-term Average 	Public

OPHI - Global MPI	<ul style="list-style-type: none"> Subnational Multidimensional Poverty Index 	Public
World Bank - Agriculture and Rural Development	<ul style="list-style-type: none"> National Rural Population National Food Production Index National Livestock Production Index 	Public
World Bank - Climate Change Indicators	<ul style="list-style-type: none"> Foreign direct investment, net inflows (% of GDP) 	Public
ND-GAIN Country Index (Notre Dame Global Adaptation Initiative)	<ul style="list-style-type: none"> Readiness and vulnerability scores (economic, social, governance dimensions) Sector-specific adaptive capacity (food, water, health, ecosystem, habitat, infrastructure) 	Public
INFORM Risk Index (EU JRC / OCHA)	<ul style="list-style-type: none"> Integrates hazard exposure, vulnerability, and coping capacity—combining climate and conflict risk 	Public
OECD - Official Development Assistance (ODA)	<ul style="list-style-type: none"> ODA Total Net from Official Donors ODF Total Net 	Public

Conflict Dataset

The research team decided to use the UCDP dataset instead of the ACLED dataset. ACLED adopts a bottom-up approach, coding every event that involves political violence, regardless of whether the actor is identified or a fatality threshold is met.¹¹⁴ In contrast, UCDP employs a top-down approach, whereby a specific conflict (i.e. a dyadic engagement) must first be identified before individual events can be coded.¹¹⁵ To be included, the conflict must meet a fatality threshold of at least 25 battle-related deaths within a calendar year and involve clearly identified actors. Consequently, ACLED uses broader inclusion criteria and therefore covers a much wider range of events than UCDP.

The team also ran regression tests using the same PCs with conflict data from the ACLED dataset. In the ACLED dataset, PC1, PC2, PC3, PC4, and PC6 were valid, with an R-squared value of 0.283, whereas in the UCDP dataset, PC1, PC2, PC4, and PC5 were valid, with an R-squared value of 0.226. Although the ACLED dataset yielded a slightly higher R-squared value, this study ultimately relied on UCDP data. Its stricter inclusion criteria ensure greater consistency and comparability in event sampling, making it more suitable for the statistical analysis and cross-regional comparisons conducted for this study.

Variables Description

Table 5: Description of variables

Variable Label	Description	Source
oda_total_net	ODA total net from official donors	OECD
odf_total_net	ODF total net	OECD
female_pop	Female population at the ADM1 level	UN OCHA
male_pop	Male population at the ADM1 level	UN OCHA
people_in_need	Number of people in need	UN OCHA
INFORM_risk	Global, open-source risk assessment for humanitarian crises and disasters	INFORM Risk Index (EU JRC / OCHA)
conflict_count	Number of conflict incidents	UCDP Georeferenced Event Dataset
military_spending	Military expenditure by country as percentage of government spending	SIPRI - Military Expenditure Database
ipc_food_insecurity	Proportion of IPC4 and IPC5	IPC - Acute Food Insecurity Country Data
rule_of_law	Level of Rule of Law & Justice	Ibrahim Index of African Governance (IIAG)
gender-devel	Subnational Gender Development Index (SGDI): The male and female values of the Subnational Human Development Index and the underlying gender-specific education, health and standard of living indices	Global Data Lab
mpi	Subnational Multidimensional Poverty Index: The index measures poverty within specific regions of a country, revealing disparities in poverty levels across different subnational areas	OPHI - Global MPI

114. Roudabeh Kishi, 'A Quantitative Look at Global Conflict Trends | Pathways for Peace', 2023.

115. Kishi, 'A Quantitative Look at Global Conflict Trends | Pathways for Peace'.

nd_readiness	Readiness to make effective use of investments for adaptation actions refers to the extent to which a safe and efficient business environment enables a country to leverage investments for adaptation. ND-GAIN measures readiness by considering a country's capacity to translate investments into adaptation actions. Overall readiness is assessed through three components: economic readiness, governance readiness, and social readiness.	ND-GAIN Country Index
nd_vulnerability	ND-GAIN assesses a country's vulnerability by considering six life-supporting sectors: food, water, health, ecosystem services, human habitat, and infrastructure.	ND-GAIN Country Index
foreign_invest	Foreign direct investment (FDI) refers to the net inflows of investment made to acquire a lasting management interest, typically 10 per cent or more of voting stock, in an enterprise operating in an economy other than that of the investor. The World Bank considers FDI an important indicator related to climate change.	World Bank
rural_population	National rural population	World Bank
fpi	National food production index: The index covers food crops that are considered edible and that contain nutrients. Coffee and tea are excluded because, although edible, they have no nutritive value.	World Bank
lpi	National livestock production index: The index includes meat and milk from all sources, as well as dairy products such as cheese, eggs, honey, raw silk, wool, and hides and skins.	World Bank
rfh_avg	Annual Sum of Rainfall Long-term Average	WFP

c_drought	Number of drought events	EM-DAT - Emergency Events Database
c_flood	Number of flood events	EM-DAT - Emergency Events Database
c_storm	Number of storm events	EM-DAT - Emergency Events Database

Principal Component Analysis (PCA)

The multivariate statistical method, Principal Component Analysis (PCA), was used to reduce the dimensionality of the data and generate weights for each variable¹¹⁶. PCA groups these variables into a certain number of components, providing a generalized understanding of the impact of climate change and adaptation on security. The method revealed patterns and relationships in the dataset by generating new uncorrelated variables, called principal components (PC). Each component is a linear combination of the original variables and is orthogonal to the others, removing redundancy and highlighting the key factors for each PC. The PCs were ordered according to the amount of variance they explain in the data, with the first PC explaining the most variance. The weights of each variable in the PCs were measured to determine how each variable contributes to the composition of the principal components. The team used 80 per cent of the variance as a threshold, following the approach used in a similar study, 'Spatial Analysis of Socio-Economic and Demographic Factors Influencing Urban Flood Vulnerability'.¹¹⁷ Moreover, the team excluded principal components with eigenvalues less than 1. This is because eigenvalues below 1 explain less variance than a single variable and may be considered uninformative for dimensionality reduction purposes, according to the Kaiser rule.¹¹⁸

Principal Component Regression (PCR)

The research team then used Principal Component Regression (PCR) to establish a general model of the relationships between the identified PCs and regional security. PCR is a regression method similar to standard linear regression, but it uses principal components as predictors instead of the original variables to model the relationship with the target variable. The number of conflicts in each region was assigned a value to compare regional security and identify statistically significant dimensions. This method provided an overview of how climate change impacts and adaptation efforts generally influence regional security. It is particularly important because the assumptions of a linear model require explanatory variables to be independent of one another, which this method ensures. It revealed how each PC is related to regional security. By understanding the weights of each variable within each PC and how these PCs influence regional security, the study provides insights into how adaptation policies can contribute to enhanced security in selected regions of Africa.

Participatory Case Study

The case studies were selected based on data availability, policy relevance, innovative practice, and potential for replication. Drawing on quantitative hotspot analysis, two regional cases—one in the Horn of Africa and one in the Sahel—were developed through 2-3 key informant interviews each. Given their broader, cross-country focus, the case studies are integrated into the overall analytical narrative, illustrating how adaptation interventions contribute to security outcomes.

116. Detlef Groth et al., 'Principal Components Analysis', in Computational Toxicology: Volume II, ed. Brad Reisfeld and Arthur N. Mayeno (Humana Press, 2013).

117. Md Tazmul Islam and Qingmin Meng, 'Spatial Analysis of Socio-Economic and Demographic Factors Influencing Urban Flood Vulnerability', Journal of Urban Management 13, no. 3 (2024): 437–55.

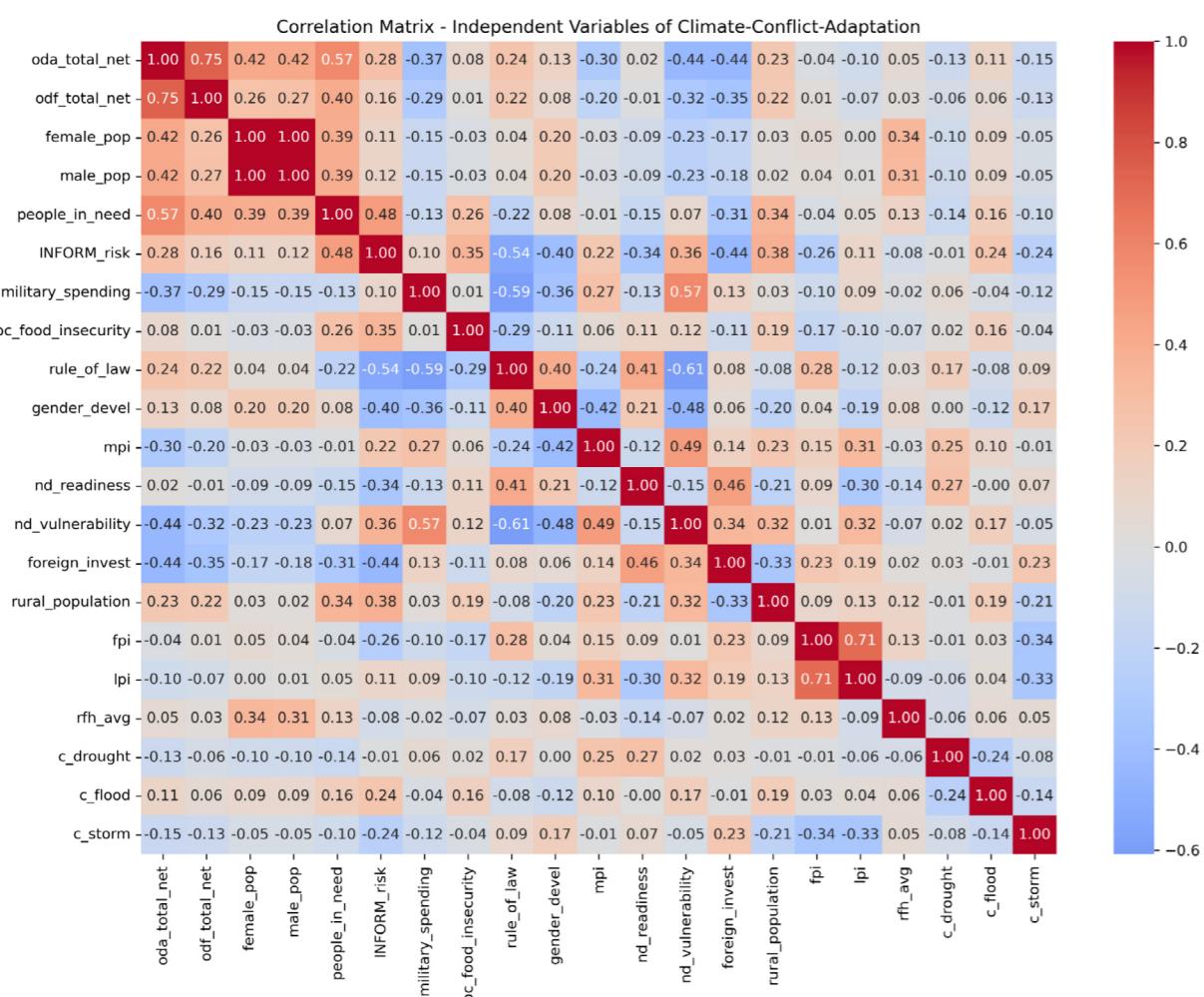
118. Henry F. Kaiser, 'The Application of Electronic Computers to Factor Analysis', Educational and Psychological Measurement 20, no. 1 (1960): 141–51.

Data Preprocessing

The research team aggregated a total of 17 datasets and used 22 variables, as described in Table 4. After aggregating the data at the ADM1 level, where ADM1-level data were not available, data from the corresponding country (ADM0) were used instead. If data for a specific year were unavailable, the previous year's data were used; if these were also unavailable, the following year's data were used. In cases where no year-specific data were available, the most recent data were applied. For any dataset in which information for a country was missing, the missing values were replaced with the regional average for the corresponding year.

Subsequently, the research team checked the Pearson correlation coefficients of each independent variable to identify relationships and exclude certain variables, as detailed in Figure 4.

Figure 4: Correlation Matrix - Independent Variables

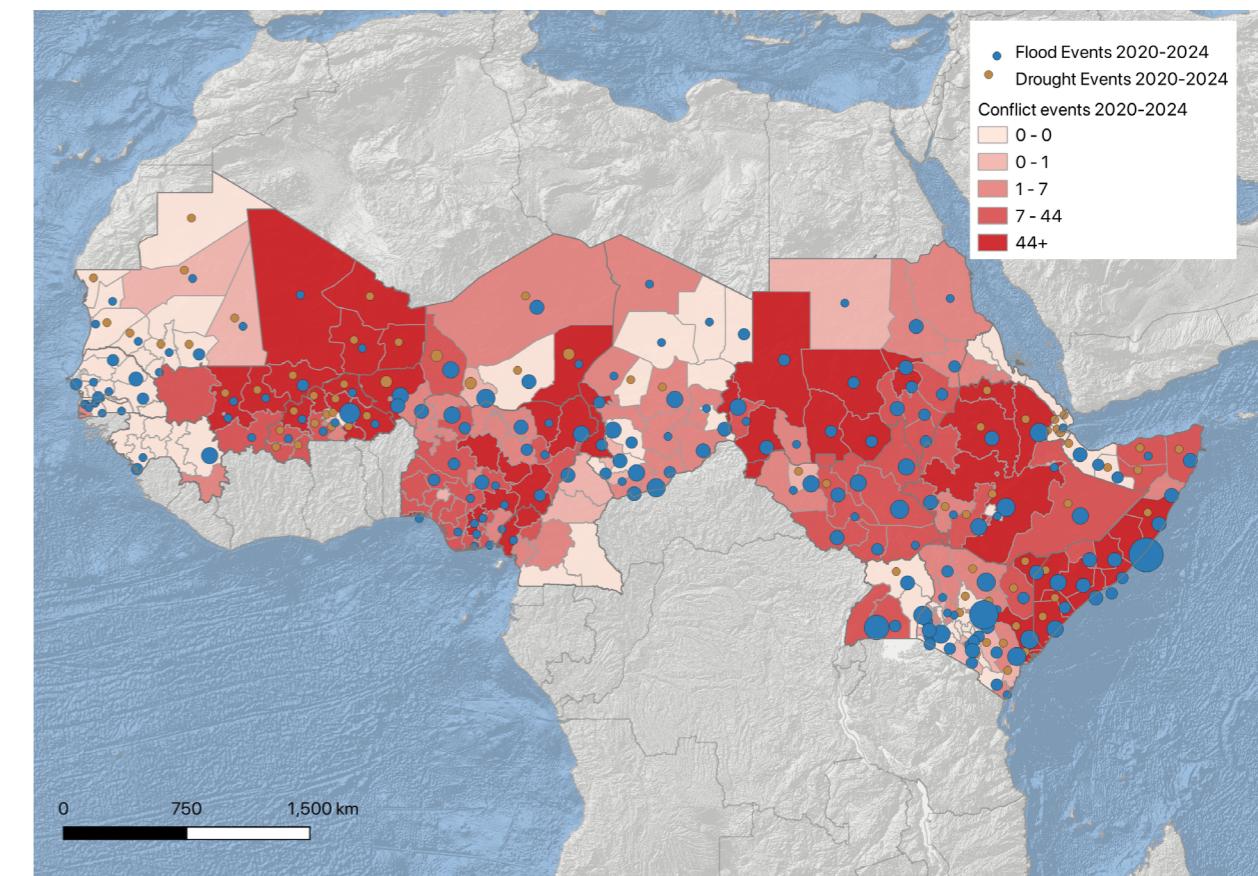


As a result, a total of 5 variables were excluded from the analysis: 'oda_total_net', 'male_pop', 'rule_of_law', 'nd_vulnerability', and 'fpi'. The team used a correlation coefficient of 0.5 as the threshold for exclusion, as it is commonly used as an indicator of a medium effect size.¹¹⁹

119. Ibrahim Said Humaid Alwahaibi et al., 'Cohen's Criteria for Interpreting Practical Significance Indicators: A Critical Study', Cypriot Journal of Educational Sciences 15, no. 2 (2020): 246–58.

Conflict-Climate Hotspots Map

Figure 5: Conflict-Climate Hotspots in the Sahel and the Horn of Africa (with bubbles)



The research team also developed a Conflict-Climate Hotspots map, featuring two types of bubbles. Blue bubbles represent the frequency of flood events in each region over the past five years, while brown bubbles indicate the frequency of drought events during the same period. Each region was further classified into five levels based on the number of conflict incidents recorded over the past five years. Regions with seven or more conflict incidents, marking the start of the fourth risk level, were considered to have a high security risk.

KIIs

Table 6: Overview of expert interviews

KII Number	Title	Organization
KII 1	Climate Peace and Security Advisor	UN/AU
KII 2	Climate Peace and Security Advisor	UNOWAS
KII 3	Climate Adaptation and Conflict researcher	Consultant
KII 4	Climate Peace and Security Advisor	UN Somalia
KII 5	Environmental and Adaptation Officer	Action Against Hunger
KII 6	Regenerative Resilience & Environmental Peacebuilding	IOM Somalia
KII 7	Program Manager	European Institute of Peace



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