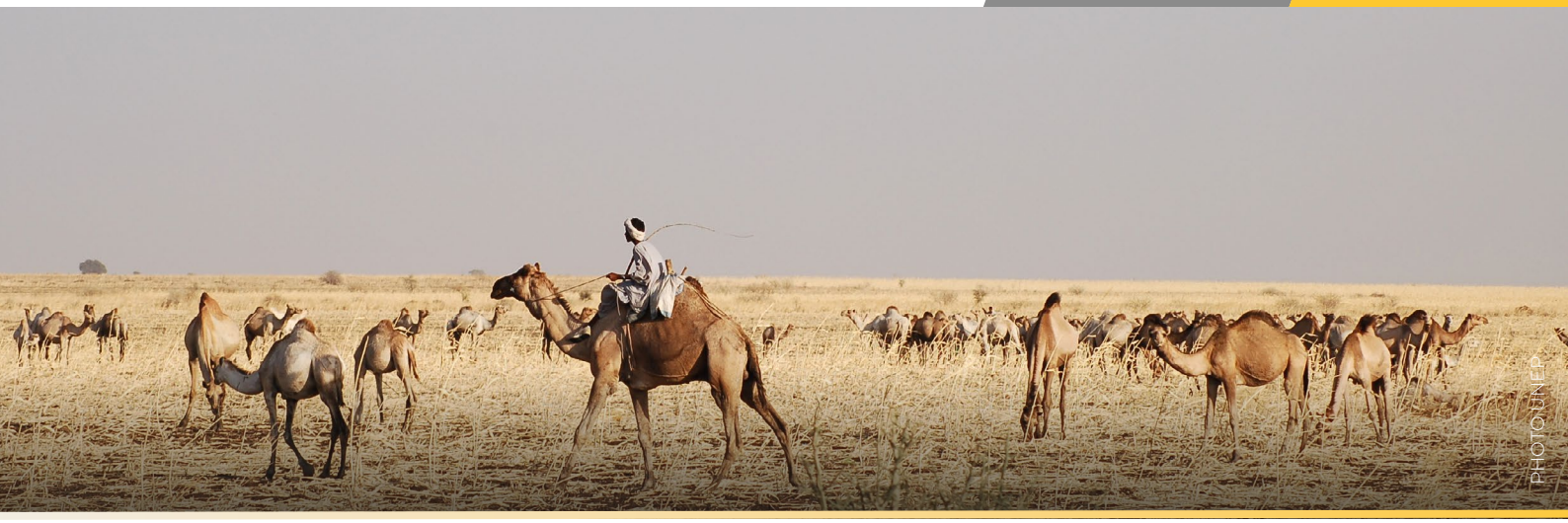
ClimBeR: Building Systemic Resilience Against Climate Variability and Extremes

FACTSHEET 2023/2



How does climate exacerbate root causes of conflict in Sudan?

Climate Security Pathway Analysis

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This factsheet gives answers on how climate exacerbates root causes of conflict in Sudan, using an impact pathway analysis. Two main impact pathways are identified:

1. Livelihood and Food Insecurity: Climate variability is reducing agricultural production in Sudan, leading to high food insecurity and protests, while food and input imports are challenged by high prices and national inflation. Agricultural and pastoral livelihoods relying on natural resources are particularly vulnerable to climatic slow onset and extreme events. To sustain livelihoods, maladaptive strategies are being adopted, such as deforestation, mining or choosing violent alternatives, all of which contribute to an increase in violence and environmental degradation. Displacement due to floods or conflict and (in)voluntary migration fostered by drought and loss of livelihoods are leading to a large number of Internally Displaced People (IDPs). Informal settlements around cities where many IDPs congregate, create social exclusion and contribute to grievances.

2. Resource Availability and Access: Climate variability and extreme events are putting pressure on land, water and pasture; while increasing desertification is pushing pastoralists ever further south in their quest to feed their livestock. Increasing competition over scarce resources in the areas they turn to, as well as in areas with comparably more water availability, are leading to conflict among farmers and herders. Capacities to manage resources sustainably and peacefully are undermined by a history of conflict and the erosion of state and local institutions, particularly in marginalized regions such as Darfur, Kordofan and Blue Nile states. Climate change impacts on water availability of the Nile river mean further challenges for regional stability and relations between riparian countries.

IGAD CAEP IGAD Centre of Excellence For Climate Adaptation and Environmental Protection

CGIAR FOCUS Climate Security

This publication is part of a factsheet series reporting on the findings of the CGIAR FOCUS Climate Security Observatory work in Africa (Kenya, Ethiopia, Mali, Nigeria, Senegal, Sudan, Uganda, Zimbabwe). The research is centered around 5 questions*:

1 How does climate exacerbate root causes of conflict?

Climate Security Pathway Analysis

Kenya Ethiopia Mali Nigeria Senegal Sudan Uganda Zimbabwe

Econometric analysis

Kenya Mali Nigeria Senegal Sudan Uganda Zimbabwe

Scopus analysis**

2 Where are the climate insecurities hotspots?

Spatial analysis

Kenya Mali Nigeria Senegal Sudan Uganda Zimbabwe

3 What is the underlying structure of the climate, conflict, and socio-economic system?

Network analysis

Kenya Mali Nigeria Senegal Sudan Uganda Zimbabwe

4 Are climate and security policies coherent and integrated?

Policy coherence analysis

5 Are policy makers aware of the climate security nexus?

Social media analysis

Kenya Mali Nigeria Senegal Sudan Uganda Zimbabwe

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* Questions 1, 2, 3, 5 are analyzed at country level through a Climate Risk Lens (impact pathways, economic, spatial, network and social media analyses). The policy coherence and scopus analyses are at continental level.

**Scopus is one of the largest curated abstract and citation databases, with a wide global and regional coverage of scientific journals, conference proceedings, and books. We used Scopus data for analyzing: (1) how global climate research addresses the dynamics between climate, socio-economic factors, and conflict, and (2) how the countries studied are represented in the database.

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1. CONTEXT

Climate Profile

The geography of Sudan consists mostly of arid and semi-arid ecosystems. Its northern part is dominated by desert and semi-desert areas, while from southeast to the southwest, low rainfall savannah and montane vegetation are prevalent. The climate varies within the country, with the main rainy season from May to October and precipitation ranging from less than 50 mm in the extreme north to more than 1500 mm in the extreme south (UNFCCC 2013). In the period from 1960 to 2009, the temperature has risen by 0.2 to 0.4 °C per decade (UNFCCC 2013). The annual seasonal rainfall during that time span has increased by 20 to 30 mm per decade in the extreme north and south and decreased by 10 to 30 mm per decade in the west of the country (UNFCCC 2013). Sudan is considered one of the most climate-vulnerable countries in the world. The frequency of extreme events such as droughts (mainly in Kordofan, Darfur and Central) and highly unpredictable floods (especially in Gedaref, Darfur and White Nile) have increased notably (USAID 2016; OCHA 2022; ND-GAIN 2022). Historically, droughts have occurred in Sudan in the 1910s, 1940s, 1970s and 1980s but the frequency of recurring droughts since 1987 is unprecedented (UNFCCC 2013). The same can be said about flooding; whereas Sudan recorded two severe floods in the 100 years from 1878 to 1977, already five severe floods have occurred since then (UNFCCC 2013; OCHA 2022).

Temperatures are predicted to increase between 1 to 3 °C by 2050, with the north expecting the most extreme rises. This will intensify the severity of droughts through higher rates of evaporation (UNFCCC 2013). Rainfall is predicted to increase slightly by 4 percent annually, coupled with a higher rate of rainfall variability (USAID 2016). Meanwhile, desertification is expected to continue, with the Sahara Desert advancing southwards 1.5 km each year (USAID 2016). Sea level rise, which has already risen by a gradual increase globally of 10 to 20 cm in the last century, is projected to further rise between 38 to 58 cm by 2060 (UNFCCC 2013).

Conflict and Fragility

Sudan is a heterogenous, multi-ethnic and multi-religious country in which tribal divisions along with resource competition have been a continuing source of conflict (Johnson 2021). Since independence in 1956, and especially since Omar al-Bashir came to power in 1993, the country has struggled with political instability and civil wars between the government in Khartoum and the south as well as with marginalized regions such as Darfur, Blue Nile State and Kordofan. Sudan has experienced various internal conflicts, humanitarian crises and a decades-long phase of international isolation (Cohen 2019). The two largest conflicts were in the south and in Darfur, with devastating effects up to now.

The roots of the North-South civil war can already be found in 1821 when an Ottoman Turk-Egyptian army took military control over modern Sudan and South Sudan, imposing heavy tolls and slaving on the African tribes and influencing their fears of oppression following independence in 1956 (Natsios 2012). After the denial of autonomy and self-determination, southern citizens fought two protracted civil wars (1956 to 1972 and 1983 to 2005) against the Khartoum government (Natsios 2012). In the second civil war, 2.5 million lives were lost before the Comprehensive Peace Agreement (CPA) in 2005 paved the way for the secession of South Sudan in 2011 (World Peace Found. 2017; Johnson 2021).

The third Darfuri rebellion of 2003 to 2010 was the largest civil war fought by the Fur, Masalit and Zaghawa tribes in Darfur with the government in Khartoum and its Janjaweed militia (Johnson 2021). An interplay of reasons fuelled the violence (Shai & Vunza 2021), including increased pressure on natural resources as a result of climate change and desertification. Competition among farmers and herders led former UN Secretary-General Ban Ki-Moon, along with scholars, to see the roots of the Darfur conflict in the ecological crises (Ki Moon 2007; Leroy 2009). Newer research on Darfur,

however, has advanced beyond causal models that seek to show a direct link between conflict and climate change to one that integrates more contextual drivers of marginalization, history of conflict and poor governance (Foong et al. 2020; Verhoeven 2011). Climate change can thereby be seen as a 'risk multiplier' to already existing political grievances in the country (Scheffran et al. 2014).

In 2018, continuing repression, corruption, and economic mismanagement sparked protests over increasing cost of food and medicine, as well as fuel and cash shortages (ICG 2019). The following year, President Omar al-Bashir was overthrown leading to a military-civilian transitional government that continued to struggle with tensions (ICG 2019; Hoffmann 2021). In 2021, there was a military coup framed as an effort towards stability and progress but was heavily protested against by the civilian side (Tchie and Mashamoun 2022; Hoffmann 2021). Another wave of protests in 2022 led to an agreement between the military council and protestors to form a new administration (Boswell 2022), which itself precipitated a political impasse with oppositional forces not being able to agree on a way forward (Boswell 2022). While the political situation creates power vacuums, inter communal violence has increased again in Blue Nile State (Elfaki 2022).

In mid-April 2023, tensions again escalated, resulting in heavy fighting between the Sudan military and the paramilitary Rapid Support Forces (RSF) for the control of the northeastern part of the country. The power struggle between these factions traces back to the period preceding the 2019 uprising that had led to the removal of Sudan's former leader, Omar al-Bashir (Guardian 2023). The ensuing political uncertainty that followed al-Bashir's ouster triggered a contest for influence among regional and international powers (Atta-Asamoah and Mahmood 2019). At the local level, civilians demanded the integration of the RSF into Sudan's army, the introduction of oversight mechanisms to check military powers, and justice for the victims of the 2003 Darfur conflict. These diverging interests created a stalemate, setting the stage for the current conflict.

The current fighting has resulted in a breakdown of law and order, leading to a surge in criminality. The fighting has led to the loss of hundreds of lives, widespread destruction, and forced migration from affected areas (Alfadul and Alrawa 2023). Armed clashes continue in the southern region, and the conflict between the RSF and local Sudanese army brigades has extended to North Kordofan State, particularly the capital El Obeid.

Efforts to achieve peace between the warring groups by regional bodies such as IGAD, AU, and the UN have had limited success. This can be attributed to various geo-political dimensions, both international and regional, which have complicated the situation (IGAD CGIAR 2023). The delayed intervention of the international community has also been recognized as a failure (Alex de Waal 2023). Efforts to achieve peace between the warring groups by the UN, the international community as well as regional bodies have had limited success. This can be attributed to various geo-political dimensions, both international and regional, which have complicated the situation (IGAD CGIAR 2023). The delayed intervention of the international community has also been recognized as a failure (Alex de Waal 2023). IGAD, as the regional bloc, has not given up on restoring peace in Sudan despite the overwhelming mistrust between the two warring groups. In its recent 14th Ordinary Session of the IGAD Assembly of Head of States and Government, the bloc communique stated, "IGAD underlined the importance of consultation and coordination with the Government of Sudan regarding all-inclusive efforts to solve the conflict". With IGAD's renewed efforts in close coordination with the African Union and the Sudanese parties, there is hope that an amicable solution to the crisis can be found.

Socio-Economic Profile

Of Sudan´s population of 45 million, 46.5 percent live in poverty, challenging government efforts to balance a high urban population growth with an environmentally sustainable use of its natural resources (World Bank 2022; Alnour et al. 2022). The secession of South Sudan strongly affected the economy with Sudan's GDP per capita significantly declining from $2034 in 2011 to $775 in 2020 (Statista 2022).

After losing 75 percent of its oil reserves following succession of the south, the Sudanese economy, which is highly dependent on natural resources, was restructured with a stronger focus on agricultural production and artisanal gold mining (UNEP 2020). Climate change has a strong impact as Sudan is highly dependent on rainfed agriculture. Even though the country has many arid areas, historically it has been considered a potential breadbasket (Verhoeven 2011). However, insufficient investment in agricultural production, coupled with increasing rainfall variability continues to lead to crop losses, endangering food security (Vidal 2011). Sudan's agriculture, forestry and fisheries sectors, which employ nearly 65 percent of the workforce and are the main suppliers of raw materials to industry, declined in 2021 to an all-time low of only 6.4 percent of value added to the GDP (World Bank 2022; FAO 2022). This significant decline in agricultural production is attributed to unfavourable weather conditions, outbreaks of pest and diseases, shortages of inputs and challenges in irrigation systems (FAO 2022). Additionally, Sudan currently has the highest annual inflation rate in the world, at 382 percent (World Bank 2021).

The combination of conflict, economic crises and poor harvests due to prolonged dry spells has severely impacted food security (FEWS 2022). Approximately, 18 million people, accounting for 40 percent of the population, are currently experiencing acute food insecurity, despite significant contributions of humanitarian aid from the international community (UN-News 2022). The food crisis has been exacerbated by the Ukraine-Russia War, as about 60 percent of Sudan´s wheat imports come from these two countries, and global market prices are experiencing shocks (FEWS 2022). Increasing prices of fuel, wheat and agricultural products continue to spark widespread protests and strikes in major cities. Meanwhile, socioeconomic conditions remain critical under the transition government due to reduced imports of gasoline and wheat, combined with high inflation rates (FAO 2022; Amin 2022).

2. CLIMATE SECURITY PATHWAYS

Sudan is highly vulnerable to severe climate impacts that are degrading natural resources and strongly affect the livelihoods of people depending on them. This is compounded by internal conflict, harsh socioeconomic conditions and a large number of displaced people. This section draws links between climate change and variability and conflict over two identified pathways: 1) Livelihood and Food Security, and 2) Resource Access and Availability.

The identified pathways represent logical mechanisms of how the climate-security nexus may operate in Sudan, based on an approach combining: 1) systematized search and interpretation of existing understanding in academic and grey literature; 2) verification of identified linkages and key points of discussion emerging from the "IGAD-CGIAR: Climate Vulnerability and Impact Pathway Analysis Workshop" with several governmental and non-governmental stakeholders from Sudan in an online workshop in March 2023 cited in the document as (IGAD – CGIAR 2023).

PATHWAY #1: Livelihood and Food Insecurity Pathway

Climate variability is reducing agricultural production in Sudan, leading to high food insecurity and protests, while food and input imports are challenged by high prices and national inflation. Agricultural and pastoral livelihoods relying on natural resources are particularly vulnerable to climatic slow onset and extreme events. To sustain livelihoods, maladaptive strategies are being adopted, such as deforestation, mining or choosing violent alternatives, all of which contribute to an increase in violence and environmental degradation. Displacement due to floods or conflict and (in)voluntary migration fostered by drought and loss of livelihoods are leading to a large number of Internally Displaced People (IDPs). Informal settlements around cities where many IDPs congregate, create social exclusion and contribute to grievances.

Agriculture is a crucial livelihood in Sudan, a sector in which 65 percent of the population is engaged and which, in regular years, generates around one-third of the country's GDP (Siddig et al. 2020; FAO 2015). In Sudan, 72 percent of the landmass is desert and only sparsely populated. Of the 23.5 million hectares of arable land under cultivation, 12.4 million hectares are rainfed, 6.7 million hectares mechanized and 3.5 million hectares irrigated (UNEP 2020). The sector is divided into three major subsectors (with respective contributions): cropping (39 percent), livestock (60 percent) and forestry/ fisheries (1 percent); showing the relative importance of livestock (Siddig et al 2020). Having suitable land for animal husbandry, Sudan has a total livestock population of around around 111 million cattle, sheep, goats, camels and other animals, all of which mainly depend on natural grazing areas for fodder and hafirs, rivers, streams and wells for water (FAO 2022).

The agricultural sector, with its main crops of sorghum, cotton, groundnut, sesame, millet and wheat, operates below its productive potential (Siddig et al. 2020). Main staple crops such as sorghum or millet are produced by more than 95 percent of farmers in the traditional rainfed sector, achieving only a third of their potential due to the instability of rainfall together with low use of fertilizers (Siddig et al. 2020). The crop suitability of areas, such as Darfur for millet or central and northern parts for sorghum, is diminished due to climatic impacts of higher temperatures and shorter growing seasons (IGAD-CGIAR 2023). Even in irrigated fields, irregular rainfall is affecting crop production, as irrigation water alone is seldom sufficient for all main crops (FAO 2022). In Gaderef State, the most important rainfed agricultural area in Sudan, temperatures are steadily increasing while rainfall is characterized by high variability, ranging between 57 and 117 days per year (Osman et al. 2021). While the rise of temperature is negatively affecting all crops, yields are most closely linked to fluctuation in rainfall, significantly increasing yields in some years while a lack of of rain contributes to crop loss in other years (Osman et al. 2021). Similar conditions can be found in the three major wheat-producing areas of Northern State, Gezira State and Kassala State, where temperatures are increasing with a negative impact on yields, with especially devastating effects in the north (Musa et al. 2021).

The total seasonal rainfall in 2021 was above average in most states, but rains were irregularly distributed, and the erratic rainfall amount and distribution resulted in late sowing, long dry spells, and flooding from intense downpours, causing the necessity to re-sow and, in many cases, a complete crop failure (FAO 2022). In the Darfur, Blue Nile, and Kassala regions new kinds of pest infection have further

affected crop yields, leading to harvest losses (IGAD-CGIAR 2023). Compounding irregular rainfall are shortages of farm machinery, credit capital, an affordable work force, appropriate crop varieties and improved seeds, pest control and efficient irrigation systems, which resulted in a significant decline in the national cereal production in 2021, being 30 percent below the average output of the previous five years (FAO 2022).

Such pressures on agricultural systems have important implications for fragility in Sudan, as wheat prices and the affordability of flour and bread are crucial to political and economic stability. Rising bread prices sparked protests in Khartoum in 1985, leading to the coup of Omar al-Bashir and again initiated protests in late 2018 that emerged with multiple grievances leading to a popular revolution the following year (Resnick 2021). Consumer demand, particularly from urban areas, exceeds domestic wheat production. As a key component of the state's social contract with its citizens, under former leader al-Bashir approximately 85 percent of wheat was imported in order to maintain low bread prices (Resnick 2021). As with the previous regime, the present government aims to secure the affordability of bread and other key commodities through subsidies to ensure political stability and avoid protests in Khartoum (Resnick 2021). This poses a challenging task considering the effects of climate change on the domestic agricultural production, the high level of national inflation and rising international food prices due to the Ukrainian-Russian war. In 2021, Sudan declared a state of emergency, imposing curfews in 10 cities following violent protests against food price rises, which continued to spike in 2022 after Russia's invasion of Ukraine (Salih 2021; Breisinger et al. 2022).

Rural livelihoods are highly vulnerable to climatic slow onset and extreme events, particularly in the northern and western states. This vulnerability is contributing to already high levels of poverty and food insecurity (IGAD-CGIAR 2023). Water supply is a crucial issue for rural communities, ranging from insufficient supply in drought years to highly uncertain and largely destructive floods (Fadul et al. 2019). While stakeholders at all levels have developed numerous measures to cope with the uncertain water supply, many farmers are ill-equipped to withstand the pressure (Fadul et al. 2019). In 2020, the country was hit by the worst floods in history, breaking all previous records and displacing 500 000 people (Modber et al. 2021). These devastating droughts threaten the livelihood of Sudanese by destroying infrastructure, property and crops, endangering health through the rise of water-borne diseases and push already vulnerable people into severe phases of acute food insecurity (Modber et al. 2021; FAO 2020). The increasing frequency and intensity of droughts are diminishing yields, leading rural communities to intensify their agricultural and pastoral activities, which is reshaping arable areas by degrading soil fertility (Elagib et al. 2017). The infertility of land and degrading ecosystems are particularly sensitive to further detrimental effects of drought and rainfall variability (Elagib et al. 2017). The arid and semi-arid areas of Sudan have always presented challenging conditions for Sudanese farmers and pastoralists who, over centuries, have evolved strong adaptation capacities to protect their livelihoods. However, the additional pressure of climate change on the ecosystems, together with conflict and weak governance, overburden the livelihood of many (Young 2009).

It is crucial to acknowledge the differences in vulnerability among different groups. Pastoral livelihoods are especially vulnerable to climatic changes in Sudan (Anderson et al. 2021). Their exposure to climatic impacts on the natural resources upon which they rely for their livelihood is combined with a lack of basic services, which contributes to their socioeconomic marginalization (Bronkhorst

2011). The severity of prolonged droughts combined with other shocks, such as livestock diseases and occurrence of conflict, are often devastating to the livelihoods of pastoralists, curtailing their adaptive capacity (Young & Ismail 2019). After prolonged and severe droughts of 1972 to 1973 (132 mm mean precipitation in El-Fasher, 40 to 70 percent livestock mortality) and 1982 to 1984 (97 mm mean precipitation in El-Fasher, 60 to 90 percent livestock mortality), the pastoralist livelihoods collapsed, pushing many into poverty (Ibrahim 1988). The increased frequency and intensity of such droughts is projected to exacerbate the famine and humanitarian crises that typically follow these extreme events. Moreover, disparities in exposure to climate and conflict exist with groups, especially in relation to gender, disproportionally affecting women (IGAD-CGIAR 2023). In areas such as Darfur, the majority of the people engaged in agriculture and water collection are women. As water availability diminishes due to heightened competition for this already scarce resource, women bear the brunt of the consequences. They must walk longer distances and wait longer to access water, rendering them more vulnerable to harassment and violence (IGAD-CGIAR 2023).

Workshop results identified the importance of resilience-building in rural communities (IGAD-CGIAR 2023). Even though international programmes around enhancing resilience exist, implementation is often undermined by unsustainable measurements, as well as political instability affecting many vulnerable areas in the country (IGAD-CGIAR 2023).

> *"After the implementation of these projects, there is often a gap of who is responsible, which undermines the sustainability of the interventions. In one case, for example, a project intended to increase the resilience of women over the allocation of land has ultimately found to be given land to men."* (IGAD-CGIAR Workshop participant 2023)

Climatic pressure on livelihoods contributes to violence through feedback loops linked to local governance and maladaptive behaviour. In Darfur, a conflict-livelihood circle has emerged through an interplay of droughts placing pressure on livelihood systems, leading to increasing competition over land, pasture and water (Young 2009). With inadequate management of access to resources, conflict escalates between competing groups, which then undermines local governance further and which, together with population pressure, leads to degradation of the environment and places further strain on livelihoods; and the circle continues (Young 2009). Farmers and herders affected by livelihood and food insecurity may resort to maladaptive strategies such as overgrazing, shifting cultivation and deforestation, which contribute to the unsustainable use of natural resources and further degrades the environment, as well as causing them to resort to violence, crime and joining militias, further increasing insecurity and instability (Young & Ismail 2019; Hakim 2011). Although deforestation for timber and charcoal provide an income for some individuals, allowing them to cope with livelihood and food insecurity, it is detrimental to Sudan´s resilience (Bronkhorst 2011). Others resort to gold mining, an economic activity that has been heavily promoted by the government since the secession of South Sudan in 2011, as compensation for the loss in oil revenues (Foong et al. 2020). However, gold mining has also been linked to violence and insecurity, mainly linked to armed groups such as the Rapid Support Forces (De Coning et al. 2022). Meanwhile, small-scale artisanal mining has had negative environmental consequences and led to small-scale conflicts in the region, as seen in Kordofan and East Sudan (De Waal 2019; De Coning et al. 2022). At the onset of the Darfur conflict, the deterioration of livelihoods through climate change experienced by the Fur, Zaghawa and Masalit

peoples contributed to their recruitment into paramilitary groups, leading to large-scale violence (Silander 2021).

Livelihood and Human Mobility

The livelihoods of Sudanese affected by climate and conflict are compounded by the dynamics of human mobility. Rural communities in the north are especially affected by climate impacts, which exacerbate existing patterns of rural-urban migration (Elagib et al. 2017). These dynamics are closely intertwined with other factors that propel migration and displacement, including incidents of violence and conflict, natural disasters, and resettlement programmes (Mohamed 2020). As a result of an intensification of inter-communal violence in 2021, the number of internally displaced people (IDPs) fleeing Sudan increased to 3.7 million (IOM-DTM 2022). The number of IDPs that are linked to extreme weather events has risen especially in 2020 with an estimated 1.9 million affected (IDMC 2021). Aside from conflict, environmental degradation and extreme weather events, different development schemes such as the construction of dams and expansion of large-scale mechanized agriculture, have displaced close to a million people in the last decade (Mohamed 2020). Further increasing the number of displaced people are about 1.1 million refugees in Sudan, who mainly come from neighbouring South Sudan, Eritrea and Ethiopia (UNHCR 2022). Although essential for the provision of humanitarian assistance, refugee camps in Sudan have become associated with degradation of the local environmental, being the focus of severe deforestation as households seek to meet their energy needs (Suliman 2011). Some camps have also become hotspots for human rights abuses, conflicts over resources and food insecurity (PBF 2021).

> *"We have seen climate change leading to displacement considering the vulnerability of population in areas of high exposure and vulnerability towards climate impacts. This overburdens the means of people to overcome and adapt to climate change."* (IGAD-CGIAR Workshop participant 2023)

In respect to the increasing impact of climate change on livelihoods, the workshop identified the need for a national strategy to address the challenges faced by displaced people and migrants. This strategy could explore assisted relocation as a possible means to mitigate the effects of climate change and build the resilience of pastoralists and farmers in vulnerable areas (IGAD-CGIAR 2023). As many displaced people are moving to areas already facing resource limitations, conflicts with indigenous communities have increased, underscoring the urgency for a more coordinated approach (IGAD-CGIAR 2023).

Internally displaced persons find themselves in a vulnerable position, often being almost permanently resettled on the outskirts of urban areas. Models consistently demonstrate that deteriorating forests, rainfall variability and lack of economic growth have long-term adverse effects on their food security. The contributing factors include insufficient support from national and international organizations, as well as a lack of self-adaptation (Mohamed 2020). These urban peripheries, especially those around Khartoum, where nearly half of the IDPs reside, are experiencing rapid growth beyond their capacities (Mohamed 2020). Rapid and imbalanced urban growth, coupled with increasing urban population, rising land prices, and pressure on urban land, has resulted in the proliferation of informal settlements or ashwaeyat in Khartoum. Many of these settlements expand during periods of drought, desertification and conflict to accommodate additional displaced people (Assal 2004; Steel et al. 2019).

However, unsustainable policies in urban planning have led to spatial segregation and social exclusion, exacerbating grievances against the state (Steel et al. 2019). On the other hand, refugees, who are often placed in spatially segregated camps rather than integrated into urban areas, face heightened vulnerability to extreme climatic events that destroy shelters and contribute to the spread of diseases (Ahmed et al. 2021). Facilitating the reintegration of IDPs is a key priority for achieving lasting peace, particularly in Darfur, where the majority of IDPs express a preference for local integration over returning to their places of origin. However, barriers such as insecure tenure of agricultural land are sparking new conflicts (PBF 2021).

PATHWAY #2: Resource Availability and Access

Climate variability and extreme events are putting pressure on land, water and pasture; while increasing desertification is pushing pastoralists ever further south in their quest to feed their livestock. Increasing competition over scarce resources in the areas they turn to, as well as in areas with comparably more water availability, are leading to conflict among farmers and herders. Capacities to manage resources sustainably and peacefully are undermined by a history of conflict and the erosion of state and local institutions, particularly in marginalized regions such as Darfur, Kordofan and Blue Nile states. Climate change impacts on water availability of the Nile river mean further challenges for regional stability and relations between riparian countries.

The high dependency of the Sudanese economy and society on climate-sensitive sectors is being coupled with increasing pressure on natural resources arising from an interplay of climatic and non-climatic factors (Alnour et al. 2022). The rise in temperatures and increased rainfall variability, as well as droughts and floods, are contributing to the degradation of ecosystems, diminishing already scarce arable land and water resources (Hakim 2011). The progressive movement southwards of the Sahara Desert, degrading what is left of vegetation on its fringes, is estimated to have shifted the boundary between desert and semi-desert 50 to 200 km to the south since 1930 (Daoudy 2021; Maystadt et al. 2015). Furthermore, a reduction of the Sudanese GDP by $27.9 billion in the period 2018 to 2050 is predicted compared to a no climate change scenario (Siddig et al. 2020). The greatest impact of climate change is on agriculture, which is predominantly rainfed in Sudan, as well as on aquaculture, natural ecology systems and biodiversity, water resources, energy production and consumption (Siddig et al. 2020). Competition for land resources in Sudan is exacerbated by the phenomenon of internationally-driven land grabbing, originating with the directive of Gulf States to outsource large-scale and water-intensive agricultural production to foreign countries since the 2000s (Henderson 2021). These practices involve the utilisation of Sudan's biophysically valuable land, which is irrigated by the Nile river, resulting in the extraction of large amounts of water. This, in turn, leads to the displacement of people from their land and exacerbates resource conflicts between tribes due to the reduction of available space (Mugira 2019).

Projections generated by the Water Evaluation and Planning (WEAP) model for the Nile river raise severe concerns for high levels of water stress in coming decades, with demand increasing by 11 percent by 2050 due to rising population and an expansion of irrigated agriculture. River flow of the Nile is projected to decrease by 20 to 30 percent while water storage is expected to decrease

by around 40 percent (UNFCCC 2013). One of the most pressing issues in Sudan identified in the workshop, concerns the need to revise the outdated water law in the country (IGAD-CGIAR 2023). Currently missing are effective policies to guide water stakeholders concerning various water uses, coordinate the federal and state levels and demarcate clear responsibility for monitoring the quantity and quality of the water (IGAD-CGIAR 2023). This undermines the resilience of water sources and small dams against both manmade and natural degradation, thereby impacting the livelihoods of people reliant on this infrastructure (IGAD-CGIAR 2023). Furthermore, the hydrological impact of climate change will reduce hydropower generation from dams in the Blue Nile River Basin (Tariku et al. 2021). Considering that 60 percent of Sudan's electricity is generated through hydropower, which already faces challenges due to inadequate supply, this situation presents difficult trade-offs regarding water allocation during periods of drought (IGAD-CGIAR 2023). The absence of a clear mechanism for water allocation, the balance of distribution of water supply between hydropower and agriculture largely depends on the prevailing political will, which can contribute to conflict (IGAD-CGIAR 2023).

Conflicts around the access and use of water and land are found in many rural areas of Sudan, especially in Darfur, Kordofan, Gadarif and Blue Nile states (Elagib et al. 2017; Chanavanduka & Bromley 2011; Suliman and Ahmed 2017; Ali & Mustafa 2019). The Nile River Basin offers substantial freshwater resources, albeit with significant but poorly developed groundwater reserves (UNEP 2020). However, access to water differs between regions (UNEP 2020). Empirically, violence tends to arise in areas where water is more abundant, attributed to the movement of people towards water sources (Selby & Hoffmann 2014). Water is a critical determining factor for rangelands, with some areas underutilized due to water scarcity while others are overgrazed, particularly if permanent water sources are present (Ali & Mustafa 2019). In the dry season, pastoralists move their livestock to riverbanks, streams or manmade wells such as hafirs situated in areas distant from the river (Ali & Mustafa 2019). Water availability is the most pressing issue for most pastoralists, but hafirs often become depleted, abandoned or blocked by farming communities, which can constitute a source of local conflicts (Suleiman & Ahmed 2013). Especially in lowland areas, the availability of water is thereby generating conflict (Maystadt et al. 2015).

The pressure on natural resources is leading to increased competition over land, pasture and water, while unsustainable usage leads to further degradation of resources, thereby precipitating a vicious circle (Foong et al. 2020). Sudan has been plagued by a long history of conflict, state interference and the erosion of institutions, leaving it with weak governance that hampers the sustainable management of resources (Young 2009). While Sudan has the framework of policies and necessary laws in place, their implementation and the capacities of the responsible institutions are not sufficient to prevent the degradation of natural resources (IGAD-CGIAR 2023).

> "*In Sudan, there are many policies interlinked with natural resources, such as forest, water or land policies. But the enforcement and implementation of these policies is very weak. This, combined with a lack of coordination between institutions, largely affects the development of the country by affecting natural resources and enhancing the impacts of climate change due to less resilient systems.*" (IGAD-CGIAR Workshop participant 2023)

Conflict between herders and settled farmers is the most prominent form of climate-related conflict in Sudan. Relationships between temperature anomalies and intergroup violence are particularly strong in pastoralist and agro-pastoralist areas (Maystadt et al. 2015). The workshop identified the most apparent overlap of climate and conflict as occurring in areas such as Darfur, Kordofan, Blue Nile State and Kassala, where most people depend on natural resources either for agriculture or livestock and the population is a mix of herders and farmers (IGAD-CGIAR 2023). The competition between these groups for the already scarce resources of water and land, as well as bordering disputes over livestock trekking routes, is intensifying due to the stress imposed by climate change. This significantly contributes to inter-communal conflict and acts of violence (IGAD-CGIAR 2023). In Sudan, mobile livestock and crop production are shaped by the climatic differences between the north and south. Pastoralists move southwards during the dry season and back north again during the wet season (Chanavanduka & Bromley 2011). The limited availability of arable land for farming, pasture for grazing and water for human and animal consumption are thereby a focus for competition among people who come into contact while pursuing different livelihood strategies (Bronkhorst 2011). With pressure from climate change and desertification, pastoralists are moving ever further south in their quest for grazing and water for their livestock. This is, however, straining the capacities of the areas they turn to, leading to tensions with settled farmers (Chanavanduka & Bromley 2011). Lack of water and grazing land also forces pastoralists to move earlier than usual during the dry season, often arriving in farming communities before crops are harvested, which then results in conflict between the two groups when crops are damaged (De Coning et al. 2022). Without consultation prior to their arrival and approval to move through farmland, the potential for conflict with the settled communities increases (Ahmed 2012). Further contributing to resource competition are the adaptation strategies adopted by farmers as a response to degrading soil conditions and diminished harvests, which often means increasing the size of their fields in line with the governmental approach to lift agricultural production through greater adoption of mechanized farming (Foong et al. 2020).

> *"In areas dependent on natural resources, the productivity of crops and livestock are diminished which can lead to famine. This leads to movements of pastoralist with their livestock to other areas looking for land with more rainfall availability. During their movements, they might cross land that belongs to other groups. The competition over natural resources there is exacerbating conflict. As pastoralist lose their assets within highly affected areas, they are trying to access resources within more productive lands."* (IGAD-CGIAR Workshop participant 2023)

Resource Availability and Access in Darfur

Farmer-herder resource conflicts have contributed to the war in Darfur, and are often held up as an example of how climate-induced competition over natural resources can turn violent (UNEP 2007; Hakim 2011; Silander 2021; Leroy 2009). Certainly, the natural resource base in Darfur has been severely strained by repeated droughts, while ecological collapse has led to an erosion of social cohesion (Hakim 2011). Scarcity of fodder and water have been and still constitute a root cause for many small-scale conflicts (IGAD-CGIAR 2023). The focus of government on large-scale mechanized farming has also had an impact (Young & Ismail 2019), with traditional cooperative agreements between farmers and herders disrupted by not only the eviction of small-scale farmers from their land but also the blocking of habitual migratory routes used by pastoralists (Elagib et al. 2017). Government-fostered fragmentation and interethnic power struggles in Darfur have undermined traditional institutions

for mitigating resource conflicts, allowing tension over resources to escalate into larger violence (De Juan 2015; Castro 2018). The narrative of climate-induced war in Darfur, however, needs to be treated with caution, as it has been criticised for oversimplifying what is a complex conflict, neglecting its political dimensions (Verhoeven 2011). This can also be seen in the comparison of Darfur with eastern Sudan, where similar conditions of ecological hardship and tribal tension have also led to resource competition but did not escalate into large-scale conflict and civil war (Brosché 2022).

> "*Direct impacts of climate change on water availability are due to temperature rise, lack of precipitation, shorter rainy season and erratic rain, which affects rain fed agriculture. In 2021 in North Darfur the impacts have been so severe, that no cultivation was possible. Most wadis were without water, affecting the access to drinking water for human and livestock. Many have lost their livelihood from agriculture or livestock, being left with nothing. Contributing to this is also desertification as well as desert storm affecting the health of people in the region. Strong winds are destroying the crops of farmers, affecting the yields of farmers.*" (IGAD-CGIAR Workshop participant 2023)

Resource Availability and Access in Blue Nile State

In Blue Nile State, two different categories of resource competition are common: 1) between pastoral groups due to crowding and competition at water points and along the banks of the Blue Nile River, and 2) between pastoralist and sedentary communities during the migration southwards in the dry season (Ali & Mustafa 2019). With the border between Sudan and South Sudan established in 2011, reduced access to pasture in the south has contributed to more tension over water sources within both categories of resource competition (Ali & Mustafa 2019). Tensions arising from seasonal climate variability occurs among farmers and herders as well as between large-scale and traditional farmers, due to weak institutionalized land and water rights (Suliman 2011). A land tenure system that favours large-scale farming is marginalizing the historically dominant pastoralist livelihood system, while significantly reducing the area of natural vegetation (Suleiman & Ahmed 2013; Suliman 2011). Large-scale farms encroach on traditional migration routes of pastoralists, curtailing their mobility (Suleiman & Ahmed 2017). The often deliberate decision of large-scale farmers to hinder livestock from entering their vicinity also contributes to conflict (Suleiman & Ahmed 2013). Traditional animal grazing routes are being altered as well for other reasons, such as drought and desertification, establishment of natural reserve parks, the occurrences of civil wars and the secession of South Sudan (Ali & Mustafa 2019). These shifts in migratory routes exacerbate conflict over natural resources in the areas where pastoralists find themselves (Bronkhorst 2011; Suliman & Ahmed 2013). Pastoralists tend to let their livestock wander into farms to access fodder and water, igniting farmer-herder conflicts, which in some cases can become larger conflicts necessitating community conflict resolution mechanisms (IGAD-CGIAR 2023).

> "*In Blue Nile State, large scale farms which are mostly owned by people from outside the area are strongly affecting livelihoods of local communities. This is perceived as a large threat as their land has been taken by others to generate income. Especially younger generation suffer from this. Local communities are very upset about this, court cases arise and grievances are increasing. In community consultation within the area, people have mostly focused on this matter in a very aggressive manner as their main concern.*" (IGAD-CGIAR Workshop participant 2023)

Resource Availability and Access in Nile River Basin

Competition around water resources also has a regional dimension whereby climate change poses important challenges for the management of shared water sources such as the Nile River. The Nile is the lifeline for many of its riparian countries and communities. For Sudan, it is the main water source (67 percent), and home to half of its population who live in the 15 percent of the country's land area that lies along the river (UNFCCC 2013). In 2011, Ethiopia announced the construction of the Great Ethiopian Renaissance Dam (GERD) on the Blue Nile river without prior consultation with the downstream countries of Sudan and Egypt (Allam & Eltahir 2019). The impact of the dam in the face of climate change are presently inconclusive. On the one hand, it provides several positive benefits for Sudan, including flood mitigation and provision of a more continuous flow of water that can be used for irrigation to increase agricultural production (Andualem et al. 2021). On the other hand, the amount of water that can be stored by GERD worries downstream countries since it gives Ethiopia control over water flows. Others point out that agricultural productivity for downstream riparian states may decline due to the lack of nutrients transported by naturally flowing water (Modber et al. 2021). Nonetheless, climate change will make regional stability along the Nile Basin more unpredictable, with rising temperatures, declining precipitation and increased evaporation reducing water capacities and magnifying the perceived threat of projects such as GERD for downstream countries (Mohammad 2020).

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About CGIAR FOCUS Climate Security

CGIAR aims to address gaps in knowledge about climate change and food security for peace and security policies and operations through a unique multidisciplinary approach. Our main objective is to align evidence from the realms of climate, land, and food systems science with peacebuilding efforts already underway that address conflict through evidence-based environmental, political, and socio-economic solutions.