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Niklas Placke B.A.

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Abstract

This thesis investigates the extent to which climate change has contributed to violent conflict in Sudan's Darfur region. Using a mixed-methods approach, it combines statistical analysis of climate and conflict data with a qualitative perspective rooted in political ecology. The numbers suggest a correlation between rising temperatures and violent incidents, though no consistent pattern was found for rainfall. However, it is the qualitative findings that provide deeper insights: climate change did not act alone but rather intensified existing inequalities and governance failures. The analysis shows how access to land, state interventions in environmental governance, and the politicization of climate adaptation measures all shaped how communities in Darfur experienced environmental stress. Rather than framing the conflict as a direct result of climate impacts, the study argues that structural injustice, political exclusion, and contested resource governance are key to understanding how climate change became entangled in violence. In short, Darfur is not simply a "climate war," but a case where climate change amplified already existing political and social fault lines.

Zusammenfassung

Diese Masterarbeit geht der Frage nach, ob und wie der Klimawandel eine Rolle bei der Entstehung und Eskalation des Konflikts in Darfur (Sudan) gespielt hat. Im Zentrum steht die Kombination aus quantitativen Datenanalysen zu Temperatur- und Niederschlagsveränderungen und einer qualitativen Untersuchung, die auf dem Ansatz der Politischen Ökologie basiert. Die statistische Analyse zeigt eine erkennbare Korrelation zwischen steigenden Temperaturen und zunehmender Gewalt, während sich für Niederschlag keine klare Beziehung herstellen lässt. Entscheidend sind jedoch die qualitativen Erkenntnisse: Der Klimawandel wirkt nicht isoliert, sondern entfaltet seine Wirkung in einem politischen Umfeld, das von staatlicher Vernachlässigung, ungleicher Ressourcenzuteilung und historischer Marginalisierung geprägt ist. Besitz- und Gebrauchsrechte von Land, die Rolle des Staates in der Reglementierung von Landfragen und die politische Instrumentalisierung von Anpassungsmaßnahmen zeigen, dass strukturelle Ungleichheiten entscheidend dafür sind, ob klimatische Belastungen in Gewalt umschlagen. Die Arbeit zeigt, dass Darfur weniger ein „Klimakrieg“ ist, sondern vielmehr ein Fall, in dem Umweltveränderungen bestehende Konfliktlinien verschärfen.

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I. Introduction

All Wars are Civil Wars, because all Men are Brothers.

- François de Salignac de la Moth-Fénelon (1651-1715)

Few regions in the world encapsulate the complexity of modern conflict like Darfur. Once a peripheral region in western Sudan, Darfur has become emblematic of the 21st century's most pressing security, humanitarian, and environmental challenges. Since the eruption of large-scale violence in the early 2000s, the region has witnessed protracted civil war, mass displacement, widespread atrocities, and deepening political fragmentation. Despite the magnitude of the crisis, sustained international academic and media attention has remained sporadic at best. When Darfur has entered global conversations, it has often been framed through a narrow lens: as an ethnic conflict, as a case of political marginalization, or, more recently, as one of the world's first "climate wars." This last theme, particularly, has gained widespread recognition among policymakers and international institutions, positing the war was caused or at least significantly exacerbated by climate change – namely, rising temperatures, desertification, drought, and changed rainfall patterns.

This thesis takes Darfur – its landscape, its history, and its conflicts – as the point of departure to explore a broader and deeply contested question in contemporary environmental security debates: *does climate change cause conflict?* More specifically, *how, and to what extent, has climate change contributed to the outbreak and persistence of violence in Darfur?* The premise that climate-induced environmental degradation has fueled resource competition, and thereby contributed to armed conflict, has been popularized by figures such as former UN Secretary-General Ban Ki-moon (2007), who famously described the war in Darfur as a blueprint for future climate-driven conflicts. Numerous reports have echoed this view, arguing that rising temperatures, declining rainfall, and expanding deserts have undermined livelihoods and triggered competition between pastoralists and farmers, particularly along ethnic lines (cf. UNEP, 2007; Sova, 2017; Kamen, 2021).

However, while intuitively appealing and politically potent, the climate-conflict narrative has drawn considerable criticism. Scholars have pointed out that empirical evidence for a direct causal link between environmental stress and violent conflict remains inconsistent and often inconclusive (cf. Buhaug, 2010; Selby and Hoffmann, 2014). Moreover, critics argue that prioritizing climate change as a causative factor risks obscuring the multidimensional political,

economic, and historic factors that set regions like Darfur on the trajectory to violence in the first place. To this argument, environmental stresses may be understood as a "threat multiplier" but rarely a cause of conflict in and of itself. To critically engage with this debate, this thesis adopts a mixed-methods approach and a political ecology framework. The study is designed to probe both the empirical validity of the climate-conflict thesis in Darfur and to interrogate the structural conditions under which climate variability might influence violence. The research question guiding this thesis is: *how do the effects of climate change drive conflict in Darfur?* To answer this, the analytical part is structured twofold. Firstly, it offers a quantitative analysis of climate and conflict data from 1989 to 2019, examining long-term trends in temperature and rainfall and their statistical correlation with reported violent events. This is achieved through statistical modeling and spatial mapping of both conflict and climate anomalies. This aims to determine whether there is a measurable correlation between climatic trends and the occurrence of conflict events in the region. However, quantitative methods alone are insufficient to capture the layered realities of conflict. For this reason, the second part of the thesis turns to qualitative analysis, using the framework of political ecology to explore causal pathways that cannot be uncovered through statistical techniques. Political ecology is particularly well-suited to this task because it situates environmental phenomena within broader systems of power, governance, and historical transformation. The qualitative analysis is built around three core themes: access to land and the political economy of resource distribution; state power and environmental governance; and climate adaptation as a site of political contestation. These themes are not treated in isolation but are woven into a broader narrative that emphasizes the historical and institutional legacies of colonialism, the centralizing tendencies of the postcolonial Sudanese state, and the differential access to adaptive capacity among Darfur's diverse populations.

In taking this approach, the thesis aims to contribute to both scholarly and policy debates on climate-conflict linkages. Empirically, it adds much-needed regional specificity to a field that often relies on large-N cross-country studies with limited contextual depth. Theoretically, it challenges deterministic assumptions about environmental causality and instead emphasizes the mediating role of governance structures, institutional arrangements, and socio-political inequalities. The objective is not to deny the reality or severity of climate change in Darfur, but rather to understand how and under what conditions environmental stress translates into violence.

The thesis is structured as follows. Chapter 2 gives an introduction to Darfur's history, as historical grievances are still at play in today's conflict(s) and are all so readily omitted in popular discourses. Chapter 3 presents a literature review, situating this study within the broader

academic debate on climate change and conflict. It critically examines existing research – especially in the Darfuri context – trying to identify gaps and entry points for a political ecologist analysis. Chapter 4 outlines the theoretical framework, discussing political ecology as an analytical lens for understanding the relationship between environmental change and conflict. Chapter 5 details the research methodology, explaining the mixed-methods approach and justifying the selection of quantitative and qualitative methods. It also provides an overview of data sources, including climate records, conflict databases, and qualitative source materials. Chapter 6 presents the quantitative analysis, examining statistical correlations between climate change indicators and conflict patterns in Darfur. This chapter utilizes climate and conflict data to assess whether we find a measurable link between environmental changes and violence. Chapter 7 shifts to a qualitative analysis, identifying potential causal pathways through which climate change may contribute to conflict. This chapter applies political ecology to examine governance structures, land tenure policies, and economic factors that mediate environmental stress. Finally, Chapter 8 concludes the thesis by summarizing the main findings, reflecting on their implications, and situating them within the broader literature.

II. A Quick History of Darfur

Violence in Darfur in cataclysmic.

- Emmanuel Jal (b. 1980)

If you were to ask an unsuspecting passerby what comes to mind when they hear "Darfur," chances are their answer would include some combination of "war," "genocide," "famine," and "humanitarian crisis," or – probably most likely – "never heard of it." This is not surprising, given the fluctuating media coverage Darfur has received since its most infamous outbreak of violence in the early 2000s. However, as with many conflicts in history, the simplified narratives we encounter in those (rare) headlines and political speeches often obscure more than they reveal.

To understand how climate change might impact conflict in 21st-century Darfur, one must first grapple with the region's long and often turbulent history. Far from being an isolated periphery, Darfur has been an integral part of broader regional and international networks for centuries, shaped by trans-Saharan trade, colonial interventions, and postcolonial state-building projects

(Flint & De Waal, 2008). The very name "Darfur," meaning "land of the Fur," reflects the deep historical presence of the Fur sultanate, which ruled over a multi-ethnic polity until its conquest by the British-Egyptian administration in the early 20th century. But Darfur's history is not just about kings and colonial officers – it is also a story of ordinary people, pastoralists, and farmers who have long navigated the challenges of resource competition, shifting political allegiances, and environmental uncertainty (Ahmad & Manger, 2006). Understanding Darfur's conflicts requires looking beyond the immediate violence to the structural factors that sustain cycles of war and instability. As this chapter unfolds, we will – in a compromised fashion – trace Darfur's history from its pre-colonial sultanates to the devastating war of the 2000s, laying the groundwork for later discussions on how climate change might interact with these deeper historical and structural drivers of conflict.



Figure 1: Map of Modern Sudan highlighting the Darfuri Region (Source: BBC)

A. An Early History of Darfur

Darfur, whose name has become almost synonymous with conflict, has a complex and rich history shaped by shifting political power, ecological pressure, and socio-economic transformation. Situated in western Sudan, Darfur has for centuries been a crossroads of culture, trade, and migration. Darfur's history is intimately tied up in the broader history of Sudan and the Sahel, with successive sultanates ascending and descending, colonial exploits, and post-independence struggles.

1. The Darfur Sultanate and Early Political Structures

The earliest known political entity in Darfur was the Darfur Sultanate, established in the 17th century by the *Keira* dynasty. The Sultanate, which emerged as a dominant political entity in western Sudan, represents a unique case of early state formation in the African Sahel. It was a hybrid polity, integrating indigenous governance structures with Islamic influences that had been steadily advancing through trans-Saharan trade and scholarly exchanges (O'Fahey, 2008). It came to power in the 17th century under Sultan *Sulayman Solong* (r. 1596–1637). Solong is credited with consolidating control over disparate communities in Darfur, unifying them under a centralized authority while maintaining a degree of local autonomy (O'Fahey, 1980). Keira's rulers expanded their territory through conquest, diplomacy, and marriage, and Darfur became a significant regional power. During its expansion, the Sultanate came in touch with a number of ethnic groups, including the *Fur*, *Zaghawa*, and *Tunjur*. These groups played a pivotal role in determining the sociopolitical fabric of Darfur because the Keira leadership integrated them into the system of governance, at times allocating them governmental positions in exchange for their loyalty. Contrary to the European model of the nation-state, the Darfur Sultanate was grounded in an evolving and multi-layered system of government that sustained centralized authority but allowed for local autonomy. This approach effectively managed its ethnically diverse population (Braukämper, 1992). At its core was the Sultan, who wielded supreme authority and was regarded as both a political and spiritual leader. The legitimacy of the Sultan was reinforced through Islamic principles, and he was often seen as a protector of Islam in the region (O'Fahey & Spaulding, 2018). Beneath the Sultan was a hierarchical bureaucracy composed of advisers, military commanders, and provincial governors. The *Shartai* and *Maqdum*, key administrative officials, managed regional affairs and reported directly to the Sultan. These officials exercised a degree of local autonomy, which allowed them to respond effectively to regional dynamics while still being accountable to the central authority (Lobban, 2001).

The legal system of the Darfur Sultanate was a blend of Islamic law (*Sharia*) and customary law. Sharia was predominantly applied in urban centers and among the elite, while customary laws, known as *Urfi* law, governed rural areas and pastoralist communities (O'Fahey, 2008). This dual legal structure reflected the Sultanate's pragmatic governance approach, allowing it to maintain control over both sedentary and nomadic populations without imposing a rigid legal framework that could lead to resistance.

Economic prosperity was a key pillar of the Darfur Sultanate's stability. The kingdom benefited from its strategic location along trans-Saharan trade routes, which promoted the exchange of

goods such as gold, ivory, enslaved people, and textiles between North Africa, the Sahel, and sub-Saharan Africa (Collins, 2008). Merchants from as far as Tripoli and Cairo conducted trade in Darfur, leading to the growth of commercial hubs such as Al-Fashir, which served as the Sultanate's capital and economic center. The state also controlled key agricultural and pastoral resources. Darfur's agrarian economy was based on millet and sorghum cultivation, while extensive cattle and camel herding supported its pastoral economy. The Sultanate implemented a taxation system where traders and farmers contributed a portion of their earnings to the state, enabling the ruling elite to finance military campaigns and governance structures (Braukämper, 1992).

Islam had a great impact on the sociopolitical and cultural landscape of the Darfur Sultanate. Traditional spiritual beliefs persisted among some groups, but Islam was the dominant religious paradigm, particularly among the ruling elite. The sultans patronized Islamic scholars, built mosques, and maintained close ties with religious leaders, some of whom also served as state advisers (O'Fahey, 2008). Socially, Darfur was a stratified society with a hierarchical system that included aristocrats, religious elites, traders, farmers, and enslaved persons. Social mobility was possible despite these divisions, particularly through military service or religious scholarship. Enslavement, while a key part of the economic system, was not necessarily permanent; some enslaved individuals gained influence as royal guards or administrative officials (Collins, 2008).

The decline of the Darfur Sultanate began in the late 19th century due to internal strife, external pressures, and the changing geopolitical landscape. Ottoman-Egyptian expansion into Sudan in the 1820s and 1830s increased pressure on Darfur, disrupting trade networks and weakening the state's economic foundations. Additionally, tensions between the sultans and regional elites and competition over resources led to internal instability. By the late 19th century, Darfur faced its most significant challenge with the rise of the *Mahdist* movement in Sudan. The Mahdists, led by *Muhammad Ahmad*, sought to unify Sudan under Islamic rule and launched military campaigns that ultimately led to the conquest of Darfur in 1874. Sultan *Ibrahim Garad*, the last independent ruler of Darfur, was killed during the Mahdist invasion, marking the formal dissolution of the Sultanate (O'Fahey, 2008). However, Darfur's legacy persisted, as many of its governance structures and social dynamics continued to influence the region under later colonial and postcolonial administrations.

2. Colonial Rule and Marginalization

At the dawn of the 20th century, Darfur stood as one of the last independent territories in the Sudanese region, governed by Sultan *Ali Dinar*. His rule was dominated by efforts to consolidate power, assert regional autonomy, and resist external domination, particularly from the Anglo-Egyptian authorities who had their eyes set on expansion (O'Fahey, 2008). Ali Dinar's political maneuvering during World War I – namely, his ill-fated alignment with the Ottoman Empire – provided the British with a convenient pretext for intervention. In 1916, British forces launched a military campaign against Darfur, swiftly defeating Ali Dinar's army, killing the Sultan himself, and formally annexing Darfur into the Anglo-Egyptian Condominium (Collins, 2008). With that, centuries of independent rule ended abruptly, and Darfur was absorbed into a colonial structure that barely acknowledged its existence.

Unlike other parts of Sudan, where British rule brought a semblance of modernization in administrative structures, Darfur was largely neglected. The British, ever pragmatic in their governance strategies (which often meant spending as little effort as possible on "troublesome" territories), decided that Darfur was best left as an underdeveloped frontier. It was portrayed as an unruly and backward periphery, unworthy of significant investment or political integration (Mamdani, 2009). The colonial administration introduced indirect rule, a system designed to control the region through local tribal leaders rather than direct governance. While convenient for the British, this strategy had profound and long-lasting consequences for Darfur's political and social landscape (De Waal, 2007).

One of the most damaging effects of indirect rule was the institutionalization of ethnic identities. Pre-colonial Darfur had a complex and fluid socio-political structure, where ethnic categories were often secondary to economic and social affiliations. However, the British, always eager to categorize and codify, imposed rigid distinctions between so-called "Arab" and "African" groups. This bureaucratic obsession with classification reinforced divisions and laid the groundwork for ethnicizing political conflict in the decades to come (Flint & De Waal, 2008). At the same time, by empowering local chiefs while dismantling centralized authority, the British effectively fragmented governance in Darfur. This administrative fragmentation made it nearly impossible for the region to establish an effective political leadership, resolve conflicts, or push for collective interests at the national level. What remained was a patchwork of tribal authorities, each vying for influence in an increasingly anarchic environment.

Beyond governance, colonial rule deepened Darfur's economic and political marginalization. While the British poured resources into developing the Nile Valley – establishing large-scale irrigation projects like the Gezira Scheme, which transformed Sudan's agricultural sector –

Darfur was left out of the equation (Collins, 2008). Infrastructure development was virtually nonexistent; roads, railways, and communication networks remained rudimentary, ensuring Darfur remained isolated from national markets (Kevane & Gray, 2008). The region's educational opportunities were similarly bleak. While missionary and government schools proliferated in other parts of Sudan, particularly in the north and center, Darfur was ignored. The result was a lack of access to formal education, which curtailed Darfuris' ability to participate in political and economic life. And then, of course, there was taxation, a ubiquitous feature of colonial rule. The British had no bad feelings about imposing heavy taxes on Darfur's agricultural and pastoralist communities, extracting revenue without reinvesting in local development. This economic exploitation fueled resentment and reinforced the perception that Darfur was little more than a resource pool for an indifferent colonial administration (Burr & Collins, 2006).

By the time Sudan gained independence in 1956, Darfur had already been relegated to the margins of the new state. The exclusion and underdevelopment structures established under British rule did not disappear – they would be inherited and, in many cases, reinforced by postcolonial Sudanese governments. Power and resources remained concentrated in Khartoum, leaving Darfur in perpetual neglect.

3. Post-Independence Instability and the Rise of Political Exclusion

The transition from colonial rule to an independent Sudan in 1956 did not bring the long-awaited political and economic integration that many in Darfur had hoped for. Instead, the newly formed national government, dominated by elites from the Nile Valley, inherited and perpetuated many of the structural inequalities established during the colonial era (De Waal, 2007). The political landscape of post-independence Sudan was shaped by a combination of authoritarian governance, economic neglect, and ethnic favoritism, all of which contributed to Darfur's deepening marginalization (Flint & De Waal, 2008). Over the following decades, successive governments prioritized the interests of the central regions while sidelining the peripheries, reinforcing patterns of exclusion that fueled grievances and sowed the seeds of future conflicts (Mamdani, 2009).

At independence, Sudan faced the immense challenge of constructing a unified national identity from a highly diverse population with significant ethnic, linguistic, and regional differences (Sharkey, 2008). The central government, controlled by an Arabized elite primarily from Khartoum and the Nile Valley, viewed peripheral regions such as Darfur, the Nuba Mountains, and the South through a lens of economic and political subordination (Johnson, 2016). The

ruling class, composed mainly of riverine Arabs, saw themselves as the legitimate heirs to state power and dismissed calls for federalism or equitable resource distribution, thereby alienating large segments of the population (Woodward, 1990). In Darfur, this translated into a lack of meaningful political representation, economic investment, and social development. Despite its vast size and substantial population, Darfur remained politically peripheral, its concerns dismissed by decision-makers in Khartoum who saw little reason to incorporate the region into national planning and governance (Burr & Collins, 2006).

Economic policies following independence reinforced this exclusion. While the central government invested heavily in large-scale development projects such as the Gezira Irrigation Scheme and infrastructure expansion in the Nile Valley, Darfur was systematically ignored. Roads, schools, and healthcare facilities remained underdeveloped, and government spending on public services in the region was minimal compared to the northern and central provinces. Agriculture, the primary economic activity in Darfur, received little state support, and state policies favored large commercial farming enterprises in the heartlands over the West's traditional pastoralist and smallholder farming economies. This economic neglect left the region vulnerable to recurrent drought and food scarcity, further escalating tensions among different livelihood groups and intensifying feelings of exclusion (Keen, 2008).

Politically, more and more, Darfuris were being denied access to key government institutions and decision-making systems. In the early years of independence, Sudan was governed by a series of fragile coalitions that struggled to balance the demands of competing regional and ideological factions (Lesch, 1998). However, these governments were overwhelmingly dominated by elites from the north and central regions, who maintained their grip on power through patronage networks that systematically excluded representatives from Darfur (Collins, 2008). The few Darfuris who managed to secure positions within the government often found themselves relegated to symbolic roles without substantive influence (Prunier, 2007). The centralization of political authority in Khartoum meant that local governance structures in Darfur remained weak, leaving the region with little autonomy over its affairs.

The arrival of military dictatorship in Sudan entrenched such trends of marginalization. General *Ibrahim Abboud's* military government (1958–1964) continued policies of economic neglect and political centralization, marginalizing the Darfuris and other peripheral groups in the Sudan. The brief return to civilian rule under the Umma Party and the Democratic Unionist Party in the mid-1960s did little to alter the status quo, as political parties remained dominated by the northern elite and failed to address the demands for regional autonomy and fair resource allocation (Daly, 2007).

The subsequent military takeover by General *Jaafar Nimeiri* in 1969 initially raised hopes for greater regional inclusion, as his government espoused socialist and pan-Sudanese rhetoric. However, Nimeiri's policies ultimately reinforced regional inequalities, as his government prioritized consolidating power through alliances with northern elites while cracking down on opposition movements in the peripheries (Beshir, 1975).

Throughout the 1970s and 1980s, Darfur's political and economic neglect deepened, creating conditions for rising ethnic tensions and local conflicts. The collapse of Nimeiri's regime in 1985 and the brief return to civilian rule under Prime Minister *Sadiq al-Mahdi* (1986–1989) did little to reverse these trends. Instead, the state's inability to effectively govern Darfur and provide essential services led to localized disputes over land and resources, which the government failed to mediate (Flint & De Waal, 2008). By the late 1980s, Darfur had become increasingly polarized along ethnic lines, as state policies and regional inequalities fueled tensions between Arab and non-Arab communities (Harir, 1994). The growing economic hardships, exacerbated by recurrent droughts and the Sahelian famine of the 1980s, intensified resource competition, leading to violent clashes that the central government either ignored or, in some cases, actively exacerbated by arming militias aligned with its interests (Flint & De Waal, 2008).

The 1989 coup that installed Omar al-Bashir in power was a watershed moment in the political history of Darfur. The Islamist government, backed by Hassan al-Turabi's National Islamic Front, sought to entrench state power by further rooting itself in Sudan's peripheries while pursuing an assertive Arabization policy (Gallab, 2011). This resulted in further exclusion of Darfur's non-Arab population, as the government pursued policies that favored Arab pastoralist communities at the cost of African farming communities. The early 1990s saw a growth in government-sponsored militia activity in Darfur as the government equipped Arab militias to quash opposition movements. This pattern would later culminate in the large-scale violence of the Darfur conflict in the 2000s (Flint & De Waal, 2008). By the end of the 20th century, Darfur had become a deeply fractured region, its people caught between economic deprivation, political exclusion, and escalating ethnic tensions fueled by state policies of divide and rule (Mamdani, 2009).

Thus, post-independence Sudan did not effectively deal with the colonial legacies of marginalization under British colonialism. Instead, every new government replicated and exacerbated these inequalities so that Darfur became a peripheral and politically excluded region within the Sudanese state. The failure to integrate Darfur into national governance

structures and provide equitable economic opportunities set the stage for the region's descent into protracted conflict.

B. The Outbreak of Conflict (2003-2005): From Rebellion to War

It should have become clear by now, that the war in Darfur did not erupt spontaneously in 2003 but was the culmination of years, if not decades, of rising tensions, political marginalization, and militarization. By the mid-1990s, a combination of state policies, ethnic mobilization, and regional instability had already set Darfur on a trajectory toward conflict.

1. Path to War: Late 1990s

By the mid-1990s, Darfur's political and security landscape had undergone significant transformation. The government of Omar al-Bashir, consolidated under the National Islamic Front (NIF), increasingly relied on a strategy of ethnic favoritism and militarization to maintain its grip on power. This period was marked by growing tensions between local communities, the proliferation of armed militias, and external influences that further exacerbated the fragile security situation in the region (Flint & De Waal, 2008).

The Sudanese state had, by this time, firmly established a pattern of using paramilitary forces and tribal militias to enforce its authority in restive regions. This was especially evident in Darfur, where the government fostered alliances with Arab pastoralist groups while marginalizing non-Arab farming communities such as the Fur, Zaghawa, and Masalit. The preferential treatment of Arab militias was not new. Still, it became more pronounced as the government increasingly relied on them for security purposes, effectively outsourcing law enforcement and counterinsurgency operations to local armed groups (Flint & De Waal, 2008). Concurrently, Darfur's security situation was influenced by external factors. Libya's *Muammar Gaddafi* had, since the 1980s, promoted an expansionist ideology in the Sahel, particularly through his vision of an "Islamic Legion." While Libya's direct influence in Darfur had waned by the mid-1990s, the ideological legacy remained, emboldening Arab militias who saw themselves as agents of a broader Arab-Islamic cause. Chad, too, played a role in Darfur's militarization. The ongoing civil war in Chad led to the movement of armed factions across the border, with various groups using Darfur as a staging ground for their operations. The Sudanese government, in turn, played a double game—supporting Chadian rebels while also maintaining strategic alliances with elements within Chad's government (Seymour, 2010).

Within Darfur itself, tensions between communities increased as competition for land and resources intensified. The catastrophic droughts of the 1980s had already placed immense strains on local livelihoods, and by the mid-1990s the situation remained precarious. Arab pastoralist groups, increasingly struggling to feed their herds, pushed into agricultural lands traditionally held by Fur, Zaghawa, and Masalit communities. These localized conflicts, once held in check by customary mediation mechanisms, were now increasingly weaponized, by the proliferation of modern weaponry into the region. Small-scale in intensity but frequent battles between armed groups became the norm, setting the stage for the large-scale violence that would follow in the 2000s (De Waal, 2007).

The Sudan government's response to these disputes was opportunistic. Instead of acting as an arbiter, it selectively armed and supported Arab militias and thus transformed local disputes into state-sponsored terror. The period saw an increase in instances of government-backed militias attacking non-Arab villages with great impunity. The Masalit people, in particular, suffered the worst of such onslaughts. Between 1996 and 1999, Masalit villages in West Darfur were repeatedly targeted by government-aligned militias, leading to thousands of deaths and large-scale displacement (Flint & De Waal, 2008). In several instances, survivors of these attacks reported that the Sudanese army had provided logistical support to the militias carrying out the raids, including vehicles and aerial reconnaissance.

During this period, non-Arab communities in Darfur began recognizing the need for organized resistance. While grievances against the government had been longstanding, the shift to armed mobilization was a significant development. The first signs of organized rebellion were in the late 1990s when local leaders, disillusioned military officers, and student activists started organizing underground networks. These groups initially focused on political mobilization, publishing manifestos and attempting to secure the support of sympathetic actors within Sudan and abroad. Among the earliest signs of such militarization were the increasing frequency of clashes between militias supporting local communities and government-backed militias. In particular, the Fur and Zaghawa communities began forming small-scale paramilitary units, initially armed with rudimentary weapons but gradually acquiring more sophisticated arms through cross-border smuggling. The experiences of Darfurian fighters in other conflicts – some had fought in the *Sudan People's Liberation Army* (SPLA) in the South, while others had connections to Chadian rebel movements – contributed to the growing military expertise among these groups (Flint & De Waal, 2008).

By the turn of the century, the groundwork for full-scale rebellion had been laid. The Sudanese government, perhaps underestimating the level of discontent, continued its policy of arming

militias while offering little in the way of political concessions. Meanwhile, Darfurian resistance groups increasingly looked toward formalizing their military structures, which would soon evolve into the *Sudan Liberation Army* (SLA) and the *Justice and Equality Movement* (JEM). Though these organizations had not yet officially declared their insurgency, the conditions for war were firmly in place by the end of the 1990s.

2. The Final Sparks of Rebellion: 2000-2002

As Sudan entered the 21st century, Darfur stood on the brink of open rebellion. Attacks by government-backed Arab militias had become more coordinated, with entire villages being wiped out in targeted raids. The Sudanese government, committed to suppressing dissent, escalated its use of aerial bombardments and direct military intervention. In response, local self-defense groups began consolidating into more structured resistance movements.

By 2001, the foundations of the Sudan Liberation Army (SLA) and the Justice and Equality Movement (JEM) had taken shape. The SLA, led by *Abdul Wahid al-Nur*, emphasized autonomy for Darfur and an end to marginalization. At the same time, the JEM, whose ideological roots were an Islamist opposition to Khartoum, sought broader political transformation (Flint & De Waal, 2008). Early confrontations between the new movements and regime forces were largely symbolic but marked a radical shift away from isolated self-defense toward organized insurgency.

All through 2002, conflict intensified. In most regions, SLA and JEM forces launched preemptive strikes against government forces in a bid to vanquish militia operations. The Sudanese military retaliated with overwhelming force, deploying helicopter gunships and Antonov bombers against villages suspected of harboring rebels. Reports from the time document widespread civilian casualties, with entire communities accused of supporting the rebels being targeted in retaliatory strikes (HRW, 2004).

By mid-2002, rebel forces had gained momentum. SLA units conducted increasingly bold operations, seizing weapons and supplies from government garrisons. By leveraging its political networks, JEM expanded its recruitment base, drawing fighters from disenfranchised communities across Darfur. Government intelligence agencies, caught off guard by the rapid escalation, struggled to contain the insurgency. In an attempt to crush the rebellion before it could spread further, Sudanese forces launched a series of brutal offensives, culminating in large-scale massacres in areas suspected of rebel activity (De Waal, 2007).

Despite these crackdowns, by the end of 2002, the insurgency had become an undeniable reality. The SLA and JEM had transitioned from loosely organized resistance groups into fully

operational rebel armies. The Sudanese government, rather than de-escalating tensions, had effectively driven more communities into the arms of the rebellion through its heavy-handed tactics. As 2003 approached, the stage was set for a conflict that would engulf Darfur in one of the most devastating wars of the early 21st century.

3. Full-Scale Violence and War: 2003-2005

The outbreak of full-scale war in Darfur in 2003 marked the beginning of one of the most devastating humanitarian crises of the 21st century, one that continues in one shape or another to this day.

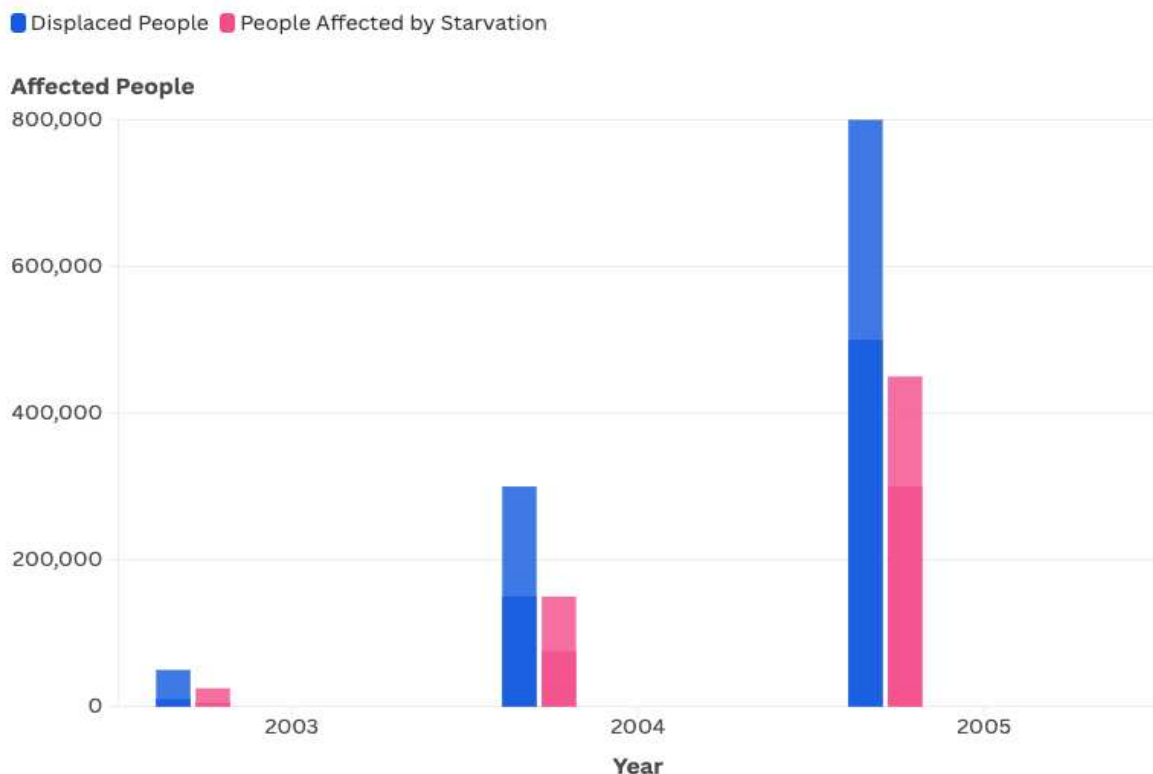
The war officially began in February 2003 when the SLA and the JEM launched a coordinated attack against government positions, targeting military installations and police outposts in North and West Darfur (Flint & De Waal, 2008). The rebels, equipped with small arms and light vehicles, took the Sudanese government by surprise, exposing the weakness of the Sudanese Armed Forces (SAF) in the region. The Sudanese government, under President Omar al-Bashir, responded swiftly and brutally. Lacking a strong military presence in Darfur, Khartoum relied heavily on proxy forces, particularly the *Janjaweed* militias. These militias, composed mainly of Arab pastoralist groups, were armed, trained, and given free rein to attack villages suspected of harboring rebel sympathizers. The government also launched aerial bombardments using Antonov aircraft and MiG fighter jets to target rebel-held areas, causing widespread destruction and civilian casualties (HRW, 2004).

By mid-2003, the conflict had escalated into widespread violence, with the Sudanese military and Janjaweed militias conducting mass killings, rapes, and the destruction of villages. According to Human Rights Watch (2004), thousands of civilians were killed in the initial months of the war, and over 200,000 people were displaced by the end of the year. As the war progressed into 2004, the violence intensified. The Sudanese government continued its campaign of destruction, targeting entire non-Arab villages in what many observers, including the United Nations, described as ethnic cleansing. Reports from the time estimated that over 70,000 people had been killed by the end of the year, and approximately 1.2 million had been displaced (UN, 2005). Refugees began fleeing into neighboring Chad, creating a regional humanitarian crisis.

The international community took notice, and in April 2004, the African Union (AU) brokered a ceasefire between the Sudanese government and rebel groups. The truce, however, was poorly enforced and quickly collapsed. That same month, the African Union deployed the *AU Mission in Sudan* (AMIS), a small and underfunded peacekeeping force tasked with monitoring the

ceasefire. However, AMIS lacked the necessary personnel, equipment, and mandate to prevent further violence (Prunier, 2007). In July 2004, the United Nations Security Council (UNSC) passed Resolution 1556, calling on the Sudanese government to disarm the Janjaweed militias and prosecute those responsible for human rights abuses. Khartoum ignored the resolution, and attacks on civilians continued unabated. By the end of 2004, reports suggested that over 2 million people had been displaced and that famine conditions were emerging due to the destruction of farmland and food supplies (see Figure 2).

Displacement and Starvation in Darfur (2003-2005)



Source: UN Mission in Sudan (UNMIS), Internal Displacement Monitoring Centre (IDMC), Young et al. (2005)

Figure 2: Numbers of Displacement and Starvation during the Darfur War, 2003-2005 (Own Visualization with Data from UNMIS, IDMC, and Young et al. (2005)).

By early 2005, the war in Darfur had become an international crisis, drawing comparisons to the Rwandan genocide of 1994. The U.S. government formally declared the violence in Darfur as genocide, a designation that was echoed by human rights organizations but not officially adopted by the United Nations. The humanitarian situation worsened as Sudanese government forces and Janjaweed militias continued their attacks. Reports indicated that nearly 300,000 people had died from violence, starvation, and disease by mid-2005 (WHO, 2005). Meanwhile, international pressure mounted on Khartoum to negotiate a peace settlement. In May 2005, the Darfur Peace Agreement (DPA) was signed between the Sudanese government and a faction of the SLA led by *Minni Minnawi*. However, the agreement failed to gain widespread support, as

other rebel factions, including JEM, rejected it, citing insufficient guarantees for political representation and security (Flint & De Waal, 2008).

The war drew significant international attention, but responses varied. The United Nations struggled to take decisive action due to opposition from key Security Council members, particularly China and Russia, who had economic and strategic interests in Sudan (De Waal, 2007). The African Union's peacekeeping efforts were limited in effectiveness, and Western nations, while vocal in their condemnation, were hesitant to commit military forces to the region. In late 2005, the UN began pushing for a stronger peacekeeping mission, setting the stage for later intervention efforts. However, the Sudanese government remained resistant to international involvement, arguing that it was an internal matter. Despite growing international pressure, the conflict in Darfur continued to rage, setting the stage for further humanitarian catastrophe in the years that followed.

The human toll of the war between 2003 and 2005 was catastrophic. By the end of 2005, an estimated 200,000 to 300,000 individuals had directly or indirectly died as a consequence of the fighting. Over 2.5 million people had been displaced and humanitarian agencies had struggled to get aid through, given the intensity of violence on the ground as well as blockades by the Sudanese authorities. Food shortages, insufficient water supply, and even targeted killings of relief workers also added to the woes. Reports by NGOs such as *Médecins Sans Frontières* (MSF) reported widespread malnourishment and epidemics among refugees in refugee camps, further perpetuating the crisis.

In general, the period from 2003 through 2005 saw Darfur descend into full-scale war, marked by wholesale slaughter, ethnic cleansing, and one of the worst humanitarian disasters of the 21st century. The employment of Janjaweed militias by the Sudanese government, international paralysis, and failed peace accords ensured the war persisted beyond 2005. The second stage of the Darfur conflict would be characterized by greater international intervention. However, the root issues driving the war were not addressed, and the region was left trapped in a cycle of violence and instability.

4. The Protracted Crisis: 2005-Present

In the wake of escalating international pressure, two major peace agreements were signed in the years following the initial phase of the Darfur war. The first, the *Darfur Peace Agreement* (DPA), was signed in May 2006 in Abuja, Nigeria, after months of negotiations facilitated by the African Union and the international community. The Sudanese government signed the agreement, and a faction of the Sudan Liberation Army led by Minnawi. Still, key groups such

as the Justice and Equality Movement (JEM) and another faction of the SLA refused to sign (Flint & De Waal, 2008). As a result, the agreement lacked the support necessary for implementation. Following its signing, violence not only persisted but intensified in many areas, as rebel groups that had been excluded from the negotiations were further marginalized. The *Doha Document for Peace in Darfur* (DDPD) was signed in July 2011 between the Sudanese government and the Liberation and Justice Movement (LJM), a coalition of rebel factions created in the context of the negotiations. The agreement focused on power sharing, wealth distribution, compensation for victims, and the return of displaced persons. While the Doha Agreement had broader international backing, including from Qatar and the African Union, it suffered from limited implementation on the ground. Many key rebel groups, including JEM and Abdel Wahid al-Nur's SLA faction, again declined to sign, and sporadic clashes continued across the region. The lack of enforcement mechanisms continued distrust among parties, and the government's limited capacity and willingness to deliver on its promises contributed to the agreement's ineffectiveness (Nathan, 2014).

During the 2010s, Darfur was experiencing ongoing turmoil and political upheaval. The most significant trend of the period was the fracturing of the rebel movements. Originally a coherent movement, the SLA fragmented into many factions, including SLA-Minni Minnawi, SLA-Abdel Wahid, and others. Competing leadership, internal power struggles, and divergence in strategy eroded the coherence of the rebellion, making military opposition and negotiations more complicated (Young, 2012). Similarly, JEM experienced leadership issues, most notably after its founder, Khalil Ibrahim, was killed in 2011.

As rebel unity declined, inter-communal violence began to surge, particularly between nomadic pastoralists and sedentary farming communities. While some of these clashes had deep historical roots, their intensity and frequency grew without strong state governance and meaningful reconciliation processes (Buchanan-Smith & Bromwich, 2016). Villages continued to be attacked, markets destroyed, and civilians displaced well into the late 2010s.

The Sudanese government's role also evolved during this time. While the Sudanese Armed Forces (SAF) remained a presence in Darfur, most of the counterinsurgency work was outsourced to paramilitary units, most notably to the *Rapid Support Forces (RSF)*. Formed from the remnants of the Janjaweed, the RSF operated with considerable autonomy under *Mohamed Hamdan Dagalo (Hemeti)*, who became a national figure later. The RSF also participated – and participates to this day – in several human rights abuses, such as mass killings, rape, and forced relocations. Despite such allegations, the RSF entrenched itself at the heart of Khartoum's

security system. The force was used not only in Darfur but also in other Sudanese conflicts, as well as in missions abroad, for instance, in Yemen.

In parallel, the international community's involvement in Darfur shifted. The joint *United Nations-African Union Mission in Darfur* (UNAMID), established in 2007, initially deployed thousands of troops and police across the region. While its mandate included civilian protection and support for the peace process, UNAMID often struggled to fulfill its objectives due to restricted access, logistical difficulties, and resistance from the Sudanese government. Over time, as international attention waned and funding declined, UNAMID began a phased withdrawal, concluding its mission at the end of 2020.

In April 2019, the Sudanese revolution ousted President Omar al-Bashir and initiated a new chapter in the country's political history. While these developments held significant implications for the wider Sudanese state, the focus of this thesis remains on the period from the late 20th century up to 2019. The 2019 uprising marked a turning point that fundamentally altered the political landscape, and as such, the dynamics of Darfur's conflict in the post-2019 context fall beyond the scope of this study.

C. Key Themes in the Darfur Conflict

The prior chapters have offered a – admittedly concise – overview of the historical trajectory of the conflict in Darfur, providing the reader with an entry-level understanding of the key events and developments in the region. While this may sufficiently address *what* occurred in Darfur, it naturally leads to a second, more critical inquiry: *why* the conflict unfolded as it did. What were the underlying drivers of violence, and how could the conflict persist over such an extended period? A survey of both academic scholarship and media representations reveals a recurring theme: the characterization of the Darfur conflict as an ethnic war, often portrayed as a confrontation between Arab nomadic herders and African sedentary farmers. While undoubtedly some truth is embedded in this framing, it masks the complexity of the region's history and the shifting alliances, strategies, and grievances that have shaped the conflict over time, as we shall see later in this thesis.

1. The Common Cause: Ethnicity and Identity

Among the most widely circulated explanations of the Darfur conflict is the emphasis on ethnicity and identity as principal fault lines. In both academic and policy literature, as well as mainstream media reporting, the violence that erupted in the early 2000s has frequently been

framed through the lens of inter-ethnic hostility, often simplified as a clash between "Arabs" and "Africans" (see for example Mahmoud, 2004; El-Tom, 2006). This framing, though increasingly criticized in recent years, has played a significant role in shaping both scholarly analyses and international responses to the crisis.

Early interpretations of the conflict frequently presented it as a binary confrontation between nomadic Arab groups and sedentary African farming communities. The former was portrayed as being aligned with the government in Khartoum. At the same time, the latter was associated with insurgent movements such as the Sudan Liberation Army (SLA) and the Justice and Equality Movement (JEM) (Flint & De Waal, 2008). According to this view, longstanding tensions between these groups—primarily over land access and political power—erupted into open violence, compounded by a government counterinsurgency campaign that relied heavily on ethnically aligned militias.

This narrative gained significant traction during the early stages of international engagement with the crisis. The U.S. government's declaration of the conflict as a case of "genocide" in 2004 and the subsequent indictments by the International Criminal Court were grounded in the assumption that the Sudanese state had weaponized ethnic identity to carry out systematic attacks against particular communities (Mamdani, 2009). Numerous humanitarian and advocacy organizations also adopted this framework, emphasizing ethnic cleansing and identity-based violence as central explanatory motifs (e.g., Save Darfur).

Several scholars have echoed these interpretations, arguing that Darfur's patterns of land use, migration, and resource competition became increasingly ethnicized over the late 20th century. In this literature, identity is often linked to structural factors such as access to political power, state resources, and military patronage. Researchers, including Totten and Markusen (2006), have focused on the explicit targeting of Fur, Zaghawa, and Masalit populations during the conflict's early years, treating this as evidence of deliberate ethnic persecution.

At the same time, however, a substantial body of scholarship has emerged to critique what it sees as an oversimplification of Darfur's social fabric. Authors such as Mamdani (2009), De Waal (2007), and Young (2007) have emphasized the fluidity of identity in Darfur, challenging the notion that "Arab" and "African" are meaningful, fixed categories. Rather than being primordial divisions, they argue, these identities are historically constructed and often politically instrumentalized. The labels themselves – "Arab" and "African" – are shown to be socially contingent, with groups identifying across lines of language, livelihood, and administrative classification rather than descent or race (Manger, 2004).

Colonial administrative practices are frequently cited as having played a pivotal role in shaping ethnic identification in Darfur. Under the British system of indirect rule, ethnic categories were institutionalized through tribal administrations, land tenure systems, and native authority structures. These bureaucratic distinctions were often arbitrary but became deeply embedded in local governance, contributing to the politicization of ethnicity in the post-independence era (Daly, 2007). The argument here is not necessarily that colonialism caused ethnic conflict in Darfur but that it laid the groundwork for the kind of identity-based claims and exclusions that would later be mobilized during times of political crisis. Postcolonial state practices are also seen as crucial in the literature that views ethnicity as a product of structural marginalization. Several scholars have traced how successive governments in Khartoum favored specific communities – often those identifying as Arab – while excluding others from political representation and economic development. According to this body of work, these policies of exclusion contributed to the salience of ethnic identity as a political tool, especially in Darfur, where groups historically marginalized by the center began to organize along communal lines (see Keen, 2008; Harir, 1994).

Another significant theme in the literature is the ethnic composition of the armed actors in the conflict. Studies have noted that the Janjaweed militias, widely reported to have perpetrated atrocities during the war, were predominantly drawn from Arab camel-herding tribes in northern Darfur (Flint & De Waal, 2008). Meanwhile, the rebel movements were primarily composed of fighters from non-Arab agricultural communities, particularly the Fur, Zaghawa, and Masalit. While most academic sources caution against reducing group behavior to identity alone, they nonetheless acknowledge that the organizational logic of the conflict – recruitment, alliance formation, territorial claims – was often shaped by ethnic affiliation (Prunier, 2007).

In more recent years, the literature has moved toward more nuanced interpretations of identity in Darfur. Instead of treating ethnicity as a static background variable, scholars have increasingly focused on how identity is activated, transformed, and politicized in specific contexts. This includes work on the micro-dynamics of violence, the role of communal narratives, and the administrative politics of land and representation in the aftermath of conflict (cf. Buchanan-Smith & Bromwich, 2016; Manger, 2004). These studies stress that identity is neither wholly endogenous nor entirely imposed from above but rather negotiated through interaction between communities, the state, and external actors.

In summary, existing literature offers a range of perspectives on the role of ethnicity and identity in the Darfur conflict. Some accounts stress deep-rooted animosities and identity-based grievances; others view ethnicity as a political construct shaped by historical processes, state

policy, and strategic interaction. While few scholars today would argue that ethnicity alone can explain the outbreak or endurance of the conflict, there remains broad agreement that identity has played a central role in the conflict's organization, representation, and aftermath. As such, it continues to serve as a key theme in scholarly and policy analyses of Darfur.

2. An Alternative Cause: Climate Change and Ecological Stressors

As we have outlined in the preceding chapters, much of the dominant discourse surrounding the conflict in Darfur has revolved around issues of ethnicity, identity, and political marginalization. These themes have long structured both media portrayals and scholarly interpretations of the war, often reinforcing simplified narratives such as the "Arab vs. African" binary. However, over the past two decades, a parallel line of interpretation has emerged – one that seeks to locate the roots of Darfur's crisis not solely in its political history or ethnic composition but in its environment.

This alternative explanation proposes that environmental degradation, climate variability, and ecological stress played a central role in precipitating and sustaining the conflict. According to this view, Darfur's descent into violence must be understood not only through its fractured political landscape but also in light of the long-term environmental pressures that have reshaped livelihoods, increased resource competition, and heightened social tensions. From this perspective, the war in Darfur is not merely a result of tribalism or state repression – it is, at least in part, a manifestation of the broader global challenge posed by climate change.

The appeal of this explanation is not hard to grasp. Darfur lies within the Sahel, a semi-arid region that has experienced severe and protracted climatic stress over recent decades. Recurring droughts, declining rainfall, desertification, and soil degradation have placed mounting pressure on both pastoralist and agricultural communities. As access to water and fertile land declined, so too did the capacity of traditional institutions to mediate between groups competing for dwindling resources. In this context, what may have once been routine disputes over grazing routes or land rights began to escalate into violence, exacerbated by the absence of robust governance mechanisms and the increasing militarization of rural life.

It is this confluence of ecological stress and institutional fragility that lies at the heart of the climate-conflict thesis as applied to Darfur. Some analysts have gone so far as to characterize Darfur as the world's "first climate war," arguing that the violence that erupted in 2003 was the culmination of decades of environmental decline and demographic pressure (Ki-Moon, 2007). These narratives suggest that environmental change was not merely a backdrop to the conflict but a key driver – an accelerant that helped transform latent grievances into open warfare.

Importantly, this climate-centered explanation is not without precedent. As we will explore in detail in the next chapter, the broader academic field of environmental security has for years sought to establish links between ecological stress and violent conflict (cf. Koubi, 2019; Adger, 2010; Homer-Dixon, 1999). Neo-Malthusian scholars, in particular, have warned of the destabilizing effects of resource scarcity in fragile states, arguing that climate change may act as a "threat multiplier" in regions already marked by inequality, weak institutions, and social fragmentation (CNA, 2007; Homer-Dixon, 1999).

The case of Darfur has become a frequently cited example within this growing body of work. International organizations such as the United Nations Environment Programme (UNEP, 2007) have drawn explicit connections between environmental degradation and violence in western Sudan. Academic studies have likewise attempted to link climate variability—such as changes in rainfall and vegetation cover—with patterns of displacement, conflict, and food insecurity in the region (Maystadt et al., 2015; De Juan, 2015). For many commentators, Darfur represents a real-world illustration of how global climate change can interact with local vulnerabilities to produce large-scale humanitarian crises. And yet, the climate-conflict narrative remains contested. As the following chapter will show, not all scholars agree that environmental stress was a decisive factor in the Darfur conflict, and many have raised concerns about environmental determinism and oversimplified causal claims.

This study aims to engage directly with this debate. While not denying the relevance of environmental pressures, it asks whether climate change can explain the outbreak and persistence of violence in Darfur. More specifically, it seeks to understand **how** ecological stress interacts with political, economic, and social factors to shape the dynamics of conflict. To do so, we will need to move beyond simple correlation and examine the underlying mechanisms that may link climate change to violence in this context. Accordingly, in the chapters that follow, we will survey the literature on the climate-conflict nexus more broadly, with a specific focus on its application to Sudan and Darfur. This will allow us to assess the strength of the climate-conflict argument critically, identify its main narratives, and consider alternative explanations. Ultimately, this investigation will help determine whether the characterization of Darfur as a "climate war" holds up under closer empirical and theoretical scrutiny.

III. Climate Change and Conflict in the Literature

Amid the diverse social and political causes, the Darfur conflict began as an ecological crisis, arising at least in part from climate change.

- Ban Ki-moon, *A Climate Culprit in Darfur* (2007)

Researching the implications of climate change for conflict dynamics represents a relatively recent – yet rapidly evolving – field of environmental security. It emerged – at least academically – in the late 20th century with such works as by Homer-Dixon (1991) or Hauge & Ellingsen (1998), primarily focused on establishing a link between resource scarcity and the onset of violent conflict. The relationship between climate change-induced transformations and the emergence of conflict did not garner significant political and public attention until the mid-2000s. This shift was propelled by cautionary reports from the Intergovernmental Panel on Climate Change (IPCC), which highlighted the potential societal ramifications of climatic shifts (IPCC, 2007), alongside the acknowledgment by the United States government of climate change as a prospective threat to national security (CNA, 2007). Since then, the relationship between climate change and conflict has been widely debated in the literature, as the following chapter(s) will lay out. We start by giving a general overview of the debates and arguments within the field of climate-conflict overall. Readers should get a first impression of the overarching arguments and theories being used to discover (or not discover) links between the two phenomena. Subsequently, the chapter provides an introduction to the literature on climate-conflict within the Sudanese context and how the conflict in the country is being connected to climate aberrations. As a last step, we will summarize and critically examine the literature that researches explicitly the effects of climate change on conflict in the Darfuri regions of Sudan. This will lay the groundwork for our later work, which will position itself as an explicit critique of the dominant narratives and the specific ways they are trying to link climate change and conflict in Darfur.

A. Climate-Conflict Nexus in General

Researching the relationship between climate change and conflict has become increasingly popular in recent decades. Whilst early research often sought to establish a direct causal link between environmental stress and violence, more recent studies highlight the complexity of this

nexus, emphasizing mediating political, economic, and social factors. This subchapter provides an overview of the main arguments and recurring themes in the broader literature on climate change and conflict and aims to present a starting point for navigating later discussions surrounding the specific cases of Sudan and Darfur.

One of the earliest influential perspectives on this issue is the Neo-Malthusian approach, which argues that resource scarcity caused by environmental degradation increases the likelihood of violent conflict (Homer-Dixon, 1999). According to this framework, climate-induced shortages of water, arable land, and food create competition among groups, which can escalate into armed conflict, particularly in fragile states. This idea builds on Malthusian population theory, which suggests that population growth outstripping resource availability leads to crises, including war, famine, and societal collapse (cf. Ehrlich, 1968; Hardin, 1968).

Some recent empirical studies support this argument, showing that changes in temperature and precipitation are associated with an increased risk of civil wars, particularly in Sub-Saharan Africa. Burke et al. (2009) find that rising temperatures correlate with increased conflict incidence, estimating that warming trends could elevate civil war risks by 54% in Africa by 2030. Similarly, Miguel, Satyanath, and Sergenti (2004) argue that economic shocks, often triggered by climate variability, significantly increase the likelihood of civil conflict, as weakened economic conditions create grievances and recruitment opportunities for armed groups. Additional studies have reinforced the scarcity-conflict hypothesis. Hendrix and Glaser (2007) demonstrate that rainfall variability is a significant predictor of conflict onset, particularly in agrarian societies where subsistence farming is vulnerable to droughts and floods. Raleigh and Urdal (2007) further suggest that demographic pressures—such as rapid population growth in areas with diminishing resources – intensify competition, heightening conflict risks. Meanwhile, Kahl (2006) introduces the concept of "state capacity mediation," arguing that resource scarcity alone does not trigger conflict, but rather, the interaction between scarcity and weak governance structures determines whether violence erupts.

Despite the prevalence of some studies linking climate change to conflict, several scholars find little to no empirical support for a robust causal relationship. Buhaug (2010) argues that climate variability has limited explanatory power for the onset of civil wars, emphasizing that political and economic factors are far more significant. His study critiques large-N statistical analyses for failing to account for key contextual variables that mediate conflict risk. Similarly, Theisen, Gleditsch, and Buhaug (2013) find no consistent correlation between temperature anomalies and conflict onset, suggesting that conflict-prone regions often experience violence due to pre-existing socio-political vulnerabilities rather than environmental stress alone. Additional studies

have also questioned the strength of the climate-conflict relationship. Benjaminsen et al. (2012) argue that conflicts in the Sahel are often mistakenly attributed to climate change when they are, in fact, rooted in historical land use policies and socio-political tensions. Meierding (2013) similarly finds little empirical support for climate-driven conflict, contending that narratives linking climate change to violence often rely on anecdotal rather than systematic evidence. Busby (2018) reinforces this skepticism, arguing that while climate change may contribute to insecurity, its effects are highly mediated by governance and institutional capacity, making it an insufficient explanation for conflict on its own. Other studies highlight the methodological challenges in attributing conflict to climate change. Selby and Hoffmann (2014) argue that much of the climate-conflict literature suffers from selection bias, where researchers disproportionately focus on cases that fit the climate-conflict narrative while neglecting instances where climate stress does not lead to violence. These findings underscore the need for a more nuanced understanding of the climate-conflict nexus, where environmental factors are considered alongside broader structural determinants of conflict. Recent meta-analyses have sought to reconcile these competing perspectives. Burke, Hsiang, and Miguel (2015) conducted a systematic review of 50 quantitative studies and found that deviations in temperature and precipitation patterns consistently increase the probability of conflict. Their analysis suggested that a 1°C increase in temperature raises the likelihood of intergroup conflict by 11.3%. However, they also noted significant variations depending on local conditions, with conflicts being more likely in economically underdeveloped and politically unstable regions. In contrast, Koubi (2019) finds that the literature has not detected a robust and universal effect linking climate change to conflict onset. Instead, climate change tends to act as a threat multiplier, exacerbating pre-existing social and political tensions in regions highly dependent on agriculture and with weak adaptive capacities.

In sum, the empirical literature on climate change and conflict presents a mixed picture. While some studies provide strong statistical evidence that climate variability can increase the likelihood of conflict, others find little to no direct causal relationship. The Neo-Malthusian perspective suggests that resource scarcity and climate-induced economic shocks drive competition and violence, while skeptics emphasize the importance of political, financial, and institutional factors in mediating these effects. Overall, the evidence suggests that climate change is best understood as a threat multiplier rather than a direct cause of conflict.

B. The Climate-Conflict Narrative in the Sudan

Sudan, with its diverse ecological zones and long history of conflict, has been at the center of debates about whether climate change acts as a primary driver of violence or merely exacerbates existing socio-political tensions.

Much of the early literature on climate and conflict in Sudan was influenced by Neo-Malthusian theories, which argue that resource scarcity, exacerbated by climate change, leads to violent competition (Homer-Dixon, 1999; Kahl, 2006). Reports such as the United Nations Environment Programme (UNEP, 2007) emphasized that Sudan, particularly its arid and semi-arid regions, has suffered from desertification, declining rainfall, and recurrent droughts, leading to conflicts between pastoralists and farming communities over dwindling resources. Ban Ki-moon (2007) described the Darfur conflict as a "climate war," reinforcing the notion that environmental degradation is a root cause of Sudan's violence. The Sudan Post-Conflict Environmental Assessment (UNEP, 2007) further argued that ecological degradation and climate variability have exacerbated food insecurity and water shortages, making vulnerable populations more susceptible to conflict. Similarly, Reuveny (2007) proposed that climate-induced migration in Sudan has contributed to tensions between groups competing for land and water. Maystadt et al. (2015) used quantitative models to show that fluctuations in temperature and precipitation in Sudan correlate with increases in communal violence, particularly in rural areas where economic dependence on agriculture is high.

More current empirical research on the climate-conflict link in Sudan presents mixed findings. Some studies support the argument that environmental stress contributes to communal and interethnic violence. De Juan (2015) conducted a spatial analysis using satellite imagery and conflict data, finding that vegetation loss and water scarcity influenced migration patterns, leading to increased competition over natural resources and heightened intercommunal tensions. Similarly, Brosché (2023) identified government bias in resource allocation as a key factor, arguing that conflict is often driven by the uneven distribution of state-controlled resources rather than by environmental stress alone. However, as with the general empirics in this field, other research challenges the direct causal link between climate change and conflict. Kevane and Gray (2008) found no significant correlation between rainfall variability and land degradation and the outbreak of violence, arguing instead that historical land tenure disputes and state-sponsored militarization played a more decisive role. Benjaminsen et al. (2012) argued that conflicts attributed to climate change in Sudan often stem from historical patterns of economic marginalization, particularly regarding the control of grazing lands and water resources. Recent scholarship has also questioned the methodological approaches used to study

the climate-conflict nexus in Sudan. Selby and Hoffmann (2014) critiqued large-N statistical studies for oversimplifying complex social and political processes, arguing that such approaches fail to account for political manipulation of resource conflicts. Furthermore, Verhoeven (2011) criticized global narratives framing Sudan as an environmental crisis zone, emphasizing that local power struggles, patronage networks, and economic interests are more significant in shaping conflict dynamics than climate change alone.

Rather than viewing climate change as a primary cause of Sudanese conflict, some scholars conceptualize it as a threat multiplier – analogous to the general debate on climate-conflict (Koubi, 2019). This perspective suggests that environmental stress in Sudan interacts with socio-political vulnerabilities – such as economic inequality, weak governance structures, and ethnic tensions – to create conditions where conflict is more likely. In Sudan, climate change has compounded longstanding grievances between pastoralist and agricultural communities, but violent conflicts have typically emerged only when political actors exploit these divisions for strategic gain (Verhoeven, 2011; De Waal, 2007). Bromwich (2018) highlights that while environmental stress can contribute to livelihood insecurity, violent conflict is more often linked to state repression, militarization, and struggles over political power. Similarly, Hendrix and Salehyan (2012) argue that Sudanese disputes have been driven more by government policies and elite competition than by climate-induced resource scarcity. These critiques caution against environmental determinism, emphasizing the need to contextualize climate stress within broader governance failures and social inequalities.

In sum, the empirical and analytical literature on climate-conflict in the Sudan somewhat mirrors that on the general level (see Chapter A), as it presents a diverse and inconclusive set of findings. While some studies provide statistical correlations between climate variability and conflict, others highlight the overwhelming importance of political, economic, and historical factors in shaping violence. The strongest consensus in the literature suggests that climate change acts as a threat multiplier rather than a direct driver of conflict, exacerbating existing social tensions when combined with weak governance, political marginalization, and economic hardship.

C. The Climate-Conflict Narrative in Darfur

The conflict in Darfur, which escalated in the early 2000s, has only scarcely been examined within the climate-conflict debate. Whilst other major conflicts – such as the ones in Libya, Syria, or Israel-Palestine – have generated numerous in-depth studies that investigate the role

climate change has played in these conflicts, there remains a surprising dearth when it comes to similar research for Darfur. Ethno-religious, power, and/or tribal explanations of the origins and main drivers of conflict in the Darfuri regions of Sudan dominate the academic, political, and media discourses. Still, a select number of scholars and international organizations have argued that climate change played a significant role in exacerbating resource scarcity and tensions, ultimately contributing to the outbreak of violence. Others, however, have pushed back against this framing, contending that political, economic, and historical factors were the primary drivers of the war.

One of the most widely cited reports linking climate change to the Darfur conflict is the United Nations Environment Programme (UNEP) Sudan Post-Conflict Environmental Assessment (2007). The report argues that long-term environmental degradation, particularly desertification and declining rainfall, has led to increased competition over water and arable land, exacerbating tensions between pastoralist and sedentary communities. This perspective was reinforced by former UN-general secretary Ban Ki-moon (2007), who described Darfur as an example of a "climate war", driven by global warming-induced resource scarcity. Reuveny (2007) similarly argues that climate-induced migration contributed to intercommunal tensions in Darfur. He suggests that pastoralist groups, displaced by desertification and drought, moved into areas occupied by settled farming communities, leading to disputes over land and water. Supporting this argument, Abouyoub (2012) describes climate as the "forgotten culprit" of the Darfur conflict, emphasizing the ecological dimensions of the war and arguing that environmental degradation created conditions conducive to violence. Empirical studies further reinforce this perspective. Maystadt et al. (2015) use econometric models to show that variations in rainfall and temperature correlate with an increased risk of conflict in Darfur. Their findings indicate that climate stress, particularly in the form of droughts, contributed to local outbreaks of violence by reducing agricultural productivity and intensifying resource competition. Raleigh and Urdal (2007) also link population pressures and environmental degradation to heightened risks of armed conflict, suggesting that scarcity-induced grievances played a role in the escalation of violence in Darfur. Akasha (2014) echoes these concerns, arguing that climate change disrupted traditional livelihoods in Darfur, leading to economic dislocation and increased dependence on government-controlled food aid and resources. This dependence, in turn, made communities more vulnerable to political manipulation, with the government using access to resources as a tool of control. Akasha suggests that while climate change was not the sole cause of the conflict, it acted as an accelerant, exacerbating underlying economic and political tensions.

Despite the prevalence of studies linking climate change to the Darfur conflict, several scholars have contested the strength of this relationship. Critics argue that the climate-conflict narrative oversimplifies the conflict's origins and underplays the role of governance failures, political marginalization, and militarization (Kevane & Gray, 2008; Verhoeven, 2011). De Juan (2014) provides a spatial analysis of conflict in Darfur, finding that violence was more strongly correlated with political and economic factors than with environmental degradation. His study, which utilizes satellite imagery and conflict data, shows that areas experiencing improved environmental conditions also witnessed high levels of violence, suggesting that other factors – such as state intervention and local power struggles – were more influential in determining conflict patterns. Verhoeven (2011) critiques the global Neo-Malthusian narrative, arguing that the portrayal of Darfur as a climate war ignores historical land tenure disputes, state-backed militia campaigns, and the political economy of resource control. He contends that international organizations and policymakers have misrepresented the conflict by emphasizing climate stress while downplaying the Sudanese government's role in manipulating ethnic divisions and distributing resources unevenly. Brosché (2022) similarly highlights the role of state favoritism in resource allocation, arguing that the government intentionally fueled communal conflicts by privileging certain ethnic groups over others. This perspective is shared by Selby & Hoffmann (2014), who caution against environmental determinism and emphasize that political and military dynamics, rather than climate stress alone, explain the patterns of violence in Darfur. Hendrix and Salehyan (2012) further argue that while climate variability may exacerbate grievances, it does not automatically lead to war. Their research suggests that the presence of strong governance and conflict resolution mechanisms can prevent climate-induced resource competition from escalating into violence. Brown (2010) reaches a similar conclusion, stating that the Darfur conflict cannot be attributed solely to climate change, as state-backed paramilitary groups, land expropriation policies, and economic inequalities played more decisive roles.

The literature across all subchapters demonstrates that the relationship between climate change and conflict remains inconclusive. While some studies emphasize environmental degradation, resource scarcity, and climate-induced migration as key contributors to war, others highlight political, economic, and historical factors as more decisive. The strongest consensus in the research suggests that climate change may act as a threat multiplier rather than a primary cause of conflict. However, most – if not all – research does not provide a systematic account of how climate change impacts conflict. This holds true for the general relationship between the two concepts, as well as for specific case studies, such as in Darfur. Moreover, a significant

limitation of the existing literature – also on Darfur – is its methodological imbalance. Much of the research relies on large-N statistical studies that correlate climate variability with conflict onset but fail to account for local socio-political histories and governance structures. Conversely, qualitative studies tend to be anecdotal, often emphasizing simple narratives of ethnic, religious, or political divides without providing sufficient socio-political contextualization. This methodological divide complicates efforts to draw definitive conclusions about the role of climate change in conflict dynamics. Moving forward, future research should focus on integrating political, historical, and environmental analyses, ensuring that climate-conflict narratives do not oversimplify the complexities of war in Darfur and beyond. A more nuanced approach, combining quantitative models with grounded qualitative insights, is necessary to fully understand how climate stress interacts with governance, economic structures, and social tensions in conflict-prone regions. Political Ecology, with its emphasis on contextualizing the political in everything ecological, might be just that – a promising analytical tool to understand better how Darfuri conflicts are fueled and elevated by climate change.

IV. Political Ecology as a Theoretical and Analytical Tool

[...] political ecological accounts also share a common premise, that environmental change and ecological conditions are the product of political process.

- Paul Robbins, *Political Ecology* (2012)

As should have become evident from Chapter III, the existing literature on climate change and conflict is dominated by neo-Malthusian assumptions, which argue that environmental degradation, resource scarcity, and population pressures inevitably lead to competition and violence. This perspective, which underpins much of the climate-conflict research, assumes that as resources such as water and arable land become scarcer due to climatic shifts, societies will increasingly struggle over access, leading to tensions, displacement, and in extreme cases, war (Homer-Dixon, 1999; Burke et al., 2009). Many large-N statistical studies adopt this framework, drawing broad correlations between rising temperatures, decreased rainfall, and the incidence of armed conflict. Reports from international organizations, including UNEP (2007),

have further reinforced this view, very much so in the case of Sudan and Darfur, where desertification and drought have been widely cited as root causes of violence.

However, despite its prominence, the neo-Malthusian framework has significant limitations. As discussed in Chapter III, this perspective oversimplifies complex socio-political realities, reducing conflicts to struggles over natural resources while neglecting political histories, governance structures, and economic inequalities (Selby & Hoffmann, 2014; Verhoeven, 2011). This critique is particularly relevant in the case of Darfur, where climate variability undoubtedly shaped local economic conditions but where state policies, ethnic hierarchies, and militarization played a decisive role in transforming resource disputes into large-scale violence. Political ecology offers a more nuanced approach by situating environmental change within broader political, economic, and historical contexts. Rather than viewing climate change as an external force acting upon societies, political ecology examines how power structures, governance decisions, and historical processes shape the way environmental stress is experienced and managed. This perspective moves beyond deterministic explanations and instead emphasizes how access to and control over resources is politically mediated, often benefiting some groups at the expense of others (Robbins, 2012; Peets & Watts, 2004).

This chapter introduces the theoretical foundations of political ecology, tracing its emergence as a response to mainstream environmental thinking. Section A explores the intellectual origins of the field, showing how it developed as a critique of deterministic and depoliticized approaches to environmental change. Section B outlines the core theoretical perspectives of political ecology, including its focus on power relations, structural inequalities, and historical processes. Section C applies political ecology to the climate-conflict nexus, contrasting it with neo-Malthusian explanations and demonstrating how it provides a more comprehensive understanding of the Darfur conflict. Finally, Section D discusses why political ecology is particularly well-suited for this study, highlighting its ability to integrate both quantitative and qualitative research methods to analyze climate change, conflict, and governance dynamics in Sudan.

A. Origins of Political Ecology

Early Intellectual Foundations of Political Ecology

Political ecology emerged as a critical response to the limitations of traditional environmental studies, which often treated ecological changes as separate from broader political, economic, and social structures (Robbins, 2012). Throughout the mid-to-late 20th century, scholars

increasingly recognized that environmental degradation, resource access, and land use conflicts were deeply embedded within historical power dynamics and economic systems (Blaikie & Brookfield, 1987). Early environmental research was dominated by apolitical ecological perspectives, which tended to focus on natural processes and population pressures as primary drivers of environmental change (Walker, 2005). However, this approach was increasingly criticized for its failure to account for how governance structures, colonial legacies, and capitalist expansion shaped environmental transformations (Peets & Watts, 2004).

The intellectual foundations of political ecology draw from several disciplines, including political economy, human geography, and ecological anthropology (Neumann, 2005). Inspired by Marxist and structuralist traditions, early political ecologists sought to explain how global economic systems and historical processes influenced local environmental outcomes, particularly in the Global South (Watts, 2000). These scholars argued that environmental changes could not be understood in isolation from the larger social forces of capitalism, imperialism, and state control (Bailey & Bryant, 1997). The focus on political economy led early political ecologists to examine issues such as land dispossession, labor exploitation, and state-led environmental interventions. These analyses laid the groundwork for understanding how political power determines environmental access and control, shaping the winners and losers of ecological transformations. Marxist theory played a particularly influential role in shaping the early development of political ecology. Drawing from Karl Marx's analysis of capital accumulation, class struggle, and the metabolic rift between humans and nature, political ecologists have explored how capitalist modes of production drive environmental degradation and shape access to resources (Harvey, 1996; Foster, 1999). Scholars such as Peet and Watts (2004) applied a historical materialist lens to environmental change, arguing that ecological crises are inextricably linked to the dynamics of surplus extraction, commodification of nature, and uneven development. Political ecologists influenced by Marxism have thus emphasized the role of global capitalism in creating environmental vulnerabilities, particularly in postcolonial contexts where resource exploitation and land tenure policies have deep historical roots (Moore, 2015).

A particularly influential contribution to early political ecology came from Blaikie and Brookfield (1987), whose work "Land Degradation and Society" became foundational in the field. They introduced the idea that environmental degradation must be understood within the broader political and economic structures that shape land use practices and access to resources. Their research challenged dominant narratives that blamed environmental crises on local mismanagement, instead emphasizing how colonial land policies, global markets, and state

interventions often played more significant roles in driving land degradation and resource conflicts (Blaikie & Brookfield, 1987).

Expansion and Diversification of Political Ecology

By the 1990s and early 2000s, political ecology had expanded beyond its early focus on agrarian change and land degradation to incorporate a broader range of issues, including conservation politics, environmental governance, and the role of discourse in shaping environmental policies (Peets & Watts, 2004). This period saw a growing influence of post-structuralist and feminist perspectives, which challenged earlier materialist and deterministic approaches by emphasizing the role of knowledge, discourse, and representation in environmental struggles (Escobar, 1999; Rocheleau, 1995). Post-structuralist political ecologists critiqued the ways in which environmental problems were framed in mainstream discourse, arguing that dominant environmental narratives often served to justify particular power structures and economic interests (Fairhead & Leach, 1996). For example, scholars such as Forsyth (2003) examined how scientific knowledge about environmental degradation is often politically constructed, reinforcing particular policy approaches while marginalizing alternative local perspectives. This line of inquiry positioned political ecology as a critical counterpoint to technocratic and market-driven environmental governance, challenging the objectivity of dominant scientific and policy discourses (Forsyth, 2003).

At the same time, feminist scholars within political ecology sought to highlight the gendered dimensions of environmental change and resource conflicts, arguing that access to land, water, and other natural resources was often mediated by social hierarchies, including gender and class relations (Rocheleau, 1995). These perspectives expanded political ecology's analytical scope, making it more attuned to the ways in which power, identity, and environmental struggles intersect.

By integrating insights from multiple theoretical traditions, political ecology has evolved into a highly interdisciplinary and dynamic field, one that critically examines how environmental issues are shaped by historical, political, and economic structures. Today, political ecology continues to be a leading approach in environmental research, particularly in critiques of neoliberal conservation policies, climate change adaptation, and extractive industries. As the field moves forward, scholars emphasize the need to maintain both a structural and contextual approach, recognizing that environmental struggles are always embedded in broader systems of power and inequality. The following Section will further explore the core theoretical

principles that define political ecology, providing a more detailed analysis of its key concepts and methodological approaches.

B. Theoretical Assumptions in Political Ecology

A central tenet of political ecology is that environmental change is inherently political. Unlike apolitical environmental perspectives, which often treat ecological processes as neutral and detached from human systems, political ecology insists that power relations, governance structures, and economic forces fundamentally shape environmental outcomes (Robbins, 2012). This perspective challenges the idea that environmental problems arise purely from population growth, mismanagement, or natural scarcity, instead arguing that they are deeply embedded in historical and political contexts (Neumann, 2005).

The Political in Environmental Change

Political ecology asserts that environmental change is not simply the outcome of natural processes or population pressures but rather a function of power relations, economic structures, and historical trajectories (Bailey & Bryant, 1997). This perspective diverges sharply from conventional environmental studies, which often emphasize biophysical causes of land degradation, deforestation, and resource depletion while neglecting the social, economic, and political factors that mediate environmental access and control (Peluso & Watts, 2001).

Political ecology theorizes power in environmental change through multiple lenses, including Marxist political economy, Foucauldian discourse analysis, and postcolonial critiques. Central to this framework is the idea that environmental change is fundamentally shaped by who has control over natural resources, how they exercise this control, and who benefits from ecological transformations (Robbins, 2012). This understanding contrasts with technocratic and managerial approaches that assume environmental problems can be solved through policy adjustments or technological innovations without addressing the underlying power structures that determine resource distribution (Forsyth, 2003). One of the earliest political ecology critiques came from Blaikie and Brookfield (1987), who argued that land degradation was not a result of overpopulation or local mismanagement but rather a consequence of historical processes of land expropriation, colonial legacies, and capitalist expansion. They demonstrated how state policies and global economic forces shape land use, often prioritizing commercial agriculture, extractive industries, and infrastructural projects over the needs of local communities (Blaikie & Brookfield, 1987). This stands in stark contrast to neo-Malthusian

perspectives, which attribute environmental decline to demographic pressures and resource scarcity (Homer-Dixon, 1999).

Another defining feature of political ecology is its focus on the asymmetrical distribution of environmental costs and benefits. Environmental degradation and resource scarcity do not affect all social groups equally; rather, they are experienced along the lines of class, race, gender, and geopolitical positioning (Rocheleau, et al., 1996). Political ecologists analyze how policies that promote large-scale development projects, such as hydropower dams, logging concessions, and agribusiness plantations, often enrich elites while dispossessing marginalized communities (Peluso & Lund, 2011). For instance, studies on deforestation in Southeast Asia have shown that commercial logging operations sanctioned by state authorities have led to widespread displacement of Indigenous communities despite official conservation rhetoric (Vandergeest & Peluso, 1995). Similarly, Fairhead and Leach (1996) demonstrate how narratives of desertification in West Africa have been weaponized to justify land enclosures and conservation policies that benefit external investors while restricting the traditional land-use practices of local farmers. Political ecologists also challenge the narrative of environmental refugees, which suggests that climate-induced displacement is a straightforward consequence of environmental collapse (Hartmann, 2010). Instead, they argue that displacement is a politically mediated process shaped by government resettlement schemes, land tenure policies, and economic restructuring programs that determine who is forced to move and who retains access to resources (Hartmann, 2010; Ribot, 2014).

A third significant area of political ecology research focuses on resource conflicts and environmental justice movements. Unlike mainstream conflict studies that attribute resource wars to natural scarcity and competition, political ecologists argue that violence over land, water, and forests is often the result of state interventions, corporate interests, and exclusionary policies (Peluso & Watts, 2001). For example, land conflicts in Latin America have been closely linked to the expansion of extractive industries, where multinational mining corporations secure vast concessions through state-backed agreements, leading to local resistance movements (Bebbington, et al., 2008). Similarly, water privatization schemes in sub-Saharan Africa have disproportionately impacted lower-income communities, fueling political mobilization against corporate and state actors who control access to essential resources (Swyngedouw, 2005). Political ecologists also highlight how militarization and securitization strategies are used to justify land grabs and environmental control. States and private entities frequently employ military forces, paramilitaries, or police to suppress local resistance against large-scale development projects, often criminalizing environmental activists and Indigenous

leaders (Temper, et al., 2018). The concept of green militarization further illustrates how conservation policies are increasingly enforced through violent means, with national parks and biodiversity protection initiatives becoming sites of conflict between state authorities and local communities (Duffy, 2014). In Chapter C, we will dive deeper into the climate-conflict nexus from a political ecology perspective.

Additionally, political ecologists examine how legal frameworks and property rights systems influence environmental struggles. Land titling programs, often promoted as tools for securing tenure and reducing conflict, have, in many cases, exacerbated disputes by favoring corporate entities over customary landholders (Zoomers, 2010). Such policies reflect broader neoliberal trends in environmental governance, where market-based solutions prioritize economic efficiency over social justice (McCarthy & Prudham, 2004). Environmental justice movements – ranging from anti-mining protests in the Andes to Indigenous land struggles in North America – are likewise very much central to political ecology's analysis of power in environmental change. These movements expose the structural inequalities embedded in environmental governance, revealing how policies that claim to promote sustainability often serve entrenched economic and political interests. Political ecologists argue that true environmental justice must go beyond the redistribution of resources to address the deep-seated political and economic inequalities that drive environmental conflicts (Martinez-Alier, 2002).

By emphasizing power, historical inequalities, and economic structures, political ecologists challenge dominant apolitical and scarcity-driven explanations of environmental crises. They reveal that access to and control over resources is not neutral or inevitable but rather shaped by governance structures, corporate power, and political struggles. This perspective offers a critical alternative to neo-Malthusian and technocratic approaches, which tend to obscure the underlying structural causes of environmental degradation and conflict.

Discourse and Knowledge Production in Environmental Change

Another vital contribution of political ecology is its critical analysis of how environmental knowledge is produced, framed, and applied in governance and policy. Political ecologists challenge the assumption that scientific and technical knowledge about the environment is neutral or objective, arguing instead that knowledge production is inherently political and serves particular interests (Forsyth, 2003). This perspective builds on Foucauldian discourse analysis, which examines how power operates through knowledge, shaping dominant narratives that justify specific environmental interventions while marginalizing alternative perspectives (Escobar, 1999).

Political ecologists argue that environmental knowledge is not simply a reflection of ecological reality but rather a social construct shaped by historical, political, and economic contexts. Scientific research, conservation policies, and climate change narratives are often developed in ways that reinforce the authority of states, international organizations, and corporations while excluding local knowledge systems, Indigenous epistemologies, and alternative environmental perspectives (Agrawal, 2005).

For example, research on conservation policies in the Amazon has revealed how international environmental organizations and national governments have promoted the idea of pristine wilderness in order to justify large-scale conservation projects. These initiatives, while framed as efforts to combat deforestation and biodiversity loss, have frequently resulted in the forced displacement of Indigenous communities and restrictions on traditional subsistence practices (Hecht & Cockburn, 2010). Similarly, studies of water governance in India have demonstrated how the discourse of water scarcity has been used to promote dam construction and privatization initiatives, often benefiting industrial and agribusiness interests at the expense of rural populations (Baviskar, 2007). These cases illustrate how scientific knowledge can be selectively used to support particular policy agendas, often privileging economic growth, conservation, or geopolitical interests over community well-being (Goldman, 2003). Political ecologists argue that this process is not merely a distortion of facts but a fundamental aspect of how power operates in environmental governance – by determining whose knowledge is considered legitimate and whose experiences are dismissed (Rocheleau, et al., 1996).

One of the more influential applications of discourse analysis in political ecology has been in the study of green governmentality and neoliberal conservation. Scholars such as Goldman (2001) and Ferguson (1994) show how international development organizations and environmental NGOs use global discourses of sustainability to justify interventions that reinforce state authority and corporate control over natural resources.

For instance, the rise of "carbon offset" programs and market-based conservation initiatives has been promoted through discourses of climate mitigation and sustainable development. However, research indicates that these programs often result in land dispossession and resource enclosure, as carbon markets prioritize economic efficiency over the rights of Indigenous and local communities (Büscher, et al., 2012). Similarly, discourses surrounding biodiversity protection have been used to justify the establishment of protected areas, frequently leading to the eviction of traditional land users under the guise of conservation (Duffy, 2014).

Political ecologists also critique how discourses of environmental security and climate conflict have been instrumentalized to support military interventions and state securitization. We will

explore this topic in greater depth in the next Section. Just as much for now: narratives that link climate change to armed conflict—such as the framing of the Darfur conflict as a climate war – have been challenged for oversimplifying complex socio-political dynamics and reinforcing neo-Malthusian scarcity arguments (Hartmann, 2010; Selby & Hoffmann, 2014). These discourses serve to depoliticize environmental struggles, shifting blame onto ecological factors rather than addressing the deeper political and economic causes of conflict (Ribot, 2014).

This Section has examined the role of discourse and knowledge production in shaping environmental governance, highlighting how dominant narratives reflect power relations and serve specific political and economic interests. Political ecologists argue that scientific and policy knowledge is not neutral but is often constructed in ways that justify elite control over natural resources while marginalizing alternative perspectives. By analyzing how discourses of conservation, climate security, and sustainable development are used to legitimize environmental policies, political ecology reveals the political nature of knowledge itself.

The following Section will apply these insights to the climate-conflict nexus, illustrating how political ecology offers a critical alternative to mainstream scarcity-driven explanations of environmental violence.

C. What Political Ecology has to say about Climate-Conflict

As established in previous chapters, much of the existing literature in the field of environmental security is dominated by neo-Malthusian assumptions, which argue that environmental stressors such as droughts, desertification, and resource depletion directly contribute to competition and violence (see Chapter III). These perspectives, often grounded in large-N statistical analyses, tend to frame environmental variables as independent drivers of conflict while overlooking historical, political, and economic factors that shape how societies experience and respond to climate change. As discussed in the prior Section, political ecology challenges such reductionist views by emphasizing the political nature of environmental change, showing how governance structures, power dynamics, and economic inequalities mediate access to and control over natural resources. This Section applies the political ecology framework to the climate-conflict nexus, critically assessing mainstream claims that climate change is a direct or primary driver of armed conflict. Rather than treating environmental degradation as an autonomous trigger of violence, political ecology situates climate-related conflicts within broader political-economic processes, highlighting the role of resource governance, land tenure policies, and state interventions (Benjaminsen, et al., 2012). This approach not only challenges deterministic

interpretations of climate-induced conflict but also provides a more nuanced understanding of how climate change interacts with existing social and political tensions.

Challenging Neo-Malthusian Narratives of Climate-Conflict

Political ecologists have long critiqued neo-Malthusian climate-conflict narratives for their over-simplification of environmental violence and their reliance on deterministic models that link resource scarcity to war (Benjaminsen, et al., 2012). These models often draw from large-scale statistical analyses that correlate rising temperatures or declining rainfall with increased incidences of conflict but fail to account for the social, economic, and political factors that determine how environmental changes are managed (Buhaug, 2010). A core issue in neo-Malthusian approaches is their causal linearity, which assumes that environmental stress directly leads to conflict without considering the intervening social and political structures. Political ecology, in contrast, argues that climate change interacts with pre-existing vulnerabilities, governance failures, and power dynamics, meaning that environmental stress alone cannot explain why conflicts emerge in some cases but not in others (Ribot, 2014).

Climate Change as an Amplifier, not a Cause

One of political ecology's key contributions to climate-conflict research is its emphasis on climate change as an amplifier of existing inequalities rather than an independent driver of violence (Peluso & Watts, 2001). This challenges the assumption that resource scarcity automatically leads to conflict, highlighting instead how unequal access to land, water, and state resources shapes patterns of adaptation or violence.

For example, research on conflicts in the Sahel region of Africa has frequently framed violence between pastoralists and farmers as the result of desertification and shrinking water resources (Homer-Dixon, 1999). However, political ecology challenges this framing by demonstrating how these conflicts are shaped by colonial land tenure policies, state resource allocation, and political exclusion, which determine who has access to dwindling resources and who is marginalized (Turner, 2004). This perspective is particularly relevant in the study of climate-related migration, where mainstream narratives often depict displaced populations as a security threat, reinforcing militarized border policies and restrictive migration laws (Bettini, 2013). Political ecology counters this by highlighting how displacement is frequently the result of economic restructuring, land grabbing, and state neglect rather than a direct consequence of climate change alone (Ribot, 2014).

The Role of Power, Political Economy, and Cooperation in Climate-Conflict

Accordingly, political ecologists argue that climate-related conflicts must be understood within the context of political economy, where power and resource distribution shape environmental vulnerability (Benjaminsen & Ba, 2019). Unlike neo-Malthusian perspectives, which focus on absolute resource scarcity, political ecology asks: *Who controls resources? Who benefits from environmental policies? Who is excluded from decision-making processes?*

For example, state-led water privatization in sub-Saharan Africa has exacerbated tensions between urban and rural communities, not because of absolute water scarcity but due to corporate monopolization and exclusionary governance structures (Mehta, 2010). Similarly, political ecologists have examined how land grabs in Latin America – justified under the guise of conservation or climate mitigation policies – have displaced Indigenous communities and smallholder farmers, fueling localized resistance and conflict (Borras Jr. & Franco, 2013).

Additionally, political ecology critiques the depiction of climate-conflict relationships in international policy discourses, where climate change is often framed as a threat multiplier that justifies increased militarization and securitization (Dalby, 2013). By focusing on power, governance, and economic structures, political ecology reveals how climate-related conflicts are often symptoms of more profound structural inequalities rather than autonomous outcomes of environmental change (Le Billon, 2012).

Another major flaw in neo-Malthusian climate-conflict research is its neglect of adaptive and cooperative responses to environmental stress (Meierding, 2013). Political ecologists argue that while climate-induced resource scarcity can lead to disputes, it more often results in cooperative strategies for resource-sharing, migration, and adaptation (Adger, 2010). For example, studies on water management in arid regions have demonstrated that local governance institutions play a decisive role in whether droughts lead to conflict or adaptation (Ostrom, 1990). Political ecology highlights historical examples of cooperative resource management, such as traditional irrigation systems in the Middle East and community-based land-sharing agreements in sub-Saharan Africa, challenging the assumption that scarcity inevitably leads to violence (Zeitoun & Warner, 2006). This approach underscores the importance of inclusive governance, decentralization, and equitable resource distribution in mitigating climate-related tensions. By shifting the focus from deterministic climate-conflict narratives to political and institutional responses, political ecology provides a more policy-relevant framework for addressing environmental stress and building resilience (Ribot, 2014).

From this Section, we have gathered that political ecology is challenging deterministic climate-conflict narratives by demonstrating that environmental violence is not simply the result of

resource scarcity but is fundamentally shaped by political structures, economic policies, and historical inequalities. Instead of treating climate change as an autonomous trigger of conflict, political ecology asks who controls resources, how environmental stress is governed, and whose interests are protected or marginalized. By integrating insights from historical land struggles, governance failures, and global economic structures, political ecology provides a more nuanced and policy-relevant framework for understanding the climate-conflict nexus. The following Section will introduce the methodology for the empirical part of this study. The first part will employ a quantitative approach, testing if there are statistical correlations between climate change and conflict in Darfur, while the second part will take a qualitative approach, mapping out potential causal pathways from climate change to conflict in the Darfuri context, using the framework of political ecology presented in this chapter.

V. Methodology of the Study

This chapter outlines the methodological design and research process adopted in this thesis. As the research aims to explore how and to what extent climate change contributes to conflict in Darfur, a multifaceted methodological approach is necessary. Because of the complex character of the climate-conflict connection and the specificity of the Darfuri context, this study employs a mixed-methods approach that combines quantitative analysis of empirical data with qualitative interpretative research grounded in political ecology. This combination is designed to uncover both statistical patterns and underlying causal processes behind the apparent correlation between climate change and violence. The time period chosen – 1989 to 2019 – has been selected for both empirical and analytical reasons. Politically, 1989 captures the rise to power of *Omar al-Bashir* through the aforementioned military coup, initiating a new age in Sudanese politics that witnessed the expansion of militarized rule and continued indifference towards peripheral regions like Darfur. 1989 thus represents a critical fulcrum point towards understanding state policy and its interplay with environmental changes. On the other end, 2019 marks the ousting of Bashir and the beginning of another transformative political era. Concluding the study at this point allows the research to capture a coherent historical phase characterized by authoritarian rule, state-sponsored militia violence, and shifting environmental dynamics – without introducing the significant political discontinuities and uncertainties that followed the 2019 revolution.

The research design combines quantitative and qualitative methods to triangulate findings and enrich explanatory depth. The quantitative component is primarily used to test for correlations

and statistical relationships between climate variables and conflict incidence in Darfur. The qualitative component, informed by political ecology, is employed to interpret these patterns and uncover causal mechanisms and narratives that are otherwise obscured in large-N statistical analyses. This dual strategy follows a sequential explanatory model: the quantitative phase identifies patterns, which are then further explored and contextualized through qualitative inquiry.

A. Quantitative Methodology

The quantitative analysis draws on multiple secondary datasets. Climate data were sourced from the Climatic Research Unit and the Climate Change Knowledge Portal, providing monthly temperature and precipitation records at the subnational level from 1901 to 2020. Conflict data were extracted from the Uppsala Conflict Data Programme (UCDP), covering violent incidents across Darfur from 1989 to 2019.

The unit of analysis is the Darfuri administrative region, disaggregated into the five states of North, South, West, East, and Central Darfur. The dependent variable is the annual number of violent conflict events per state-year. Independent variables include annual mean temperature and total precipitation, both averaged over the calendar year. To address potential endogeneity, lagged variables (one-year and two-year lags) were constructed. Interaction terms were also created to explore the conditional effects of temperature and precipitation combined.

A range of statistical models was employed. Initial bivariate Pearson correlations were calculated to establish preliminary relationships. Ordinary Least Squares (OLS) regression was then used to test the explanatory power of climate variables on violence. To account for unobserved heterogeneity across states and years, fixed-effects models were introduced. Lagged regressions allowed for testing delayed effects of climate variability, while interaction regressions examined whether combined stressors were more predictive of violence than singular factors. These analyses were conducted using Stata, with all variables standardized to improve interpretability.

To complement the descriptive component of the quantitative analysis, geospatial visualizations were designed. Conflict event locations and manifestations of climate change were mapped, using QGIS and Flourish. These maps enable visual comparison of hotspots of conflict and ecological stress alike, which might reveal and corroborate correlations between climate change and conflict.

However, the quantitative approach faces several limitations. First, statistical models are able to recognize associations but by no means causality. Second, there might be potential measurement errors in both conflict and climate data, particularly with the historical underreporting of local conflict events. Third, annual aggregation might obscure intra-annual dynamics, such as the seasonal timing of violence relative to rainfall. Finally, climate-conflict relationships are inherently non-linear and shaped by a multitude of intervening variables, many of which cannot be adequately captured in regression models.

B. Qualitative Methodology

The qualitative methodology employed in this thesis is rooted in the epistemological and theoretical foundations of political ecology. This approach emphasizes the embeddedness of environmental conflict in historically situated power relations, economic systems, and governance structures (see Chapter IV). Given the limitations of quantitative approaches in capturing these multi-scalar and deeply contextual dynamics, the qualitative strand of this research seeks to dig into the narratives, structures, and institutional arrangements that shape the lived experience of climate change and conflict in Darfur.

The primary aim of the qualitative analysis is to uncover causal pathways that cannot be readily identified through large-N statistical analyses. While the quantitative findings might suggest that temperature anomalies correlate with increased violence, they would be unable to explain how or why this relationship unfolds in Darfur specifically. The qualitative inquiry, therefore, functions as both a complement and a corrective to the statistical analysis, offering interpretive depth to the patterns identified in earlier chapters.

The methodology is guided by the principles of progressive contextualization (cf. Vayda, 1983), which entails beginning with an observable event or phenomenon – such as a violent conflict or land dispute – and progressively tracing back to its structural, institutional, and historical causes. This technique aligns well with political ecology's insistence on embedding environmental dynamics within broader systems of inequality, governance, and exploitation. Accordingly, the analysis explores how land scarcity, resource control, and climate adaptation are mediated by historical legacies and current power configurations in Darfur.

The qualitative data corpus includes a diverse range of secondary materials. These comprise peer-reviewed journal articles, historical monographs, policy reports from multilateral organizations such as UNEP, UNDP, and the African Union, and NGO reports from actors including Human Rights Watch and the Small Arms Survey. Additionally, Sudanese and

regional scholarly literature has been reviewed to incorporate locally grounded perspectives. Where available, ethnographic studies and first-person accounts have been used to enrich the narrative, providing insight into the everyday realities and coping strategies of affected communities.

The thematic focus of the qualitative analysis was structured around three central and interrelated areas of inquiry: access to land and the political economy of resource distribution, state power and environmental governance, as well as climate adaptation as a site of power. These themes were selected on the basis of their relevance to both the empirical patterns observed in Darfur and the theoretical underpinnings of political ecology. Each of these chapters follows a consistent analytical logic. They begin by presenting the empirical material – such as narratives from reports or case study evidence – and then interpret these findings through the lens of political ecology. The method of interpretation centers on power mapping: identifying which actors benefit from specific arrangements, whose voices are marginalized, and how environmental narratives are weaponized in the service of political or economic goals. A crucial component of this method is attending to scale. Political ecology insists that environmental conflicts cannot be fully understood without considering local, national, and international dynamics simultaneously. For example, a land dispute between herders and farmers in West Darfur may reflect not only immediate ecological pressures but also decades of state neglect, donor-driven adaptation programs, and shifting regional security logics. Consequently, the analysis situates micro-level events within these broader political-economic landscapes.

With this methodological groundwork in place, the thesis now transitions to the quantitative analysis of climate-conflict patterns in Darfur. The following chapter draws upon a combination of climatological and conflict data from 1989 to 2019 to statistically explore whether changes in temperature and precipitation correlate with patterns of violence across the region.

VI. Climate Change and Conflict in Darfur: A Quantitative Analysis

Having presented the historical context and various explanatory narratives surrounding the conflict in Darfur in previous chapters, we now transition into its analytical core. This chapter constitutes the first major analytical segment of this research, employing quantitative methods to examine one of the central claims prevalent in both scholarly literature and popular discourse:

the assertion that climate change significantly contributed to the outbreak and perpetuation of violence in Darfur. Specifically, the goal here is to visually and statistically assess whether environmental stressors such as rainfall variability, droughts, and rising temperatures correlate systematically with the patterns and intensity of conflict events in the region between 1989 and 2019.

As highlighted in Chapters II and III, the narrative of Darfur as a "climate war" has gained considerable attention and traction, shaping perceptions and policy responses globally (Ki-Moon, 2007; CNA, 2007). Yet, as shown in Chapter III, the empirical literature on climate-conflict dynamics offers a mixed and inconclusive picture, particularly in regions as socio-politically complex as Darfur. While some studies suggest a clear relationship between climatic anomalies and increased incidence of violence (e.g. Burke et al., 2009; Hendrix & Glaser, 2007), others find limited or no robust statistical support for such a causal link (e.g. Buhaug, 2010; Theisen et al., 2013). Given these ambiguities, a detailed quantitative analysis is essential to test the validity of these widely cited but heavily contested claims within the specific context of Darfur.

To achieve this objective, this chapter systematically evaluates two critical questions. First, it examines whether significant statistical associations exist between climatic variables – such as rainfall and temperature patterns – and conflict indicators, including the number of violent events and their fatalities. Second, it assesses the strength and consistency of these relationships across different time periods and geographical locations within the region. In doing so, this analysis seeks to clarify whether – and to what extent – climatic conditions are empirically connected to variations in the intensity and distribution of conflict. Importantly, this chapter is explicitly descriptive and exploratory rather than conclusive in terms of causality. While quantitative analysis can identify statistical correlations and patterns, the interpretation of these findings regarding causal mechanisms and underlying dynamics necessitates qualitative inquiry – a task reserved for Chapter VII. Consequently, this chapter concludes by summarizing the empirical evidence obtained and highlighting any preliminary insights or anomalies discovered, thereby setting the stage for the detailed qualitative analysis that follows.

A. Darfur's Climate Profile and How it is Changing

After reading this subchapter, the reader should have a somewhat comprehensive understanding of the climatic trends in the Darfuri region of the Sudan. It provides a descriptive analysis of

historical and recent climatic patterns in Darfur, serving as an introduction upon which further statistical analyses – correlation, regression, and spatial – will build.

1. An Introduction to Darfur's Climate Profile

Darfur, located in western Sudan, encompasses a vast and diverse landscape characterized by varying climatic conditions. Understanding the region's climatology is essential for comprehending the environmental challenges faced by its inhabitants and the broader implications for socioeconomic development and conflict dynamics.

This chapter provides a comprehensive overview of Darfur's climate, examining its geographical setting, climatic zones, temperature and precipitation patterns, and the impacts of climate variability on the region's ecosystems and livelihoods.

Geographical Setting of Darfur

Darfur, situated in the western part of Sudan, encompasses a vast and ecologically distinct region whose geography plays a central role in shaping both climatic conditions and human livelihoods. Spanning approximately 493,180 square kilometers, Darfur is nearly equivalent in size to mainland Spain. It forms a significant portion of Sudan's total land area – roughly a fourth – and is subdivided into three main administrative states: North Darfur, South Darfur, and West Darfur. As of recent reforms from 2012, two additional statehoods – Central Darfur and East Darfur – have also been established, reflecting the region's complex social and political landscape.

Darfur's physical geography is characterized by striking contrasts in elevation and terrain. The most prominent feature is the Marra Mountains (*Jebel Marra*), a dormant volcanic massif located in Central Darfur. This highland zone reaches its peak at *Mount Deriba*, which rises to approximately 3,042 meters above sea level. The Marra Mountains significantly affect local climate patterns, creating a microclimate with higher rainfall and lower temperatures compared to the surrounding lowlands. Outside the highlands, Darfur's landscape is composed of flat plains, gently undulating plateaus and scattered inselbergs. The eastern and southern parts of Darfur are predominantly made up of sandy soils known as *goz*, which support limited vegetation and are prone to erosion. The northern sector of the region gradually merges into the Sahara Desert, typified by hyper-arid conditions, sand dunes, and sparse vegetation. These varied landforms result in ecological zonation, which in turn shapes livelihood strategies.

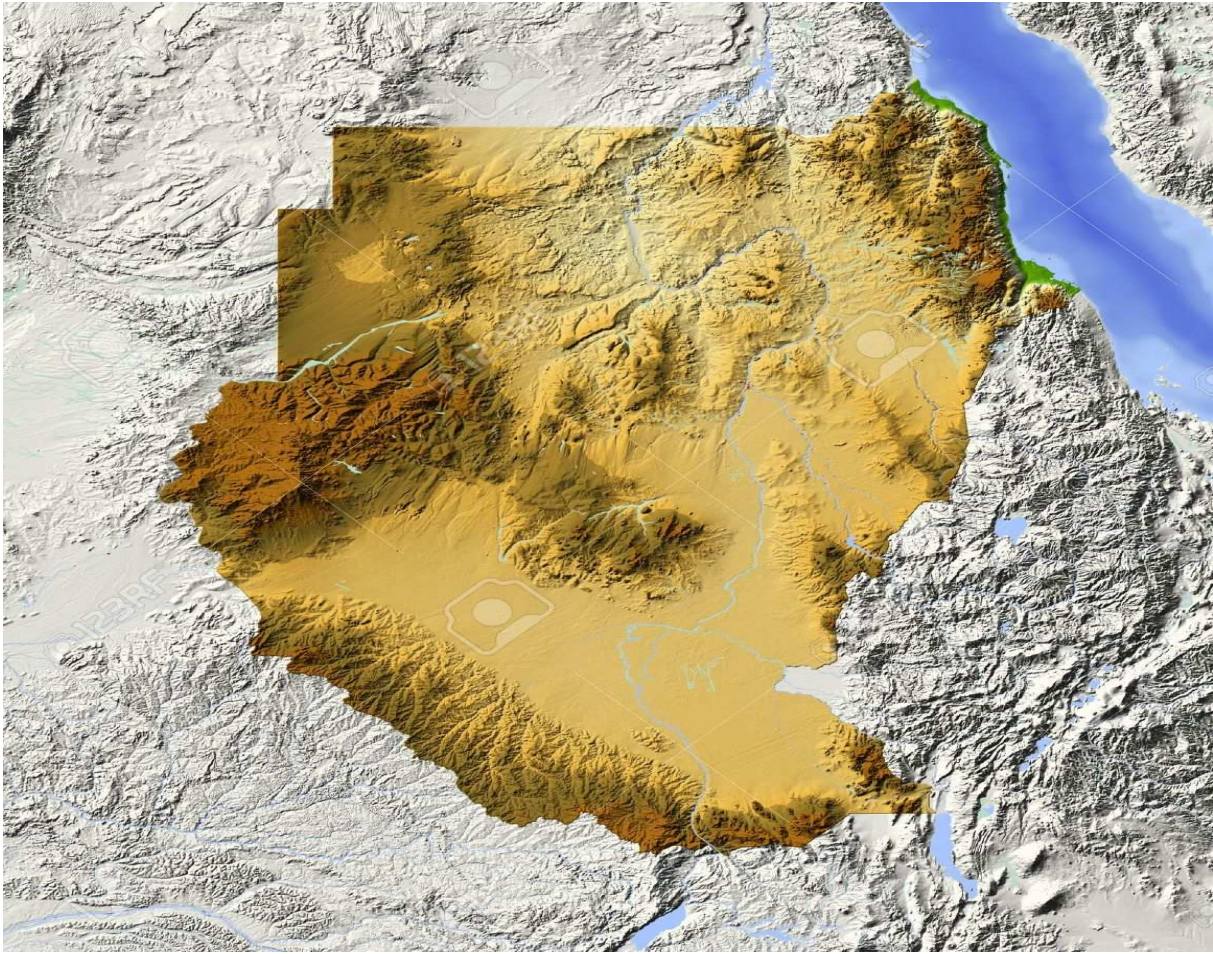


Figure 2: Topographic Map of Sudan and South Sudan (NASA).

Water

Water availability in Darfur is highly variable and closely tied to the region's geomorphology. The absence of perennial rivers means that the region relies on seasonal watercourses, known as wadis, such as Wadi Azum and Wadi Bari, which carry runoff during the rainy season and replenish shallow aquifers. These temporary water bodies are critical to both agricultural and pastoral communities. In the highlands of Jebel Marra, numerous springs and ephemeral streams emanate from the volcanic slopes, feeding small-scale irrigation systems and sustaining local biodiversity. The Deriba Caldera within the Marra Mountains contains crater lakes that serve as unique hydrological features. Nevertheless, the broader region suffers from chronic water scarcity, especially in the dry season. Groundwater exploitation via boreholes and hand-dug wells has become increasingly common, but this resource is unevenly distributed and often overused. In arid and semi-arid zones, communities frequently depend on hafirs – man-made reservoirs – to store rainwater.

Soil

Soil composition across Darfur varies considerably by region. In the north, sandy and gravelly soils dominate, offering low fertility and limited capacity for water retention. These soils support only sparse vegetation, including xerophytic shrubs and acacia trees. In central areas, goz soils provide moderate productivity under rain-fed conditions but are susceptible to erosion and degradation due to overgrazing and deforestation. Southern Darfur, in contrast, contains more loamy and clay-rich soils, particularly in areas close to the seasonal watercourses. These soils are relatively fertile and support a variety of crops, including millet, sorghum, groundnuts, and sesame. The Marra Mountains constitute an ecological refuge, home to montane forests and high-altitude pastures. This biodiversity hotspot hosts endemic plant species and rare fauna, offering both ecological and economic value. Vegetation patterns in Darfur closely mirror rainfall gradients. In the south, savannah woodland dominates, transitioning to thorn scrub and desert flora in the north. Shifting cultivation, fuelwood collection, and drought have contributed to widespread deforestation and land degradation. These ecological changes, while partly driven by natural variability, are also the result of anthropogenic pressures, including conflict-driven displacement and unsustainable land use (Young, 2012).

Livelihoods

Human settlements in Darfur are shaped by environmental factors, resource availability, and socio-political history. Major urban centers such as Al-Fashir (North Darfur), Nyala (South Darfur), and Geneina (West Darfur) serve as administrative and commercial hubs. These cities are strategically located near water sources and crossroads of trade routes. In rural areas, settlement density increases in regions with access to cultivable land and water. In northern and central zones, pastoralism is the dominant livelihood strategy. Communities practice nomadic or transhumant herding of camels, sheep, and goats, often migrating seasonally in search of grazing land. In the south and southwest, agriculture is more prevalent, with smallholder farmers engaged in subsistence and semi-commercial production. Land tenure in Darfur is governed by a dual system of customary rights and formal law. Communal land is managed by tribal leaders under the hakura system, which historically allocated land for specific uses. However, demographic pressure, migration, and state-led resettlement schemes have intensified competition over land. This contestation over space is further aggravated by environmental degradation and shifting precipitation patterns.

Seasons

Darfur's climate is governed by two principal seasons: the rainy season (*kharif*) and the dry season (*shita* and *sayf*), which determine the annual agricultural and pastoral cycles. The *kharif* season typically spans from June to September and is crucial for rain-fed agriculture and pasture regeneration. During this period, most crops – such as millet, sorghum, and groundnuts – are sown and cultivated, with harvests taking place between October and December, depending on the crop type and precipitation levels. The dry season is divided into two phases: *shita* (cool dry season), from November to February, and *sayf* (hot dry season), from March to May. The *shita* period is characterized by cooler temperatures and residual moisture that allows for the drying and processing of harvested crops, while the *sayf* is marked by intense heat and little to no rainfall, often triggering seasonal migration for pastoral communities in search of greener pastures and water. These seasonal patterns are deeply embedded in the socioeconomic fabric of rural Darfur, shaping migration, food security, and inter-communal relations. Shifts in the timing or intensity of these seasons, often linked to climate change, have increasingly disrupted traditional calendars, posing risks to both subsistence and commercial agricultural productivity.

2. Trends in Temperature

Historically, Darfur's climate has been defined by high average temperatures, a result of its geographic position within the Sahelian belt. The region lies between the arid Sahara Desert to the north and the more humid savannah zones to the south, and this positioning exerts a strong influence on temperature regimes. Long-term observational data indicates that mean annual temperatures across Darfur have typically ranged between 26°C in the highland areas of Jebel Marra and up to 32°C in the low-lying northern plains (Hulme, 2000).

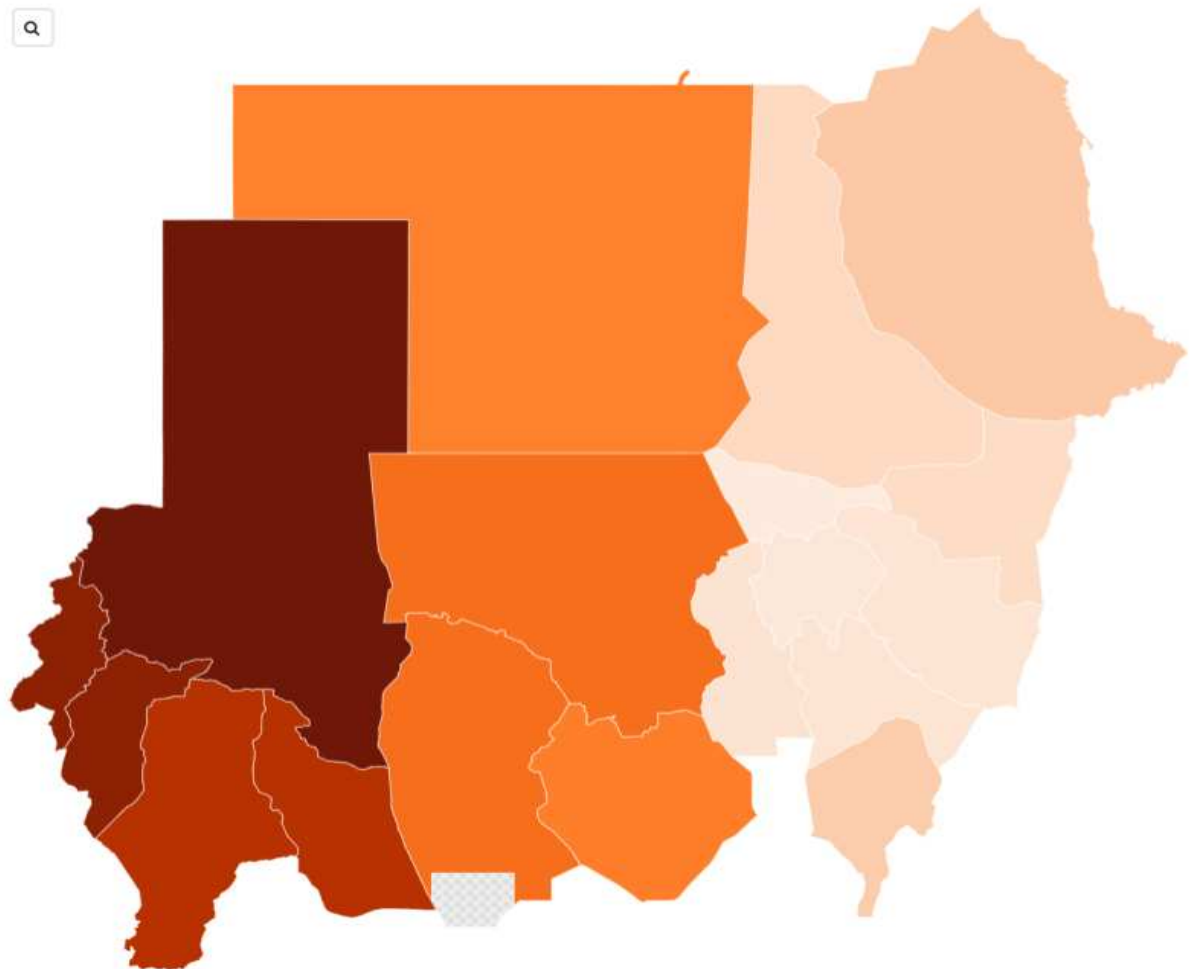
In the early 20th century, between 1901 and 1930, recorded average temperatures across the Darfuri states remained relatively stable, with localized fluctuations primarily driven by natural variability such as El Niño-Southern Oscillation (ENSO) events. For example, North Darfur recorded an average of 25.47°C, South Darfur 26.79°C, and West Darfur 25.68°C during this period. These figures remained largely consistent through the mid-century. However, a substantial shift became apparent beginning in the late 1970s and has since accelerated.

Data compiled by the Climatic Research Unit (CRU) and corroborated by World Bank Climate Change Knowledge Portal datasets show that between 1991 and 2020, average annual temperatures rose the steepest across the Darfuri states in comparison to the other Sudanese states (see Figure 3). In North Darfur, temperatures increased to 26.56°C (+4.27%), in South Darfur to 27.86°C (+4.00%), and in West Darfur to 26.75°C (+4.16%). Though these

percentage increases may seem modest at first glance, even a 1°C rise in mean temperature can significantly affect evapotranspiration rates, soil moisture retention, and agricultural cycles in semi-arid regions like Darfur (Burke, et al., 2009).

Percentage Change in Average Surface Air Temperature in Sudanese States (1901–1930 to 1991–2020)

Temperature Change (%) 2.94 4.28



Source: Climate Change Knowledge Portal

Figure 3: Changes in Average Temperature across Sudan (Own Visualization with Data from the Climate Change Knowledge Portal)

More broadly, Sudan’s national climate data reflect this regional trend. According to the Sudan Meteorological Authority, the national average temperature has increased by approximately 1.1°C over the past century (Osman-Elasha, et al., 2006). Notably, the post-1970 period has been characterized by increasingly frequent extreme heat events. Average maximum temperatures during peak summer months (April to June) have risen more sharply than minimum temperatures, suggesting an intensification of heatwaves. This asymmetric warming has led to a greater thermal stress on crops, livestock, and human populations alike.

Spatial analysis also reveals geographic heterogeneity in warming rates. The northern parts of Darfur, which transition into the Sahara Desert, have warmed more rapidly than the southern regions. Satellite-derived temperature datasets, such as MODIS and ERA5 reanalysis models, indicate surface temperature anomalies exceeding 1.5°C in some parts of North Darfur since the 1980s. This pattern aligns with broader Sahelian warming trends observed across neighboring regions of Chad and Niger (Giannini, et al., 2008).

The temporal distribution of warming in Darfur has also shifted. Whereas earlier decades saw peak temperatures predominantly during the core summer months (June–August), recent years have seen prolonged periods of elevated temperature extending into the shoulder seasons. March and October, which historically marked transitional periods, now frequently register above-average temperatures. This extension of the hot season shortens the growing season for rain-fed crops and accelerates soil moisture loss.

Further complicating this trend is the diurnal temperature range (DTR), which refers to the difference between daytime highs and nighttime lows. In much of Darfur, DTR has widened in recent decades. Minimum temperatures have increased more slowly than maximum temperatures, possibly due to clearer skies and reduced vegetation cover leading to faster nighttime cooling. This widening DTR has implications for plant growth and disease dynamics, particularly in crops sensitive to temperature stress (Lobell & Field, 2007).

Comparative data between 1901–1930 and 1991–2020, compiled in Figure 3, demonstrate these long-term warming patterns. Not only have all states in Darfur experienced absolute increases in mean annual temperature, but they also show a consistent upward trend when examined through both ground-based stations and satellite observations. This data lends strong empirical support to the assertion that Darfur is warming at a rate comparable to or even exceeding global averages.

In Darfur, where almost half of all livelihoods are closely tied to temperature-sensitive sectors such as rain-fed agriculture and pastoralism, these temperature changes are not just statistical anomalies – they translate into real and pressing livelihood threats. The ramifications of this warming are multifaceted. Increased temperatures exacerbate desertification processes, particularly in northern Darfur where vegetation cover is already sparse. Moreover, rising temperatures influence human settlement patterns by increasing water demand and reducing agricultural productivity, often forcing migration or urban relocation (De Waal, 2007). The empirical data on temperature changes in the Darfuri states provides a first clue, how man-made climate change might have significantly increased the potential for disruption and conflictual behavior in the region.

To conclude, historical temperature data confirms that Darfur has undergone significant warming over the past century, with the most pronounced increases occurring in the last three to four decades, coinciding with the lead-up period of the Darfur war in the early 2000s. This warming is not uniformly distributed across space or time, but its cumulative effects are deeply felt across the region. As we will explore in the following chapters, these temperature shifts interact with other climatic and socio-political variables to shape patterns of conflict, displacement, and adaptation in the region.

3. Trends in Precipitation

Darfur's precipitation patterns, like its temperature trends, have undergone significant changes over the past century. The region's climate is governed by the seasonal movement of the Intertropical Convergence Zone (ITCZ), which influences rainfall distribution and intensity across much of the Sahel. In a region already vulnerable due to its semi-arid to arid ecology, fluctuations in precipitation not only affect water availability but also carry significant implications for agricultural productivity, pastoral mobility, and the likelihood of environmental stress-related conflict.

Rainfall in Darfur is highly seasonal and markedly variable both spatially and temporally. Historically, the rainy season (*kharif*) spans from June to September, during which most of the annual precipitation occurs. The amount of rainfall generally decreases from south to north, with southern Darfur receiving annual averages between 500 and 800 mm, while northern Darfur often receives less than 150 mm.

The early twentieth century was a relatively stable period in terms of rainfall, particularly between 1901 and 1930 (see Figure 4). The data suggests a relatively consistent pattern of seasonal rainfall that supported the traditional agropastoralist systems of Darfur. South Darfur received an average of approximately 655 mm annually, while West Darfur registered around 590 mm and North Darfur, further towards the Sahelian fringe, averaged only 177 mm. These patterns aligned well with the ecological zoning of the region, where agriculture was concentrated in the wetter southern zones and nomadic pastoralism dominated the arid north.

During this baseline period, rainfall was relatively dependable in terms of timing and distribution. Communities organized their agricultural calendars around predictable rain events, and transhumant pastoralists had clear migration schedules based on water and pasture availability. Oral histories and colonial-era records suggest that the period between the early

1900s and the 1960s featured fewer years of severe drought, although localized dry spells were not uncommon (Mason, 2001).



Figure 4: Precipitation Patterns for Three Darfuri States, 1901-2023 (Climate Change Knowledge Portal)

However, post-1960s, Darfur's rainfall regime began to show signs of increasing variability and a decline in predictability. The 1970s and 1980s brought a series of prolonged droughts that drastically altered perceptions of climate stability across the Sahel, including Darfur (compare Figure 4). These droughts were not singular events but rather formed a long-running pattern of below-average rainfall, particularly between 1968 and 1985, during which multiple failed rainy seasons occurred consecutively (see Figure 4). In many parts of North and West Darfur, annual rainfall totals during the worst years fell by more than 30–40% relative to the 1901–1930 average. Entire harvests failed, surface water sources dried up, and pasturelands deteriorated. The socioeconomic impacts of these droughts were immense. Crop failures became common, leading to increased food insecurity and malnutrition, especially among vulnerable populations such as children and the elderly. Livestock mortality soared as pasture and water became scarce,

devastating the livelihoods of pastoralist communities. The economic structure of many Darfuri villages collapsed under the dual burden of environmental stress and an inadequate state response. As traditional livelihoods became unsustainable, entire communities were forced to adopt new coping strategies, including seasonal migration, urban relocation, and increased dependence on external food aid (Olsson, 1993).

Moreover, the droughts catalyzed demographic shifts that had long-term consequences for the social and political landscape of Darfur. The southward migration of pastoralist groups into more fertile agricultural lands led to increased tensions between farmers and herders. Competition over land and water – already a sensitive issue – became more acute, laying the groundwork for later disputes. In some instances, customary agreements over grazing routes and water sharing broke down, overwhelmed by the magnitude and frequency of drought-induced displacements (Ahmad & Manger, 2006).

Additionally, the environmental degradation caused by prolonged droughts interacted with existing state neglect. During this period, the Sudanese central government invested little in drought mitigation infrastructure in Darfur. As a result, community-based natural resource management systems were left to bear the brunt of the crisis. When these systems faltered or collapsed under the pressure, grievances deepened, particularly in areas that were already politically marginalized (De Waal, 2007). The cumulative legacy of the 1970s and 1980s droughts thus extended well beyond their immediate ecological and humanitarian impacts. These years not only eroded Darfur's environmental capital but also frayed the social fabric of cooperation and coexistence between different livelihood groups. Many of the intercommunal tensions that would later erupt into violence in the early 2000s may well be traced back to the disruptions caused by these prolonged periods of rainfall failure.

By the time we compare the more recent climatological period of 1991–2020 with the early 1900s baseline, we observe marginal changes in total annual precipitation across Darfur's three main regions. South Darfur's average rainfall slightly declined to 650 mm (a drop of approximately 0.76%), while West Darfur recorded a minor increase to 594 mm (+0.68%) and North Darfur decreased slightly to 176 mm (-0.56%). While these shifts in absolute values may appear modest, they must be interpreted within the context of seasonality, rainfall intensity, and day-to-day variability. Critically, while the total rainfall may not have dropped precipitously, the number of rainy days has declined in many areas. This means the same or slightly less rainfall is falling over fewer days, resulting in higher intensity events. Such patterns increase the likelihood of surface runoff and reduce water infiltration into the soil, thereby undermining the effectiveness of rainfall for agricultural and pastoral uses (Osman-Elasha, et al., 2006).

Another dimension of change relates to the spatial consistency of rainfall. Earlier records indicate relatively homogeneous spatial coverage of rainfall across the rainy season, especially in South and West Darfur. Contemporary observations, however, point to increasingly fragmented rainfall patterns, with some localities experiencing intense rainfalls while adjacent areas remain dry. This fragmentation adds complexity to rain-fed agricultural planning and further complicates traditional pastoralist migration patterns (Bromwich, 2017).

Inter-annual variability has also intensified. Whereas the early part of the twentieth century saw fewer abrupt transitions between wet and dry years, the period since the 1970s has been marked by sudden and extreme oscillations. For instance, a year of average or above-average rainfall might be followed by two or three consecutive years of drought-like conditions. This volatility reduces the effectiveness of indigenous climate knowledge and traditional adaptive strategies, such as seed variety rotation or staggered planting.

Climate reconstructions using remote sensing data, including Normalized Difference Vegetation Index (NDVI) and satellite-derived rainfall estimates, reinforce the narrative of variability and stress. Particularly from the 1980s onward, satellite records show decreasing vegetation cover and soil moisture levels during the growing seasons, indicating that the effective utility of rainfall has declined even when total annual values appear relatively stable (Tucker, et al., 1991).

The consequences of these rainfall trends are compounded by broader ecological degradation. Over the past several decades, increasing pressure from human activity – such as land clearing for farming, overgrazing by expanding herds, and deforestation for fuelwood – has reduced the land's absorptive capacity. Thus, rainfall that might once have supported grassland regeneration now often results in flash flooding or is lost to runoff (Kevane & Gray, 2008).

When examined alongside the documented temperature increases discussed in the prior chapter, the impact of climatic change in Darfur becomes even more pronounced. The combination of rising temperatures and erratic rainfall compounds environmental stress, accelerating evapotranspiration, shrinking growing seasons, and deepening water insecurity. These climatic shifts do not act in isolation, they interact with Darfur's fragile socio-political and economic systems to heighten vulnerability. In rural communities where agriculture and pastoralism remain the backbone of survival, the dual burden of temperature and precipitation change presents a formidable challenge – disrupting traditional adaptation mechanisms, altering settlement and migration patterns, and exacerbating tensions over dwindling natural resources. Together, these climatic pressures form a critical backdrop for understanding the broader conflict dynamics explored in the subsequent chapters.

B. Mapping Climate Change and Conflict in Darfur

Building upon the extensive climatological data outlined in the previous sections, we now seek to assess the extent to which environmental changes – particularly variations in temperature and precipitation – are statistically correlated with conflict occurrence in the Darfur region. This chapter comprises two main sections. First, we offer a descriptive spatial and temporal mapping of climate and conflict events. Second, we provide a quantitative correlation and regression analysis to examine potential statistical relationships between climate anomalies and violent conflict. Through these approaches, we begin to address the first core research question: is there a correlation between climate change and the incidence of conflict in Darfur?

1. Climate and Conflict in Space: Mapping Ecological Stress and Violent Episodes in Darfur

In order to understand the (statistical) relationship between climate change and conflict in Darfur, it seems warranted to zoom out first and zero in on the spatial and temporal patterns that characterize both environmental change and the occurrence of violence. This section aims to provide a preliminary spatial overview of climate trends and conflict events across the Darfuri states from 1989 to 2019. Using geographic information system (GIS) mapping, we visualize temperature and precipitation changes in tandem with the locations and intensities of violent incidents, revealing patterns that might otherwise remain obscured in purely statistical formats.

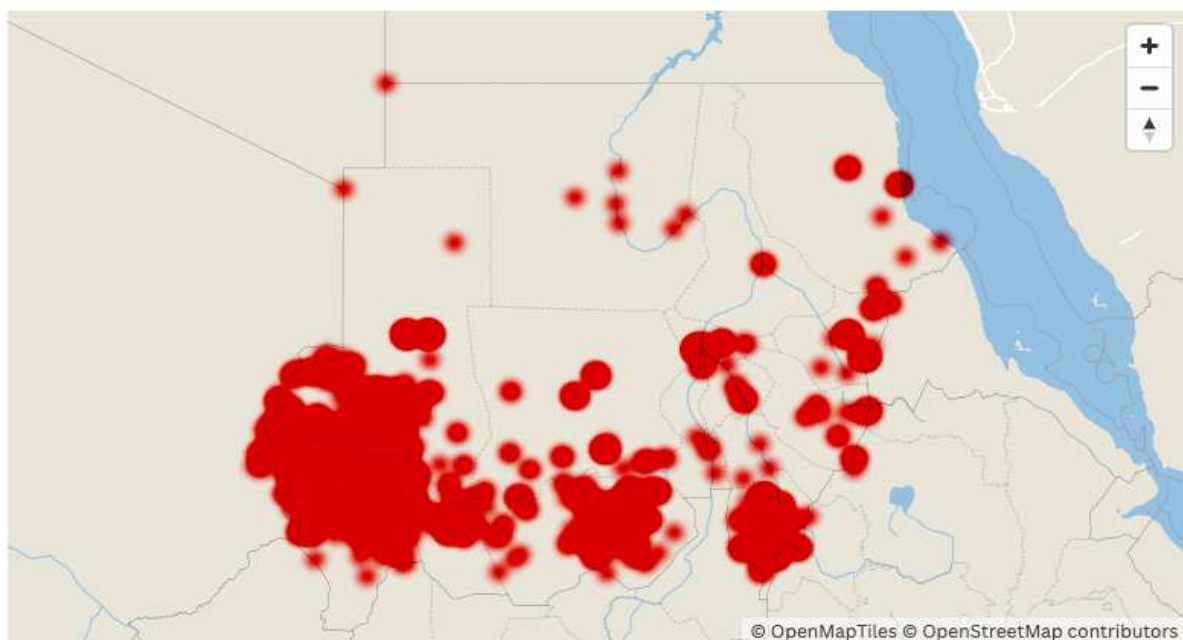
Figure 5 illustrates the spatial concentration of violent conflict across the Sudan, highlighting a pronounced clustering in the Darfuri states located in the western and southern regions of the country. Using gridded temperature data from the Climatic Research Unit (CRU) and conflict incident data from the Uppsala Conflict Data Programme (UCDP), we mapped annual mean temperature anomalies alongside the spatial distribution of violent events across Sudan between 1989 and 2019. The results highlight a gradual and geographically uneven increase in average temperatures, with North, West and Central Darfur experiencing the most pronounced warming trends. These same areas also show a concentration of violent events, particularly from the early 2000s onward.

Figure 6 visualizes this dual trend in regard to climate change related increases in temperature. Each grid cell displays the average temperature increase in the 1991 to 2020 period relative to a 1901-1930 baseline, overlaid with point data representing the location of violent incidents. A striking pattern emerges, as clusters of violence are often located in areas where temperature

anomalies exceed +1.5°C. Similarly, conflict density increases in zones where seasonal temperature variability is most pronounced, particularly during the summer and early autumn months when traditional farming and pastoral cycles are disrupted. These spatial overlaps suggest that an increase in temperatures may act as an aggravating factor in areas already prone to instability. As Burke et al. (2009) argue, heat stress can reduce agricultural productivity, increase resource competition, and lower economic resilience – all of which are plausible pathways through which temperature changes may influence conflict dynamics. In Darfur's context, where agriculture and pastoralism are the primary means of livelihood, even minor disruptions to ecological rhythms can have significant socio-political ramifications.

Where Conflict occurred in Sudan (1989-2019)

Georeferenced Episodes of Violence



Source: Uppsala Conflict Data Programme (UCDP)

Figure 5: Where Conflict is happening in the Sudan (Own Visualization)

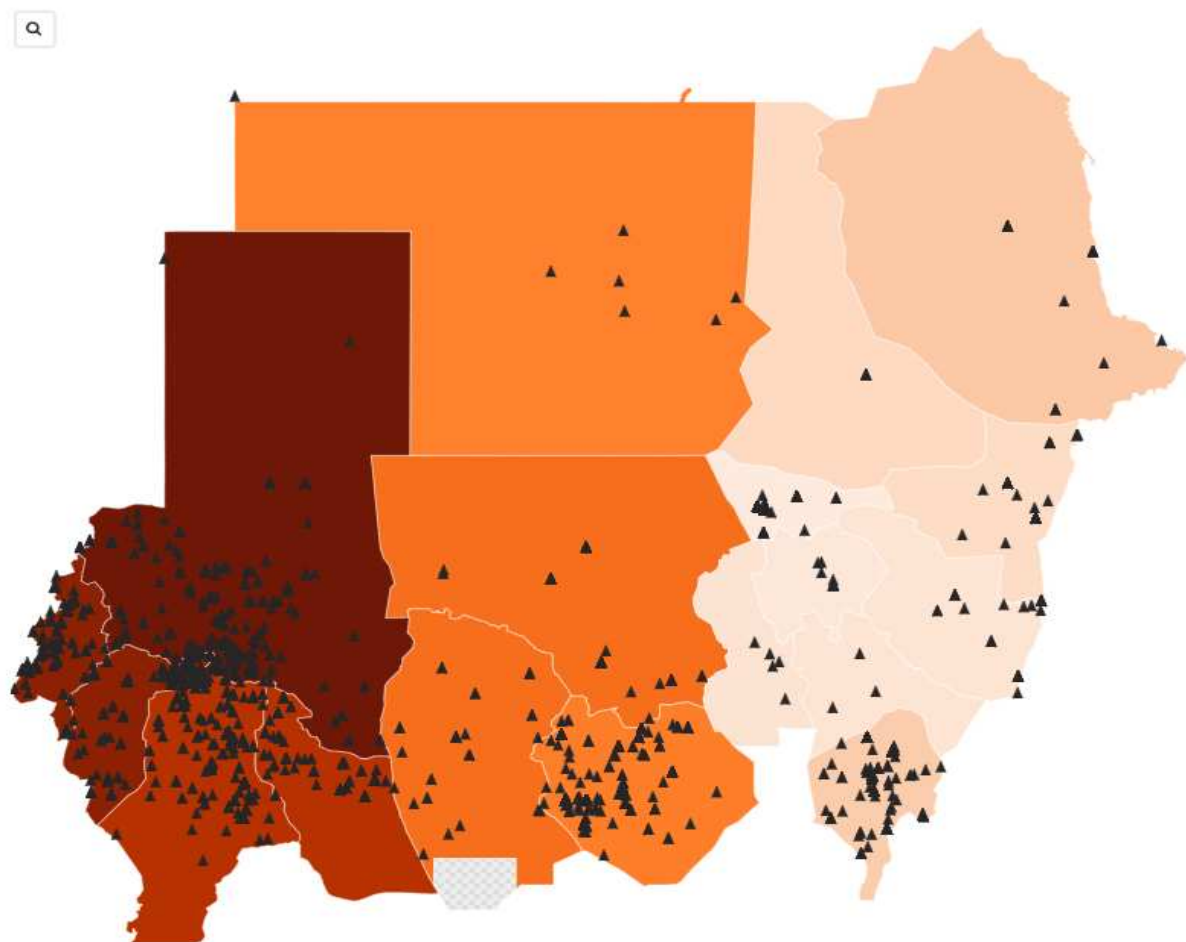
On the other hand, precipitation data reveals a more complex and variegated picture. Rainfall patterns in Darfur have become increasingly erratic over the past three decades, with sharp declines in annual totals in certain years, interspersed with years of sudden, intense rainfall events (see Table 1). These fluctuations might have altered the timing and reliability of both agricultural planting and pastoralist migration cycles, contributing to localized conflicts over land and water in some instances. But overall, spatial and temporal trends reveal no immediate correlation between precipitation patterns and conflict events in Darfur. The data indicates that while no direct, linear relationship is apparent across all years and regions, certain periods of severe rainfall decline – notably in the early 2000s and again in the mid-2010s – coincide with

spikes in violent events, particularly in South and West Darfur. The spatial correlation is strongest in agricultural zones near Nyala and Geneina, where rainfall-dependent cropping systems are dominant. Importantly, the violence observed in these regions tends to revolve around disputes over farmland, grazing routes, and water access. This supports the argument that environmental stress acts as a "threat multiplier" by exacerbating pre-existing social cleavages, especially when institutional mechanisms for resource sharing and conflict resolution are weak or absent.

Spatial Relationship between Temperature Change and Conflict in Sudan

Based on Historical Temperature Data and Geocoded Conflict Events

Temperature Change (%) 2.94 4.28



Source: Climate Change Knowledge Portal, Uppsala Conflict Data Programme (UCDP)

Figure 6: Spatial Overlap of Conflict Occurrence and Temperature Warming in the Sudan, 1989-2019 (Own Visualization)

To examine the heterogeneity of climate-conflict dynamics, we also conducted a comparative spatial analysis across three Darfuri states. While all three states have experienced increasing average temperatures and erratic rainfall, the patterns of violence differ significantly.

North Darfur, for instance, shows the strongest correlation between rising temperatures and conflict events, with violence concentrated in areas experiencing the most significant warming.

This state has also seen the most severe pasture degradation and groundwater depletion, factors often cited in interviews and reports as contributing to herder-farmer disputes (Kevane & Gray, 2008). West Darfur, by contrast, exhibits a higher incidence of intercommunal violence linked to land tenure and ethnic tensions, particularly around El Geneina. Here, climatic factors appear to act more as aggravators than direct triggers. Lastly, South Darfur displays a more diffuse pattern, with conflict and environmental stress spread across multiple localities, making it difficult to isolate specific climate-conflict pathways without further qualitative investigation. This variation underscores the importance of spatial disaggregation in climate-conflict analysis. As Meierding (2013) argues, broad generalizations about climate-induced violence risk overlooking the local political, historical, and economic dynamics that mediate environmental stress. Our spatial analysis supports this claim by demonstrating that while climatic factors are present across all states, their relationship with violence is contingent upon local contexts. We return to said local contexts in the final part of our analysis.

Table 1: *Changes in Precipitation across Sudanese States, 1991-2020 relative to 1901-1930*

State	Precipitation Change (in %)
Khartoum	-12.65
River Nile	-11.67
Northern	-11.54
North Kordofan	0.42
El Gazira	-7.91
Sennar	-5.36
White Nile	-4.13
Kassala	-7.34
Red Sea	2.08
Gedaref	-7.28
South Kordofan	3.13
Blue Nile	-4.12
West Darfur	0.68
North Darfur	-0.56
South Darfur	-0.76

Note: West Kordofan, Abyei PCA Area, Central Darfur and Eastern Darfur have been omitted due to No Data. Data taken from Climate Change Knowledge Portal.

In sum, the spatial mapping of climate data and conflict incidents across Darfur provides a somewhat nuanced picture of how environmental stress and violence interact geographically. Rising temperatures show a relatively consistent spatial correlation with conflict clusters, particularly in North Darfur, where ecological degradation and livelihood vulnerability are most pronounced. Rainfall patterns, while less consistently correlated, show episodic linkages to violence, especially in agricultural zones affected by drought or flooding. These findings suggest that climate change does not act as a uniform or deterministic driver of conflict in Darfur. Rather, it appears to interact with pre-existing vulnerabilities and governance failures in complex and localized ways. The spatial convergence of high-temperature anomalies, rainfall variability, and conflict hotspots offers preliminary support for the thesis that climate change contributes to conflict risk, particularly when compounded by institutional fragility and resource dependence.

In the following section, we build upon these spatial insights by conducting a series of statistical tests, including correlation and fixed-effects regression models, to assess the robustness of these observed patterns. These analyses will allow us to quantify the strength of the climate-conflict relationship and to begin disentangling the various channels through which environmental stress may influence the outbreak and intensity of violence in Darfur.

2. Quantifying the Climate-Conflict Nexus in Darfur: Statistical Evidence

While maps and visualizations help us trace where conflict and climate stress coincide, they don't quite tell us how strongly – or consistently – these two phenomena are actually related. In this next step, we turn from visualizations to statistical models, digging into the data to see whether patterns in temperature and rainfall align meaningfully with the occurrence of violence in Darfur. This is where we begin to put numbers to our hypotheses.

Using annual panel data from 1989 to 2019, this chapter explores whether years of heightened heat or erratic rainfall are followed by spikes in conflict. To do so, we employ a combination of correlation analyses and fixed-effects regression models, allowing us to assess both immediate and delayed effects of climatic variables on violent events. The aim here isn't to produce a final answer, but rather to rigorously test whether the oft-suggested climate-conflict connection holds up under quantitative scrutiny – at least within the Darfuri context. This will form a foundation upon which the later, more qualitative and context-sensitive analysis can build.

We begin with a simple Pearson correlation matrix to evaluate the bivariate associations between our key variables: average temperature (*avgtemp*), average precipitation (*avgprecipitation*), and conflict incidence (*violence*). The correlation between violence and *avgtemp* is 0.324, indicating a moderate positive relationship. This suggests that as temperatures increase, the frequency of violent conflict tends to rise. Conversely, precipitation is negatively correlated with violence, with a coefficient of -0.059, implying that higher rainfall is associated with marginally lower levels of violence. While these correlations do not imply causation, they serve as an initial indicator that climate anomalies may be associated with conflict trends.

Table 2: OLS-Regression Results for Violent Episodes and Climate Variables across North, West and South Darfur (1989-2019)

Variable	Coefficient
Avg. Temperature (°C)	12.79264***
Avg. Precipitation (mm)	-.0292375***
R ²	0.1813
N	93

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Following the initial descriptive and correlational insights into the relationship between climate variables and conflict incidence in Darfur, this section turns to Ordinary Least Squares (OLS) regression modeling. This widely used statistical technique provides a more robust method for identifying whether and to what extent climate factors such as temperature and precipitation are associated with increased violence in the region.

The purpose of running an OLS regression in this context is to quantify the potential effects of environmental changes on conflict patterns. Whereas simple correlations suggest an association between variables, OLS allows us to control for confounding effects and to test whether changes in climate variables have a statistically significant and independent impact on the number of violent incidents recorded. In this analysis, we focus on two explanatory variables: average annual temperature and average annual precipitation, both of which have been collected at the state level for North Darfur, South Darfur, and West Darfur from 1989 to 2019. The dependent variable in the regression model is the annual count of violent events in each state, derived from the Uppsala Conflict Data Programme's georeferenced event dataset.

The OLS regression model returned statistically significant coefficients for both explanatory variables, providing initial evidence that climate conditions may indeed influence conflict levels

in Darfur (see Table 2). The positive coefficient for average temperature suggests that a 1°C increase in annual temperature is associated with roughly 12.8 additional violent events in a given year in those three Darfuri states, holding precipitation constant. This result is statistically significant at the 1% level, implying strong evidence for a positive relationship between rising temperatures and conflict. Conversely, the coefficient for precipitation is negative and also statistically significant at the 1% level. For every additional millimeter of annual rainfall, the number of violent incidents declines by approximately 0.029. While this number may seem small, its cumulative effect over years of reduced precipitation could be substantial.

The significance of both temperature and precipitation in this model aligns with much of the Neo-Malthusian literature, which posits that environmental stress – whether from heat or drought – can intensify competition over scarce resources (Homer-Dixon, 1999; Burke, et al., 2009). In Darfur, where rural livelihoods depend heavily on agriculture and livestock, both forms of climatic stress could easily erode economic security and inflame communal tensions. As manifestations of climate change, such as temperature increases, droughts and/or floods, can have long-term effects rather than immediate ones, we extended our analysis by implementing fixed-effects regression models with one-year and two-year lags. These models are intended to assess whether climatic anomalies in a given year might not trigger immediate conflict but instead produce effects that unfold over time. Lagged models seem particularly useful in the climate-conflict context, as they accommodate delayed socio-political responses to environmental stress.

The first lagged model introduces average temperature and precipitation with a one-year lag. This approach accounts for the possibility that changes in climate conditions might influence the socio-political environment with a temporal delay, through mechanisms such as agricultural failure, food price increases, or gradual erosion of livelihood security.

The regression output for the one-year lag model is telling. The coefficient for lagged temperature is 11.34, with a p-value of 0.005 (see Table 3). Statistically speaking, this result is highly significant. It suggests that a one-degree Celsius increase in average temperature in the previous year is associated with an increase of approximately 11 violent events in the current year. This finding reinforces the results of the OLS model and strengthens the case for a causal relationship between heat stress and violent conflict in Darfur.

In contrast, the lagged precipitation variable fails to attain statistical significance. The model indicates no meaningful association between rainfall levels in the previous year and current conflict incidence. This result, while initially surprising, is consistent with a growing body of literature that suggests temperature anomalies have more direct and disruptive effects on human

behavior and institutional stability than rainfall variability (Burke, et al., 2009; Carleton & Hsiang, 2016).

To explore whether climate anomalies have even longer-lasting effects, we implemented a second fixed-effects regression model, this time incorporating a two-year lag for temperature and precipitation. The logic here follows insights from empirical and theoretical work suggesting that climate impacts may take several years to fully materialize in conflict outcomes – especially in agricultural or resource-based economies (Schleussner, et al., 2016).

Table 3: 1-Year & 2-Year Lagged Regression Results for Temperature and Precipitation Changes and their Effect on Conflict in Darfur (1989-2019)

Variables	1-Year Lagged Coefficient	2-Year Lagged Coefficient
Avg. Temperature	11.338***	8.46238***
Avg. Precipitation	.0241736	.0141489
Rho	.35953309	.21722744
N	90	87

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

The coefficient for the 2-year lagged temperature is 8.46. While the magnitude of the effect is slightly smaller than in the one-year lag model, it remains statistically significant (see Table 2). This result indicates that climatic stressors have durable effects: the heat experienced in a given year continues to influence conflict dynamics up to two years later. The finding is particularly relevant in Darfur, where agricultural and pastoral systems rely on long-term seasonal predictability. A poor harvest due to a particularly hot year may create scarcities and vulnerabilities that only erupt into violence during subsequent planting or migration seasons. On the other hand, the two-year lagged precipitation variable again fails to show significance. This persistent non-significance across both lag periods suggests that rainfall variability, while undoubtedly disruptive in some contexts, may not be as central to the dynamics of armed conflict in Darfur as previously suggested by certain climate-conflict narratives.

The main takeaway remains the significance of lagged temperature effects, suggesting that policy responses aimed at mitigating climate-induced violence must adopt a longer-term perspective, addressing not only immediate environmental shocks but also their residual socio-economic and political impacts.

The combined results from the one-year and two-year lagged fixed effects models provide compelling evidence that average temperature has a temporally persistent impact on the incidence of conflict in Darfur. By contrast, average precipitation, whether in the current or

prior years, does not appear to exhibit a measurable effect. The consistency of the temperature variable across both models enhances our confidence in the robustness of the finding. This adds to a growing empirical consensus that temperature-driven shocks – by undermining agricultural yields, increasing competition for resources, and exacerbating livelihood stress – can act as catalysts for violence in fragile political contexts (Koubi, 2019; Hsiang, et al., 2013)

From a theoretical perspective, these results align more closely with the "threat multiplier" framing of climate-conflict research, wherein climate stress exacerbates existing social tensions rather than directly causing conflict.

Finally, these findings raise important methodological questions. The absence of a significant precipitation effect suggests that large-N quantitative studies should be cautious in generalizing from precipitation-based models without accounting for local ecological, institutional, and socio-political conditions. It also highlights the value of subnational, panel-based fixed-effects models, which allow for more fine-grained temporal and spatial analysis.

In the chapters that follow, we will seek to interpret these quantitative findings through the lens of Political Ecology. Doing so allows us to investigate how and why heat stress might translate into conflict in a given sociopolitical context, exploring the mediating role of governance, land tenure systems, and patterns of exclusion that are specific to Darfur. But for now, what remains clear from the statistical evidence is that temperature anomalies are a consistent and meaningful correlate of conflict in the region – and they merit serious consideration in both academic analysis and policy design.

VII. From Correlation to Causation? A Political Ecology Perspective on Climate and Conflict in Darfur

It would be convenient to take the empirical evidence above and play into the aforementioned narratives within academia and policymaking, where Darfur has often served as a convenient case study – evoked as a tragic emblem of how climate change can spark war. Our quantitative analysis revealed a statistically significant correlation between rising temperatures and the occurrence of violent conflict across Darfur, but such correlations alone cannot explain *how* or *why* heat translates into bloodshed. This chapter turns, therefore, to the slower, deeper, and more politically charged processes that underpin that relationship – processes that unfold not in

scatterplots and regression models but in everyday struggles over land, identity, power, and survival.

Guided by the theoretical framework of political ecology, this chapter departs from reductionist explanations that treat conflict as the mechanical outcome of environmental scarcity. Instead, we examine (some of) the ways in which ecological stress interacts with histories of marginalization, state violence, and the restructuring of local livelihoods. Here, drought is not just a lack of rainfall – it is a political event, a moment in which power is redistributed, rights are contested, and violence becomes a tool for negotiating resource access. Drawing on historical narratives, documented case studies, and qualitative insights from the literature and field reports, we aim to uncover (a few) potential causal pathways that link climate change to conflict in Darfur – not as a singular driver, but as one thread woven into a much larger, and deeply entangled, political fabric.

This chapter, therefore, marks a shift: from numbers to narratives, from patterns to processes. While our statistical models suggested that temperature anomalies are associated with increased violence, they could not tell us *why* some areas erupted while others remained peaceful or *how* climate stress became weaponized by political actors. Through a political ecology lens, we begin to trace these pathways, asking not only what happened but who shaped it – and for whose benefit.

A. Access to Land and the Political Economy of Resource

Distribution

The first potential entry point for an ecology that is political, is access to land – and subsequent questions of *who* has access to land and who does *not*. In Darfur, access to land is not merely a question of physical geography or agricultural potential – it is a profoundly political issue, one that has been shaped by centuries of shifting power dynamics, legal regimes, and social hierarchies. Land in this context is both a livelihood and a symbol: it represents survival for agro-pastoralist communities, a source of wealth and influence for local elites, and a mechanism of control for the Sudanese state. As previous chapters have shown, particularly Chapters III and VI, Darfur's climatic profile has become increasingly inhospitable over the past century. Rising temperatures, erratic rainfall, and prolonged droughts have placed immense pressure on the region's already fragile ecological systems. Chapter VI quantitatively demonstrated a robust correlation between temperature anomalies and spikes in violent conflict. However, this correlation alone does not explain why some communities mobilize violently in response to

ecological stress while others do not. The answer lies, at least in part, in how access to land and resources is structured, contested, and weaponized.

Historically, land tenure in Darfur was governed by a flexible and pluralistic set of customary rules. The *hakura* system, a form of land grant bestowed by sultans during the era of the Darfur Sultanate, provided communal land rights to various ethnic groups and religious leaders (O'Fahey, 1980). This system emphasized usufructuary rights – the right to use land for subsistence or communal benefit – rather than individual ownership. Notably, the system recognized the mobility of pastoralist groups and allowed for seasonal access arrangements between nomadic herders and sedentary farmers. This ecological adaptability and social negotiation helped sustain inter-communal relations even in periods of environmental stress (De Waal, 2007).

Colonial rule, however, began to erode this flexibility. As discussed in Chapter II, British administrators codified land tenure systems, favoring sedentary agricultural production and marginalizing mobile pastoralist practices. In the process, the colonial state began to fix land ownership along ethnic and territorial lines, embedding new hierarchies and sources of exclusion into the legal and administrative structure (Mamdani, 2009). The emphasis on indirect rule reinforced tribal identities and reified ethnic claims to land, weakening the traditional systems of land-sharing and mutual reciprocity. The introduction of taxation, land registration, and bureaucratic oversight alienated many Darfuri communities from their ancestral lands (De Waal, 2007).

Post-independence governments inherited and expanded these colonial practices. Successive regimes in Khartoum pursued policies that centralized land governance, often bypassing traditional authorities and favoring politically loyal groups with land rights, investment, or legal protection. The Unregistered Land Act of 1970 was a specific turning point: it declared all unregistered land to be state property, effectively undermining customary land rights in vast rural areas of Darfur (Pantuliano, 2007). Though framed as a modernizing reform, the act allowed the state to redistribute land arbitrarily and without due process, often privileging elite actors from outside the region.

These developments have had enduring effects on the political economy of Darfur. As land became scarcer due to environmental degradation, its political and economic value increased. Land allocation became a tool of patronage, with the government rewarding militia groups, loyal tribes, and business elites by granting access to fertile or strategically located lands. The resulting system was not merely inefficient – it was fundamentally violent. The land was no

longer accessed through negotiation or reciprocity but was seized through political favor or brute force. Violence, in this context, became an extension of property claims.

In the 1990s and early 2000s, these dynamics intensified. As the Sudanese state increasingly relied on paramilitary groups – many drawn from nomadic Arab tribes – to suppress dissent in Darfur, these militias were granted *de facto* access to land previously inhabited by farming communities, especially those associated with the Fur, Masalit, and Zaghawa ethnic groups (Flint & De Waal, 2008). Displacement was not simply a by-product of war but a mechanism of territorial reordering. The term "ethnic cleansing," often used to describe the events of this period, must be understood not only as a form of genocidal violence but also as a strategy of land reallocation.

Political Ecology helps us understand this process as more than a clash over dwindling natural resources. Instead, it is a struggle over politicized access to those resources – access mediated by institutions, power structures, and forms of coercion. As Ribot and Peluso (2003) argue, access is not only about having the right to benefit from resources but also about having the power to do so. In Darfur, that power has increasingly rested in the hands of armed actors and state-backed intermediaries who control who gets to stay on the land and who must flee.

Moreover, these dynamics have been exacerbated by the commodification of land. As land values rise – due to urban expansion, commercial agriculture, or even speculative investment – the incentives for violent land grabbing grow. The expansion of mechanized farming in the south and east of Sudan, supported by international donors and investors, has displaced pastoralist routes and restricted access to traditional grazing lands (Bromwich, 2017). Although less pronounced in Darfur, similar pressures have emerged as external actors, including Gulf state investors, eye Sudanese land as a resource for food security and agribusiness. This global dimension underscores the importance of understanding local conflict not just in terms of scarcity but within broader political-economic systems that valorize land as an asset.

Finally, the humanitarian response to the Darfur conflict has itself reshaped patterns of access. Displacement camps have become semi-permanent settlements, often located on land previously used for farming or grazing. The reallocation of aid and services – food, water, infrastructure – has created new political economies within and around these camps. In some cases, communities have been incentivized to remain displaced, as returning to former lands might provoke violent reprisals or entail negotiating with new occupants. In others, local elites have capitalized on aid distribution to consolidate their control over territory and labor (De Waal, 2015).

This complex web of access relations has helped sustain the protracted nature of conflict in Darfur. When land is not only an economic necessity but a vehicle for political power and ethnic assertion, disputes over land cannot be resolved through technical solutions alone. Climate change, in this framework, acts as a stressor that amplifies underlying vulnerabilities but does not determine outcomes. The critical question becomes: who gets to adapt, and who is left behind? Who gets to claim the land when the rains fail – and with what consequences? It is here where Political Ecology is most powerful, shedding light on the underlying power brokerage by acknowledging that ecology is always constructed politically and never organically.

B. State Power and Environmental Governance in Darfur

Not only is the access to land highly politicized, but the State itself has been functioning as a partisan entity rather than as a neutral arbiter. Accordingly, environmental governance in Darfur has long been marked by a mix of institutional weakness and political opportunism. From colonial times through independence, the state has viewed peripheral regions like Darfur primarily as sources of extractable resources or as buffer zones rather than as integral parts of the national polity requiring investment, governance, and inclusion (Flint & De Waal, 2008). During the Anglo-Egyptian condominium, British administrators introduced the Native Administration system, which delegated authority to tribal leaders and sought to govern through indirect rule. Though seemingly efficient, this system sowed the seeds for future conflict by rigidifying ethnic boundaries and localizing governance in ways that fractured state authority (Mamdani, 2009). The colonial government paid little attention to sustainable land use or water management in Darfur, and this disinterest persisted after independence. Postcolonial regimes in Khartoum largely continued the neglect. Successive governments failed to invest in rural infrastructure, provide agricultural extension services, or develop effective drought mitigation strategies in the western regions (Kevane & Gray, 2008). As a result, environmental degradation – particularly desertification, deforestation, and soil exhaustion – was met with policy inertia. During the rule of President Jaafar Nimeiri (1969–1985), there were brief attempts at centralizing environmental governance, especially with the introduction of state-led agricultural schemes and decentralization laws. However, these policies often undermined rather than strengthened local management systems. Large-scale irrigation projects, particularly in central Sudan, diverted attention and resources from rain-fed agriculture and pastoralism in the west (De Waal, 2007). The state prioritized commercial farming in the Nile corridor, leaving

traditional land-use systems in Darfur unsupported and increasingly vulnerable to climatic shocks.

The 1971 Local Government Act abolished the Native Administration in an attempt to modernize rural governance. Yet, this created a vacuum in local land management. The Native Administration, for all its flaws, had provided a structure for mediating disputes over land and water. Its removal, without adequate replacement, eroded conflict-resolution capacities just as environmental pressures were mounting (Assal, 2006).

By the time Omar al-Bashir came to power in 1989, Sudan had become a heavily centralized authoritarian state. Al-Bashir's regime continued the marginalization of Darfur, not only economically but also administratively. The Sudanese government viewed environmental governance through a security lens, often conflating land management with issues of loyalty and political control. Access to land, grazing routes, and agricultural inputs were increasingly distributed as part of patronage networks, favoring pro-government groups (Verhoeven, 2011). Rather than mitigating environmental stress, the state weaponized it. One of the most glaring examples of state manipulation in Darfur is the strategic allocation of land rights. In the 1990s and early 2000s, Khartoum systematically supported Arab nomadic groups by granting them rights to land historically farmed by non-Arab communities like the Fur, Masalit, and Zaghawa. This shift was politically motivated: Arab groups were perceived as more loyal to the regime and were often recruited into government-aligned militias.

In addition to land, water access became a contentious issue. With rainfall declining and aquifers depleting, competition over wells and seasonal rivers (*wadis*) intensified. The state failed to invest in the maintenance or expansion of water infrastructure in Darfur, further concentrating pressure on existing resources. Yet rather than addressing these bottlenecks equitably, government authorities often gave preferential access to pro-government militias, especially the Janjaweed and, later, the Rapid Support Forces (RSF) (Gramizzi & Tubiana, 2012).

Rather than serving as a neutral arbiter, the Sudanese state has often used environmental governance to punish dissident communities and reward loyalist ones. This is evident in the manipulation of food aid, access to seeds, and grazing rights. Areas perceived as supportive of rebel groups were deliberately deprived of agricultural inputs and humanitarian assistance. Reports from the early 2000s indicate that government forces and allied militias deliberately destroyed water sources and agricultural fields in non-Arab villages (HRW, 2004). These actions constitute not only violations of human rights but also deliberate environmental warfare. In targeting the environmental foundations of rural livelihoods – crops, animals, wells – the

state effectively turned environmental vulnerability into a form of counterinsurgency. Moreover, environmental management institutions were never meaningfully empowered in Darfur. The Ministry of Environment and other state-level agencies remained chronically underfunded and undercut by security institutions. Environmental laws, such as the Forests and Renewable Natural Resources Act (1989), were rarely enforced outside central Sudan, and most environmental assessments in Darfur were donor-driven, not state-led.

The international community has attempted to fill some of the governance void in Darfur through programs on environmental rehabilitation, sustainable agriculture, and conflict mediation. However, these efforts were frequently hampered by the absence of a coherent state strategy or willingness to decentralize authority. Donor-funded projects often found themselves operating in a policy vacuum or were co-opted by state actors for political gain (Bromwich, 2017).

For instance, several UN-led environmental rehabilitation programs attempted to restore degraded pastureland and reforest areas affected by desertification. However, in the absence of local ownership or inclusive governance, many of these programs had limited success. Furthermore, the allocation of international aid itself became a site of political contestation, with pro-government groups reportedly receiving disproportionate support (Young, et al., 2005).

The case of Darfur underscores a central tenet of political ecology: environmental degradation becomes a driver of conflict not in a vacuum but within specific political and institutional contexts. The Sudanese state has failed to provide equitable environmental governance in Darfur and, in many cases, has actively contributed to ecological and social breakdowns through politicized land allocation, strategic neglect, and environmental repression. Climate change may have intensified pre-existing scarcities, but it is the state's response – or lack thereof – that has transformed these pressures into sources of violence. The absence of effective environmental institutions, the instrumentalization of natural resources for political ends, and the collapse of traditional management systems have all shaped Darfur's vulnerability to both climate change and conflict. Thus, any analysis of climate-conflict dynamics in the region must account for the central role of state power and governance – or, indeed, its weaponization.

C. Climate Adaptation as a Site of Power

A final – and often overlooked – theme that political ecology can critically examine is climate adaptation. In recent decades, the discourse surrounding climate adaptation has shifted from a

technical and apolitical framework toward a more critical and politicized lens. No longer solely understood as a set of neutral strategies to help communities cope with the impacts of climate change, adaptation is increasingly recognized as a field of governance shaped by power dynamics, institutional arrangements, and contested interests (Eriksen, et al., 2011; Nightingale, 2017). In the context of Darfur, adaptation is not simply about adjusting to environmental change. It is also about negotiating authority, claiming access to resources, and navigating inclusion or exclusion from decision-making processes.

In its early stages, climate adaptation was often framed as a depoliticized, technocratic response to global warming. Adaptation strategies – such as drought-resistant crops, early warning systems, and water conservation – were presented as universally beneficial and straightforward to implement. However, political ecologists have criticized this view for ignoring the socio-political contexts in which adaptation occurs. As Adger et al. (2008) argue, adaptation is never value-neutral; it is deeply embedded in existing power structures that determine which risks are prioritized, which communities receive support, and which forms of knowledge are legitimized. In Darfur, where state institutions are weak or actively partisan, the implementation of adaptation policies cannot be separated from questions of governance and authority. Who gets access to adaptation resources – such as seeds, irrigation tools, or drought-resilient infrastructure – is not merely a matter of need or vulnerability. It is often shaped by patronage networks, ethnic affiliations, and political loyalty to the central government (Verhoeven, 2011). Consequently, adaptation becomes a mechanism through which state and non-state actors reproduce or challenge existing hierarchies.

International donors, NGOs, and multilateral institutions have played a leading role in shaping these mechanisms in Darfur. Following the humanitarian crisis of the early 2000s, a wave of international aid flooded into the region, much of it aimed at supporting environmental recovery and resilience-building. Projects such as reforestation campaigns, climate-smart agriculture, and pasture rehabilitation were launched with the stated aim of helping communities adjust to long-term environmental shifts (UNEP, 2007). Yet, these externally driven adaptation efforts often lacked grounding in local socio-political realities. Programs were frequently implemented in a top-down manner, with limited community consultation or involvement in planning. This disconnect meant that adaptation initiatives sometimes failed to address the actual needs and capacities of local populations. In some cases, they reinforced existing inequalities. For instance, donor-funded agricultural development projects often favored sedentary farming communities over nomadic pastoralists, exacerbating tensions between groups whose livelihoods were already under stress (Pantuliano, 2007). Moreover, the presence of

international actors introduced new forms of power competition. Local elites sometimes capture aid resources, using their positions within NGOs or community-based organizations to distribute benefits along clientelist lines. In turn, marginalized communities – particularly those without strong representation in formal institutions – were sidelined from adaptation assistance. As Mosberg and Eriksen (2015) have noted in similar contexts, adaptation can become a form of "green governmentality," where resource flows are controlled by intermediaries who act as gatekeepers to international support.

One of the most troubling aspects of adaptation as a site of power in Darfur is its intersection with militarization and conflict. The Sudanese government has long used resource distribution, including climate-related aid, as a tool of political control. Reports from the early 2000s indicate that state forces and their allied militias deliberately denied access to food aid, water, and farming inputs to communities perceived as sympathetic to rebel movements (HRW, 2004). Furthermore, the Sudanese military and the Rapid Support Forces (RSF) have been known to manipulate climate financing and environmental projects to consolidate their influence. In some cases, military-affiliated contractors were granted contracts for adaptation infrastructure, such as dam construction or borehole drilling. These projects, instead of serving public interests, were used to reward loyalist regions or to assert territorial control in contested areas.

Despite the dominance of state and international actors, customary institutions continue to play a significant role in managing environmental adaptation at the local level. In many rural areas of Darfur, community elders, tribal sheiks, and religious leaders remain central figures in coordinating land use, water access, and agricultural cycles. Their role in adaptation planning, however, is double-edged. On the one hand, customary leaders possess invaluable ecological knowledge and have historically played a mediating role in conflict resolution. For example, traditional systems like the "*hawakir*" – communal land tenure arrangements – have governed the distribution of farmland and grazing routes for generations (Abdul-Jalil & Rabih, 1986). Reintegrating these institutions into adaptation strategies can promote legitimacy and sustainability. On the other hand, customary leaders are not immune to political manipulation. Since the 1980s, successive Sudanese governments have co-opted or undermined traditional authority structures to serve their political agendas. In some instances, parallel governance institutions were established, displacing traditional leaders with pro-government appointees. This has undermined the capacity of communities to autonomously manage their own adaptation responses and has introduced new layers of fragmentation and contestation.

Another critical aspect of adaptation as a site of power in Darfur involves gender dynamics. Women, particularly in rural areas, are often the most exposed to climate impacts. They are

responsible for collecting water, gathering firewood, and cultivating subsistence crops – all activities highly vulnerable to environmental stress. However, they are also the least likely to participate in formal adaptation planning processes, whether through state agencies or international NGOs (Kevane & Gray, 2008). This gendered exclusion reflects broader patriarchal structures in Darfuri society and is often compounded by the top-down nature of adaptation programming. Few projects actively consult women or incorporate their priorities into resilience planning. Yet, research shows that women’s participation leads to more effective and equitable adaptation outcomes (Terry, 2009). Addressing this imbalance requires not only programmatic changes but also a rethinking of how power, voice, and representation are structured in climate governance.

Given the politicization of adaptation in Darfur, it is clear that future efforts must go beyond technical fixes and donor checklists. Adaptation cannot be understood merely as a means of survival; it must also be seen as a vehicle for justice and empowerment. This means placing local communities – not just local elites – at the center of adaptation planning. It also requires addressing the root causes of vulnerability, including land dispossession, political exclusion, and militarization. A just adaptation framework would involve strengthening customary institutions without subordinating them to state or donor control. It would ensure gender parity in adaptation planning and recognize the value of local knowledge systems. Importantly, it would also demand accountability from both state and non-state actors who use adaptation resources for coercive or exclusionary purposes.

Political ecology reminds us that climate adaptation is never neutral. It is a process marked by competing interests, contested claims, and power-laden decisions. In Darfur, where the stakes are extraordinarily high, adaptation is both a promise and a battleground – a space where futures are negotiated and where the capacity to cope with climate change is inseparable from the politics of who gets to decide, who gets to benefit, and who gets to adapt at all.

VIII. Conclusion

This thesis set out to explore one of the most widely debated and deeply complex claims in contemporary security discourse: the proposition that climate change plays a significant role in triggering or exacerbating violent conflict. We set out to tackle a big question: how—and to what extent—does climate change play a role in the conflict in Darfur? It was a deliberately ambitious choice, driven by how urgent the issue is and how many unanswered questions still exist in the academic work on this topic.

To begin, we immersed ourselves in the existing literature. What we found was a field largely shaped by neo-Malthusian thinking—an approach that often oversimplifies complex realities by linking environmental stress directly to violence, without accounting for the political and historical forces at play. Within much of the academic and policy literature, climate change is portrayed as a deterministic catalyst – declining rainfall, expanding deserts, and intensifying competition over resources are frequently cited as inevitable precursors to violence. In the case of Darfur, the idea that climate change was a driving force behind the conflict caught on quickly. International figures, including the United Nations and even Ban Ki-moon, called it the world's first 'climate war.' But while that framing grabbed headlines, it often glossed over the deeper political and historical forces that were also at play.

To dig into the issue more thoroughly, this thesis took a mixed-methods approach. By blending statistical analysis with insights from political ecology, it aimed to get both a wide-angle view of broader trends and a more detailed understanding of how those trends played out within Darfur's unique social and political context..

The quantitative analysis drew on an original dataset covering the years 1989 to 2019, examining temperature and precipitation changes alongside incidences of violent conflict across the Darfuri states. The results suggested a modest correlation between increased temperatures and conflict occurrence. This pattern held steady across various statistical models, including those that accounted for delayed effects, strengthening the case that rising temperatures may be contributing to the breakdown of livelihoods and social cohesion. Conversely, precipitation showed little to no consistent statistical association with conflict, casting doubt on some of the more alarmist claims regarding rainfall decline as a direct driver of violence.

Yet, numbers alone could not fully explain the patterns observed. Correlation, after all, is not causation. To go beyond surface-level connections, the thesis shifted toward qualitative analysis, using political ecology as a lens to explore the deeper structural and institutional roots of the conflict in Darfur. Three interrelated themes were explored: access to land and the political economy of resource distribution, state power, and environmental governance, and climate adaptation as a site of power contestation. The findings from these chapters underscored the importance of viewing climate stress as embedded within and mediated by political processes. Environmental degradation in Darfur only became a source of violent conflict when coupled with structural inequalities in land access, discriminatory state practices, and the militarization of local disputes. The Sudanese state, rather than acting as a neutral arbiter, frequently exacerbated tensions through selective governance, resource allocation, and support

for paramilitary actors. Meanwhile, external interventions aimed at climate adaptation often reinforced existing power imbalances, privileging certain groups over others and failing to address root causes of vulnerability.

Crucially, this research has demonstrated that Darfur's vulnerability to both conflict and climate stress cannot be divorced from its long-standing political and economic marginalization. As detailed in earlier chapters, Darfur's integration into the Sudanese state has been marked by neglect, uneven development, and exclusionary politics. These dynamics have not only hindered the region's adaptive capacity to climate variability but have also created fertile ground for grievances to escalate. What emerges is a portrait of Darfur as a region where the environment and politics are deeply entangled – where resource pressures alone do not generate conflict, but where institutional failures and historical injustices transform environmental stress into violence.

In sum, the thesis found that while climate change is indeed a relevant factor in understanding the conflict in Darfur, it operates less as a deterministic trigger and more as a threat multiplier. This aligns with a growing consensus in the literature that climate-related stress amplifies pre-existing social, political, and economic grievances rather than initiating conflict independently. As such, simplistic causal narratives must be replaced with more nuanced and historically informed analyses. Darfur is not merely a case of climate-induced collapse – it is a deeply political space where environmental dynamics are filtered through decades of state neglect, contested governance, and socio-economic marginalization.

Several contributions emerge from this research. Empirically, the study adds new data and insights to the limited body of work focused specifically on Darfur. Methodologically, it demonstrates the utility of mixed methods for disentangling complex socio-environmental phenomena. Theoretically, it makes a case for political ecology as a vital framework for analyzing climate-conflict linkages, emphasizing power, history, and institutional dynamics.

Nonetheless, the thesis is not without limitations. The reliance on secondary qualitative sources means that some arguments are mediated through existing interpretations rather than direct fieldwork. The quantitative models, while robust within their design, are constrained by the availability and granularity of data. Additionally, the regression models employed in the statistical analysis are intentionally simplified, relying primarily on temperature and precipitation as independent variables. This approach, while useful for establishing baseline relationships, omits potentially significant control variables such as GDP per capita, education levels, population density, and institutional quality. The absence of these covariates limits the

explanatory power of the models and may mask more complex interactions between climate stress and socio-political conditions.

Future research would benefit from incorporating primary data collection through ethnographic fieldwork or interviews with affected communities. Longitudinal studies could track the evolving interplay between environmental stress and political change in Darfur and beyond. Comparative research across similarly affected regions in the Sahel or Horn of Africa could also help refine theoretical frameworks and test the generalizability of findings.

In conclusion, this thesis began by asking whether climate change plays a role in driving conflict in Darfur. The answer, as the evidence now suggests, is both yes and no. Climate change matters, but not in isolation. It intersects with systems of governance, land tenure, historical grievance, and adaptation policies. Understanding its impact requires more than climate models – it requires an appreciation of how environmental stress is shaped by, and shapes, the political and social landscapes in which it unfolds. Darfur, in this context, is neither an anomaly nor a universal blueprint, it is a poignant example of how environmental and political crises can converge with devastating consequences. The findings of this thesis reiterate the importance of context in climate-conflict research. They challenge us to move beyond reductionist models and embrace analytical approaches capable of capturing the complexity of real-world conflict dynamics. Political ecology, as demonstrated here, offers such a lens—one that foregrounds the role of power, history, and institutional asymmetries in shaping how climate stress translates into human insecurity. For Darfur, any durable solution must reckon not only with environmental vulnerabilities but also with the deeply embedded inequalities that render the region so susceptible to crisis.

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