

Integrated Assessment of Climate-Related Security Risks for Peace and Security in Blue Nile, Sudan, and Their Gender Dimensions



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Acronyms and abbreviations

CPA	Comprehensive Peace Agreement
CSO	Civil Society Organization
GERD	Grand Ethiopian Renaissance Dam
FGD	Focus group discussion
Ha	Hectare
IPCC	Intergovernmental Panel on Climate Change
JPA	Juba Peace Agreement
KII	Key Informant Interview
Mm	Millimeter
PDF	Popular Defense Forces
RSF	Rapid Support Forces
SAF	Sudanese Armed Forces
SGBV	Sexual and Gender-Based Violence
SPLM	Sudanese Peoples Liberation Movement
SPLM-N	Sudanese Peoples Liberation Movement-North
UN	United Nations
UNICEF	United Nations Children's Fund
UNITAMS	United Nations Integrated Transition Assistance Mission in Sudan
UN PBF	United Nations Peacebuilding Fund
UN Women	United Nations Entity for Gender Equality and the Empowerment of Women
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme

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Executive Summary

The Blue Nile State in Sudan is currently at the epicenter of a severe crisis, characterized by an intensifying conflict between the Sudanese Armed Forces (SAF) and the Rapid Support Forces (RSF) that erupted in April 2023. This conflict has exacerbated longstanding tensions in the region and resulted in the displacement of 8.7 million, including 4.6 million children as of December 2024, including 336,710 who have sought refuge in the Blue Nile State¹. These dynamics have intensified intercommunal conflicts and presented complex challenges in managing the region's natural resources, which are strained by the impacts of climate change.

Since the breakdown of the 2011 peace process, Blue Nile State has faced protracted armed conflict, with unresolved disputes between the Government of Sudan and the Sudan People's Liberation Movement – North (SPLM-N). These conflicts are deeply intertwined with disputes over fertile lands needed for grazing and agriculture. Blue Nile's ecosystems have been degraded due to unsustainable uses and are further stressed by erratic rainfall, prolonged dry spells, and increased flooding. Climate change compounds these challenges, pushing the region towards ecological and social tipping points.

Women, who are pivotal in managing natural resources like land, water, and livestock, find themselves disproportionately burdened. Violence and displacement have not only increased the number of female-headed households but have also heightened the economic and political marginalization of women, leaving them out of critical decision-making processes.

This integrated assessment, conducted under the auspices of a forty-five-month initiative funded by the UN Peacebuilding Fund and implemented by UNEP, UN Women, and UNDP, seeks to address these intersecting issues of gender, climate change, and security. Utilizing a gender and intersectional lens, the report identifies both current and projected risks and proposes transformative actions aimed at building resilience.

The necessity for integrated approaches that combine security, governance reforms, environmental action, climate adaptation strategies and sustainable livelihoods development is clear. These efforts must be inclusive, sensitive to the diverse needs of the community, and particularly supportive of the most vulnerable groups, including women and internally displaced persons (IDPs).

The report advocates for five strategic actions tailored to address the immediate and long-term challenges faced by the Blue Nile State:

1. **Contribute to the stabilization of the current situation and build the foundations for longer-term peacebuilding efforts:** To address the dynamic conflict in Blue Nile State, immediate actions include facilitating community-based peace dialogues, supporting local peace committees, and ensuring climate-sensitive humanitarian efforts.
2. **Promote Climate-Smart Livelihoods:** Focus on sustainable livelihood initiatives that are community-driven and scientifically informed, targeting women, IDPs, and other marginalized groups.

3. **Strengthen Community-Based Conservation:** Support the protection, conservation, and restoration of natural ecosystems through inclusive and community-led efforts that respect local and indigenous knowledge.
4. **Establish Inclusive Governance for Natural Resources:** Create governance structures that integrate the voices and leadership of all community members, especially those typically excluded, to ensure equitable resource management and conflict prevention.
5. **Enhance Protections Against Sexual and Gender-Based Violence (SGBV):** Implement comprehensive measures to address SGBV within resource-dependent roles, enhancing legal awareness, safety infrastructure, and effective response systems.
6. **Foster Transboundary Environmental Cooperation:** Promote collaboration with neighboring countries on the sustainable management of shared ecosystems, crucial for regional peace and environmental stability.
7. These recommendations aim to create a robust framework that not only navigates the current crisis but also paves the way for sustainable peace and development, aligning local efforts with broader regional and international goals for resilience and conflict resolution.

1. Introduction

Blue Nile State has experienced protracted armed conflict since the 2011 peace process, when agreement between the Government of Sudan and the Sudan People's Liberation Movement – North (SPLM-N) could not be reached. This conflict has added to other longstanding tensions in the area, including disputes between and among livelihood groups over natural resources, such as fertile land for grazing animals and crop production. The strain on natural resources is further exacerbated by the worsening impacts of climate change: rainfall has become more erratic and dry spells longer and floods more frequent, while population and livestock growth have increased demand for ever scarcer fertile land.

This conflict-climate landscape has important implications for women, who play essential roles in natural resource, land, and livestock management, and in supporting the livelihoods of families and communities. The conflict has seen the expectations on women rise significantly, with violence and displacement dramatically increasing the number of female-headed households. Yet women remain marginalized economically and typically excluded from political and decision-making structures.

The 2020 Juba Peace Agreement (JPA) established a framework for peace and development in the region. Building sustainable peace in Blue Nile, however, requires concertedly addressing tensions over land and natural resources lying at the heart of the conflict. This entails an integrated approach able to blend necessary security sector and governance reforms with local level conflict resolution processes. Behind all these efforts, it is vital to continuously promote the inclusion, leadership, and essential capacities of women in natural resource management and conflict resolution.

Unfortunately, after the start of the war in April 2023, the Office of the High Commissioner for Human Rights (OHCHR) documented an overwhelming violence in Sudan. For instance, only between June and August 2024, over 864 civilian deaths resulted from attacks on residential areas across Sudan. UN Deputy High Commissioner for Human Rights, Nada Al-Nashif, voiced concern about “the use of sexual violence as a weapon of war” since the conflict’s onset, noting that 81 per cent of these incidents were linked to men in RSF uniforms and allied militias. She also mentioned credible reports of sexual violence involving SAF troops and associated armed groups (Security Council Report, 2024).

At the same time, Sudan has been grappling with severe rainfall and flooding during 2024 affecting 13 out of its 18 states. Disease outbreaks, particularly cholera, are exacerbating humanitarian needs and further deteriorating the already challenging situation (UNHCR, 2024). Sudan is currently experiencing unprecedented food insecurity, with an alarming 26 million individuals affected by acute hunger. Famine conditions were officially recognized in August 2024, and the situation³ has been especially dire in conflict affected States such as Aj Jazirah, Darfur, Khartoum

Kordofan and Blue Nile. Furthermore, these results are consistent with the IPC forecasts for April 2024 to February 2025, which suggest that the regions of Greater Darfur (comprising all five states), South Kordofan, Blue Nile, and Khartoum will experience the most severe food insecurity

during this period (FEWS Net, 2024).

Against this background, the United Nations Environment Programme (UNEP), the United Nations Entity for Gender Equality and the Empowerment of Women (UN Women), and the United Nations Development Programme (UNDP) partnered to deliver the project “Supporting sustainable peace in Blue Nile through gender-inclusive natural resource governance, strengthened conflict resolution mechanisms and climate-resilient livelihoods,” a forty-five-month initiative funded by the UN Peacebuilding Fund (PBF). The project was designed to promote sustainable peace in Blue Nile by supporting climate resilient livelihoods, gender-inclusive governance, and effective conflict resolution mechanisms that underpin the peace and development prospects of all groups. Specifically, it seeks to promote the empowerment of women change agents, capitalizing on their important roles as natural resource users and the social shifts resulting from the increased numbers of female-headed households.

As a contribution to this project, this assessment examines the impacts of climate and environmental change on socio-economic dynamics and resulting risks for the project area. The analysis focuses on both current risks and future projections, in order to inform the selection and design of transformative actions for building resilience to the identified risks. The assessment was led by UNEP, in collaboration with adelphi, UN Women and UNDP, who contributed to data collection, analysis, validation, and the formulation of recommendations. A gender and intersectional lens were applied in the analysis to capture the unique experiences, risks, and opportunities people of all ages, genders and ethnicities linked to their multiple factors of identity.

1.1. Geographical scope

The assessment was conducted in Al Kurmuk, Baw and Geisan localities in Blue Nile State (Figure 1). In each of these localities, the project is implementing activities in two communities, as follows:

- Alkaili and Gambrda in Al Kurmuk locality;
- Samsur and Derang in Baw locality; and
- Deim Saad and Yara in Geisan locality.

While the assessment focuses primarily on Blue Nile State, broader regional dynamics are also considered, as many of the issues affecting the project area are regional in nature.

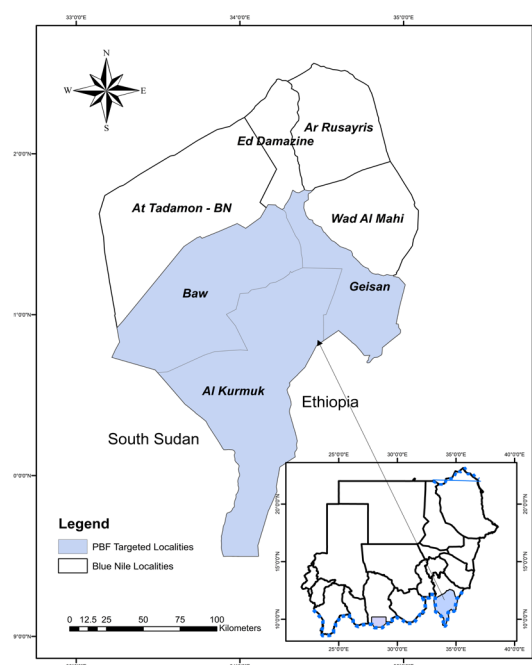


Figure 1. Map of the project area.

1.2. Methodological approach

The analytical approach used in this study draws on the Weathering Risk methodology developed

by adelphi. This is an interdisciplinary, mixed-method approach used to assess risks at the intersection of climate change, conflict, and other contextual factors shaping vulnerability and resilience (adelphi, 2024). The methodology includes four key steps:

1. A context analysis of the conflict, political, and socioeconomic context drawing on scientific and gray literature, including published conflict analyses, newspaper articles, and journal articles; as well as primary data collection methods including 5 in-depth interviews (1,5 hours) conducted online in December 2024 with Sudanese experts from the Blue Nile State;
2. An environmental and climate analysis of historical and recent trends, as well as future projections in the region, including an analysis of environmental and climate data collected from local government as well as trusted open source data such as data from the World Bank;
3. An analysis of pathways linking climate change, peace and security in Blue Nile State, based on primary data collected during the project baseline assessment; this includes 23 key informant interviews (KII) and eight focus group discussions (FGDs) conducted across the six communities in the three project localities with male and female community members, community leaders and government officials, as well as a household survey assessing community perception of climate change impacts on their lives and livelihoods with 390 respondents; and
4. Recommendations for building inclusive peace and resilience to these risks, developed through a workshop with project partners.

Using a gender and intersectional lens was central to this analysis, recognizing the distinct experiences people of different genders and other intersecting identities face with regards to preexisting power dynamics, norms, inequalities, roles, and responsibilities. To the extent possible, the analysis draws on sex disaggregated data and acknowledges the differences in perception between different gender groups. However, significant limitations for assessing the full extent of gender-related issues remain, as detailed in the section below.

1.3. Limitations

Several challenges present limitations to this assessment. First, highly localized environmental and climate data is limited for the project region. Historical data of more than twenty years is typically unavailable through local government records. Local data is also often geographically limited and collected from one specific weather station rather than from weather stations across the area. In some cases, environmental data is not publicly available at all, such as up-to-date data on commercial and small-scale mining activities. To manage this limitation, the assessment team complemented local data with open-source data derived from remote sensing techniques enabling analysis of longer historical trends.

The qualitative data also presents significant limitations. The household survey, KIIs, and FGDs

were not gender balanced. For example, 66 per cent of respondents to the household survey were male, and only 34 per cent female. This significantly reduced the accuracy of this survey data set in capturing the perspectives of women. Men were also disproportionately represented in key informant interviews and discussions. The perspectives of other stakeholder groups are also limited: the assessment does not clearly capture the experiences of displaced populations including IDPs and refugees, nor does it fully capture the range of perspectives of nomadic pastoralists, as disaggregated by sex.

Finally, the geographic scope of this assessment is limited by the project area. Qualitative data collection was only carried out in three localities where the project is being implemented, while experiences and perspectives as well as climate and environmental challenges vary significantly across Blue Nile State. The narrow geographic scope also limits analysis of how climate or environmental change elsewhere in the region (within and outside Sudan) may impact peace and security dynamics with the state, such as through mobility.

Most recently, the conflict between the Sudanese Armed Forces (SAF) and the paramilitary Rapid Support Forces (RSF) that began on 15 April 2023 significantly affected the context within which this research took place. Whilst most of the fighting to date has been concentrated around Khartoum and the Darfur region, as of December 2024 around 24,000 people have been killed, and 8.7 million people have been displaced within and outside Sudan – with hundreds of thousands seeking safety in Blue Nile State (OCHA, 2024).

1.4. Key Concepts¹

The core concepts used in this report are as follows:

- **Climate Change:** The intergovernmental panel on climate change (IPCC) defines climate as “average weather” or more rigorously, as the “statistical description in terms of the mean and variability of relevant quantities [of temperature, precipitation or wind] over a period of time ranging from months to thousands of years” (Masson-Delmotte et al, 2018). This report refers to impacts of climate change, understood as “change in the state of the climate that can be identified by changes in the mean and/or variability of its properties and that persists for extended periods” (Masson-Delmotte et al, 2018). In particular, the report considers communities’ capacity to adapt to – or even prevent – the impacts of climate change, including ecosystem degradation and resource scarcity due to erratic, extreme and/or changed rainfall patterns, temperature increase and extreme weather events.
- **Gender:** Gender is understood as the social (rather than biological) attributes, norms, roles, and attitudes considered appropriate for groups by a given society at a given point in time and learned through socialization. Gender shapes and reinforces power relations between and among these different groups (OSAGI, 2001). This report applies an intersectional approach, which exposes the dynamics that occur as gender identity interacts or overlaps with other identity markers, such as race, socio-economic status, culture, or ethnicity, creating multiple layers of marginalization and discrimination. Intersectionality emerged through

1 For definitions see https://gender-nr-peace.org/assets/2020_GCS_Report/GCS_PolicyReport_200611.pdf.

the observation that black women experienced a double oppression from patriarchy and racism, which affected their access to justice compared to white women in the United States (Crenshaw, 1989). In the context of environmental justice, indigenous women often face multilayered risks as they are discriminated against as environmental activists, as women, and as part of an ethnic minority group. Age can also play a factor. Therefore, considering men and women as homogenous groups can reinforce harmful stereotypes that perpetuate economic, social, or political inequalities, and fail to recognize the challenges faced by different groups experiencing multiple layers of marginalization.

- **Sustainable Peace:** Framed in the context of the UN Charter, peace is denoted by the absence of war, armed conflict, and the ability of actors to peacefully settle disputes. This report, however, is grounded in a broader understanding of sustainable peace, recognizing that peace is not merely the absence of war at the state level, but the result of positive experiences of human security at multiple levels from individual up to interpersonal, household, community, state, and transnational.

Human security has been characterized as having seven dimensions, namely economic, food, health, community, environmental, personal and political (UN, 2016). Where people experience security across these dimensions, and where each reinforces the linkages between development, human rights, and peace and security, we may be able to infer a higher likelihood of sustainable peace (UNGA, 2012).

1.5. Report structure

Following this introduction, this report comprises four sections. Section 2 describes the political context and provides an analysis of conflict dynamics in the project region. Section 3 provides a description of the geography of Blue Nile State, as well as an analysis of key environmental and climate trends and change projections, using information provided by local government, as well as open-source environmental and climate data. Section 4 presents an integrated analysis of how climate change, environmental degradation and peace and security currently interact, and how they might interact in the future. The report concludes with Section 5, which suggests a range of possible responses, drawing on best practice solutions for building gender-inclusive resilience to environment- and climate-related security risks at local level.

2. Conflict context

Since its independence from colonial rule in 1956, the Blue Nile State in Sudan has been affected by conflict marked by a complex interplay of political rivalries, ethnic tensions, and disputes over land and resources. Situated on Sudan's southern border, Blue Nile State shares boundaries with Ethiopia and South Sudan, further complicating its conflict dynamics, particularly those related to natural resource governance.

Recently, two violent conflict incidents underlined the simmering grievances over land governance and ethnic identities, underscoring the deep-seated tensions within the region. First, in July 2022, a violent eruption of inter-communal strife between the Hausa tribe and Funj communities left a devastating toll of casualties, injuries, and displacement (OCHA, 2022a). This inter-communal conflict is still ongoing, with the latest incident in December 2024 resulting in the killing of a Hausa fisherman along the banks of the Blue Nile – where the Hausa community usually pursue their subsistence agricultural and fishing activities. These incidents are intensified by the current wider conflict and the impacts of seasonal and rainfall fluctuations, further restricting livelihood activities and eroding social cohesion between communities.

Second, the ongoing armed confrontation between the Sudanese Armed Forces (SAF) and the Rapid Support Forces (RSF), which ignited in April 2023, has only deepened the region's woes. Reports of clashes between these government forces and the Sudan People's Liberation Movement-North (SPLM-N) have led to widespread clashes over control of resources and led to civilian displacement, exacerbating an already dire humanitarian situation (ACLED, 2023).

Following the RSF's advance into Blue Nile State in early August 2024, SAF troops that had been stationed there pushed RSF forces out and relocated north towards Sinja. This movement could be attributed to the challenging geography, with the Dinder River limiting the RSF's mobility, the superior numbers of SAF troops, or shortages in RSF weaponry and reinforcements. The SAF is strengthening its position by advancing from multiple bases and connecting its forces across Sennar, Gedaref, White Nile, and Blue Nile states. The presence of RSF forces has led to significant impacts in the region, including the displacement of farmers, restricted access to farmland due to insecurity, hindered pastoral mobility, and the looting and intentional destruction of forest and both harvested and unharvested crops.

This section aims to give a broader perspective on the conflict dynamics in Blue Nile State. It outlines three main types of conflicts that prevail in the region: political conflicts, intercommunal conflicts, and natural resource-based conflicts. These conflicts have been ongoing for a long time, and the access to and control of natural resources is a significant factor contributing to them.

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2.1. Political conflict

Like many regions on Sudan's periphery, communities in Blue Nile have a long history of economic, political, and social marginalization by the central government. The exploitation of Blue Nile's rich natural resource base by elites during the colonial period and after independence has displaced local communities from their land, limited the availability of land for small-scale farming and open pasture, and contributed to environmental degradation, deforestation, and pollution (ICG, 2013). Interview partners from the Blue Nile also reported that the centralization of most basic services in Khartoum and larger states such as specialized hospitals with special equipment led to further marginalization and social fragmentation of the region. Large agricultural schemes were introduced in the 1920s and expanded in the 1950s with the introduction of mechanized agriculture. Industrial mining operations for gold also started in the state in the 1960s, and

chromite mines first opened about 80 km southwest of Ed Damazine in the Ingassana-Al Kurmuk Ophiolite Belt in 1963, contributing to pollution and further degrading the environment (Babiker, 1982). In 1966, the Ar Rusayris Dam was constructed on the Blue Nile River to provide irrigation to nearby farms and hydroelectric power to Sudan. The dam, which was expanded by 11 meters in 2013, more than doubling storage capacity, displaced thousands of households from their land with limited consultation and compensation.²

The exploitation of Blue Nile's diverse natural resource base for economic gain by national and foreign elites – often at the expense of local communities and the environment – led many communities to understand and sympathize with grievances underlying the independence movement in southern Sudan. In 1986, Blue Nile became a stronghold for the Sudanese People's Liberation Movement/Army (SPLM/A), marking the beginning of two decades of conflict between the SPLM and the Sudanese Armed Forces (SAF) in the region.



Ar Rusayris Dam harnesses the Blue Nile State for irrigation and hydropower in Sudan. Photo Credit © UNEP

In 2005, the Government of Sudan and the SPLM/A signed the Comprehensive Peace Agreement (CPA), paving the way for an independent South Sudan below the 1956 colonial-era boundary separating the southern region from the mostly Muslim and Arab north (UNMIS, 2005 P. 74). The agreement stipulated that the situation of Blue Nile and neighboring South Kordofan – two regions in the north held by the SPLM-N which came to be known as the “Two Areas” – would be resolved through popular consultations, which would inform a comprehensive agreement between the SPLM and the Government of Sudan (UNMIS, 2005 P. 74). However, the consultations were never fully carried out and in 2011, when the people of southern Sudan voted overwhelmingly for independence, the SPLM/A refused to withdraw from Blue Nile, transforming into the SPLM/A-North (SPLM/A-N), which would continue to fight for a secular, autonomous government.

² Expert interview with civic actor, Khartoum. The United Nations Mission in Sudan, (2005), *The Comprehensive Peace Agreement between The Government of the Republic of The Sudan and The Sudan People's Liberation Movement/Sudan People's Liberation Army*.

Fighting between the SPLM-N and the Government of Sudan returned to the region in 2011, beginning in South Kordofan and quickly spreading to Blue Nile. In 2017, the SPLM-N split into two factions led respectively by Malik Agar and Abdelaziz Al Hilu, who were developing divergent views on the movement's direction within an increasingly Islamic Sudan. The split further entrenched ethnic divisions in the state, with Malik Agar's following comprising primarily of people from Ingassana communities and Al Hilu's from the Uduk community. Internal fighting, and the fight against the government of Sudan, brought with it a renewed humanitarian crisis marked by food insecurity, massive displacement both internally and across the border to South Sudan and Ethiopia.

In 2019, the democratic transition across Sudan created an opening for peace in the state. The Juba Peace Agreement, of which SPLM-N leader Malik Agar became a signatory on 3 October 2020, designated Blue Nile as an autonomous region and renewed hope for peace in the state despite significant challenges (not least of which that Abdel Aziz Al Hilu did not sign the agreement). However, following the October 2021 military coup in Sudan, renewed tensions in Blue Nile in the summer of 2022 mirrored growing instability across the country and threatened to reverse progress towards peace in the state. In addition, Malik Agar and Yasir Arman, two leaders of the SPLM-N Sudanese Revolutionary Front, announced a sudden split in August 2022 due to a disagreement over the alignment of the movement with the new military-led government, leading to the establishment of the SPLM Democratic Revolutionary Movement, led by Yasir Arman.

In July 2022, a wave of intercommunal violence spread across Blue Nile State's Wad AlMahi, Ar Rusayris and Geisan localities.

Two weeks of violent clashes between members of the Hausa tribe and the Funj communities killed 142 people, injured an additional 383, and displaced more than 30,000 people from their homes (OCHA, 2022a). Tensions between ethnic groups over land governance intensified in the weeks prior, and escalated following the death of two individuals from the Hamaj tribe, who also identify as Funj (DTM Sudan, 2022).

The conflict between Sudan Armed Forces (SAF) and Rapid Support Forces (RSF) that erupted in Khartoum on 15 April 2023, expanded to Kordofan, Darfur and Blue Nile states, and has compounded these challenges. In Blue Nile, the Abdelaziz al-Hilu faction of the Sudan People's Liberation Movement-North (SPLM-N) opened a new frontline in June 2023 and seized control of several villages in Al Kurmuk locality. In response, and as clashes intensified, the SAF called for a general mobilization of young civilians, reservists and SAF retirees. In addition, the Popular Defense Forces (PDF) in Blue Nile increased their recruitment of pastoralist groups such as the Hausa and Falata to combat the SPLM-N (ACLED, 2023).

The war has resulted in an unprecedented number of internally and externally displaced persons, estimated as approximately 8.7 million, as of December of 2024 (OCHA, 2024). Hundreds of families have arrived in Blue Nile State, seeking security in Ed Damazine, other cities and villages; as of December 2024, the number of IDPs was estimated to be at least 336,000 (IOM, 2024).

This conflict has impacted local markets, with local stocks depleted and transport networks irregular, and the prices of most of the essential commodities have increased rapidly. While relatively available in Blue Nile, the price of fuel in rural areas (especially during the rainy season) has increased dramatically and negatively impacted both the local economy and transportation. Furthermore, after the RSF entered the Blue Nile, frequent military confrontation and bombardment of gas stations significantly decreased the availability of fuel in the State and forced many traders to depend on motorcycles to transport their agricultural products. Meanwhile, markets in less impacted areas are strained, as the influx of displaced people has put additional pressure on local resources. Communication networks are also affected by the current conflict, and civil servants in Blue Nile have not received salaries for several months. This has dramatically increased existing vulnerabilities, with criminal cases and looting on the rise, as well as incidences of psycho-social challenges and trauma.

The conflict has also contributed to degrading an already fragile security situation. There have been occasional military attacks by the SPLA-AI Hilu faction south and west of Al Kurmuk in Blue Nile. And whilst the SAF are preoccupied fighting the RSF in Khartoum and other states, the SPLA have seized the opportunity to expand into new areas of control both for immediate strategic reasons as well as for leverage during any future political settlement. As the conflict intensifies and lingers, it is likely the SPLA will continue this expansive policy. The confrontations have persisted in 2024. The SPLM-N faction under Agar's leadership, which has been aligned with the SAF since the conflict's onset in April, commenced relocating its troops from Blue Nile State towards Wad Madani in mid-February 2024 (ACLED, 2024a). Furthermore, the conflict in Blue Nile has had adverse consequences as in prior years, including looting, devastation, and disruptions to agricultural activities and commerce. The positioning of armed factions within Blue Nile State is still a significant concern (Mercy Corps, 2024). According to the experts interviewed, when the Rapid Support Forces (RSF) entered the western part of the Blue Nile State in December 2024, they gained favour particularly among previously marginalised groups from Arab origins. Some of these marginalised groups view the conflict as an opportunity to gain power in a region often overlooked by the central government, despite its wealth in natural resources. Additionally, the RSF forced many people to move to Ed Damazine or South Sudan, and blocked the main road to Wad Madani, forcing people to use Ad Dinder road which is severely affected by the rainfall in Autumn. The RSF has developed strategies to recruit young people from these communities. However, as of December 2024, the Sudanese Armed Forces (SAF) have regained control of the At Tadamon locality and people are starting to return to their homes. Fighting still continues in Sennar State.

The proliferation of small armed groups in the Blue Nile further complicates these dynamics. For instance, a small militia that came from the south after the separation of South Sudan positioned themselves inside the Dinder National Park. Interview partners shared that this faction of 300-400 fighters were armed by SAF to confront the RSF in Sennar. However, this only made the armed faction more powerful, leading to systemic targeting of Falata communities and further livelihood destruction. Longstanding systemic issues, such as environmental degradation, inequitable distribution of resources, lack of development and poor infrastructure, have contributed to the political dynamics of the conflict in the region (ACLED, 2024b). As a result, many more families

in Blue Nile have seek security in refugee camps both internally and over the border in Ethiopia.

2.2. Intercommunal conflict

The ongoing political conflict between the multiple factions of the SPLM-N, SAF and the RSF constitutes a layer of conflict that is both contributing to and affected by multiple other existing tensions among the communities linked to identity, culture, access to power, and control over natural resources.

Blue Nile is home to a highly diverse mix of communities. United under “a common history of living between rival kingdoms and states that have expanded into, and then retreated from, this foothill area between the Ethiopian highlands and the Nile,” (Johnson, 2010) Blue Nile’s ethnically diverse communities have been caught for centuries between the shifting balance of power based on political, economic, and religious intentions.

Blue Nile was part of the Funj Sultanate from the fourteenth century until it was destroyed by the Turco-Egyptian invasion in 1821 (Jedrej, 2004). Turco-Egyptian rule transformed it into the Anglo-Egyptian Condominium, which lasted from 1898 to 1956. Communities in the southern part of Blue Nile – many of whom were neither Arab Muslim nor African Christian – were caught in increasingly defined divisions between the mostly African and Christian south and mostly Arab and Muslim north (Johnson, 2010).

Today, several ethnic groups identify as decedents of the Funj kingdom, including members of the Hamaj and Berta tribes (ICG, 2013). Other ethnic groups indigenous to the region include the Ingassana, who live primarily in the center of the state in the Ingassana Hills, the Burun communities in the southern hills, and Uduk and Jumjum communities living on the South Sudan border in the south and west (ICG, 2013). The Ganza and Koma communities are located in the south of the state (ICG, 2013).

Communities who identify as Arab include the Jellaba, who first came to Blue Nile as traders and religious leaders and later as workers in, or owners of large agricultural schemes, and Arab pastoralists such as the Rufa’a al-Hoy who have traditionally migrated to Blue Nile during the dry season from other parts of Sudan.

The region is also home to non-Arab communities who came to Blue Nile in search of opportunities for better livelihoods. In the 1920s, and increasingly in the 1940s, Falata and Hausa nomadic pastoralist communities came from West Africa in search of fertile grazing land. During the 20th century, Darfurian tribes, including Masalit, Zaghawa and Fur communities, also migrated to Blue Nile to work on expanding agricultural schemes.

In Blue Nile, like elsewhere in Sudan, two parallel systems of land tenure co-exist: the statutory legal system and the indigenous system based on customary rights (Gari, 2018). This co-existence of systems is one of the key drivers of gender inequality, exclusion, and unequal power

dynamics, all of which can trigger intercommunal conflicts. This is particularly evident regarding land access and ownership, and the justice systems' persistent challenge of resolving tensions between farmers and herders.

Prior to Sudan's 2019 revolution, for example, SPLM-N followers tended to comprise members of indigenous groups from the central and southern regions, including the Uduk communities, those of the Ingassana Hills, and some members of the Funj communities who accessed land through customary rights. However, communities who migrated to Blue Nile in later years, including those from north and west Africa unfamiliar with customary land rights in the region, tended to align more closely with the central government to gain access to land through the statutory system. These dynamics have become increasingly complex since the signing of the Juba Peace Agreement, whereby some SPLM-N leaders have been integrated into the government, and others have not, leading to new sources of political disagreement and potential conflict.

Land rights are also at the core of current intercommunal tensions between members of the Hausa tribe, who seek customary land rights through representation in the Native Administration, and the Funj community, who feel close ownership of indigenous land. Tensions between the two groups turned violent in July 2022, when clashes between members of the Hausa tribe and members of the Berta and Hamaj tribes broke out in Wad Al Mahi locality, quickly spreading to neighboring localities (ACAPS, 2022). Together with subsequent waves of violence in September and again in October 2022, an estimated 359 people were killed in Blue Nile and 97,000 displaced between July and November 2022 (OCHA, 2022b). This has had significant gendered impacts and raised worrying protection concerns, with women bearing the brunt both of intercommunal clashes, and the effects of displacement.

Most recently, in the Blue Nile State, tensions escalated between Arab and Fulani pastoralist communities, who are considered non-indigenous to the region and align with the RSF, and the predominantly indigenous groups who support SAF and continue to join in big numbers. Interview partners shared that the region has seen the highest recruitment numbers for the SAF compared to any other part of the country. According to all the interviewees, the Blue Nile State is known for its "men and gold", meaning that most of the men join the armed forces and that the region is rich in gold mines. Interview partners also reported that some women fighters joined armed groups on the one hand and SAF on the other hand as part of a larger recruitment process. Other women are active agents of peacebuilding and local conflict mediation. For instance, women collectives sometimes met with the leaders of the Abdelaziz El Hilu faction to discuss how women are disproportionately impacted by the ongoing violence and displacement and negotiate a cease fire.

2.3. Natural resource-based conflict

Natural resource-based conflicts represent a third lens through which to understand conflict dynamics in Blue Nile. Blue Nile State has frequently been a focal point of these kind of conflicts, typically revolving around territorial dominance and exploitation of natural resources, such as

gold and gum Arabic (UNEP, 2022). Land governance has been a persistent source of conflict in Sudan, making it essential to integrate these efforts for lasting solutions.

Natural resource-based conflicts include local conflicts between groups over access to fertile land, water, and forest resources on which people depend for their livelihoods. Among the people's groups are farmers, agro-pastoralists, and Ingassana Ingassana pastoralists, as well as nomadic pastoralists from Arabic tribes such as the Rufa'a, the Kennana, and those with roots in West Africa, such as the Falata Umbroro tribe. These nomadic groups typically migrate with their livestock from the northern part of Blue Nile to the south between June and October, and from south to north between November and January (Ahemed, 2012).

Conflicts are most prevalent in areas where the availability of land for both grazing livestock and smallholder farming has diminished. This scarcity has been caused by the expansion of mechanized agriculture and other industrial activities, occasionally the expansion of public land and more variable weather conditions due to climate change (UNWomen, 2021). Particularly, recurrent drought and more extreme rainfall have further limited the availability of arable land for farming and grazing (UNDP, 2014). As traditional migratory corridors have narrowed, livestock density has increased, and conflicts can occur when livestock move onto farmed land, or when new migratory routes or pastureland or migratory corridors are cultivated (see chapter 4).

In the past, traditional conflict resolution structures were used to prevent and resolve conflicts between pastoralists and farmers. For example, a messenger from a migrating community would have been sent ahead to inform farming communities of the migration days before the arrival of livestock. This gave farmers and herders time to coordinate where livestock should graze and what areas should be avoided. If crops were destroyed, a traditional legal system was used to agree on compensation to prevent any escalation of conflict and restore cordial relationships. However, such mechanisms are no longer functioning optimally. This is in part due to the expansion of the large-scale mechanized agricultural schemes in the area, which are governed according to statutory law and have therefore significantly undermined the mediative strength of traditional legal systems (Ahemed, 2012).

Furthermore, the engagement of various armed factions and the funding of their activities through the extraction of resources exacerbate the situation. A notable example is how these groups have facilitated the establishment of gold extraction and production operations with the support of investors with ties to the Al-Bashir regime and foreign counterparts. This has caused environmental damage and disregard for local communities. After the ousting of Omar Al-Bashir's regime in April 2019, communities challenged state-affiliated mining practices, demanding better labor conditions and more state services (Salah, et al 2021). Most recently, people resorted to artisanal mining to cope with conflict and climate change affectations to secure their livelihoods. One interview participant indicated that if it wasn't for climate change, people wouldn't have resorted to negative coping strategies such as mining. Artisanal mining does not only deplete the land and makes it uninhabitable, but it also utilizes harmful chemicals such as cyanide and mercury, which impacts underground water and soil cohesion. This leads to desertification, landslides, and soil erosion.



Artisanal mining depletes land and contaminates water, leading to desertification and erosion. Photo Credit © Awad Siddeg

More recently, the migration of young men from conflict-affected areas in Blue Nile State, driven by economic instability or by fear to be recruited by armed factions like the SPL-M or the Popular Defense Forces, has notably increased, leading to empty lands that are the source of conflict. Moreover, these armed groups exploit those unresolved land ownership disputes, which affects the traditional mechanisms to resolve conflicts and more broadly the dynamics of governance over natural resources (UNEP, 2022). These situations highlight the powerful role of armed forces in controlling natural resources, exacerbating environmental and social concerns, and creating distrust between the State and communities.

For instance, interview partners reported that the closure of the main road for transporting agricultural products due to military operations between RSF and SAF led to intensifying food insecurity and widespread hunger in the area. The road became operational again after the SAF regained control over Sinja, albeit with restrictions and on a small scale. Overall, the harvesting

season in 2024 was unsuccessful due to a myriad of reasons. First and foremost, lack of security and stability in the region hindered farmers from accessing their farmlands – which are often situated outside of the city. In response, women began farming around their houses to ensure self-sustenance for their families using a traditional practice called Jubraka. The conflict added additional pressure on the existing resources due to increased numbers of IDPs relocating to Blue Nile to escape the war. This increase in demand coupled with lack of adequate agricultural productivity is heading towards a famine crisis.

It is important to mention that there have been longstanding systemic issues like environmental degradation, unequal resource distribution, and inadequate infrastructure, which had already resulted in poor agricultural yields, limited rural development, and chronic hunger. Addressing these challenges requires a dual approach: immediate actions to tackle acute food insecurity should be complemented by long-term strategies focused on land reform, stabilisation and sustainable natural resource management (Wahlstedt, 2024). (also see chapter 4).

2.4. Gender and conflict dynamics

Gender norms, expectations and power dynamics shape the way women, men, girls, and boys from different backgrounds perpetuate, experience, and resolve conflict in Blue Nile. Men comprise most state and non-state armed groups, leaving women in many households with the double burden of carrying out their traditional domestic roles and responsibilities in addition to serving as the primary earners. Indeed, women play vital roles in the management of natural resources such as land, and livestock. They represent the backbone of the subsistence economy by farming plots of land and rearing small flocks of livestock. However, women lack control over and ownership of land and other natural resources, which has historically excluded them from decision making processes on land and resource use. This includes exclusion from decisions to resolve disputes or pursue conflict.

Both statutory and customary systems are founded on the rationale that land is predominantly a man's issue. While both systems nominally allow women to own and inherit land, men are typically favored in practice at the expense of women's rights. There is also evidence that this feeds into a patriarchal mindset within communities, in which masculine norms dominate.

A UN Women gender, conflict and environmental assessment carried out in Blue Nile at the start of the project describes how the multiple overlapping political, intercommunal and natural resource-related conflicts are severely limiting women and men's access to land for small-scale farming or grazing animals (UNWomen, 2021). To cope, many women have taken on new roles, such as working in large-scale agriculture schemes or in gold mining. This uptick is in part driven by the growing absence of men, many of which have migrated away in search of alternative livelihoods, while some have joined armed groups.

In addition to their critical roles at the household level, women also play leading roles in grassroots organizing. For instance, women played an active role in bringing about the December 2018 revolution in Sudan, a national movement which started with protests over the rising costs of food prices and basic necessities. As the protests spread to cities across Sudan, women who took to the streets – often outnumbering men – became symbolic of the revolution. In Blue Nile, women have been actively engaged in women's movements to claim their unmet political rights. Women from political parties, civil society organizations, and the broader civic space were at the front of the demonstrations and drafted the first women's declaration after the revolution (ICG 2019). The declaration received considerable attention from the international community, as illustrated in UNITAMS Resolution 2524 (2020) integrating women's concerns.

Despite women's economic and social contributions at local levels, and their political engagement at the state level and beyond, women remain marginalized politically, economically, and socially in Blue Nile. Historically, women have been excluded from governance structures at national state, local, and community levels. However, due to the massive women's movement in 2018 that called for women's meaningful political participation, and ongoing community mobilization of women concerning their necessary role in peace and security architectures as affirmed in the recommendations of UNSCR 1325, women's participation in conflict resolution and peacebuilding has shown some progress. For example, some women participate in the peace committee at the state level, even if at the community level progress remains slow, with women typically excluded from the conflict resolution mechanisms headed by the chief of the community and other senior community leaders. This stems from deeply held social norms perpetuating the perception that men should arbitrate and resolve disputes. Further, both the statutory and customary legal systems are premised on the fundamental assumption that men are the head of the household and have privileged rights to own and control land and assets. As such both reinforce these social norms and deter women from having equal status and rights as men.

Despite this, some communities have shown slight progress, with incidences of women being invited to participate in the resolution of conflicts deemed to directly affect women, including those involving the management of resources, recognizing women's roles as active economic and peacebuilding agents. For example, interview partners shared that during the inter-communal conflict in 2021-2022, the Women Solidarity across Sudan collective took the initiative and spoke with the sheikhs of the communities to negotiate a cessation of hostilities. This initiative consists of women from all over Sudan – traveling together to the conflict-affected areas to conduct dialogues with the native administration and conflict parties and advocate for women's rights under the state of conflict. They discussed the challenges faced by displaced women who sold their houses and cannot return because of the ongoing violence. This was an important contributing factor to a cessation of hostilities – leading to a ceasefire.

Women and men also have distinct experiences of violence in Blue Nile. For women and girls, experiences of violence are often closely linked to their roles in natural resource management.

For example, they face risks of sexual and gender-based violence when collecting firewood for fuel, forest products, or water. These risks grow as resources become scarcer, forcing women and girls to travel further from their homes. Risks also increase during times of conflict, when security and rule of law are under duress. It should also be noted that women and children constitute the majority of displaced populations. According to UNICEF, Sudan is now the largest child displacement crisis in the world, with 4.6 million children fleeing violence (UNICEF, n.d.) In November 2024, internally displaced people are numbered at 11.4 million in Sudan, of which, approximately 2.7 million were women and girls of reproductive age, an estimated 272,000 were pregnant and in need of timely access to lifesaving and essential reproductive health services, and 6.9 million people are at risk of GBV (UNFPA, 2024).

As of December 2024, the United Nations have reported that sexual violence is being used as a tactical weapon of war. In October 2024, 130 women committed mass suicide by drowning

themselves in the Nile to escape being raped by RSF forces (PassBlue, 2024). The protracted war is also putting the lives and livelihoods of many women in the Blue Nile at risk. Interview participants reported that after the April 2023 escalation of violence, many women were forcibly displaced to neighboring countries including South Sudan and Uganda where they couldn't pursue their livelihoods due to limited resources. For instance, farmer women who lost their land were forced to work informal and marginal jobs to secure their livelihood. Some women build Rakouba - which is similar to a small shop with very basic materials and cook food to sell it there. Other women sell their handmade crafts in local markets. These dynamics are examined in greater detail in the subsequent sections of this report.



Women in Blue Nile remain marginalized, but advocacy efforts are slowly increasing their role in peacebuilding and governance. Photo Credit © UNEP

3. Environmental and climate context

This section presents a description of the geography of Blue Nile State, as well as an analysis of key environmental and climate trends and change projections. The projections are based on the IPCC's standard scenarios for describing future greenhouse gas trajectories. The scenarios are used to model estimated changes in weather and climate variables, such as temperature and precipitation, which are in turn used to project climate change impacts such as flooding, heatwaves, agricultural yields, etc. Specifically, the analysis is based on SSP2-4.5 and SSP5-8.5 greenhouse gas emissions scenarios. In the first scenario, progress towards sustainability is slow, but global warming is limited to under 3°C by 2100. In the second scenario, business as usual continues and global warming is 4.6–5.2°C above pre-industrial levels by 2100.

The analysis includes a mix of data, including information provided by local government in Blue Nile, as well as open-source environmental and climate data from the World Bank. It is important to note that this section does not aim to provide a comprehensive description of the environmental landscape in the country. Rather, it seeks to provide important insights into possible changes that have occurred or may occur from climate change and/or adaptation to climate change impacts in the Blue Nile State.

3.1. Geography of Blue Nile State

Most of Blue Nile State sits within a semi-humid climatic zone, with the southeastern corner of Al Kurmuk locality characterized as humid. Within Sudan, Blue Nile is known for its biodiversity and varied geographical features. The Blue Nile River enters Sudan from Ethiopia on the eastern edge of Blue Nile State and flows north through the center of the state. Blue Nile State is also replete with rich forests, which comprise some 6,653,203 hectares of land, including the southern sliver of Dinder National Park, Sudan's largest protected area (see Box 1).

The Ingassana Hills are in the center of the state, rising nearly 1,000 meters above sea level. Mineral deposits of gold and chromite are found in the hills and its alluvial plains south of the Blue Nile River (Rift Valley Institute, 2020). Artisanal and small-scale gold mining has traditionally been a communal practice, carried out both by women and men. In the last two decades, however, the region has seen a boom in mining, with both domestic and international commercial investments flowing in (Rift Valley Institute, 2020).

Blue Nile has two seasons: the rainy season from May to October and the dry season from November to April. Historically, the region's climatic conditions, freshwater rivers and streams, and clay soils have created a favorable environment for agriculture. The Ar Rusayris Dam was constructed on the Blue Nile near the capital city of Ad Damazine in the 1960s and was heightened in 2013, providing both irrigation for farmland and hydroelectric power to Sudan (Figure 2).

Rich fodder and available water sources also support pastoral lifestyles. Several migratory routes pass through the state, with four passing through Baw and Al Kurmuk and one through Geisan locality.

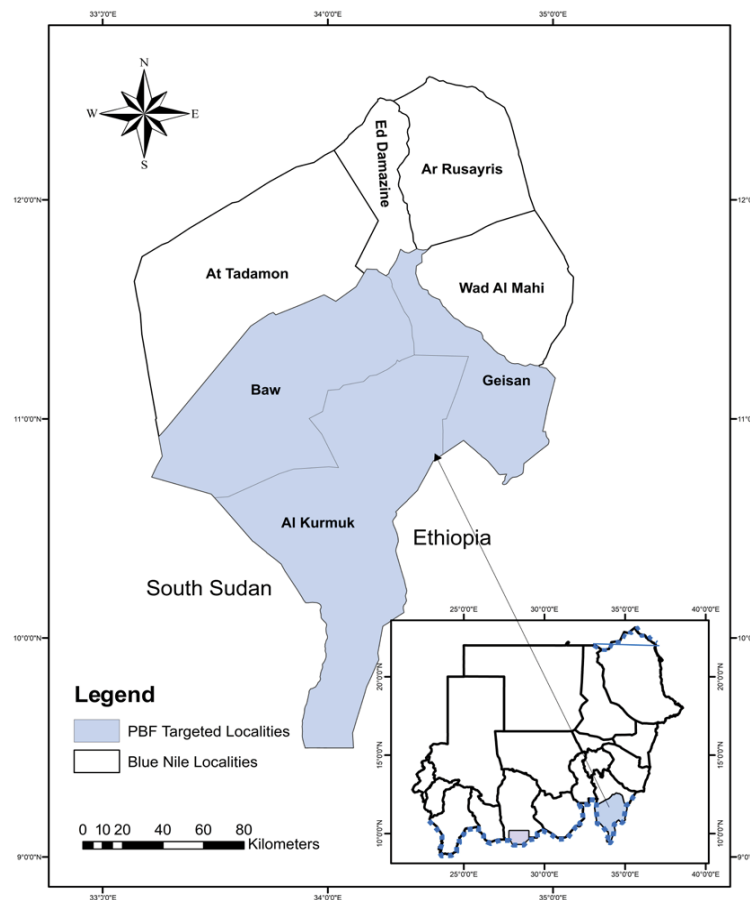


Figure 2. Hydrological network of study area (Data Source: HydroRIVERS and HydroLAKES), and inundation depth for a 25-year flood event based on baseline climate conditions (Data Source: Aqueduct).

Box 1. Dinder National Park

Dinder National Park was established in 1935 as Sudan's largest protected area. The park comprises some 10,291 square kilometers of protected land spanning three of Sudan's eastern states – Senner, Blue Nile and Gedaref. In 1979, Dinder National Park was designated a Biosphere Reserve by UNESCO. Three different ecosystems are recognized in the park: woodlands, riverine, and Mayas (meadows). The park's ecological diversity plays an important role in regulating local climactic conditions as well as water flows during the rainy season, providing a vital source of water and fertile land for humans and wildlife. A diverse mix of flora and fauna are found in the park, including antelope, warthogs, buffalo, monkeys and baboons, many different species of birds, amphibians, and a wide array of plant species.

UNESCO. Dinder National Park, Sudan. Available at: <https://whc.unesco.org/en/tentativelists/6515/>



Dinder National Park's diverse ecosystems sustain biodiversity, regulate climate, and maintain water flow. Photo Credit © Awad Siddeg

3.2. Climate and Environmental trends

3.2.1. Temperature

Temperature records of Blue Nile State obtained from the Sudan Ministry of Irrigation and Water Resources depict a relatively stable situation between 2000 and 2021. The annual mean maximum temperature oscillated between 35.5 and 36.9 degrees Celsius, and the minimum from 19.7 to 21.8. These measures provide clarity on the daily oscillation (from night to day) over the last 20 years. While annual mean maximum temperature is consistent and does not appear to show any rising or decreasing trend, the mean minimum temperatures show a slow increase. After the year 2003, no other year shows an annual mean minimum temperature under 20 degrees Celsius (Figure 3).

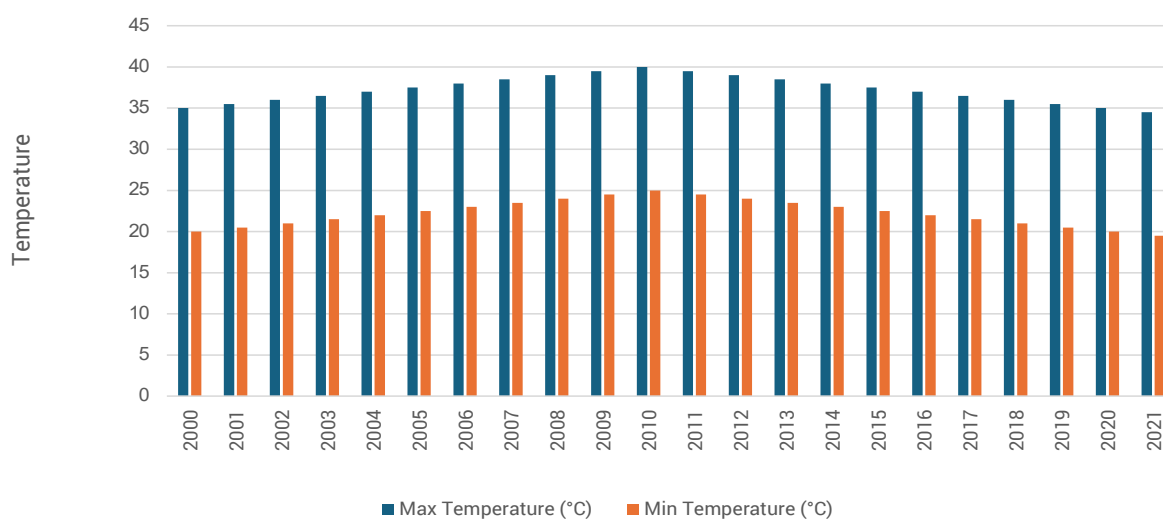


Figure 3. Annual mean minimum (yellow) and maximum (orange) temperature (°C) in Blue Nile State (2000-2021). Data source: Sudan Ministry of Irrigation and Water Resources, Meteorological Authority, Computer Center, 2022.

A longer-term historical analysis using global climate datasets, however, shows significant increases in annual mean temperature (1950-2099) in Blue Nile State, with considerable interannual variability. Projections using a moderate SSP2-RCP4.5 scenario and a starker SSP5-8.5 scenario estimate a continued temperature rise from 2022 over the next 80 years. In examining projected average mean surface air temperatures for Blue Nile State, a comprehensive analysis spanning from 1995 to 2014 reveals the historical mean temperature ranged from 28 to 29 °C, with a median of 29 °C. Looking ahead to 2099, under the SSP2-4.5 scenario, the median average mean surface air temperature for Blue Nile, Sudan, is estimated to increase to 31 °C. Contrastingly, under the SSP5-8.5 scenario, the median temperature projection surges to 33 °C. These projections signify a notable divergence in temperature trends between the two scenarios, with SSP5-8.5 portraying a substantially higher median temperature.

This disparity underscores the significant impact of differing emissions scenarios on future climate conditions, emphasizing the urgency of mitigative actions to address climate change (Figure 4).

Projected Average Mean Surface Air Temperature Blue Nile, Sudan (Ref. Period: 1995-2014), Multi-Model Ensemble

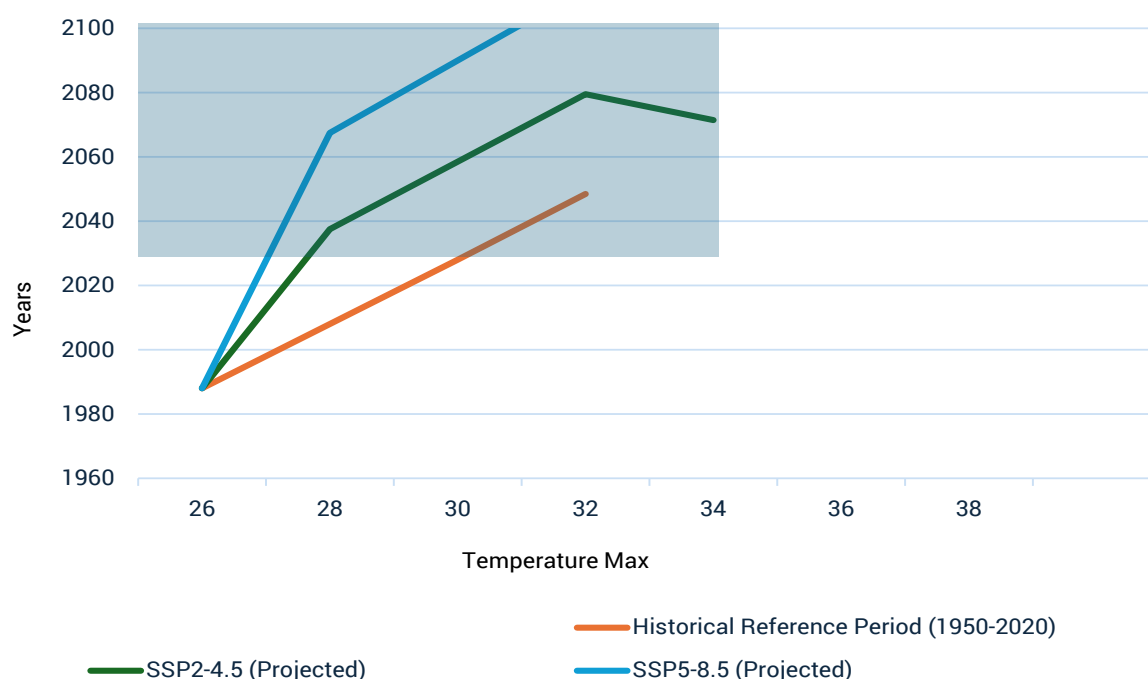


Figure 4. Projected Average Mean Surface Air Temperature Blue Nile, Sudan; (Ref. Period: 1995-2014), Multi-Model Ensemble. Data source: World Bank Group Climate Change Knowledge Platform. CRU Observed for historical data, and CMIP6 for projection data, 2022.

Under the SSP5-8.5 scenario, which represents a high-emission future trajectory, the Blue Nile State of Sudan also faces profound impacts in terms of the number of hot days ($T_{max} > 35^{\circ}\text{C}$). Historical data from 1950 to 2014 shows a median number of hot days of approximately 171

per year. However, projections for 2100 under SSP5-8.5 suggest a substantial increase in the median duration to around 300.05 days, with a wider variability spanning from 221.52 to 343.30 days (Figure 5).

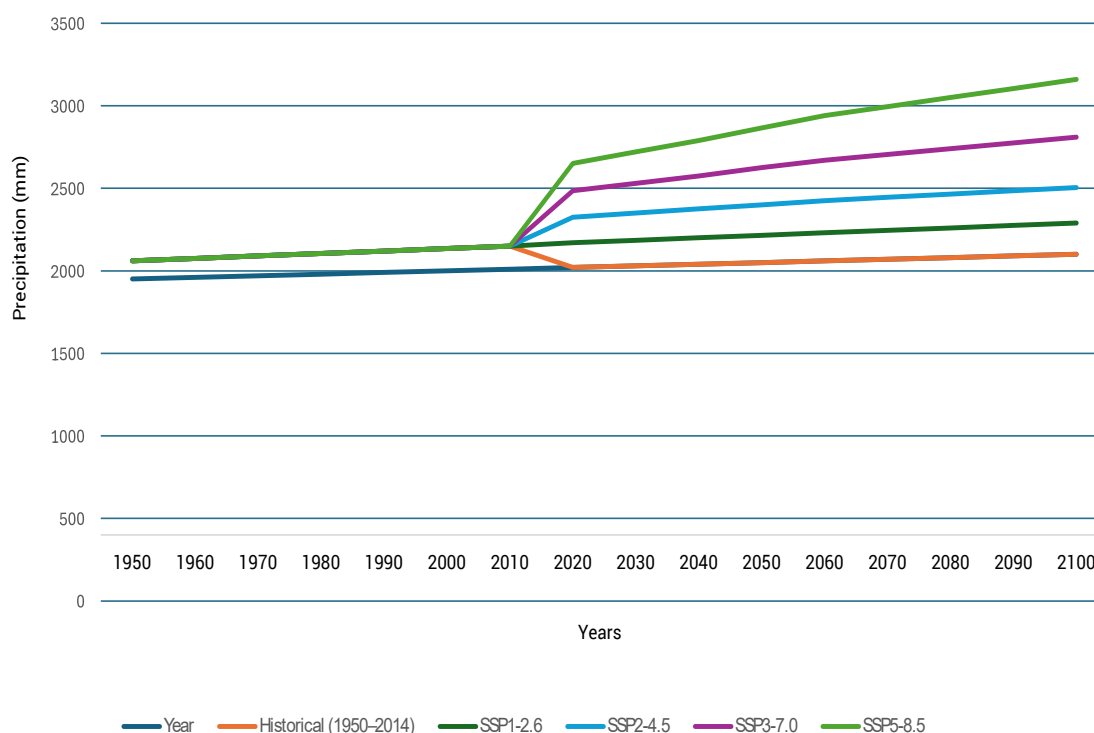


Figure 5. Projected Number of Hot Days ($T_{max} > 35^{\circ}\text{C}$) Blue Nile, Sudan; (Ref. Period: 1995-2014), Multi-Model Ensemble. Data source: World Bank (2024) Climate change Knowledge Portal.

These changes indicate a significant shift towards more extended and more uncertain periods of extreme heat, with potential implications for agriculture, water resources, public health, and infrastructure in the region. The shifts in temperature could exacerbate water scarcity, impacting agriculture and food production while posing risks to public health, particularly for vulnerable populations. Moreover, changes in temperature regimes may disrupt ecosystems, alter precipitation patterns, and increase the frequency and severity of extreme weather events like droughts and floods (IPCC, 2022).

3.2.2. Precipitation

Blue Nile State receives on average four times the volume of rainfall as that of the rest of Sudan. However, the volume of rainfall differs somewhat across Blue Nile, with south and eastern parts of the state experiencing more rainfall on average. This is illustrated in the map below (see Figure 6), which shows the average rainfall across the state from 1980 to 2014. The darker grey color indicates greater annual precipitation while the lighter grey colors indicate less.

The average annual rainfall in Blue Nile State is about 800 mm per year, with heavier rainfall in Kurmuk, averaging nearly 975 millimeters annually. Data from the Sudan Ministry of Irrigation

and Water resources indicates a steady rise in annual mean precipitation in Blue Nile State between 2000 and 2022 (see Figure 7). This increased precipitation trend is characterized by high variability over the years, as illustrated in the low levels of rain in 2002 and 2011, and the high volumes in the years 2008 and 2014.

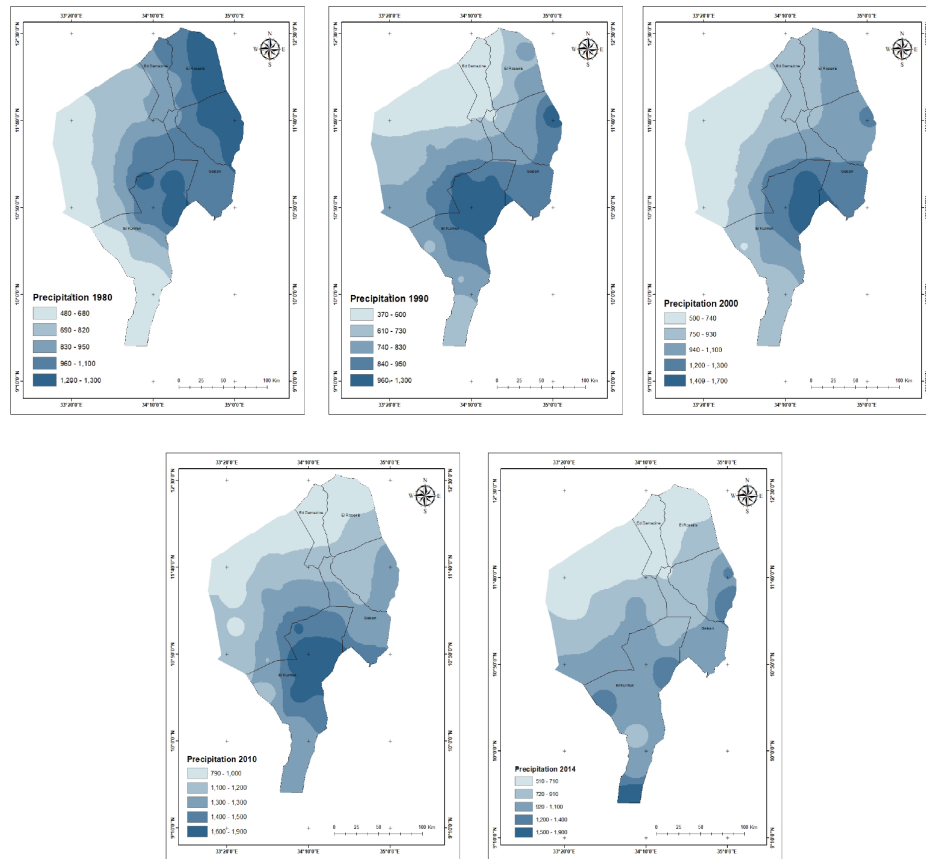


Figure 6. Mean precipitation in Blue Nile State (1980 to 2014).
Data source : Sudan Meteorological Authority.

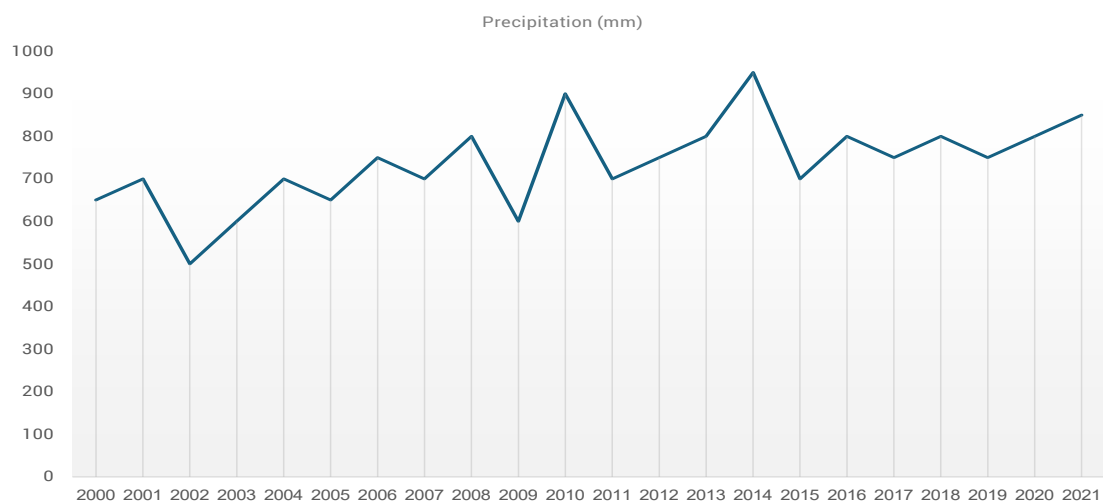


Figure7. Annual mean precipitation (mm) in Blue Nile State from 2000 to 2021. Data source: Sudan Ministry of Irrigation and Water Resources, Meteorological Authority, Computer Center, 2022.

Global data sets allow a longer-term analysis of precipitation trends in Blue Nile State. When assessing data as far back as 1901, it is possible to observe that the increase in annual mean precipitation is a recent phenomenon, only observed between 1980 and 2022. In contrast, earlier records from 1901 to 1980 show a more constant trend. While precipitation data shows no clear trend regarding changes in total amounts of rainfall per year, there is an apparent increase in precipitation variability, with more extreme changes in interannual mean precipitation visible from year to year in both the Sudan Ministry of Irrigation and Water Resources and World Bank data (see figure 8).

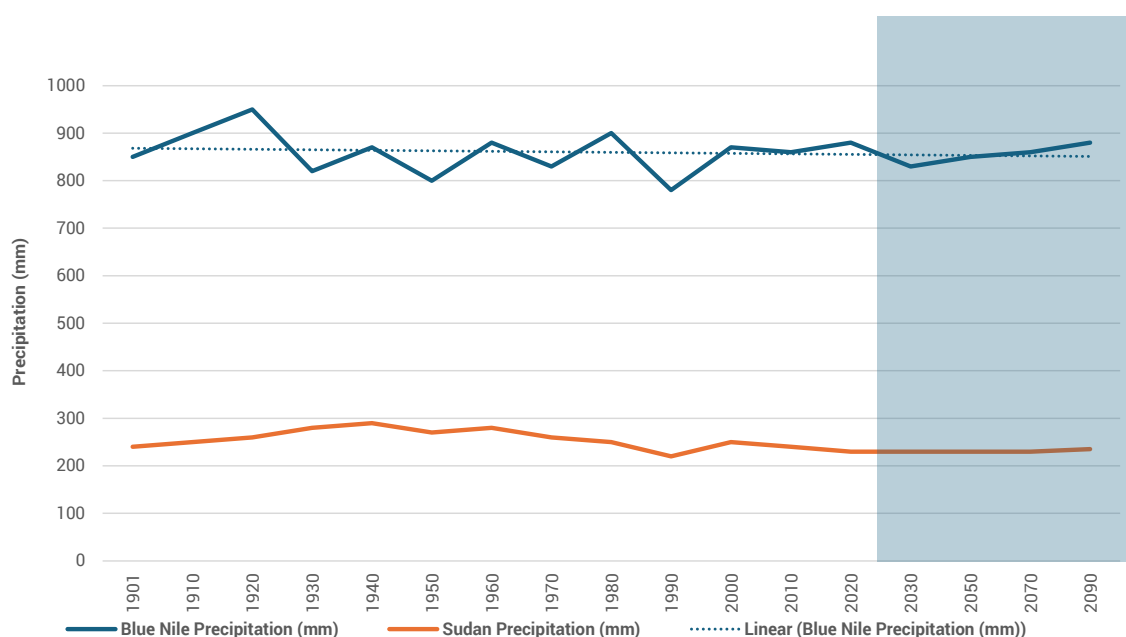


Figure 8. Annual mean precipitation (mm) in Blue Nile State (blue line) and Sudan (orange line), showing historical precipitation data averaged annually (from 1901 to 2021) and projections under SSP2-4.5 (from 2022 to 2099, showcased in light blue background). Data source: World Bank Group Climate Change Knowledge Platform. CRU Observed for historical data, and CMIP6 for projection data

3.2.3. Flood risks

The Blue Nile State is grappling with two significant climatic hazards: drought and extreme flooding. As temperatures rise due to climate change, the atmosphere can hold more moisture, leading to more intense rainfall events. A key variable for flood risks are anomalies in the projected precipitation during wet days. Based on historical and projected data about the projected precipitation amount during wet days anomalies 1951 to 2100 under RCP 4.5 and RCP 8.5 scenarios, it has been determined that the amount of rainfall during the wettest days in the rainy season is expected to increase.³ As an illustration, the historical data of precipitation amounts on wet days (1986-2005) indicates a median precipitation of 154.23 mm, ranging between 53.01 and 346.58 mm. In contrast, the RCP 2.6 scenario for 2060 projects a higher median precipitation of 226.09 mm, indicating an increase compared to historical data. The range extends from 85.91 to 367.62 mm, suggesting a wider spread of possible precipitation amounts compared to the historical period. For the same year under the RCP 4.5 scenario, the

median rainfall amount is predicted to be 222.56 mm, with a range of 70.57 to 447.13 mm. For RCP 8.5, the median rainfall amount is expected to be 276.52 mm, with a range of 90.64 to 508.69 mm (figure 9).

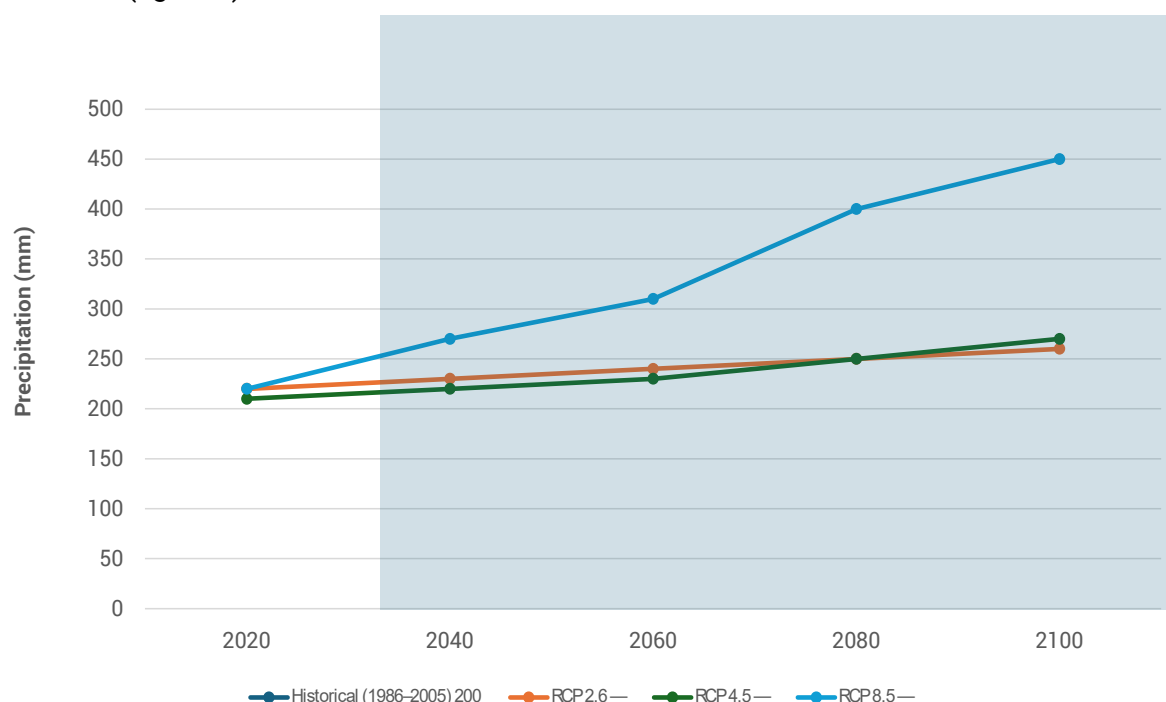


Figure 9. Projected Precipitation amount during wettest days. Blue Nile, Sudan; (Ref. Period: 1986-2005), Multi-Model Ensemble. Data source: World Bank Group Climate Change Knowledge Platform.

Overall, all scenarios present a notable increase in both the median precipitation and the range of possible values compared to historical data, indicating a potential trend towards more intense precipitation events and shorter rainfall seasons in the future. This increase in rainfall during the wettest days of the rainy season suggests that flood risks driven by climate change may also increase. Prolonged periods of rainfall or persistent storms can exacerbate flooding by saturating soils and overwhelming drainage systems. The rise in rainfall during the wet season suggests an increased likelihood of sudden floods, while reduced runoff during the dry season exacerbates the already critical water shortage needed for irrigation (IPCC 2022). Additionally, with lack of adequate infrastructure and dependency on dirt roads for trade and transportation such as the Dinder road, increased and prolonged rainfall periods result in a shutdown of these services, leading to intensified food insecurity as seen during the last rainy season as of December 2024.

This holds for the riverine areas around the Blue Nile State characterized by flat low-lying terrain. Blue Nile localities such as Geisan, Baw and Al Kurmuk already experience regular flooding, posing a threat to infrastructure and accelerating the transmission of waterborne diseases like malaria (Republic of the Sudan, 2016). However, Blue Nile state cannot be seen detached from the Blue Nile watershed when evaluating the flood risks and data for the whole Blue Nile Basin suggest even higher rainfall variabilities. Since the Blue Nile originates in Ethiopia any extreme events will directly impact the Blue Nile region in Sudan (Rettie et al., 2023). In addition, the

3 Calculations are presented as per the precipitation range between the driest and the wettest year over the period. Changes in wet and dry patterns have an impact on rain-fed agriculture, crop productivity, and food security See: <https://www.nature.com/articles/s41598-023-441155>

effects of filling and operating upstream dams like the GERD on downstream water flows to Sudan and Egypt may worsen due to climate fluctuations, especially during drought years (Tedla et al., 2022) (see box 2).

Box 2. The impacts of climate change and GERD on the Blue Nile

The Blue Nile, originating in Ethiopia and flowing through Sudan before joining the White Nile, plays a crucial role in the Nile River system. With an annual flow of about 50 billion cubic meters, it contributes significantly to the water resources of downstream countries, particularly Egypt and Sudan (Nile Basin Initiative, 2021). The Blue Nile State in particular, relies heavily on the Nile for its agricultural sector. Ecosystem degradation due to unsustainable use and climate change-induced negative impacts, such as droughts and floods, have affected the basin's hydrological characteristics and water availability, altering the dynamics of water flow and resource distribution (UNDRR, 2021). In 2011, Ethiopia began constructing the Grand Ethiopian Renaissance Dam (GERD) on the Blue Nile, primarily for hydropower generation, with a reservoir capacity of 74 billion cubic meters, potentially altering the Blue Nile flows for downstream communities (Modber et al., 2021).

The intertwining effects of GERD operations and climate change on Blue Nile flows need a comprehensive evaluation and implementation of adaptive strategies to manage water resources sustainably. So far, there are contrasting assessments regarding the impacts of climate change, such as droughts and floods, and the role of the GERD in exacerbating or regulating those dynamics. Some argue that climate change-induced droughts and reduced precipitation could worsen water scarcity downstream, especially during GERD filling and operation periods. Historical flow data spanning 105 years and simulations accounting for different initial water levels of the High Aswan Dam (HAD) reservoir in Egypt and various GERD operation scenarios have been analyzed, concluding that reduced precipitation due to climate change would further diminish Blue Nile flows exacerbating GERD's transboundary impacts (Zhang et al., 2015). A different study analyzed the effectiveness of the dam operation in moderate hydrological extreme event severity in the Upper Blue Nile Basin and found that the GERD can reduce flood and drought intensity by adjusting seasonal water release, providing a buffer against extreme events (Nile Basin Initiative 2021; Lazin et al. 2023)

Balancing the developmental aspirations of riparian countries with the imperative of safeguarding water security and adapting to climate change requires transparent dialogue, technically sound assessments, collaborative agreements, and effective management mechanisms to address the evolving dynamics of the Blue Nile Basin (Wheeler et al., 2018).

3.2.4. Drought risks

Blue Nile State is currently confronting a considerable challenge posed by escalating drought risks. Increasing temperatures elevate the demand for agricultural water, which boost irrigation needs contributing to greater reservoir losses heightening this risk. An uptick in drought occurrences, soaring temperatures and erratic rainfall patterns characterize this problematic trend (Kebede et al., 2019). The cumulative impact of these weather extremes poses significant

threats to the region's agricultural sector, water resources, and overall socio-economic stability. As droughts become more frequent and severe, the resilience of local communities is put to the test, exacerbating food insecurity, water scarcity, and environmental degradation (Republic of the Sudan, 2016).



Blue Nile State faces rising drought risks, threatening agriculture, water resources, and community resilience. Photo Credit © UNEP.

In Blue Nile State, Sudan, the past is a stark reminder of the region's vulnerability to droughts. The early 1980s saw prolonged dry spells that led to widespread crop failures and water shortages, also known as the 19884-85 famine (Teklu et al., 1992). Similarly, the late 1990s experienced reduced rainfall, exacerbating food insecurity and economic hardship. This drought brought crop failure, livestock, and pastureland loss (Zhang et al, 2012).

More recently, the early 2010s witnessed erratic rainfall patterns that resulted in diminished crop yields and heightened water stress (Ali et al, 2022). These historical drought events underscore the ongoing challenges faced by communities in adapting to climate extremes and highlight the urgent need for resilience-building efforts.

A concerning trend of frequent and severe dry spells marks the future of Blue Nile State. Climate models indicate shifts in rainfall patterns, with a higher likelihood of irregular precipitation distribution and prolonged dry periods scattered with intense rainfall events and rising temperatures, exacerbating the region's vulnerability to drought conditions (Republic of the Sudan, 2016). Such changes can further disrupt traditional agricultural practices, strain water resources, reduce soil moisture and increase the risk of crop failure and food insecurity. The implications of these projections extend beyond agriculture to encompass broader socio-economic and environmental impacts. Reduced water availability can hinder household water

access and disrupt livelihoods dependent on irrigation. Moreover, prolonged drought conditions can exacerbate land degradation, soil erosion, and desertification, posing long-term challenges to ecosystem health and biodiversity conservation (Tambel et al. 2014), and exacerbating root causes of conflicts over scarce resources.

3.2.5. Land cover/ land use

According to UNEP's Sudan's state of environment and outlook, the land in the Blue Nile State of Sudan shows a mix of different environments. Agricultural land covers a large area of 1,275,917 hectares, including areas that flood seasonally, making them suitable for farming. There are also forests and sparse woodlands covering 1,582,755 hectares, showing different levels of tree density. Shrubs cover 553,158 hectares and are spread out unevenly. Herbaceous communities cover 338,253 hectares, adding to the variety of plants and animals in the landscape. Urban areas cover 13,413 hectares and are influenced by population growth and movement. Some areas, totaling 16,248 hectares, consist of bare rocks, soils, and loose materials, showing the geological makeup of the land. Finally, there are water bodies covering 37,209 hectares, some temporary and some permanent, which support a diverse range of plants and animals and help keep the ecosystem healthy (UNEP, 2020).

Despite its increasing industrialization, the Blue Nile State of Sudan remains predominantly agrarian, facing mounting pressure on its land resources. This pressure arises from various factors, including population growth, expansion of arable farming and livestock numbers, and the booming petroleum and gold-mining industries, all against the backdrop of accelerating climate change.

As a result, competition for land has escalated, contributing to conflicts over its use (Osman et al, 2018) (also see chapter 4).

The Blue Nile State's arable land, which covers 8.2 million hectares, constitutes a mere 4.1 per cent of Sudan's total arable land. Notably, the region shares the ecologically significant Dinder National Park with Sennar and Gedaref states (see box 1). Established in 1935, this park encompasses wetlands linked to the seasonal Dinder stream, which originates from the Ethiopian highlands to the east. However, unplanned migration and unsustainable land use practices have encroached upon the park's boundaries, leading to the establishment of numerous villages in its vicinity (UNEP, 2020). The borders of the Dinder National Park were expanded three times over the course of past 50 years. Interview partners reported that the 2003 expansion had far-reaching implications on the stability of the region by subsuming large pieces of agricultural and grazing land within the borders of the park. This led to a shift in the pastoral migratory routes, forcing pastoralists to encroach on farmlands. Previously, pastoralists used to stay in the grazing land around the Dinder park during the rainy season and come down to the banks of the Blue Nile where farmers grow their crops during the harvest season. Both communities were benefitting from each other through this mechanism. However, with the changing weather patterns and the enlargement of the park, the encroachment resulted in an escalation of violence between the two communities.

Land cover change can be observed in Blue Nile in the last three decades. Satellite imagery comparing land cover from 1992 to that of 2020 shows an decrease in crop land and a increase in shrubland (Figure 10). Similarly, Figure 11 shows a increase of shrubland, decrease of cropland, and slight increase of tree cover. Although not detailed in the chart, there has also been a significant increase water areas in all state as observed in the comparison maps. Key Observations from 1992–2022 (details of comparison):

- **Crops decreased** significantly by 990.37 ha, suggesting possible land abandonment, urban expansion, or vegetation regrowth.
- **Shrub & Scrub** increased from 744.26 ha to 1467.32 ha, indicating natural vegetation regeneration or classification changes in sparsely vegetated areas.
- **Bare Land** expanded from 24.92 ha to 253.41 ha, which may reflect degradation or deforestation.
- **Tree Cover** increased modestly by 121.81 ha, possibly due to reforestation or improved classification accuracy in 2022.
- **Water bodies** grew from 13.95 ha to 58.5 ha, which may be due to seasonal variation or improved resolution.
- **Built-up areas** decreased slightly from 34.19 ha to 13.79 ha, which might be due to classification confusion with bare or shrubland.

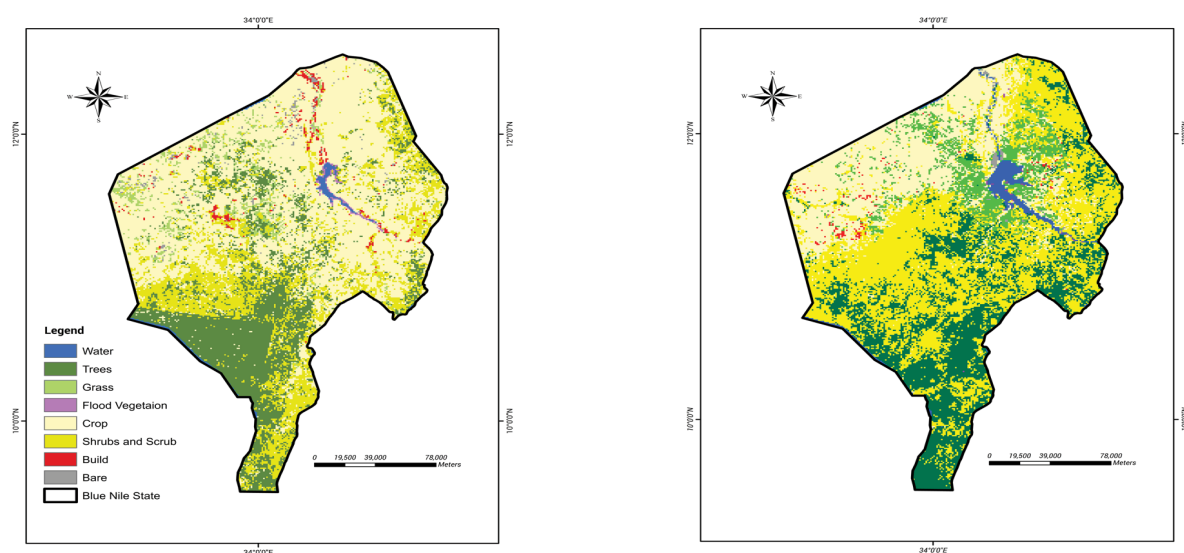


Figure 10. Land cover change in Blue Nile State in 1992 (left) and 2022 (right). The images depict an increase of cropland (pale yellow) and decrease of shrubland (brown). Data Source: EPSG data processed by google earth engine supervised classification derived from Landsat 5.

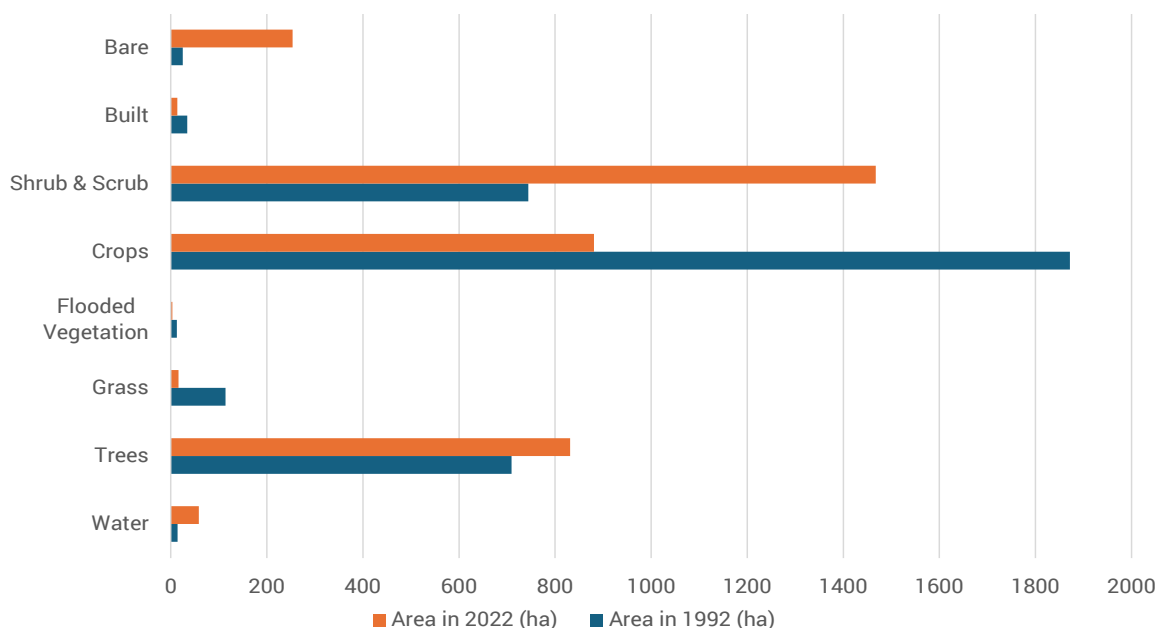


Figure 11. Land cover change in Blue Nile State from 1993 to 2020. Data Source: ESA Land Cover CCI v2.1.1, 2022.

Land cover and land use changes in the Blue Nile State present environmental risks, with deforestation identified as a significant concern in various localities. According to Sudan's land degradation report by the UNCCD, forest areas are being converted into shrubs, grasslands, and sparsely vegetated areas in hotspots like Ar Rusayris, Geisan, and Al Kurmuk due to deforestation. Similarly, unsustainable land use practices have led to declining productivity in forested areas in localities like the area between Ar Rusayris, Ed Damazine and Baw. Croplands also show declining productivity due to over-cultivation and lack of technology in areas like At Tadamon and Ar Rusayris. Additionally, shrubs, grasslands, and sparsely vegetated areas are experiencing declining productivity due to overgrazing (Republic of Sudan et al, 2018).

Land cover change to gold mining has also created negative impacts, particularly in the southern part of the Blue Nile State. Despite its economic significance, the industry lacks adequate regulation, resulting in widespread environmental degradation. Mining activities have transformed vast areas of pastoral and agricultural lands into mining sites, leading to deforestation, soil erosion, and water pollution. Additionally, artisanal mining, which often utilises mercury, poses significant environmental risks, further exacerbating land degradation and pollution (UNEP, 2020).

Efforts to address these issues include forest conservation and reforestation projects covering 66 square kilometres of degraded forests in the state (Republic of Sudan et al, 2018). However, overall land cover and land use changes in the Blue Nile State pose significant environmental risks, including deforestation, soil erosion, and water contamination, with broader implications for agriculture, livelihoods, and regional conflict dynamics.

3.2.6. Impacts of climate change, environmental degradation and conflict on livelihoods



Blue Nile State faces severe land degradation, threatening forests, biodiversity, and agricultural sustainability. Photo Credit © UNEP.

The Blue Nile state has favorable climatic conditions that support a thriving agriculture and forestry sector. This includes pastoralism and the cultivation of various crops like sorghum, corn, cotton, groundnuts, sunflower, guar, gum Arabic, and legumes. However, the combined impacts of environmental degradation, climate change, and conflict have wide-ranging impacts on livelihoods across the state.

Two land degradation hotspots of Sudan are in the Blue Nile State, particularly regarding loss on forest and shrubs, signaling a concerning trend towards ecosystem deterioration (Osman et al, 2018). Environmental degradation and desertification have become a serious challenge as arable land

is transformed into barren landscapes, diminishing the land's capacity for sustainable agricultural production and affecting rural livelihoods. Additionally, the deterioration of natural resources, including water bodies, loss of biodiversity and vegetation cover, exacerbates land degradation, undermining ecosystem resilience to the impacts of climate change on livelihoods (UNEP, 2020).

According to Sudan's National Adaptation Plan (NAP) rainfed farming and livestock grazing will be negatively impacted in the Blue Nile state by climate change. Particularly, Ed Damazine,

Ar Rusayris, and At Tadamon localities are presented as highly vulnerable to the impacts of climate change (Republic of the Sudan, 2016). Combined data of climate trends and community perceptions reveals profound implications for agricultural and pastoral livelihoods (Abdelgafaar et al, 2018). The effects of drought, unpredictable rainfall variability and unsustainable land use are already affecting agricultural cultivation, particularly on water-intensive and drought-sensitive crops like cotton (FAO, 2022). Furthermore, Blue Nile inhabitants note a significant reduction in animal products, notably milk, coupled with a decline in the number of livestock per household due to deteriorating rangelands and the scarcity of water sources for animal consumption (Abdelgafaar et al, 2018).

Climate change impacts have also affected migration patterns and livelihoods. For example, traditional southward migrations are increasingly disrupted as the rainfall season is becoming shorter. An overwhelming 90 per cent of surveyed participants (n=100) attribute alterations in their migration patterns to climate change, claiming that it has shortened their stay in the South. This disruption to established migration patterns has adverse implications for pastoral livelihoods. The shift in migration pattern is primarily linked to the progressively truncated duration of the rainy season, which, according to community discussions, has become increasingly variable in its onset and cessation, rendering it less reliable for pastoral and agricultural activities (Abdelgafaar et al, 2018). Furthermore, many individuals within pastoral communities affected by climate change have been compelled to migrate to urban centers (Abdelgafaar et al, 2018).

Additionally, the region has witnessed pests, further exacerbating crop yield losses and resulting in diminished harvests (Sax et al, 2023).

The irregular rainfall and shortages of essential agricultural resources such as farm machinery, credit capital, and appropriate crop varieties have contributed to a notable decline in national cereal production. In 2021, cereal output plummeted to 30 per cent below the average of the preceding five years, highlighting the profound challenges faced by farmers in accessing pest control measures, improved seeds, and efficient irrigation systems (FAO, 2022).

Together these challenges jeopardize livelihoods and food security exacerbating famine risks as communities struggle to meet their nutritional needs amidst climatic hazards. Furthermore, the interaction between environmental factors, dominant patriarchal norms, and gender-biased behaviors results in an unequal distribution of adverse outcomes, disproportionately affecting women, as they do not have the power to decide on their livelihood strategies and rely heavily on natural resources availability (Yahya et al, 2021). Due to these intersecting factors, women bear a more significant burden from environmental degradation (UNDP, 2012).

At the same time, previous and ongoing conflicts in the Blue Nile State of Sudan have taken a devastating toll on the region's communities. The ongoing violence has caused extensive damage to livelihoods, resulting in severe socio-economic difficulties for residents in the regions most impacted by conflict and displacement in recent years, namely, Ed Damazine town and Ar Rusayris, Wad Al Mahi and Geisan localities (Mercy Corps, 2024). Agricultural activities have been disrupted, making it difficult for farmers to cultivate crops and leading to poor harvests.

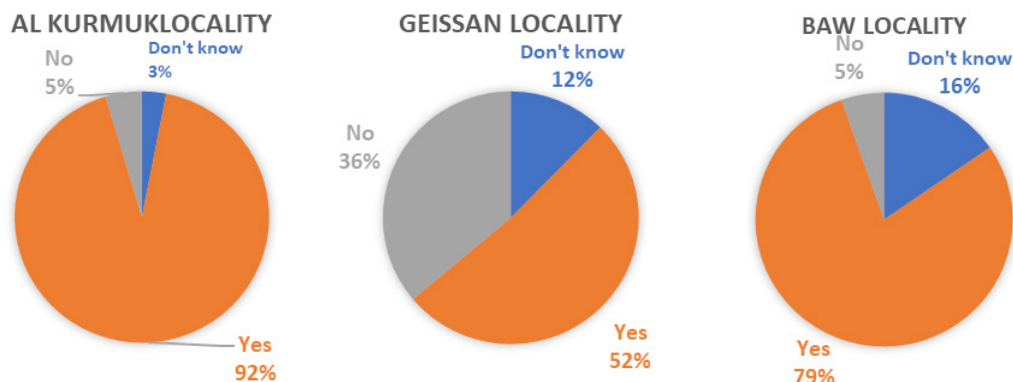


Figure 12. Community perceptions of change to agricultural productivity in the last decade. Data Source: Household survey conducted for the project baseline, February 2022.

Across the state, smallholder farmers reported declining crop productivity. In household surveys in Al Kurmuk, Geissan and Baw localities, a great majority of respondents perceived agricultural productivity to have changed in the last decade (see Figure 12). Community members ascribed such changes to increasingly erratic rainfall in Baw and Al Kurmuk, pest infestation in Geissan and Al Kurmuk, or some combination of these and other factors including high production costs, lack of agricultural inputs, and limited availability of modern machinery.⁴

These perceptions show how conflict has significantly disrupted livelihoods and markets in Blue Nile and its neighboring areas. Additionally, economic difficulties have posed challenges in securing housing, leading to a stagnation in the market's cash flow. This dire situation has resulted in depleted food reserves and widespread food insecurity among the population. Many families are facing hardships in affording food and urgently require humanitarian aid (UNHCR, 2024).

Currently, the inflow of IDPs from other regions is another challenge: Between April 2023 and December of 2024, around 336,000 people have arrived in Blue Nile State (IOM, 2024). The displaced individuals rely on support from host communities and international humanitarian agencies for food provision, yet they are encountering inflated prices of food items in the market and the risk of Famine is extremely high. Evidence collected through interviews and discussions

Box 3. Key Insight: The effects of conflict on migration and livelihoods

“When the war came and people were forced to migrate to secure areas, many habits and livelihood patterns changed. For example, people cut trees for firewood and charcoal to sell in Damazine market, Ar Rusayris, and the neighboring areas. Wage labor during the agricultural season [on commercial farms] increased. People also resorted to picking forest fruits, such as dom, baobab and lalope and selling them in the markets. Many young people also joined the armed forces.

Mayor of Greater Maqnazza in Baw

⁴ Household survey conducted for the project baseline, February 2022.

4. Climate-security pathways

with community members, government officials, and other key stakeholders indicate that climate change impacts and environmental stress are compounding risks to insecurity. At the same time, insecurity and conflict are decreasing the available options to adapt to climate change and – in some cases – leading communities in Blue Nile to adopt practices that further degrade the environment they depend on.

This section describes four key pathways for how climate change, environmental degradation and peace and security currently interact, and presents analysis on how they might interact in the future. It also highlights the current risk landscape for climate and security outcomes. The analysis was conducted using qualitative data on community perceptions of how climate change and environmental degradation are impacting human security.

Several important factors should be considered while reading this section. First, while the pathways are described as separate for the purpose of understanding specific interactions and identifying entry points for response, they are in fact intimately connected. Where possible, linkages between pathways have been described in the narrative text. Second, these pathways are not exhaustive. Rather, they represent a descriptive set of interactions identified through a defined dataset collected in specific regions. Finally, coping capacity, resilience, and peace can never be attributed to a single factor. These pathways should be considered within the broader environmental, political, economic, and social context.

Pathway 1. Climate change and conflict are contributing to livelihood insecurity, maladaptation, and negative coping mechanisms

Climate change impacts and conflict are both contributing to livelihood insecurity, maladaptation and negative coping mechanisms across Blue Nile State. These changes threaten to create negative feedback loops that further undermine the resilience of local communities, and they contribute to other security-relevant challenges such as mining, migration and the increasing competition over natural resources.

Like elsewhere in Sudan, communities in Blue Nile State rely on the region's rich natural resource-base to support their livelihoods. The three primary livelihoods are agriculture, agro-pastoralism, and pastoralism. Other livelihoods include the collection of forest products, as well as mining for gold and chrome (see box 4).

As outlined in chapter 3.2.6, climate change impacts, environmental degradation and conflict are all having significant impacts on livelihoods in Blue Nile State, in particular natural resource-based livelihoods leading many communities to alter their ways of life.

In general, conflict- and environmentally-driven livelihood insecurity is decreasing incomes and the resilience of communities in particularly women. For example, accessibility to remote villages is also limited both by conflict and a history of under development in Blue Nile that has left much of the state with unpaved roads. During the rainy season, remote villages in Geisan and Al Kurmuk localities are extremely difficult to access. It can thus be challenging for communities

Box 4. Natural resource-based livelihoods in Blue Nile State

Agriculture is the primary livelihood for most communities in Blue Nile. Farmers produce sorghum, sesame, and cowpeas, with some variation between localities. For instance, in Geisan, community members also produce vegetables, such as tomatoes and watermelons that grow along the bank of the Blue Nile. In Baw locality, the key crops are sunflower and groundnuts, and in Al Kurmuk, maize and groundnuts.

While women and men both participate in agriculture, their roles differ. Women's roles tend to be restricted to subsistence farming in close proximity to their homes. This includes small plots of land or gardens attached to their homes, where they grow vegetables for household consumption. Men tend to cultivate cash crops, such as sesame and sorghum, on plots further from their villages. In Baw locality, for example, women are actively engaged in the cultivation of groundnuts and cowpeas, while men grow sorghum, sesame and sunflower.

Community members also work as day laborers in large agriculture schemes. According to one interviewee, agricultural schemes provide an income source for those who do not have their own land or whose land is inaccessible, including women and internally displaced populations.

Pastoralism is practiced primarily by members of the Falata Umbroro communities and members of the Rufa'a and Kennana tribes. Several traditional migratory routes extend across Blue Nile, allowing nomadic pastoralists to move south during the rainy season and north during the dryer months. In recent years, however, traditionally nomadic groups have become increasingly settled, especially in Baw locality, due to the shrinking availability of land, regional insecurity, and other factors that limit safe movement. Settled or partially settled groups often practice agro-pastoralism, a mix of agriculture and livestock rearing.

Across Blue Nile, mining for critical minerals, namely gold and chromite, is also an important livelihood for communities. Chrome mining is common in Baw locality, particularly among women, and traditional gold mining is commonly practiced by women in Geisan locality, as well as in Kurmuk. Gold mining is an important source of income for men as well. Artisanal and small-scale mining has increased among men in recent years, in step with the growing use of cyanide and mercury, which are known to cause severe health complications for women, and particularly for pregnant women – deterring many women from engaging in mining activities.

who practice agriculture or horticulture to transport their crops to the local markets. This has highly gendered impacts: usually, women prefer to market their crops within the community but will travel further when local supplies are disrupted. However, fragile security situations

discourage women from traveling long distances to market their crops, leading them to sell their produce through male family members and/or mediators. This has depletive implications on the income they gain from selling crops, as they are often exploited and receive lower than market prices. Despite most crops being relatively durable in nature and storable until roads and markets become accessible, insecurity means that women favor immediate financial returns – even if they are lower than those they might achieve by holding on to supplies and selling in the future.

Livelihood insecurity also pushes both men and women to search for alternative work to supplement low incomes. Alternatives include charcoal-making and firewood collection, particularly among women, working as day laborers on large agricultural schemes among men, and greater reliance on small-scale mining activities for women and men.⁵ Interview partners shared that as of December 2024, the ongoing conflict and the intense drought forced people to encroach upon each other's land, engaging in harmful activities such as deforestation and forest destruction to produce charcoal for income. In the south, especially in Al Kurmuk, deforestation is starkly evident, particularly when crossing into Ethiopia, where the forest cover is noticeably thinner. The ongoing conflict has accelerated the destruction. With many officials unpaid, cutting down trees has become an easy way to make ends meet. The timber is often converted into charcoal, a crucial source of energy and electricity as gas supplies have been disrupted. The RSF and other groups have attempted to control charcoal production, introducing new dynamics of environmental crime and warfare economy. This situation creates a vicious cycle of ecosystem degradation, reducing resilience to climate change impacts like droughts and floods due to the loss of forest cover and land degradation.

In the Gedaref region, similar harmful practices were present as a result of exploitation and corruption. Interview partners shared that investors who are often equipped to take up to 1000 feddan of land under regulations of forestry restoration and agricultural projects, end up clearing the fields and producing charcoal for trade with limited to no attention to harmful environmental impacts. They often leave the cleared land without restoration in the absence of effective monitoring mechanisms.

While such practices play a role in meeting immediate income generation or livelihood needs, they also entail significant negative impacts on local ecosystems that ultimately undermine community resilience in the face of increasingly extreme climate conditions. Similarly, gold mining is a widespread source of income (see box 5) with devastating impacts on the environment and a driver of conflict.

Box 5. Key insight: Widespread goldmining

77 per cent of respondents to a household survey reported practicing gold mining in Geisan locality.

5 Household survey conducted for project baseline, February 2022.

These resources contribute to financing operations of various armed groups, perpetuating a vicious cycle of conflict and resource exploitation. This lawless situation leads to unequal control, exploitation, and overuse of natural resources, further fueling the conflict itself (UNEP, 2022).

Recently, due to the impacts of climate change and the ongoing conflict, gold mining has emerged as a maladaptive response. This has intensified existing tensions and dynamics within the gold mining sector. Both the conflict and climate change have exacerbated these mining activities. As agricultural activities declined, many turned to mining, which further heightened tensions. Additionally, the area has become a host community for displaced populations, adding to the strain. Interview partners reported that artisanal mining is often practiced by women on a small-scale and in a non-regulated manner. While women and children are involved in the mining process itself, the managers of mining sites are usually men. Mechanized, large-scale gold mining by big companies is also growing in the Blue Nile state, which has a detrimental effect on the land and soil and creates tensions between the Popular movements and the mining companies when both want to pursue their mining activities at the same sites. One interview participant indicated that if it wasn't for climate change, people wouldn't have resorted to negative coping strategies such as mining.

The primary cause of this damage is the use of mercury and cyanide in the purification process. This practice has caused harm to human health and led to severe ecological degradation. Pollution levels are of concern in various locations, including agricultural, residential, and tailings sites, as well as groundwater sources and Nile tap water. Mercury analysis has indicated extreme contamination in tailings-affected areas. Inhalation of mercury vapor is a primary exposure route, which is particularly worrying for vulnerable groups like children (Davis et al, 2007). The Jam area is particularly affected, as residents are exposed to high levels of chromium. This exposure pathway may have multiple sources, including contamination of drinking water, ingestion of chromium-enriched food, and the inhalation of dust and fumes from chromium mineralization activities (Ali et al, 2014).

Environmental challenges, climate change impacts and conflict are also changing migration patterns. As outlined in chapter 3.2.6. pastoralists who have historically migrated southwards during the dry season in search of water and grazing land, have changed their traditional movement patterns due to climate change. These changes are primarily attributed to the increasingly shortened duration of the rainy season, which directly impacts the sustenance of pastoral livelihoods. These changes can contribute to conflicts around natural resources (for a more detailed discussion see pathway 2).

At the same time, the conflict has forced others whose livelihoods rely on secure movement to adopt more sedentary activities. In a focus group discussion, government officials described that livelihood practices requiring movement through insecure areas, such as pastoralism, have been declining as people increasingly abandon a nomadic way of life and settle in more secure locations where grazing and water are available.⁶ In Geisan locality, for example, one farmer

6 Blue Nile UNEP/ UNITAMS report.

reported that he used to practice trade, but that war forced him to adopt farming as movement became too dangerous.⁷

Both climate affected communities and those displaced by conflict facing livelihood related challenges can also contribute to environmental degradation in particular deforestation around settlements. Often these populations resort to trading forest products such as firewood and charcoal, leading to deforestation of natural habitats. The consequences are evident in transforming once lush ecosystems like the Elnour natural forest reserve into fragmented and degraded patches of barren land (Osman et al, 2018).

Pathway 2. Climate change and conflict are contributing to competition over natural resources

Competition over access to, use, and control of natural resources is increasing across Blue Nile State. This is driven by a number of factors including displacement and conflict, mining, mechanized farming, land use policies, environmental degradation and climate change impacts which are all contributing to increased conflicts over natural resources, issues that already sit at the heart of conflict dynamics in Blue Nile.

Conflicts between pastoralists and farmers are a particular challenge. Conflicts typically break out when animals graze on cultivated land or when farmers cultivate on pastureland or traditional migratory routes. As outlined in chapter 3.2.6 climate change and environmental degradation are affecting and changing pastoralist migration patterns. Additionally, other factors such as drought, desertification, the establishment of nature reserves, civil unrest, and South Sudan's secession have contributed to altering traditional animal grazing routes (Ali et al, 2019). These changes in migration patterns exacerbate conflicts over natural resources in regions where pastoralists move through (Sulieman et al, 2013).

In addition to conflicts between pastoralists and small-scale farmers, conflicts also occur with large-scale operations and companies (Sax et al, 2023). In fact, large-scale agricultural operations are encroaching upon pastoralists' traditional migratory paths, severely limiting their freedom of movement (Sulieman et al, 2017). The deliberate efforts of these large-scale farmers to prevent livestock from accessing their land, often through fences and other barriers, further contribute to the conflict, leaving the pastoralists feeling trapped and marginalized (Sulieman et al, 2013).

The conflict between farmers and herders – and the destruction of resources, crops, animals, and property that results – also has gendered aspects as it imposes additional burdens on women, forcing them to adopt new subsistence strategies to sustain their families. As women are usually not involved in conflict resolution processes, reconciliation between the conflicting parties often includes financial compensation for only men. Further, incidences of sexual and gender-based violence associated with the original dispute or subsequent clashes typically accentuate and prolong gendered experiences of injustice, which, as a result, worsens conflict dynamics.

In some localities, competition over water and land resources also occurs between communities

7 Interview with community member in Geisan locality, conducted by UNEP/UN Women/ UNDP, 2022.

pursuing the same livelihoods. For example, in a focus group discussion with women from Derang area in Baw locality, women described the escalation of tensions over the limited supply of water. With only two out of four hand pumps functioning, the community reported that “the handpump is a constant source of dispute”. During the dry season, when the Hafeer is dry, some women reported sleeping near the hand pump to be the first in line to fetch water in the morning hours.⁸ Competition is also increasing over forest resources used both for household consumption and income-generating activities.

Further, pressures on natural resources in Blue Nile are exacerbated by conflict in the broader region that is displacing growing numbers of vulnerable people. In Al Kurmuk, community members noted that the arrival of displaced populations from other localities, combined with the arrival of populations from Ethiopia, had put pressure on local water resources. Other services are struggling to cope, too, with health workers in Geisan locality noting that they “do not have the capacity to manage the population influx” of people arriving from Ethiopia.

The latest developments of the RSF – SAF conflict have made climate and conflict dynamics much harder on livelihood security. At Tadamon locality, situated in the western part of the Blue Nile, is a crucial agricultural hub for both the Blue Nile and other Sudanese states. However, ongoing clashes between the Sudanese Armed Forces (SAF) and the Rapid Support Forces (RSF) have brought agriculture and pastoralism to a halt, severely impacting food security. Farmers attempting to work their land have been driven away by troops, seeking refuge in Ed Damazine and its surrounding areas. Internally displaced persons (IDPs), having lost their economic activities, now rely heavily on humanitarian aid with no alternative sources of income or livelihood options. This influx of IDPs from Khartoum, Aj Jazirah, and Sennar states has intensified competition for basic services within host communities. According to an expert interviewed, the conflict in the western part of the Blue Nile further strains Ed Damazine, a small area ill-equipped to accommodate the growing number of displaced individuals, exacerbating pressure on already limited resources.

Despite possessing skills and experience, livelihood opportunities are scarce for displaced population groups. The economic crises caused by the conflict have further worsened conditions, with limited access to essential resources and services, pushing many households deeper into poverty (OCHA, 2024). The constant threat of violence and displacement has disrupted social structures and shattered community cohesion, amplifying the psychological and emotional toll on individuals and families. These impacts extend far beyond the battlefield, affecting every aspect of daily life and threatening the very fabric of society.

The combination of conflict and climate change has devastated the agricultural season. RSF’s looting of the agricultural bank left farmers without essential seeds, and road closures turned the area into an isolated conflict zone.

Fuel shortages have worsened, exacerbated by airstrikes on fuel stations. Additionally, climate change has caused floods and inundations in the Blue Nile, a tropical region, further damaging

8 FGD with women from Derang village, Baw locality.

agricultural lands.

For women farmers, losing their income makes it even harder to secure loans. Banks often view women as less reliable borrowers than men, largely because women typically have less economic access, fewer savings and less gold. Without collateral, these women face significant barriers in pursuing their own projects. Alternatively, women resorted to Jibraka harvesting – small piece of land surrounding their houses that is used for agriculture, to satisfy their families' needs and sell the excess in farmers' markets for cash.

During the harvest season, many women travel long distances to work on farms, harvesting crops like maize and cotton. For instance, they travel from Ar Rusayris to Wad Al Mahi and stay in camps known as Jongo, set up near the fields, for months at a time. These conditions often fail to provide a safe environment for women or protect them from violence. In urban areas, women frequently engage in informal work, such as selling tea, living day-to-day without assurances of safety or financial stability.

Furthermore, when the RSF entered the Blue Nile, their actions led to significant biodiversity loss by destroying numerous wildlife species. Similarly, the government's restriction over natural resources have created unintended consequences further constraining livelihoods and increasing tension over access to natural resources. For example, women, who previously cultivated and sold decorative flowers for income, saw their livelihoods disrupted when the local government sold the land to shop owners, halting flower production. In Al Kurmuk, what was once a forest rich with diverse and rare tree species has been transformed into a barren landscape. This change occurred as governmental bodies cut down trees, such as those used for producing Gum Arabic, without formalisation, standardisation, or transparency.

Several committees and local mechanisms exist to support conflict prevention and resolution regarding these matters. In Geisan locality, for example, these include the market committee, crop damage committee, school committee, and village committee.⁹ In Baw, traditional committees include the crop damage committee and a conflict resolution committee. However, in a conflict context where traditional governance and mediation structures are not functioning optimally – or are being undermined by the wider political conflict – there is a risk that competition over natural resources remain unresolved and escalate into conflict. Furthermore, whilst community members across localities stressed the importance of women's involvement in decision-making processes, this appears to have some limitations in practice. For example many male respondents described women's participation as only relevant when discussing "women's issues" such as women's specific roles or women's health.¹⁰ Others described women's roles as ideally limited to "awareness raising."¹¹

Encouragingly, in some cases male community leaders described the need to provide education for women to enable participation in such structures,¹² but women generally described their own

9 Interview with community leader, Deim Saad village, Geisan locality; male, 63 years old.

10 For example, interview with community leader from Geissan locality, male, 63 years old.

11 Community leader in Geissan locality, male, 45.

12 A male Sheik from Al Kurmuk locality noted that education for women is more frequently requested to support their effective participation in community issues such as natural resources management, conflict resolution and SGBV.

roles in decision-making and conflict resolution processes as extremely limited with regards to access to, use, and ownership of natural resources.

According to a women leader interviewed in December 2024, women play a crucial role in mediation and dialogue between conflicting parties. For example, women's collectives have met with militia leader El-Hilu to address the disproportionate impact of violence and displacement on women in the Blue Nile. Women fighters are also present in armed groups in the Blue Nile, many of whom returned after the Juba peace agreement, having left the city post-2011. Some women have joined the Sudanese Armed Forces (SAF). Many women in the region are involved as peacebuilders and mediators in both the ongoing conflict and local tribal disputes. During the 2021-2022 tribal war, women's collectives engaged directly with tribal sheikhs, demonstrating solidarity across Sudan. These women travel to conflict zones to negotiate a cease fire with the native administration and leaders of Hausa and Hamaj communities and advocate for women's rights amidst the conflict. Their efforts, including addressing the plight of displaced women unable to return home, have significantly contributed to ceasefire agreements and immediate medical attention to the injured people.

Pathway 3. Climate change and conflict increase the risk of sexual and gender-based violence

Evidence points to a concerning link between environmental degradation, insecurity, and the prevalence of sexual and gender-based violence (SGBV), particularly against women and girls. In interviews with community members, women reported experiencing gendered and sexual violence when carrying out their resource-related roles, including collection of firewood and water. As droughts become more common, places of residence, leaving women more vulnerable.

Box 6. Key Insight: Tokenistic female inclusion

"Women do not participate in conflict resolution and decision-making. When they do, it is decorative."

Community member, FGD in Derang village, Baw locality

In some cases, the prevalence of SGBV was also recognized by male interviewees. An interview with a male police officer in Geissan stated that he was involved with SGBV cases three to four times per week, closely linked to the collection of water and firewood far from women's homes.

In his interview, he cited a range of cases, including physical violence, sexual violence, psychological violence, and economic violence.¹³ Women in Al Kurmuk locality reported that they were also subject to different types of gender-based violence when carrying out their natural resource related roles, including agricultural and mining work.¹⁴

In Blue Nile, due to the conflict and growing presence of rebels and armed groups around many residential areas, women are often exposed to SGBV with little recourse to either prevent attacks

13 Interview with police officer, male, Geissan locality.

14 FGD with women in Al Kurmuk locality.

or seek redress. Across localities, community members, health workers and police officers described some integrated systems of reporting in which health workers examine a survivor of SGBV and provide medical care, and police investigate the accused crime. For example, a male health worker in Yara village in Geisan locality noted that “in cases of gender-based violence, the investigation is carried out by the police, and then the report is written by the health center and returned to the police.”¹⁴ However, according to many community members, SGBV takes place in an environment of impunity. Police centers in rural areas are rare, and where they are present, there is often very little capacity to manage and respond to reports of SGBV.

Box 7. Key Insight: Husbands must confirm an incidence of domestic SGBV before a wife is referred to the police

“I have never come across a rape case. However, in cases of physical violence perpetrated against women, such as cases of husbands beating women, the husband is requested to confirm the beating and then the wife is referred to the police to obtain Form 8, through which she can go out of the area to Damazine for treatment.”

Woman health worker from Baw locality

In Samsur village, Baw locality, for example, there is no police unit. Some cases of SGBV are managed by the Sheik, while more serious cases are referred to Damazine.¹⁵ A police officer from Derang village, Baw locality, also stated that he referred SGBV cases to other police services across Baw as the caseload in his department was too heavy.¹⁶ Additionally, analysis revealed that cases of SGBV often go underreported due to the perceived shame and stigma associated with such types of violence.¹⁷ Several community members and professionals described that where a reporting system does exist, it often fails to prioritize the rights of the survivor, and requires an admission from the accused to pursue an investigation. Difficulty in recognizing the perpetrators typically detracts the survivor’s family from reporting the case. And where investigations do take place, justice outcomes often fall short of SGBV victim needs – one police officer in Kurmuk, for example, described that a rape case was simply resolved by forcing the survivor to marry her perpetrator (see Box 8).

Box 8. Key Insight: The relationship between rape and early marriage

“Recently, there was a case when a young girl was taken by force and kept for three days during which she was raped. The case was resolved by the marriage between the victim and criminal.”

Police officer, Kurmuk, male

Box 9. Key Insight: Inadequate services to prevent and address incidences of SGBV

"There is no system in place to ensure that cases of gender-based violence receive the required legal advice, psychological support, and referral to the police. In a case of SGBV, I examine the victim and if it is difficult case, I turn to the Sheik and then to the police. The case is not referred to the doctor or psychological counselor. The most prominent challenges in managing cases of SGBV are the inability of the victim to express and communicate information, the difficulty of accessing treatment, the stigma associated with rape, and the lack of a means of transportation which means I, as a midwife, am forced to walk long distances to examine women."

Certified midwife, Geisan locality

It is important to note, however, that while many communities reported that SGBV is linked to wider societal gender inequalities that are exacerbated by resource scarcity and unpredictability owing to environmental challenges, this perception is not shared by all. Several community members, particularly male community members, reported that there are few or zero cases of SGBV in their communities. In other instances, community members described SGBV as prevalent but did not describe any particular link to natural resource-related or environmental causes. However, given the significant underreporting of SGBV in Blue Nile, the limited available data presents important insights into risks that women and girls, as well as men and boys, clearly face – even if the extent of those risks is not yet fully understood. As such, additional research is required to fully understand the linkages between SGBV, environmental changes and violence. Poverty in Blue Nile has long seen young men leave the state, both as part of seasonal pastoralist migration and in search of better livelihoods as day laborers in agricultural schemes and in other trades. But as climactic changes force young men to travel further to find work and shifts traditional migration routes, community members described how the male population in Blue Nile was noticeably falling. This has been made more acute by the conflict, which has seen some young men join armed groups. The result has been an uptick in early marriage by families eager to secure partnerships for their daughters and sister and the perceived protection from SGBV that marriage confers. Marriage can also reduce the economic burden on a family, offering a source of income at a time of conflict when securing the basic family needs has become precarious. This systemic recruitment of

Box 10. Key insight: Lack of services for people with disabilities in Al Kurmuk locality In Kurmuk, a particular emphasis was

placed on the inability of health workers to meet the needs of people with disabilities. While lack not directly linked to gender-based violence, the lack of capacity to address health concerns of people with disabilities underscores the importance of an intersectional lens to understand specific risks faced by people with multiple, intersecting identities.

young men by armed groups coupled with early marriages added an extra pressure on women as the number of female-headed households grew larger along with their responsibility to secure an income, healthcare, and education for their families. A significant number of these women serve as the primary providers for their families, a situation arising either from the loss of their husbands due to wartime casualties or as a consequence of the men's irresponsible conduct, such as taking a second wife without securing the necessary means or assurances for their sustenance.

Additionally, women are compelled to travel long distances to work on farms during harvesting season to secure their livelihoods after losing their land and resources because of the war. They stay in Jongo harvesting camps near the fields throughout the harvesting season. These conditions do not guarantee their protection against violence. In urban areas, women frequently engage in informal work, such as selling tea, living day-to-day without assurances of safety or financial stability.

Pathway 4. Regional and international tensions over water management pose risks for Blue Nile as pressures on water resources increase

Climate change impacts are already compounding international geopolitical and regional tensions around the Blue Nile. There is a perceived risk that hydrological changes brought about by climate change and the Grand Ethiopian Renaissance Dam (GERD) further escalate tensions around water management. In addition, these changes pose risks for local livelihoods that rely on the river and its water potentially feeding the other climate-security pathways above.

Blue Nile is at the crossroads of regional dynamics impacted by hydrological changes arising from the construction of the Grand Ethiopian Renaissance Dam (GERD). The GERD, which sits some 20 kilometers south of Blue Nile State in Ethiopia, is a colossal hydroelectric dam measuring 1.8 kilometers in length and 145 meters in height that could generate more than 5,000 megawatts of electricity, more than doubling Ethiopia's current production. Neighboring countries Egypt, Ethiopia, and Sudan have sought to reach agreement regarding the filling and annual operation of the GERD for over a decade. Several rounds of negotiations had been inconclusive, and talks were suspended between 2021 and August 2023. In September 2023, Ethiopia announced that they had filled the dam without formal agreement between the three countries, a move Egypt called illegal and warned would "weigh on" future negotiations (AlJazeera, 2023).

Climate change impacts are already compounding international geopolitical tensions linked to GERD, as increasing interannual rainfall variability exacerbates water insecurity in areas downstream of the GERD. This is a particular concern for Egypt, which is facing severe water scarcity even as a growing population and expanding economy increase the country's demand for water (UNICEF 2021; Nikiel et al. 2021).

Currently, there exists a divergence of viewpoints concerning the influence of climate change and the Grand Ethiopian Renaissance Dam (GERD) on the hydrological dynamics of the Blue Nile Basin (also see box 2). The contrasting perspectives underscore the complexity of evaluating

the interactions between climate change, large-scale infrastructure projects like the GERD, the geopolitical repercussions on water resource management in the Blue Nile Basin and its associated conflict risks.

Some assert that climate change-induced phenomena like droughts and floods may aggravate downstream water scarcity, particularly during GERD filling and operation periods. Other study shows the concerns of communities along the river that believe the GERD could increase the risk of drought and change river flows. A February 2022 survey in Geisan found that 36 per cent of respondents believed water availability had decreased in recent years, almost all attributing the decrease to the GERD. Negative local perceptions about the GERD's impact on livelihoods could be risk factors for conflict and insecurity (UNICEF, 2021). One interview partner reported that a shift in the agricultural activity took place after the fourth and final filling of the dam. For instance, prior to the construction of GERD, the fertility of the land was increasing as a result of the acids and silt that flew with the water and constantly enriched the soil. The dam blocked this movement of silt and acids which led to desertification and water scarcity along the banks of the Blue Nile. This forced people to desert their primary livelihood (agriculture) and resort to gold mining to secure their incomes.

Conversely, an alternative study examined the efficacy of GERD operations in mitigating the severity of hydrological extremes in the Upper Blue Nile Basin. This investigation indicated that the GERD can lessen the intensity of floods and droughts by adjusting seasonal water releases, thereby acting as a safeguard against extreme events (Nile Basin Initiative 2021; Lazin et al. 2023).

This shows that the GERD could offer both opportunities and challenges to Sudan. It can help to manage climate change impacts through flood control. Likewise, Sudan could also benefit from hydroelectric power provided by the GERD. However, like in Egypt, there is a risk that changing water flows resulting from the GERD impacting Sudan's own agriculture or dam infrastructure, such as the Ar Rusyris dam, if water were released too quickly or without warning.

Therefore, it is of utmost importance to ensure coordination and the alignment of developmental goals and effective and collaborative transboundary water management among riparian nations to safeguard water security and synchronize climate change adaptation actions. If an agreement cannot be reached between the three countries and disputes arise concerning the management of the GERD, there is an imminent risk of the Blue Nile being caught in the middle of rising geopolitical tensions (BBC, 2021). The analysis of climate change, environmental degradation and conflict dynamics in Blue Nile, together with their specific impacts on different gender and socio-economic groups, points to several recommendations to help the UN, international organizations, NGOs, and the government at state and local levels to prevent conflict, build resilience to climate change, and promote gender equality in more integrated ways in policy development and programming. While the recommendations are generally for the Blue Nile context, specific options for local contexts are included where possible.

Cognizant of the very dynamic conflict context, the first recommendation outlines immediate

5. Recommendations

entry points to address acute needs for stabilization of the current situation and recovery while building the foundations for longer-term peacebuilding and environmental sustainability efforts. The following recommendations focus on longer-term efforts that can start in parallel, in particular if the current conflict situation turns into a longer and protracted crisis, but also include some more short-term actions.

1. Contribute to the stabilization of the current situation and build the foundations for longer-term peacebuilding efforts

The current conflict situation remains dynamic making longer term peacebuilding and environmental sustainability efforts more challenging to start and to implement. However, there are a number of short-term, immediate actions and entry points that can help address the current crisis and lay the foundation for longer-term efforts:

- Prioritise an immediate ceasefire to halt hostilities, as peace is essential for any political, social, or economic progress.
- Ensure the delivery of food and medicine; while improving safety conditions so people can return to farming and other livelihoods. Address road blockades to facilitate aid distribution.
- Involve women and youth meaningfully in mediation efforts. Adopt a bottom-up approach to peacebuilding, integrating local community needs and perspectives into peace agreements.
- Incorporate environmental and climate agendas into peace agreements. Fund ecosystem restoration as a stabilisation strategy.
- Unify international efforts to implement projects that support diverse ethnic groups, ensuring efficient use of resources without duplication.
- Organize facilitated community-based peace dialogues among local leaders, youth, women, and other community stakeholders. These dialogues should aim to address immediate conflicts, negotiate ceasefires where possible, and discuss community grievances and needs in the context of the ongoing conflict.
- Support and strengthen existing local peace committees or help establish new ones where they do not exist. Provide training, resources, and support to enable these committees to mediate local disputes effectively and prevent escalation.
- Inform and support humanitarian actions to ensure they are climate and environment-sensitive, for example, by ensuring that they do not exacerbate environmental challenges such as deforestation or pollution and build the foundation for later activities around natural resource management and sustainable livelihoods.
- Initiate quick impact projects with environmental peacebuilding components, for example,

around the provision of water and energy or small-scale livelihoods interventions.

- Integrate environment into state-wide mediation and peace efforts by addressing the climate-security pathways outlined above and utilizing environmental cooperation as a platform for peacebuilding in the region acknowledging the ongoing conflict and its impacts on the community and resource management.

2. Promote climate-smart livelihood opportunities to enhance economic security and environmental sustainability

Strengthening sustainable livelihood opportunities is essential not only to support the economic security of local communities, but also to protect the environment from further degradation through maladaptive activities and for reducing competition over natural resources. Support for sustainable livelihoods should be driven by local communities and based on a scientific analysis of risks, needs, and opportunities. It is important to support a process led by local communities to ensure that investments in local livelihoods contribute to long-term peace. This process should involve assessing their livelihood challenges and jointly developing solutions. Support for sustainable livelihoods should specifically target women and other marginalized groups, including internally displaced populations, people living with disabilities and those who lack land tenure rights. Specific recommendations include:

- Design food aid initiatives that also support community-based climate resilience and sustainable agricultural practices. For instance, distribute seeds and tools for drought-resistant crops alongside immediate food supplies, helping communities to start rebuilding their food security with crops suited to changing climate conditions.
- Capitalize on humanitarian cash transfers for climate-smart investments: Encourage the use of cash transfers to purchase climate-resilient inputs like improved seed varieties and small-scale irrigation equipment. Provide guidance and training on how to invest in these tools effectively, ensuring that aid money supports sustainable livelihood creation.
- Develop small income-generating projects for youth to counter recruitment by armed militias. Encourage vocational training and diversify livelihoods beyond agriculture and herding.
- Create shared markets to foster coexistence among pastoralists, farmers, and traders.
- Encourage diversification of the economy away from the overdependency on agriculture through building more factories and encouraging small businesses.
- Conduct mixed method integrated climate, conflict, and gender analysis to fully understand how local conflict, environmental and social factors impact the livelihoods of different groups of people according to their gender and other identities.
- Conduct analysis on agricultural and non-wood forest product value chains in the context of

climate change in different areas of the state.

- Enhance community access to local weather information through an early warning system, particularly in communities where access to information is low and weather extremes are increasingly frequent.
- Build capacity of communities for improved agricultural techniques through targeted and context-specific training and improved agricultural inputs.
- Promote income-generating activities through microfinance and help link communities with local credit institutions and strengthening their capacities in proposal writing.
- Support the development of alternative energy sources such as solar and biogas.
- Improve road infrastructure to better link rural communities to markets.
- Restore and secure access to degraded pastureland.
- Provide improved services for animals and people along migratory corridors.
- Integrate climate smart livelihood opportunities into activities supporting IDPs and returnees; and
- Identify and support viable livelihood options for disabled populations.

3. Establish or strengthen community-based mechanisms to protect, conserve and restore land and natural ecosystems

Blue Nile's moderate temperatures, fertile clay soil, ample water sources, and rich forests provide many of the ingredients necessary for the region to adapt to climate change. However, the rapid expansion of several industries is threatening to severely degrade the region's diverse ecosystems, including through the pollution and land erosion caused by mining, and deforestation for charcoal production and to make space for new large-scale agricultural schemes. Together with enhancing options for climate-smart and alternative livelihoods, establishing specific land conservation mechanisms can protect critical ecosystems from further degradation. Any such approach should be community led and bottom up, building on indigenous knowledge and approaches to conservation. Top-down approaches to land conservation could further inflame feelings of marginalization already deeply embedded in regional conflict dynamics. Conversely, if a rigorous conflict-sensitive approach is applied, land

conservation efforts could provide a platform for building social cohesion between different ethnic and livelihood groups, as well as between local communities and the government. Specific recommendations include:

- Review and improve existing land conservation and land tenure policies, including customary and statutory policies; this should be done in an inclusive manner with representatives from different communities and the local government, and assessing specific limitations and opportunities affecting different gender groups.
- Develop a community-led strategy for implementing existing protection and conservation policies and/or strengthening the conservation policy framework to reduce tensions and promote sustainability.
- Build the capacity of local government and communities to monitor protected areas such as Dinder National Park, as well as subsequently enforce protection measures where infringements occur.
- Conduct workshops and training sessions that combine conservation practices with conflict resolution skills. This approach helps communities manage natural resources in a way that minimizes conflict triggers and promotes sustainable usage.
- Extend monitoring to other potentially harmful activities, such as small-scale mining, and ensure protection measures take a gendered approach; for example, this could entail encouraging stopping the use of pollutants and toxics materials in mining to protect pregnant women's lives.
- Promote nature-based solutions to restore and protect deforested areas, including through natural and community-managed regeneration activities; and
- Use community-led two-dimensional maps for natural resources management and decision making as a guide for interventions with emphasis on the roles of women.

4. Establish or strengthen inclusive natural resource governance structures that promote the inclusion and leadership of women, displaced persons, and other marginalized groups

The breakdown of traditional governance structures – or exclusion of some groups from existing structures – has contributed to the escalation of conflict over natural resource access, use and control. Establishing community-based land governance structures inclusive of the different populations living in or passing through Blue Nile is necessary to protect the environment, enhance livelihood options and prevent conflict between different groups. Several existing community-level governance structures were identified in the different localities. However, data on the efficacy and inclusiveness of such mechanisms is sparse, as well as its coordination with the central government. Specific recommendations include:

- Support and facilitate inclusive dialogues and forums that include diverse community representatives, including women, youth, and IDPs, to discuss and plan for natural resource management in a way that acknowledges and integrates the needs of all community

segments.

- Assess natural resource governance structures at community and state levels, including the inclusion and leadership of women, displaced populations, people living with disabilities and other marginalized groups.
- Update, implement and enforce laws to regulate mining, ensuring safe practices and preventing child labour and environmental harm.
- Assess to what extent community-based structures are connected to state natural resource management mechanisms and identify ways to remedy the gender blindness of existing national and regional strategies, policies, and land laws, so that community and national structures are coherent and both working to improve gender equality.
- Identify ways to include the voices and concerns of mobile pastoralists in tandem with the settled communities and identify common issue areas for peacebuilding and mediation.
- Adopt awareness raising activities on UNSCR 1325 to enhance the role of women in decision making and participation in the management of socio-economic, political, and natural resource issues.
- Facilitate a dialogue between communities, traditional leaders, government, and other key stakeholders on shared ways to protect key areas that support both the environment and peoples' livelihoods, including Dinder National Park, forested areas, pastoral lands, and natural bodies of water.
- Enhance conservation efforts focused on preserving the Dinder National Park's wildlife and biodiversity to make it an attractive destination for ecotourists and nature enthusiasts, fostering sustainable tourism and benefiting the local economy.

5. Enhance protection and reporting mechanisms to prevent and respond to cases of SGBV

Sexual and gender-based violence perpetrated against women and girls, particularly when carrying out natural resource-related roles, must be addressed. Reporting of such acts of violence is extremely low due to the stigma associated with SGBV. At the same time, existing reporting structures are ill-equipped to fully support the needs of survivors, and in some cases can take gender blind approaches that increase risks women face, such as encouraging victims to marry perpetrators. Action is required to better understand and build awareness of SGBV and establish mechanisms to protect women, girls, men, and boys and provide the necessary care to survivors. Recommendations include:

- Ensure that sexual and gender-based violence prevention and response services are an integral part of emergency health aid, providing immediate care and support to survivors.

- Raise awareness about laws and policies protecting women, girls, men, and boys from sexual and gender-based violence.
- Invest in infrastructure that enhances the safety and protection of women and girls while carrying out natural resources related roles; one example may be to construct more water collection points, which would both reduce the distance women and girls have travel and enhance sustainable and safe livelihood opportunities.
- Train and capacitate police, community leaders, health workers and other first responders on how to manage cases of SGBV, with attention paid to the gendered needs and experiences of different victims.
- Establish or strengthen effective and safe reporting and response mechanisms to provide survivors with the care they need and hold perpetrators accountable; and
- Enhance networking between women activists including Sudanese refugees in neighboring countries to strengthen efforts and initiatives related to women protection against SGBV.

6. Promote transboundary cooperation between Sudan and neighboring countries on environmental management

Bordering Ethiopia to the east and South Sudan to the south, Blue Nile's shared transboundary resources can be both a source of international cooperation and potential conflict. While political dialogue between Sudan and Ethiopia regarding the GERD is ongoing, collaboration in other areas could demonstrate approaches for joint management of shared ecosystems and natural resources that would improve peace and cooperation along the border. Such approaches may include:

- Establishing joint Sudanese-Ethiopian approaches to managing Dinder National Park and Ethiopia's Alitash National Park; this may include developing transboundary park management, or at minimum mechanisms for regular information sharing and conservation strategizing.
- Coordinating with humanitarian and civilian services to have broader approach to secure (reducing militarization) border trade activities, allowing local populations to legally engage in commerce with South Sudan and Ethiopia.
- Building the capacity of communities to provide support for joint monitoring of transboundary movement to better prepare for likely changes in population; and
- Strengthening structures to support community-led management of transboundary migratory routes, including through supporting women's participation and leadership in such processes. Abdelgafaar, M., & Abdelnabi, M. S., 2018. Impacts of Climate Change on Al Tadamon Locality's Livelihoods, Blue Nile State, Sudan.

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1 For definitions, see https://gender-nr-peace.org/assets/2020_GCS_Report/GCS_PolicyReport_200611.pdf

2 Expert interview with civic actor, Khartoum.

3 Calculations are presented as per the precipitation range between the driest and the wettest year over the period. Changes in wet and dry patterns impact rain-fed agriculture, crop productivity and food security. See: <https://www.nature.com/articles/s41598-023-44115-5>

4 Household survey conducted for the project baseline, February 2022

5 Household survey conducted for project baseline, February 2022

6 Blue Nile UNEP/ UNITAMS report

7 Interview with community member in Geissan locality, conducted by UNEP/UN Women/ UNDP, 2022

8 FGD with women from Derang village, Baw locality.

9 Interview with community leader, Deim Saad village, Geissan locality; male, 63 years old.

10 For example, interview with community leader from Geissan locality, male, 63 years old.

11 Community leader in Geissan locality, male, 45.

12 A male Sheik from Kurmuk locality noted that education for women is more frequently requested to support their effective participation in community issues such as natural resources management, conflict resolution and SGBV.

13 Interview with male police officer, Geissan locality

14 FGD with women in Kurmuk locality

15 Interview with male community leader, Yara village in Geissan locality

16 Male health worker, Samsur, Baw locality

17 Male police officer, Baw locality

18 Male police officer, Geissan locality

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