

# Sudan



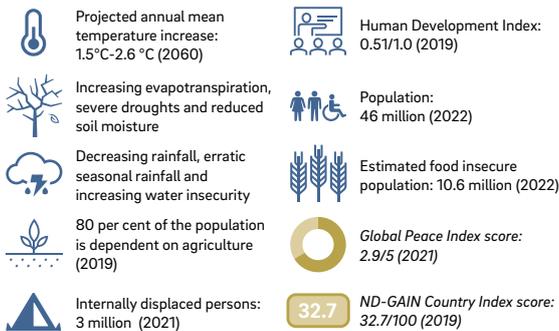
Sudan is severely exposed to climate change. As one of the world's least developed countries, extreme weather, recurrent floods and droughts, and changing precipitation interact with other vulnerabilities – such as ecosystem degradation, unsustainable agricultural practices, natural resource scarcities and resource-based conflicts – limiting societal capacities to cope and adapt. The economic consequences of COVID-19, ongoing political instability (further aggravated by the October 2021 military coup), and rising inflation all weaken state and societal resilience, livelihoods and food security.

- Rising temperatures, rainfall variability, and droughts and floods negatively impact agriculture, livelihoods and food security. In particular, the adverse effects of climate change, combined with gender-based disparities in natural resource governance, accentuate the climate-related security risks for women and girls.
- High levels of displacement sharpen humanitarian needs and vulnerability to the effects of climate change; shifting migration patterns in response to changing resource availability may increase the risk of local conflicts in some areas.
- Various conflict dynamics and decades of political interference, local conflicts (interlinked with land and natural resources) and ongoing political instability have undermined traditional resource management systems and state governance.
- The legacies of natural resource mismanagement have increased the marginalisation of rural communities and accelerated land degradation, exacerbating local vulnerabilities that add to the human security risks associated with climate change.

In the face of climate change, environmental degradation, persistent political and economic instability and violent conflict, local communities have shown remarkable resilience. However, projected increases in the magnitude and pace of climate change may overwhelm local adaptive capacities, especially taking into account the country's current political, economic and humanitarian crises.

## RECOMMENDED ACTIONS:

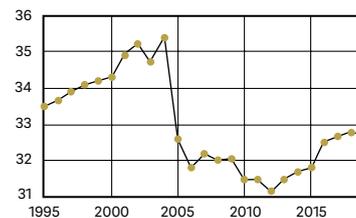
- ▶ The United Nations Integrated Transitional Assistance Mission in Sudan (UNITAMS) mandate recognises the adverse effects of climate change on the stability of Sudan and stresses the need for appropriate risk assessment and risk management strategies. An additional operative paragraph would ensure that UNITAMS and the UN system climate-proofs its programming in support of the humanitarian-development-peacebuilding nexus.
- ▶ Working with relevant and appropriate authorities, civil society organisations, and regional organisations, including the Intergovernmental Authority on Development (IGAD) and the African Union (AU); the UN system should expand its regional and cross-border climate-related risk analyses and cooperation, with a special focus on transhumance-related conflicts.
- ▶ The UN system should work with relevant Sudanese partners to incorporate indigenous knowledge on natural resource management and conflict management practices, leverage alternative energy sources, integrate flood and drought risk management into planning, and implement locally-owned adaptation programming in line with community needs.
- ▶ With assistance from international partners, including the UN, Sudanese institutions such as the Sudan Meteorological Authority should support integrated climate-sensitivity response mechanisms and durable solutions for displaced people, at the state, provincial and communal levels. Such responses should be informed by gender-differentiated analysis and programming.
- ▶ Relevant Sudanese authorities and institutions, including civil society, should explore entry points for environmental peacebuilding efforts under the framework of the 2020 Juba Peace Agreement (JPA), and with support from the UN and partners to facilitate the active participation of women and youth in environmental peacebuilding and peace processes, and in developing early warning and conflict prevention mechanisms.



### ND-GAIN Country Index

The ND-GAIN Country Index captures a country's Vulnerability to climate change and other global challenges, and its Readiness to improve resilience.

ND-GAIN Country Index score over time



Country comparison	ND-GAIN Country	Global Peace Index
Afghanistan	33.5/100	3.6/5
Niger	33.1/100	2.6/5
DRC	32.3/100	3.2/5
Guinea-Bissau	31.9/100	2.1/5

Figure 1. Data sources: World Bank. (2021). [Climate Change Knowledge Portal Sudan](#). UNEP (2020). [Sudan: First State of Environment and Outlook Report 2020](#); Harris I., et al. (2020). [Version 4 of the CRU TS Monthly High-Resolution Gridded Multivariate Climate Dataset](#). *Sci Data*, 7 (109). Taylor, K.E., et al. (2012). [An Overview of CMIP5 and the Experiment Design](#). *B Am Meteorol Soc*, 93, 485-498; Ministry of Environment and Physical Development. (2007). [National Adaptation Programme of Action](#). Food and Agriculture Organization (FAO). (2020). [Special Report: 2019 FAO Crop and Food Supply Assessment Mission \(CFSAM\) to Sudan](#). IOM. (2021). [Displacement Tracking Matrix \(DTM\) Sudan](#). UNDP. (2020). [Human Development Reports: Sudan](#). UNFPA. (2022). [World Population Dashboard: Sudan](#). WFP. (n.d.). [HungerMap Live: Sudan](#) [accessed 25 April 2022]. *Vision of Humanity*. (2021). [Global Peace Index: Sudan](#). Notre Dame Global Adaptation Initiative. (2019). [ND-GAIN Rankings](#).

## Climate Exposure: Trends and Projections

Much of the territory of Sudan is arid or semi-arid. Below the northern Sahelian belt, fertile agricultural and grazing land is found in the Nile valleys and other southern regions.<sup>1</sup> Climate change is expected to increase temperatures and change precipitation levels. Higher temperatures and evaporation rates, reduced soil moisture, and increasingly variable and reduced rainfall will exacerbate the risk of future water crises in Sudan.

**Temperature:** Sudan's mean annual temperature is estimated between 26°C and 32°C, with the northern regions experiencing very high summer temperatures often exceeding 43°C.<sup>2</sup> Mid-century mean annual temperatures are projected to increase between 1.5°C in the best scenario (SSP1) and 2.6°C in the worst scenario (SSP5).<sup>3</sup> By 2060, climate models forecast between 1.5°C and 3.1°C warming for the August rainy-season baseline, and between 1.1°C and 2.1°C above the January dry-season baseline.<sup>4</sup> Rising temperatures may contribute to intensifying droughts by increasing evapotranspiration and reducing soil moisture.<sup>5</sup>

**Precipitation:** Rainfall patterns in Sudan vary yearly and geographically: the northern regions receive almost no rain, central regions receive moderate rates of 200 to 700 mm, and some southern regions receive above 1,500 mm.<sup>6</sup> Precipitation projections are varied, but indicate greater inter-annual variability, more erratic seasonal rainfall and increased frequency and intensity of droughts.<sup>7</sup> 2050 projections indicate changes in rainfall ranging from a reduction of 9 per cent to an increase of 9 per cent.<sup>8</sup>

## Socio-ecological Vulnerabilities

Sudan's GDP growth plummeted following the 2011 secession of South Sudan. Since then, continued political instability, economic crisis, violent conflict and reduced rainfall have undermined livelihoods, increased poverty, food insecurity and forced displacement.

Agriculture is a driving force in Sudan's economy: 80 per cent of the population depends on agricultural production, and livestock accounted for 30 per cent of GDP in 2017.<sup>9</sup> Overgrazing, expanding mechanised agriculture and deforestation have further aggravated land degradation.<sup>10</sup> Sudan has one of the highest deforestation rates among the developing countries – roughly 2.4 per cent a year – increasing the intensity of dust storms, and accelerating desertification in northern regions.<sup>11</sup> The southward advance of the Sahara Desert could threaten 25 per cent of agricultural land and result in a 20 per cent drop in food production.<sup>12</sup>

The transboundary Nile River is the primary source of water for 67 per cent of Sudan's population.<sup>13</sup> Half of the population lives along the river, which covers 15 per cent of the country; they face less-certain water

flow due to the effects of climate change.<sup>14</sup> The Upper Blue Nile Basin is particularly vulnerable to temperature increases, higher evapotranspiration rates and lower annual rainfall.<sup>15</sup> Moreover, further increases in water demand stemming from population growth and agricultural development in upstream Nile basin states could exacerbate water shortages in the country.<sup>16</sup>

Food insecurity affects more than ten million people in Sudan – a figure which could double in the course of 2022.<sup>17</sup> Rising temperatures undermine the production of critical crops by increasing evaporation and evapotranspiration, increasing crop water requirements and decreasing food production by reducing farmland productivity.<sup>18</sup> Locust infestations, driven by changing climatic conditions, also exacerbate land degradation, food insecurity and social-ecological vulnerabilities.<sup>19</sup>

## Climate-related Peace and Security Risks

While there is no direct causal relationship between climate change and conflict, four pathways are used to navigate the complex relationships between climate, peace and security: (1) livelihood deterioration, (2) migration and mobility, (3) military and armed actors, and (4) political and economic exploitation and mismanagement.<sup>20</sup>

### Livelihood Deterioration

Rapid-onset disasters (like droughts and floods) and slow-onset climate change (such as changing seasonal rains) exacerbate vulnerabilities and emplace strains on livelihoods.<sup>21</sup> Rainfed agriculture accounts for 90 per cent of cultivated land in Sudan, making many vulnerable to climate change.<sup>22</sup> The effects of climate change, soil degradation, acute poverty and conflict have negatively affected natural resource-based livelihoods throughout the country.

More frequent floods and droughts impinge on farming and pastoralist livelihoods and food security. In 2020, flooding and landslides triggered by torrential downpours affected approximately 830 000 people in Sudan, destroying homes and crops. In North Darfur, Khartoum, Blue Nile, West Darfur and Sennar states, swathes of farmland were left underwater, and the Blue Nile region recorded the highest floods in over 100 years.<sup>23</sup>

Further, Sudan is affected by communal violence mobilised along ethnic or community identities. Conflicts between farmer and herder communities over access to land and water are also shaped by political interests, regional conflicts, marginalisation and exclusion, and agricultural expansion.<sup>24</sup> Evidence indicates that climate change has increased competition for access to water points, pasture and traditional grazing areas, triggering new rounds of intercommunal conflict, especially in West Darfur.<sup>25</sup> In some cases, resource competition has led

<sup>1</sup> World Bank. (2021). [Climate Change Knowledge Portal](#).

<sup>2</sup> World Bank, 2021.

<sup>3</sup> World Bank, 2021.

<sup>4</sup> Ministry of Environment and Physical Development. (2007). [National Adaptation Programme of Action](#); World Bank, 2021.

<sup>5</sup> UNEP. (2020). [Sudan: First State of Environment and Outlook Report 2020](#); Harris I., et al. (2020). [Version 4 of the CRU TS Monthly High-Resolution Gridded Multivariate Climate Dataset](#). *Sci Data* 7(109).

<sup>6</sup> World Bank, 2021.

<sup>7</sup> Taylor, K.E. et al. (2012). [An Overview of CMIP5 and the Experiment Design](#). *B Am Meteorol Soc*, 93, 485–498.

<sup>8</sup> Ministry of Environment and Physical Development, 2007.

<sup>9</sup> FAO. (2020). [Special Report: 2019 FAO Crop and Food Supply Assessment Mission \(CFSAM\) to Sudan](#).

<sup>10</sup> Dawelbait, M., & Morari, F. (2012). [Monitoring Desertification in a Savannah Region in Sudan Using Landsat Images and Spectral Mixture Analysis](#). *Journal of Arid Environments*, 80, 45–55.

<sup>11</sup> Egemi, O. (2017). [Report to Sudan LGAF Land Governance Report, Partners in Development Services](#); UNEP, 2020.

<sup>12</sup> USAID. (2016). [Climate Change Risk in Sudan: Country Fact Sheet](#); Saad, S.A.M., et al. (2018). [Combating Desertification in Sudan: Experiences and Lessons Learned](#). *Outlook* 10, 141–155.

<sup>13</sup> Ministry of Environment, Forestry and Physical Development (2013). [Sudan's Second National Communication under the United Nations Framework Convention on Climate Change](#).

<sup>14</sup> Moges, S. & Haileslassie, A. (2020) [Irrigation Development Projection in the Nile Basin Countries: Scenario-based Methodology Technical Report](#). NBI Technical Reports; Mohammed A. & Mustafa, I. (2019). [The Ecological, Socio-Economic and Political Constraints on Pastoralists' Access to Water, Blue Nile State \(Sudan\)](#).

Nomadic Peoples 23 (2), 282–302; Hamada, Y.M. (2017). [Agriculture and Irrigation in Nile Basin](#). In Hamada, Y.M. (Ed.) *The Grand Ethiopian Renaissance Dam, Its Impact on Egyptian Agriculture, and the Potential for Alleviating Water Scarcity*, Cham: Springer.

<sup>15</sup> Ministry of Environment, Forestry and Physical Development, 2013.

<sup>16</sup> Ministry of Environment and Physical Development, 2007.

<sup>17</sup> WFP. (n.d.). [HungerMap Live: Sudan](#) [accessed 25 April 2022]; WFP. (2022). [Sudan Emergency](#).

<sup>18</sup> Lizumi, T., et al. (2021). [Rising Temperatures and Increasing Demand Challenge Wheat Supply in Sudan](#), *Nature Food*, 2, 19–27; Osman-Elasha, B., et al. (2005). [Sustainable Livelihood Approach for Assessing Community Resilience to Climate Change: Case Studies from Sudan](#). AIACC Working Paper; UNEP, 2020.

<sup>19</sup> Eltourt Masaad, M. A. & Dafalla Mohamed, S. M. (2014). [Eco-Geographical Analysis of Desertification and Desert Locust Infestation Problems in Sudan](#). *Sudan Journal of Desertification Research* 6(1), 28–45.

<sup>20</sup> van Baalen, S. & Mobjörk, M. (2017). [Climate Change and Violent Conflict in East Africa: Integrating Qualitative and Quantitative Research to Probe the Mechanisms](#). *International Studies Review* 20(4), 547–575; Mobjörk, M., et al. (2020). [Pathways of Climate Insecurity: Guidance for Policymakers](#). SIPRI.

<sup>21</sup> van Baalen & Mobjörk, 2017.

<sup>22</sup> Siddig, K. et al. (2018). [Climate Change and Agriculture in the Sudan: Impact Pathways Beyond Changes in Mean Rainfall and Temperature](#). IFPRI.

<sup>23</sup> Al Jazeera. (2020, 25 Sept.). [Floods-hit Sudan Facing 'Unprecedented Challenges' UN Warns](#).

<sup>24</sup> Brosché, J. & Elfversson, E. (2012). [Communal Conflict, Civil War, and the State: Complexities, Connections, and the Case of Sudan](#). *African Journal on Conflict Resolution* 12 (1).

<sup>25</sup> Interview with humanitarian agency in Sudan, 28 April 2022.

to communal violence in other parts of southern and western Sudan.<sup>26</sup> Temperature extremes have been interconnected to conflict risk in both northern and southern parts of Sudan, due to sharper competition for water and other natural resources.<sup>27</sup> Water points, particularly hafirs—hand-dug or natural depressions—are hotspots for disputes that may escalate to clashes or conflicts.<sup>28</sup> Because of environmental degradation and climate change, pastoralists and farmers are likely to experience water shortages – and to produce less food.

Conflict and climate change have differentiated impacts on men and women, due to factors that include access to education, resources and land ownership, and mobility options. In Darfur, women make up 85 per cent of the total labour force but have restricted opportunities for land ownership.<sup>29</sup> In North Darfur, gender-based disparities in natural resource management have a negative effect on women's access to and control of resources, making them more vulnerable to the economic impacts of climate change.<sup>30</sup>

The relevant Sudanese authorities, at all levels, and their regional and international partners, should work with indigenous conflict-resolution mechanisms, civil society organisations and women and youth to enhance early warning systems and information-sharing on the effects of climate variability and climate change, including seasonal forecasts for rainfed agriculture.

### Migration and Mobility

In conflict areas, the effects of climate change have major impacts on displaced persons who have already exhausted their resources for effectively coping with shocks. While approximately 3 million people are internally displaced in Sudan, primarily by conflict.<sup>31</sup> Millions of people have remained in protracted displacement since the 2004 conflict, although provisions in the 2020 JPA are intended to facilitate the return to their land and property – much of which was farmland.<sup>32</sup> However, beyond the practical and legal complexities of the 18-year conflict, displacement, demographic increase and environmental degradation may further exacerbate the challenge of achieving durable solutions.

Reduced water availability, rainfall changes, recurrent droughts and rising temperatures have altered transhumance practices, with frequent movement through and outside seasonal migration routes in ways that increase the risk of community tensions around resources.<sup>33</sup> Herders seeking other food and water sources for their animals increase the risk of damaging the fragile ecosystems and farmland before harvests.<sup>34</sup> As a result, herders have encroached on farmlands, generating communal clashes between Arab pastoralists and non-Arab farmers.<sup>35</sup> In response, local militias assemble to defend communities and protect their resources and livelihoods. In the Kordofan region, Misseriyya herders migrate between wet-season grazing areas in the north and dry-season grazing areas in the south, but often hold competing claims over cattle-grazing lands and water resources in Ngok Dinka-dominated territories

## Livelihood Zones and Intercommunal Violence

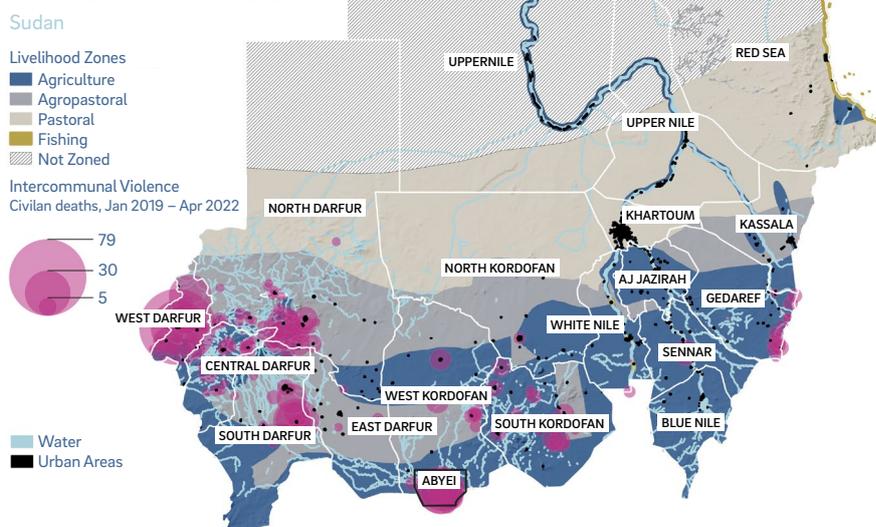


Figure 2. Data sources: FEWS, ACLED, SWAC-OECD, HDX & Natural Earth

of Abyei. This has led to mounting tensions recently between the Misseriyya and Ngok Dinka herders.<sup>36</sup>

Sudan is among the fastest urbanising countries in the world. Conflicts, flooding and droughts have contributed to urban migration, adding pressure on limited social services and leading to disruptions that can undermine stability and security in cities. This has led to an expansion of traditional rainfed agriculture at the expense of natural rangelands, leading to a reduction of the width of animal routes and ranches.<sup>37</sup>

In some regions, the growing out-migration of men has increased the number of female-headed households, who must often rely on renting land for livestock grazing and crops for income.<sup>38</sup> Because of such gender-based inequalities, female-headed households are at heightened risk of extreme weather events like floods.

Sudanese institutions, with support from regional and international partners, should enhance information-sharing and early warning tools using meteorological and satellite data for seasonal weather forecasts, migration routes and conflict hotspots, in coordination with local officials and civil society organisations, to prevent and mitigate transhumance-related conflicts, and improve the access to water and implement adequate water management systems across Sudan. The UN system can support Sudanese partners in strengthening natural resource governance, and in preventing and resolving climate-related conflicts, including those related to mobility and migration.

### Military and Armed Actors

The combined effects of climate change and violent conflict in the Darfur Region have exerted pressure on livelihood systems in the region – sometimes leading to changes in livelihood patterns.<sup>39</sup> Livelihood deterioration has had a disproportionate impact on youth, with young men increasingly migrating to urban areas for dry-season work

<sup>26</sup> Yagoub, M.A. & Egemi, O. (2012). [Environmental Governance in Sudan: An Expert Review](#). UNEP.

<sup>27</sup> Maystadt, J.F., et al. (2015). [Local Warming and Violent Conflict in North and South Sudan](#). *Journal of Economic Geography* 15(3), 649–71.

<sup>28</sup> UNEP (2007). [Sudan: Post-Conflict Environmental Assessment](#).

<sup>29</sup> UNEP, 2020.

<sup>30</sup> UNEP. (2014). [Gender Equality and the Environment: A guide to UNEP's work](#).

<sup>31</sup> IOM. (2021). [Displacement Tracking Matrix \(DTM\) Sudan](#).

<sup>32</sup> Day, A. (2020). [Climate Change and Security: Perspectives From the Field](#).

<sup>33</sup> UN University Centre for Policy Research; [Juba Agreement for Peace in Sudan between the Transitional Government of Sudan and the Parties to Peace Process](#). Signed 3 October 2020, Chapter 7.

<sup>34</sup> Sulieman, H.M., & Ahmed, A.G.M. (2013). [Monitoring Changes in Pastoral Resources in Eastern Sudan: A Synthesis of Remote Sensing and Local Knowledge](#). *Pastoralism: Research, Policy and Practice*, 3(22).

<sup>34</sup> Gramizzi, C., & Tubiana, J. (2013). [New War, Old Enemies: Conflict Dynamics in South Kordofan](#). HSBA Working Paper 29.

<sup>35</sup> Ahmed, M.E. (2012). [Blue Nile: National and Indigenous Conflict Management – Competing or Complementary Systems?](#) *New Routes* 17(2), 22–25.

<sup>36</sup> Pantuliano, S. (2010). [Oil, Land and Conflict: The Decline of Misseriyya Pastoralism in Sudan](#). *Review of African Political Economy* 37(123); Tarif, K. et al. (2021). [Abyei Offers Lessons for the Region on Climate-related Security Risks](#). SIPRI.

<sup>37</sup> Central Bank of Sudan. (2018). [58th Annual Report](#).

<sup>38</sup> UNEP, UN Women & UNDP. (2019). [Promoting Gender-Responsive Approaches to Natural Resource Management for Peace in North Kordofan, Sudan](#).

<sup>39</sup> Young, H., & Ismail, M.A. (2019). [Complexity, Continuity and Change: Livelihood Resilience in the Darfur Region of Sudan](#). *Disasters*, 43.

opportunities, to the gold mines and to armed services.<sup>40</sup>

The transboundary al-Fashaga region on the Sudan and Ethiopia border has experienced growing competition over resources and land, accentuated by the erosion of governance, weak institutions and poorly implemented policies. In 2020, clashes occurred between locals across the border between Sudan and Ethiopia over limited resources, leading to civilian casualties.<sup>41</sup>

Traditional leaders have historically played a significant role in natural resource management in Sudan, particularly in remote rural areas.<sup>42</sup> Traditional leaders would manage pre-agreed livestock migration routes and negotiate between herders and farmers, and local settled communities. However, the military regimes from the 1970s onwards have contributed to undermining such traditional conflict management systems and local governance structures. The result has been greater local vulnerability to the adverse effects of climate change, due to weakened factors for resilience.<sup>43</sup>

With support from the UN and others, Sudanese institutions responsible for conflict resolution, including indigenous mechanisms and civil society organisations, should explore entry points for environmental peacebuilding efforts, and facilitate the active participation of women and youth in dialogue and peace processes. Indigenous knowledge can usefully be leveraged to inform climate adaptation programming that responds to local needs.

**Political and Economic Exploitation and Mismanagement**

Conflicts in Sudan have repeatedly been linked to economic and political marginalisation resulting from unequal development patterns and exploitative governance. Economic liberalisation policies from the 1970s encouraged Gulf state investment and resource extraction. In the 1970s, the 1990s and as recently as 2013, the nationalisation and sale of land for large-scale mechanised agriculture favoured investors from Khartoum or outside Sudan at the expense of local communities, fuelling tensions and forced displacement.<sup>44</sup> National agriculture policies have favoured capital-intensive, large-scale farming, which has side-lined

**Food Insecurity and Internal Displacement**

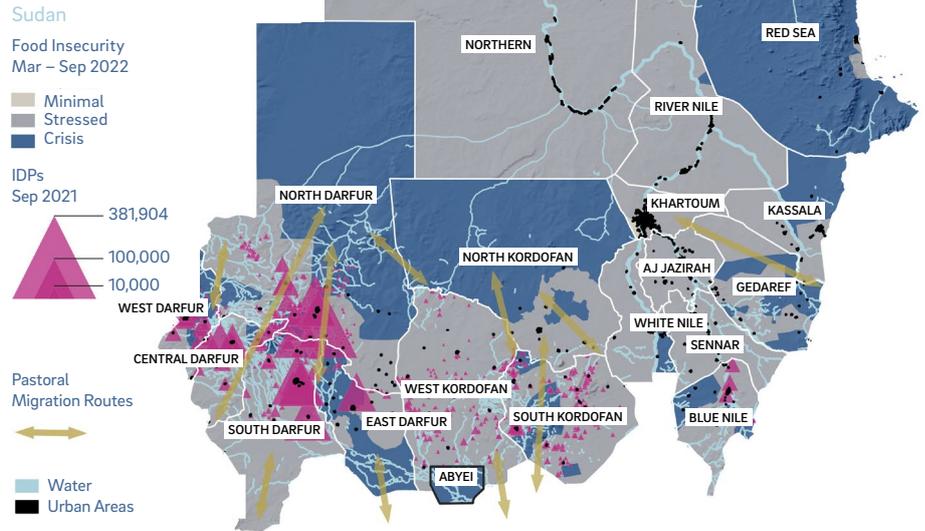


Figure 3. Data sources: FEWS, IOM, SWAC-OECD, HDX, IGAD & Natural Earth

traditional farming techniques and focused on exporting raw materials, degrading land across agricultural areas of Sudan.<sup>45</sup>

Since the 1990s, Sudan’s natural resources have been largely controlled by the security forces and Khartoum-based elites, accentuating the marginalization of peripheral areas.<sup>46</sup> Security forces, like the Rapid Support Force, held control of gold-mining areas.<sup>47</sup> Certain mining practices have led to the contamination of water bodies in West Kordofan state and the destruction of pastures in eastern Sudan.<sup>48</sup> State and military involvement in exploitative commercial farming has also renewed conflicts over timber exploitation by the North’s charcoal industry, encroaching on forests from southern areas.<sup>49</sup>

Sudan’s constitution, the Juba Peace Agreement and other key Sudanese landmark agreements contain core principles that can help Sudan to take steps to guide the protection of the environment and the management of natural resources. Steps need to address issues related to land tenure, and the lack of clarity between customary and statutory systems of land ownership, which has an impact on natural resource management and environmental conflict prevention.

<sup>40</sup> Young & Ismail, 2019.  
<sup>41</sup> Crisis Group (2021). [Containing the Volatile Sudan–Ethiopia Border Dispute](#).  
<sup>42</sup> Sulieman & Ahmed, 2013.  
<sup>43</sup> Elhadary, Y. & Abdelatti, H. (2016). [The Implication of Land Grabbing on Pastoral Economy in Sudan](#). World Environment 6(2), 25–33.  
<sup>44</sup> Tchier, E.Y.A., & Ali, H.E. (2021). [Restructuring State Power in Sudan](#). The Economics of Peace and Security Journal, 16(1), 41–51.

<sup>45</sup> Elnur, I. (2008). *Contested Sudan: The Political Economy of War and Reconstruction*. New York: Routledge.  
<sup>46</sup> Tchier & Ali, 2021.  
<sup>47</sup> Ibrahim, M, S. (2015). [Artisanal Mining in Sudan – Opportunities, Challenges and Impacts](#). UNCTAD.  
<sup>48</sup> UNEP, 2020.  
<sup>49</sup> UNEP, 2007.

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