OPUS
Journal of Society Research

Type: Research Article
Received Date: September 15, 2025
Accepted Date: February 11, 2026
Published: February 12, 2026
10.26466/opusjsr.1784600

Climate change induced political conflict and violence in greater Somalia

İklim değişikliğinin tetiklediği siyasal çatışma ve şiddet: Büyük Somali örneği

Abdirashid Driye Kalmoy[1] **Arab Dahir Hassan**[2] **Mahat Maalim Ibrahim**[2]

[1] PhD candidate, Sociology Department, Ibn Haldun University, Istanbul /Türkiye.

[2] Asst. Prof. Dr. Economics Department, Ibn Haldun University, İstanbul/Türkiye.

[3] Asst. Prof. Dr. Economics Department, Ibn Haldun University, İstanbul/Türkiye.

Corresponding Author:
Abdirashid Driye Kalmoy

Citation:
Kalmoy, A.D., Hassan, A.D. & Ibrahim, M.M. (2026). Climate change induced political conflict and violence in greater Somalia. *OPUS– Journal of Society Research, 23*, e1784600.
https://doi.org/10.26466/opusjsr.1784600

Review Note:
Evaluated by Double-Blind Peer Review

Ethics Reporting:
To report potential ethical concerns, contact: editorialoffice@opusjournal.net

Similarity screening was conducted via intihal.net.

Abstract

This study offers a critical climate history of the Somali civil war and how this political conflict proliferated to Somali inhabited regions of Kenya, Ethiopia and Djibouti and how it was exacerbated by earth aridity that occasioned famines and droughts. This study posits – as its thesis and argument – that climate change induced droughts and famines cause and exacerbate the perennial and recurring political conflicts and violence in Greater Somalia. Decreasing rainfalls and increasing aridity led to the shrinking of grazing pasturelands and tree cover in the Somali peninsula leading to massive dry earth lands. The consequences of these long abrupt dry spells of famines and droughts is both state institutions and communal vulnerabilities which translate to often violent contestations over the meagre pasturelands and water wells. Political conflict in the Somali world is invariably theorized and conceptualized to be predicated on clan and communal relations and the absence of effective state capacity in the face of clan militias and terror groups. This study argues that at the foundation of political conflict in the Somali peninsula is a climate change that disrupted centuries long pastoralist livelihoods and rendered the earth dry and destitute. This study employs a multi-disciplinary geospatial analysis framework to examine the ecological, climatic, and socio-political dynamics across Greater Somalia and depicts how tree cover change and climate variability overlap with (and translates to) conflict and violence patterns. The significance of this study is that if offers an analytical case of how aridity and dry earth occasioned by climate change lead to political conflicts and violence.

Keywords: *climate change, conflict, civil war, aridity, drought, geospatial analysis*

Öz

Bu çalışma, Somali iç savaşının iklim tarihiyle ilişkisini ve söz konusu siyasal çatışmanın Kenya, Etiyopya ve Cibuti'deki Somali nüfusunun yaşadığı bölgelere nasıl yayıldığını, ayrıca kıtlıklar ve kuraklıklara yol açan toprak kuraklığı ile nasıl ağırlaştığını incelemektedir. Çalışma, tezi ve temel argümanı olarak, iklim değişikliğinin tetiklediği kuraklık ve kıtlıkların Büyük Somali'deki sürekli ve yinelenen siyasal çatışmalara ve şiddete neden olduğunu ve bunları derinleştirdiğini ileri sürmektedir. Azalan yağışlar ve artan kuraklık, Somali Yarımadası'nda otlakların ve ağaç örtüsünün daralmasına yol açarak geniş kurak toprakların ortaya çıkmasına neden olmuştur. Bu uzun ve ani kıtlık ile kuraklık dönemlerinin sonuçları hem devlet kurumlarının hem de toplulukların kırılganlığına yol açmakta, bu da sınırlı otlaklar ve su kuyuları üzerinde sıklıkla şiddet içeren mücadelelere dönüşmektedir. Somali dünyasındaki siyasal çatışmalar genellikle, etkili devlet kapasitesinin yokluğu ile birlikte, aşiret ve topluluk ilişkilerine ve bunların silahlı milisleri ile terör gruplarına dayalı olarak kuramsallaştırılmaktadır. Bu çalışma ise Somali Yarımadası'ndaki siyasal çatışmaların temelinde, yüzyıllardır süregelen pastoral yaşam biçimlerini sekteye uğratan ve toprağı kurak ve yoksul hale getiren iklim değişikliğinin bulunduğunu savunmaktadır. Çalışma, Büyük Somali genelinde ekolojik, iklimsel ve sosyo-politik dinamikleri incelemek için çok disiplinli bir jeo-uzamsal analiz çerçevesi kullanmakta ve ağaç örtüsündeki değişim ile iklim değişkenliğinin çatışma ve şiddet örüntüleriyle nasıl örtüştüğünü (ve bunlara nasıl dönüştüğünü) ortaya koymaktadır. Bu çalışmanın önemi, iklim değişikliğinin yol açtığı kuraklık ve çorak toprakların siyasal çatışma ve şiddete nasıl zemin hazırladığına dair analitik bir örnek sunmasında yatmaktadır.

Anahtar Kelimeler: *iklim değişikliği, çatışma, iç savaş, kuraklık, kıtlık, jeo-uzamsal analiz.*

Introduction

Climate change has emerged as an analytical lens for understanding contemporary political violence, particularly in environmentally vulnerable regions such as the Horn of Africa. Prolonged droughts, recurrent famines, rising temperatures, and declining rainfall patterns have disrupted agrarian and pastoral livelihoods, hence intensifying competition over scarce natural resources and amplifying existing social and political tensions. Within this growing body of scholarship, key concepts such as climate security, environmental scarcity, livelihood disruption, and climate-conflict nexus are used to explain how ecological stressors translate into communal violence, state fragility, and armed conflict in Greater Somalia. While dominant explanations of conflict in Somalia and the wider Somali-inhabited regions have traditionally emphasized clan politics, weak state institutions, and armed actors, emerging this study highlight the role of climate variability as a structural and historically embedded driver that exacerbates these dynamics. This study situates itself within these discussions by investigating climate change as a foundational condition shaping political conflict and violence in Greater Somalia, and arguing that environmental stress is not merely a background factor but a critical force that reconfigures livelihoods, mobility, governance, and patterns of violence across the horn of Africa region (Afrika boynuzu).

This study makes two arguments: that climate change played a consequential role in the Somali state collapse in 1991; and that climate change occasioned famines and droughts exacerbated the Somali civil war violence and political conflict since 1991. Somalis are a pastoralist society whose livelihood is dependent on grazing pasturelands and rainfall (Schraeder, 1986, p.653). Decreasing pasturelands and rainfalls have not only occasioned famines and droughts, they have consequential implications for communal conflicts and political violence. Robert G. Patman (1997) argues that one of the factors that led to the violent collapse of the Somali state is the Somali famines of 1991-1992. Climate change induced famines, droughts and other natural disasters render societies and communities vulnerable and lead to both state and civilizational collapse. Tom Abate posits that "variations in aridity" and "abrupt dry spells" occasioned civilizational collapse during the Akkadian Empire (Abate, 1994, p.516). In our contemporary age "climate change is a security concern because it brings groups with existing tensions into contact, changes the scale of problems, and reduces resilience/adaptive capacity" for the nation-states (Malone, 2013, p.93). Elizabeth Malone observes how climate change and its consequences are closely analysed by the national security of different countries since "considering second or third-order impacts such as migration and state stability opens the debate on climate change to discussion of the future beyond temperature increase, severe storms and sea level rise" (Malone, 2013, p.94). Hence, climate change has implications for communal, national and state ontological existence.

Climate change and its effects have destroyed and ravaged communal livelihoods in the vast and arid Somali world (Burns, 2017). Moreover, climate change has exacerbated the Somali civil war and hinders effective state-building processes in Somalia. Karolina Eklow and Florian Krampe document "how climate-related environmental change in Somalia and the Horn of Africa is hindering the successful implementation of the UNSOM mandate, the 2014 mandate is used as the conceptual starting point. The mandate from Resolution 2158 is assessed along its two major themes: (a) peace and security and (b) governance and justice" (Eklow & Krampe, 2019, p.18). Irregular precipitations and increasing temperatures lead to the shrinking of the grazing lands which leads to inter-communal violence which translates to political violence in a country where "clan consciousness", identity and belonging shapes politics. Moreover, according to Eklow and Krampe, "herders have had to adapt their behaviour due to the impacts of climate change because traditional grazing routes have become unusable and nomadic mobility patterns more erratic due to shifts in seasonal weather patterns" (Eklow & Krampe, 2019, p.18). Communities and clans contest over grazing lands and water

wells; and the increasing climate change impact has led to perennial conflicts and violence among the pastoralist Somalis. Eklow and Krampe analyse how "protracted disagreements, relating to natural resources and land, are linked to Somalia's larger political dynamics and have resulted in some of Somalia's deadliest violent clashes" (Eklow & Krampe, 2019, pp.19-20).

Furthermore, the significance of this study is that it establishes a relationship between climate change and how it leads to the proliferation of arms and weapons and exacerbate violence and conflict. Somali pastoralists and herders, not only in Somalia but in Kenya, Ethiopia and Djibouti are armed since contestations over pasturelands and water wells are violent. Decreasing rainfalls and increasing temperatures have diminished the grazing lands and the natural resources in these geographies. This leads to violent confrontations between herders who migrate to far lands seeking pasture and water for their livestock. Climate change induced communal displacements "tripled in Somalia from 2005 to 2018. Causes for this increase included the droughts in 2011 and 2017" (Eklow & Krampe, 2019, p.30). Moreover, the violent contestations over grazing lands and water wells has diffused to neighbouring countries with Somali population such as Kenya and Ethiopia rendering this climate change-induced crisis an issue of national security and concern alongside terrorism (Oli et al, 2007).

After the introduction, the study proceeds with a historical contextualization of the Somali civil war and its "spread" to Djibouti, Kenya and Ethiopia. This is followed by a conceptual and literature review of critical climatic history and environmental conflict that situates the study within climate–conflict theories, debates and outlines the theoretical foundations of a critical climate history approach in the context of Greater Somalia. After that, the study then presents the data and methodology, and analytically detail the geospatial framework, datasets, and analytical techniques used to examine ecological, climatic, and conflict patterns across Greater Somalia. Then this is followed by an empirical analysis section that discusses one after another the land cover change, climate variability, and the spatial distribution of conflict and violence. Finally, the study concludes with a discussion and conclusion section that synthesizes the findings, and reflects on their implications for understanding Somali political violence, and highlights the broader significance of climate change for conflict dynamics in the Horn of Africa and beyond.

A Cataclysmic Civil War and its Expansion

In 1991, after a decade of violence between clan rebel groups and the Somali army, the Somali state collapsed and a convoluting bloody civil war started that continuous to this day (O'Regan, 2018). As the rebel group United Somali Congress (USC) and allied clan militias surrounded the presidential palace, and after already taking and occupying all government institutions in the capital city, "in January 1991, the government fell, and Somalia entered a new phase of clan warfare" (Shultz Jr., 1995, 85) that would devastate the whole country for decades. Deposed president Mohammed Siyad Barre fled to his home region of Gedo and was welcomed by his clansmen and allied militias in the small border town of Beled Hawo. The Somali National Movement (SNM) rebels took control of what is today the Somaliland regions; USC rebels controlled much of Central Somalia and the capital city; the Somali Patriotic Movement (SPM) was the dominant force in the Juba regions; while the Rahanwein Resistance Alliance (RRA) and allied smaller factions controlled what is today the Konfur Galbeed state. Nevertheless, after the successful ouster of Barre from Mogadishu an "internecine rivalry erupted between the rebel groups" immediately occasioning the beginnings of the Somali civil war (Ayittey, 1994, p.4) and any attempts of ameliorating the Somali state failed.

George Ayittey states that Somalia "in the process of removing Barre, had already been devastated – reduced to an ash heap of charred buildings and burned out vehicles, with decomposing bodies littering the streets" (Ayittey, 1994, p.5). As the rebel movements took control they engaged in genocidal revenge killings of individuals and civilians

who were suspected to be regime sympathizers or hailed from the clan of the president, the Marehan. Across the country civil servants of the state and civilians were executed, raped and robbed by the advancing rebels. Slowly, what was an armed struggle against a dictatorial military state morphed into a clan-based vendetta settling of scores. In the early stages of the civil war, "between November 1991 and March 1992 an estimated 41, 000 people were killed. Most of the victims were civilians, half of them women and children" in the capital city Mogadishu (Ayittey, 1994, p.5). All this happened as Somalia was devastated by the famines of 1991-1992.

A power vacuum emerged when Mohammed Siyad Barre was ousted. Soon a "government was formed by Ali Mahdi and his faction of the USC, the SNM, and the Somali Salvation Democratic Front, which is supported by the Majertain subclan. This action was taken without the involvement of the Aidid wing of the USC. And it was Aidid forces that had entered Mogadishu and forced Siad to flee, and Aidid believed he should play a major role in the government" (Shultz Jr. 1995, pp.85-86). After the declaration of Ali Mahdi as an interim president, a violent power struggle erupted in Mogadishu within the USC forces that were dominant in Mogadishu. A segment of the USC leadership hold the view that the SNM and Somali Salvation Democratic Front (SSDF) were bringing dis-unity within the USC by supporting and even grooming Ali Mahdi as the president of the Somali republic in post-Barre era. This led to suspicions and even to outright warfare between the USC and the SSDF in parts of central Somalia especially in Galkacyo.

The power struggle and the violence between the rebel groups "culminated in full scale clan and sub-clan warfare that led to the dissolution of the Somali state created in 1960" (Shultz Jr. 86) as the international community led by the United Nations (UN) failed to bring the rebels into a peaceful negotiation and a peaceful truce to rule the country without infightings. As the civil war elongated and become complicated, the rebel movement SNM declared independence for Somaliland regions and embarked on a tumultuous state-building process – to this day it is internationally not recognized. For the much of 1991-1993 "Somalia lay in ruins – effectively destroyed. It had no government, no police force or even basic services" as a third of the population fled to neighboring countries as refugees (Ayittey, 1994, p.1). To make matters worse, the raging civil war was followed by a devastating famine and lack of rainfall across the country. Somalia faced in the early 1990s a violent state collapse and a devastating humanitarian environmental crisis that were deadly. Jeffrey Clark states that during these famines amid the violent civil war "more than fifty refugees a day were dying of malnutrition" (Clarke, 1992, p.116). By 1994, an estimated 300,000 Somalis lost their live either in the ravaging political conflicts and the famines and droughts in the country (Samatar, 1994) and Abdi Cawo argues that women, children and the elderly being the most affected demographic segments during these environmental crisis (Cawo, 2007, 190).

The tragic unfolding of the Somali civil war and the subsequent famine and draught rendered Somalia an issue of international concern (Kalmoy, 2025). The United Nations (UN) discussed the Somalia matter in the Security Council and numerous proposals were submitted on how to tackle the humanitarian crisis and to bring the warring rebel groups and faction to peace conferences. Ramesh Thakur states that the "UN Operation in Somalia (known as UNSOM) was established by Security Council Resolution 75I on 24 April I 992 to monitor the ceasefire in Mogadishu, to provide security for UN personnel and supplies, and to escort humanitarian supplies to distribution centres" (Thakur 1994, p.388) across the country so as to mitigate the unfolding humanitarian crisis. This international intervention would lay the ground for both UN and African Union (AU) military and humanitarian intervention in the future.

The aims and objectives of the UNSOM were "restoring peace and mediating between warring parties. Since the beginning of the crisis, the UN was active in the area through its UNSOM one and two missions (in coordination with the US UNITAF mission) in 1992-1995" (Marangio, 2012, p.7).

Moreover, the UN-led mission was joined by the United States military and humanitarian intervention. Louis Klaveras describes that the "operation restore hope in Somalia, was one of the first large-scale, well publicized peace mission operations undertaken by the United States since the gulf war, has become an examplar of post-cold war US-military interventions" (Klarevas, 2000, p.523). And hence "on December 9, 1992 1300 marines landed in Mogadishu , and within weeks more than 25,000 US soldiers were on the ground in Somalia" (Jon Western, 2002, p.112).

Furthermore, the violent civil war in Somalia continued in full force as the rebel groups continued to fight for power and hegemony across the country. With the withdrawal of the UN and US peacekeeping troops and the failure of numerous peace processes and ceasefires, the civil war continued amid intermittent draughts and famines across the country. Slowly, what were leaders of rebel movements and armed groups morphed into warlords. In mid 1990s and late 1990s Somalia had several "household" warlords who controlled cities and whole provinces with impunity, extortions and arbitrary executions. Occasionally violence and wars will erupt between these warlords elongating and exacerbating the civil war in the countries. Roland Marchal argues that this "is generated by the crisis in the state" (Marchal, 2007, p.1095); and in Somalia the state collapse and the enduring civil war led to the mushrooming of blood-thirsty and extortionist warlords, criminals, pirates and gangs. Somalia become the wild wild west, as every individual and clans and sub-clans took responsibility to protect themselves, their interests, businesses and inhabitants. The civil war situation was so volatile that clans and sub-clans and warlords would engage in urban warfare to contest for power and dominance in urban area of towns and cities. Moreover, the warlords and their clan militias perennially embarked on environmental destructions of farmlands and grazing lands and displacing communities belonging to "enemy" clans. This exacerbated the famine and drought conditions in the country, especially in the South.

Conceptual and Literature Review: Environmental Conflict and Critical Climate History

Environmental conflict theory encompasses a range of perspectives that seek to explain how environmental conditions, abrupt climate change, resource access, and socio-political structures interact to produce disputes and, in some cases, violent confrontations between communities and societies. Traditional environmental conflict research, such as the work by Stephan Libiszewski (1992), defines environmental conflict in terms of human-induced ecological degradation that destabilizes life-supporting conditions and leads to competition over increasingly scarce environmental goods (e.g., water, soil, forests) or services, distinguishing such conflicts from classic resource scarcity disputes tied solely to physical shortage or geopolitical distribution issues. This framework emphasizes that environmental and climatic change becomes conflictual not simply because resources are scarce, but because degradation alters ecological equilibrium in ways that affect human societies, forcing them to compete or negotiate over the altered conditions of environmental support (Libiszewski, 1992).

Moreover, by contrast, political ecology theories of environmental conflict focus less on environmental scarcity itself and more on the power relations, social structures, and political processes that mediate environmental conditions and their contested meanings. According to Philippe Le Billon and other political ecologists, environmental conflicts should be understood as socially and politically produced struggles over access, control, valuation, and distribution of environmental resources or impacts, shaped by inequalities, historical legacies, and institutional arrangements rather than by "nature speaking directly" through scarcity (Le Billon, 2015; Martinez-Alier, 2002). This perspective critiques neo-Malthusian views that treat environmental drivers as natural triggers of conflict, arguing instead that conflicts are generated by unequal power dynamics around environmental processes, for example, how the environment be-

comes politicized as actors contest rights, responsibilities, and benefits in contexts of extraction, conservation, or environmental change. Political ecology thereby frames environmental conflicts as political struggles embedded in broader socio-ecological systems, not merely responses to physical resource conditions.

Hence, what role did environmental and climate change phenomena such as severe droughts, famines, decreasing rainfall and shrinking grazing and pasture lands play in the Somali state collapse in 1991 and the subsequent violent civil war? How did climate change induced violence exacerbate the Somali civil war and violence in the Somali territories in Djibouti, Kenya and Ethiopia? The Arab philosopher, sociologist and historian Ibn Khaldun's often quoted phrase "geography is fate" denotes that geographical and climatic conditions shape, structure and influences politics, the economy, life styles and historical trajectories. Hence, Mark Carey argues that a "critical climate history" (Carey, 2014) approach and perspective is necessary to properly comprehend politics, violence, and development in our contemporary world ravaged by climate change and its consequences on societies. For Carey, a critical climate history entails understanding "how different spatial and temporal scales intersect and interact (or do not) about the interplay between nature's agency and environmental determinism" (Carey, 2014, p.355). Moreover, Sherry Johnson hypothesizes in her study how climatic conditions affect history and politics that "as the earth moves from one temperature norm to another (pivot phases), extreme weather events may occur and may become the catalyst for historical processes" (Johnson, 2014, p.329). This study hypothesizes and argues that climate change phenomena has exacerbated violence and political conflict not only in Somalia during the civil war but also in the other neighbouring Somali territories in Kenya, Djibouti and Ethiopia.

What is the role of climate change in occasioning violence and political conflict in Somalia and the neighbouring Somali territories in Kenya, Djibouti and Ethiopia? Natural disasters have played a significant role in occasioning and causing of political conflict and violence in the Somali world. For instance, Robert G. Patman posits that severe droughts and famines caused the violent state collapse in Somalia. According to him "the reasons for the failure of the Somali state are complex and widely misunderstood. On the one hand, a number of commentators have attributed the demise of the Somali state to the overwhelming impact of a 'natural" disaster', the Somali famine of 1991-92" (Patman, 1997, 5). Natural disasters have a determinant role in political violence and conflict in the Somali world. By 1994 alone, Abdi Ismail Samatar posits approximately 300,000 Somalis had lost their lives either in the Somali civil war conflict or by food and water shortages caused by the droughts and famines that ravaged the country (Samatar, 1994).

More crucially, apart from the climate change caused droughts and famines, clan-based rebel groups destroyed farmlands and crops and burned large swathes of grazing lands inhabited by "enemy" clans and communities causing human-made famines and droughts during the civil war. For instance, Catherine Besteman document that:

the people of the agriculturally productive Jubba Valley were 'repeatedly victimized by the scorched-earth tactics of the SNF (Marehan), SPM (Ogaden) and USC (Habr Gidir) militias as their forces looted livestock, seeds, tools and grains, destroying water resources, raped women and killed the men' (Prendergast, 1994, 4-5 quoted in Besteman, 1996, p.582).

Scorched-earth tactics of evictions employed by the rebel groups led to the destruction of significant farmlands in Southern Somalia exacerbating the casualties of the famines and droughts. Hence the combined climate change and human-made famines and droughts ravaged livelihood during the brutal years of the Somali civil war. Somalia has witnessed decreasing rainfall over the years caused by climate change, and the destroying of water resources by clan militias and rebel groups occasioned violence and conflict over the few water resources. Moreover, grazing pasture lands and tree-coverage have decreased exacerbating violence and conflict in the country.

Climate change causes violence and conflict in the geographies it affects. In the African continent climate change, "Anthropocene Africana" and its consequences are the major contributors to conflict and violence where communities and clans fight over water resources and grazing lands (Kalmoy, 2019). Empirical studies have established that "sub-Sahara Africa is the world region most affected by climate change" (Von Soest, 2020, p.1) despite the continent being the least contributor to environmental and atmospheric pollutions. Moreover, Christian Von Soest argues that "rising temperatures threaten the most vulnerable already – namely, those that are poor and rely on rain-fed agriculture. Pastoralist agricultural production and pronounced differences between ethnic groups are particularly dangerous risk factors" (Von Soest, 2020, p.1) in occasioning conflict and political violence in the African continent. Furthermore, climate change caused rainfall decrease contributes to conflict and political violence in the Africa. Cullen Hendrix and Idean Salehyan posit that "deviations from normal rainfall patterns affect the propensity for individuals and groups to engage in disruptive activities such as demonstrations, riots, strikes, communal conflict, and anti-government violence" (Hendrix and Salehyan, 2012, p.35). Political violence and conflict are related to the patterns of rainfall. The Sahel region and the East African drylands are geographies prone with instability and political conflicts and violence. In the African continent "rainfall correlates with civil war and insurgency" (Hendrix & Salehyan, 2012, p.35).

Climate change causes communal vulnerabilities which are often translated to violent confrontations between communities, ethnic groups and clans. Climate change causes human displacement since existing livelihoods and life-styles are disrupted by the changing patterns of the climate. Climate change induced human displacements is rampant in the global south where communities and societies are economically marginalized. Shweta Jayawardhan argues that "environmental displacement is not solely an ecological problem. It is a multicausal problem where ecological and socioeconomic vulnerability act together to displace marginalized people" (Jayawardhan, 2017, p.104). And one of the consequences of social displacement is confrontations and conflict with neighbouring communities and societies. Since "Africa is widely recognized as one of the continents most vulnerable to climate change" (Busby et al, 2013, p.136) demographic displacements lead to violence and political conflicts between ethnic and tribal groups. Empirical studies have established that climate change occasions social and political vulnerabilities that have what Joshua Busby and et al called "the potential security consequences of climate change" (Busby, 2013, p.144). Climate change and its consequences have become security threats for African states since it can cause political mayhem and violence (Brown, Hammill & McLeman, 2007).

Finally, another important strand in climate and environmental conflict theory comes from Environmental Conflict Resolution (ECR) scholarship, which conceptualizes environmental conflict not primarily as interstate or violent contention but as dispute processes involving multiple stakeholders over environmental policy, use, and impact. ECR emphasizes negotiation, mediation, and collaborative decision-making among affected parties, including governments, communities, and interest groups, aiming to transform or manage disagreements tied to environmental issues through participatory and adaptive approaches (O'Leary & Bingham, 2004). Rather than theorizing causation in terms of resource scarcity or structural power alone, ECR focuses on practical mechanisms for resolving conflicts by building consensus, enhancing public participation, and evaluating outcomes, highlighting that conflict resolution effectiveness varies across contexts and that consensus-oriented tools are not universally applicable to all environmental disputes (O'Leary & Bingham, 2004).

Data and Methodology

In Greater Somalia, climate change occasions, causes and contributes to political violence through direct and interacting causal mechanisms rather than indirect environmental determinism.

Recurrent droughts, famines, rainfall variability, and extreme climatic events undermine pastoral and agro-pastoral livelihoods, leading to loss of income, food insecurity, and displacement. These pressures intensify competition over land, water, and grazing routes, particularly in contexts where customary resource-sharing arrangements and conflict-resolution institutions have been weakened by prolonged state collapse in Somalia and political marginalization in the other territories. Environmental stress also exacerbates recruitment and mobilization opportunities for armed actors by increasing economic, resources and land grievances and reducing alternative livelihood options, while simultaneously constraining the capacity of local authorities and communities to manage disputes and provide security. Climate change and environmental crisis thus functions as a contextual determinant and amplifier of political violence, shaping conflict dynamics by deepening existing vulnerabilities and sharpening contestation over resources in a region already marked by chronic insecurity.

The study applied a multi-disciplinary geospatial analysis framework (See Bahgat & Medina, 2013; Golledge, Marsh & Battersby, 2008) to examine the ecological, climatic, and socio-political dynamics across Somali territories. The analysis encompassed three primary dimensions: tree cover change, climate variability, and armed conflict distribution. We utilized Google earth engine, Python and R-based geospatial libraries. We used three datasets: TerraClimate[1], Dynamic World v1[2], MODIS[3], and the Armed Conflict Location & Event Data[4] Project (ACLED).

To begin, administrative boundaries for Somalia, Djibouti, Kenya, and Ethiopia were retrieved using geospatial R library geoboundaries[5]. Relevant regions, including Mandera, Wajir, and Garissa in Kenya, as well as Dire Dawa and Somali in Ethiopia, were filtered and combined with Somalia and Djibouti to create a unified spatial boundary for the study: Greater Somalia. These spatial boundaries were unified into a single representation of the Greater Somalia region. The processed boundary data were converted to geojson format to ensure compatibility with different datasets Google Earth Engine (GEE) platform.

The ecological component of the study focused on detecting changes in tree cover between 2000 and 2020 using the MODIS Vegetation Continuous Fields (MOD44B) dataset. Data were clipped to align with the study area using Equation 1, ensuring the exclusion of regions outside the boundaries of interest.

$$I_{clipped(x,y)} = \begin{cases} I(x,y) \ if \ (x,y) \in \text{ROI} \\ 0, \quad if \ (x,y) \notin \text{ROI} \end{cases} \qquad 1$$

In which $I(x,y)$ is the pixel value before clipping and ROI represents the geographic boundary defined by the shapefile.

Temporal mosaicking (Oyedotun et al, 2024) was employed to produce annual composite images for 2000 and 2020, enabling a consistent basis for comparison. Tree cover change was calculated as the difference between the 2020 and 2000 mosaics (Equation 2), with the resulting raster highlighting both areas of deforestation (negative values) and afforestation) positive values). Land cover classifications from the Dynamic World dataset (2015–2024) were also incorporated to complement the MODIS data, providing detailed information on vegetation types within the region.

$$\Delta T(x,y) = T_{2020(x,y)} - T_{2000(x,y)} \qquad 2$$

Where, $T_{2020(x,y)}$ is the tree cover percentage in 2020 and $T_{2000(x,y)}$ is the tree cover percentage in 2000. A positive value indicates tree cover gain, while a negative value indicates tree cover loss.

[1] https://www.climatologylab.org/terraclimate.html
[2] Dynamic World V1 | Earth Engine Data Catalog | Google for Developers
[3] MOD44B.006 Terra Vegetation Continuous Fields Yearly Global 250m | Earth Engine Data Catalog | Google for Developers
[4] https://acleddata.com/
[5] https://www.geoboundaries.org/

To quantify the aggregate impacts of vegetation and climate changes, zonal statistics[6] were employed. Using Equations 3 and 4, the study calculated total vegetation cover and climate metrics for each administrative zone, providing a granular understanding of regional disparities.

To compute the sum of tree cover or non-tree vegetation within each zone, the following operation is performed:

$$Z_{sum}(Z) = \sum_{(x,y)\in z} I(x,y).A_{pixel} \quad 3$$

Where $Z_{sum}(Z)$ is the total tree or non-tree vegetation cover for zone z. $I(x,y)$ is the pixel value for tree or vegetation cover and A_{pixel} is the area of one pixel (in km^2).

The zonal average is computed as:

$$Z_{mean}(Z) = \frac{Z_{sum}(Z)}{N_z} \quad 4$$

where N_z is the total number of pixels within zone z.

The climate analysis utilized TerraClimate datasets to assess spatial and temporal patterns of temperature and precipitation over the period 1997–2024. The selection of the period is consistent with the armed conflict data which is available from 1997. Maximum and minimum temperatures were retrieved, and monthly mean temperatures were calculated as see equation 5, before aggregating into annual averages see equations 6.

Monthly Mean Temperature Calculation:

$$T_{mean_{monthly}} = \frac{T_{max(x,y)} + T_{min(x,y)}}{2} \quad 5$$

Where $T_{max(x,y)}$ and $T_{min(x,y)}$ are the maximum and minimum temperatures for each pixel (x,y).

Annual Mean Temperature is Calculated as:

$$T_{mean_{annual}} = \sum_{i=1}^{12} \frac{\sum_{i=1}^{12} T_{mean_{monthly(i)}}}{12} \quad 6$$

Precipitation data followed a similar workflow, with monthly precipitation values averaged annually see equations 7 and 8. Spatial resolution was standardized to approximately 1 km, and all datasets were projected into the WGS84 coordinate reference system (EPSG:4326) to ensure alignment with the study boundary. The processed data were then cropped to the spatial extent of the Greater Somalia region, allowing for focused analysis of climatic trends.

$$P_{mean_{monthly}} = \frac{P_{max(x,y)} + P_{min(x,y)}}{2} \quad 7$$

Where $P_{max(x,y)}$ and $P_{min(x,y)}$ are the maximum and minimum precipitation for each pixel (x,y).

Annual Mean Precipitation:

$$P_{mean_{annual}} = \sum_{i=1}^{12} \frac{\sum_{i=1}^{12} P_{mean_{monthly(i)}}}{12} \quad 8$$

$P_{mean_{annual}}$ are the averaging monthly precipitation values across the year.

Temperature and precipitation data were combined into a raster stack and categorized using bivariate classification techniques, providing spatial representations of climatic variability over the study period see equations 9 and 10.

$$S = \{T_{cropped,} P_{cropped}\} \quad 9$$

Where $= T_{cropped}$ is the cropped temperature raster and $P_{cropped}$ is the cropped precipitation raster.

Bivariate Classification: Classify data into quantiles for xxx (temperature) and yyy (precipitation):

$$Class_{bivariate} = \text{Quantile(T, dim)} * \text{Quantile(P, dim)} \quad 10$$

Where dim= 4, resulting in 4×4=16 bivariate classes.

These data were visualized in bivariate map figure x, illustrating the co-variability of temperature and precipitation across the region.

[6] Spatial Data Science | With Applications in R | Edzer Pebesma, Roger B

To test the relationship between climate variables and political violence we employ ordinary least squares (OLS) regression with heteroskedasticity robust standard errors to test six model specifications: (M1) contemporaneous climate effects only, (M2 to M4) individual lag structures (1, 3, and 6 months), (M5) all lags jointly, and (M6) seasonal anomalies (deviations from month specific means). This approach addresses concerns about temporal aggregation bias and functional form misspecification common in climate conflict studies (Buhaug et al., 2014).

We estimate the following baseline model:

Model 1 (Baseline): Contemporaneous Effects

$$Y_t = \beta_0 + \beta_1 \text{Temp}_t + \beta_2 \text{Precip}_t + \epsilon_t \quad (11)$$

Model 2: 1 Month Lag

$$Y_t = \beta_0 + \beta_1 \text{Temp}_t + \beta_2 \text{Precip}_t + \beta_3 \text{Temp}_{t-1} + \beta_4 \text{Precip}_{t-1} + \epsilon_t \quad (12)$$

Model 3: 3 Month Lag

$$Y_t = \beta_0 + \beta_1 \text{Temp}_t + \beta_2 \text{Precip}_t + \beta_3 \text{Temp}_{t-3} + \beta_4 \text{Precip}_{t-3} + \epsilon_t \quad (13)$$

Model 4: 6 Month Lag

$$Y_t = \beta_0 + \beta_1 \text{Temp}_t + \beta_2 \text{Precip}_t + \beta_3 \text{Temp}_{t-6} + \beta_4 \text{Precip}_{t-6} + \epsilon_t \quad (14)$$

Model 5: Full Distributed Lag

$$Y_t = \beta_0 + \beta_1 \text{Temp}_t + \beta_2 \text{Precip}_t + \beta_3 \text{Temp}_{t-1} + \beta_4 \text{Precip}_{t-1} + \beta_5 \text{Temp}_{t-3} + \beta_6 \text{Precip}_{t-3} + \beta_7 \text{Temp}_{t-6} + \beta_8 \text{Precip}_{t-6} + \epsilon_t \quad (15)$$

Model 6: Seasonal Anomalies

$$Y_t = \beta_0 + \beta_1 \text{TempAnom}_t + \beta_2 \text{PrecipAnom}_t + \epsilon_t \quad (16)$$

where:

Y_t represents conflict outcome in month t, measured as: (i) conflict event count, (ii) total fatalities, or (iii) $\ln(1 + \text{fatalities})$

Temp_t is the spatially averaged maximum temperature (°C) across Somalia in month t

Precip_t is the spatially averaged total precipitation (mm) across Somalia in month t

β_0 is the intercept, β_1, β_2 are the coefficients of interest capturing climate conflict relationships

ϵ_t is the error term. All models use OLS with heteroskedasticity robust standard errors (HC1)

The study also incorporated socio-political data, examining the spatial distribution of armed conflict events from 1997 to 2024 using data from the Armed Conflict Location & Event Data Project (ACLED). These events were mapped and analyzed to explore their intersection with ecological and climatic patterns, offering a holistic perspective on the region's dynamics.

The study's integration of ecological, climatic, and conflict data represents a rigorous and unified geospatial methodology that is robust, scalable, and adaptable. The systematic use of high-resolution remote sensing datasets, advanced computational tools, and rigorous statistical methods ensured meaningful accuracy and actionable insights. Moreover, the methodology is designed to be flexible and adaptable, offering potential applicability to similar analyses across diverse geographic and environmental contexts.

Finally, this study examines patterns of political violence in Greater Somalia in the post-1991 period, drawing on climate and conflict datasets that are available only from the late 1990s onward (from 1997). Consequently, the empirical analysis does not seek to directly test the role of climate change in the 1991 collapse of the Somali state. Rather, the reference to pre-1991 droughts and famines serves as historical context, consistent with existing scholarship showing how environmental stress weakened state capacity, economic resources, and political legitimacy prior to collapse (Patman, 1997; Clarke, 1992; Samatar, 1994). The quantitative analysis is therefore explicitly focused on post-collapse conflict dynamics, assessing how environmental variability interacts with political violence in the absence of a centralized state and that it can spread to neighboring countries. This approach ensures coherence between the temporal scope of the data and the core analytical claims of the study.

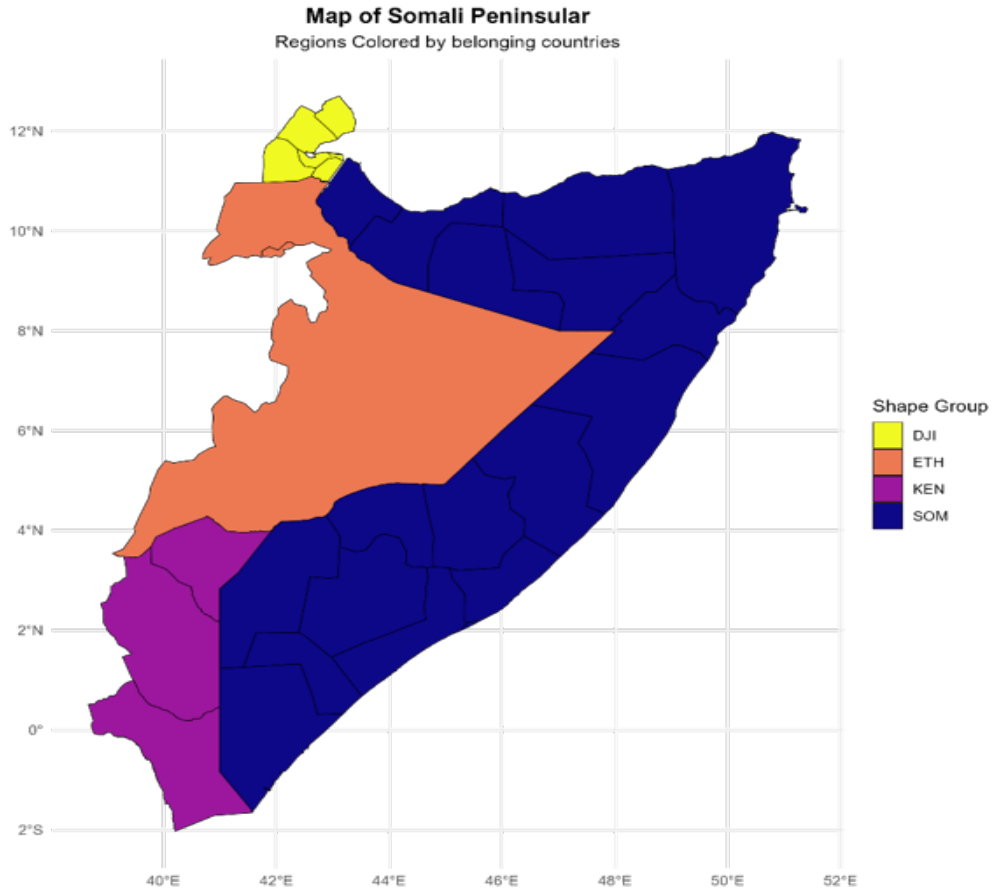

Fig. 1. The study area (Somalia peninsular)

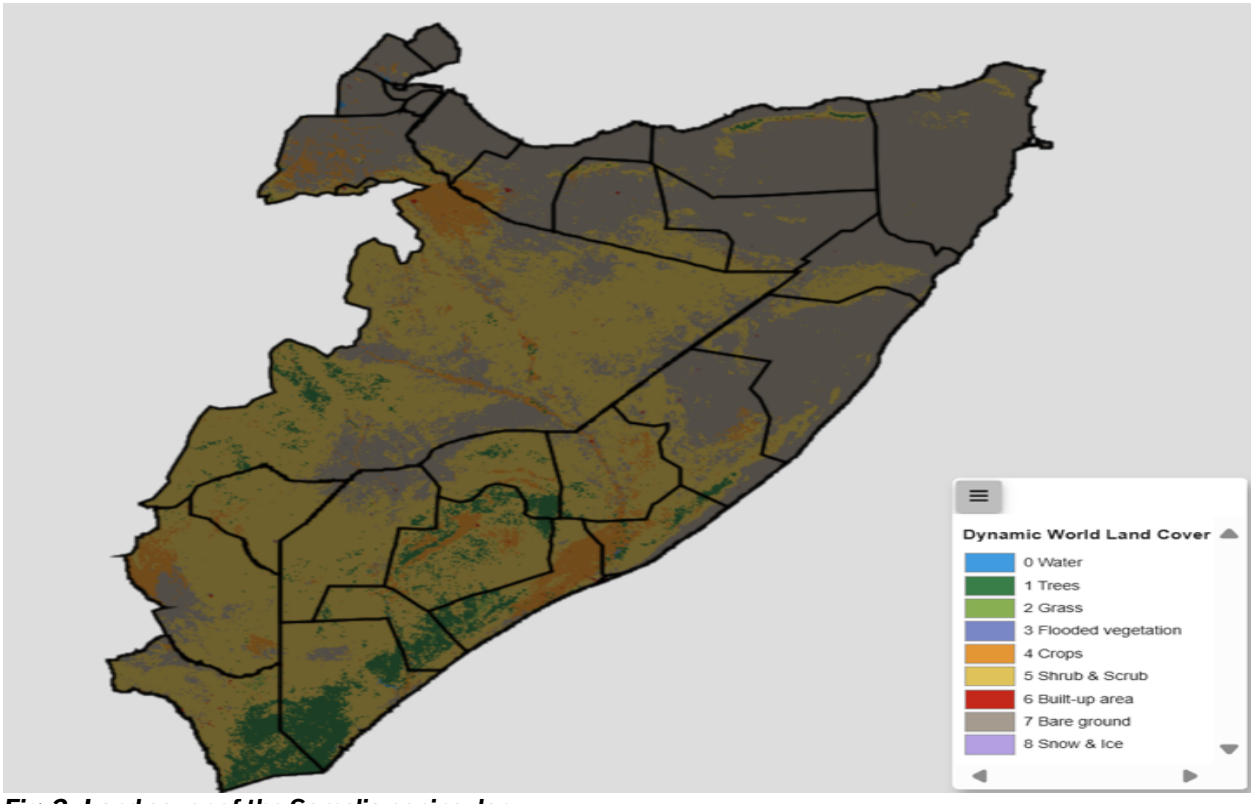

Fig. 2. Land cover of the Somalia peninsular

Fig. 3. Tree Cover Distribution

Fig. 3. illustrates the tree cover distribution across the Somali Peninsula, revealing predominantly sparse vegetation coverage throughout the region. Significant tree cover is limited to three main areas: the Raskamboni and Lower Jubba regions in southern Somalia, the Sanaag Mountains in northeastern Somalia, and the Karamara Mountains west of Jigjiga in Ethiopia's Somali Region. This pattern of vegetation distribution reflects the largely arid climate of the peninsula, with higher tree density concentrated in areas of elevated topography or proximity to water resources.

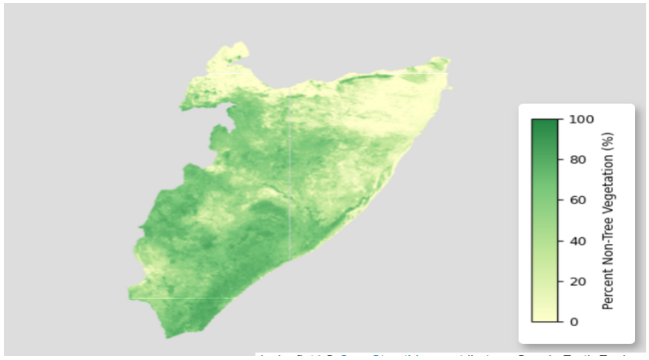

Fig. 5 percentage of non-tree cover in the Somalia peninsular

Figure 5 depicts the distribution of non-tree vegetation cover across the Somali Peninsula. In contrast to the sparse tree coverage shown in Figure 3, non-tree vegetation dominates the landscape throughout the peninsula. The map reveals extensive areas covered by shrubs, grasses, and other low-lying vegetation, indicating the region's adaptation to semi-arid conditions. This predominance of non-tree vegetation characterizes the peninsula's natural ecosystem, where drought-resistant plant species form the primary vegetative cover across the vast territory.

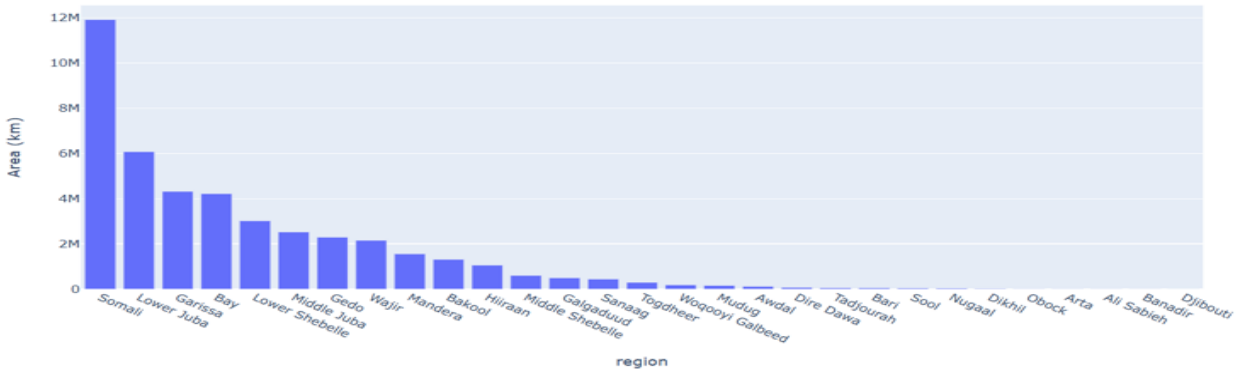

Fig. 4 Tree cover based on regions

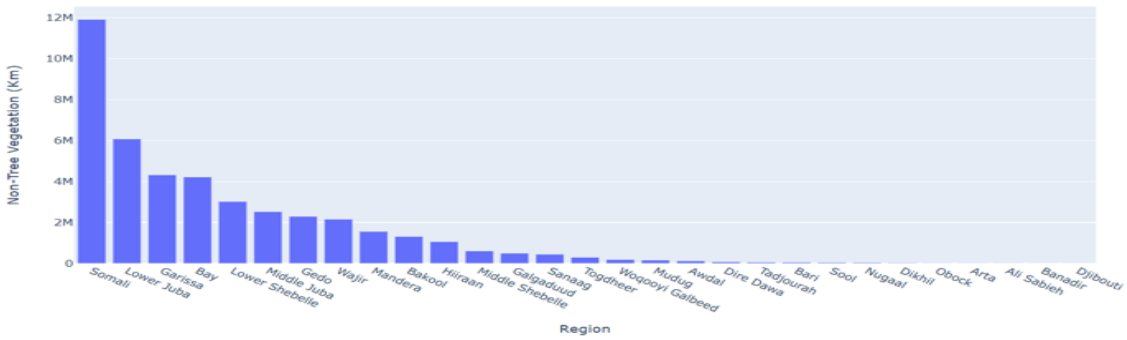

Fig. 6 Non tree cover based on regions.

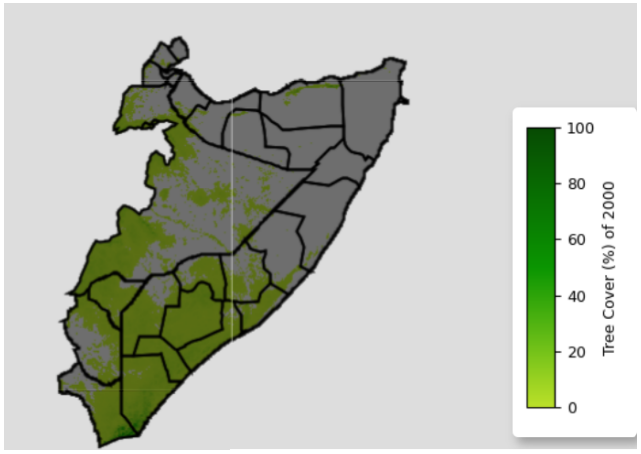

Fig. 7 percentage of land covered by trees in 2000

The percentage of tree cover in 2000 shows that most of the central Somali republic and the north as treeless while the southern Somalia and north eastern regions of Kenya are largely covered by trees same as the Somali region in Ethiopia.

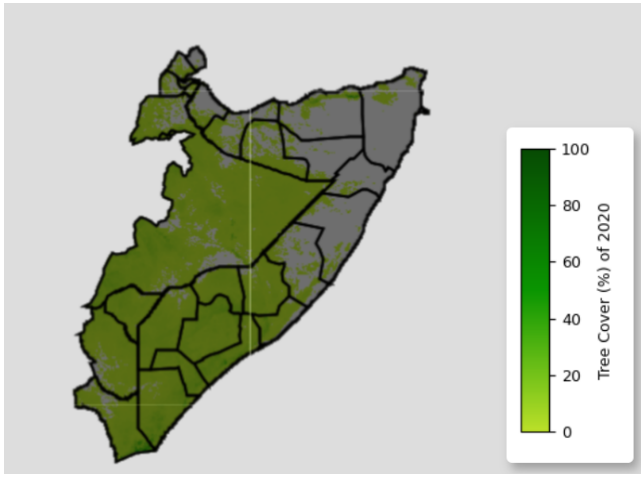

Fig. 8 percentage of land covered by trees in 2020.

The tree cover distribution in 2000 reveals distinct spatial patterns across the region. Central and northern Somalia exhibit minimal tree coverage, characterized by largely treeless landscapes. In contrast, southern Somalia, northeastern Kenya, and Ethiopia's Somali Region demonstrate significantly higher tree density. This vegetation pattern reflects the region's diverse ecological zones, with more favorable conditions for tree growth in the southern and peripheral areas of the peninsula, while the central regions remain predominantly devoid of substantial tree cover.

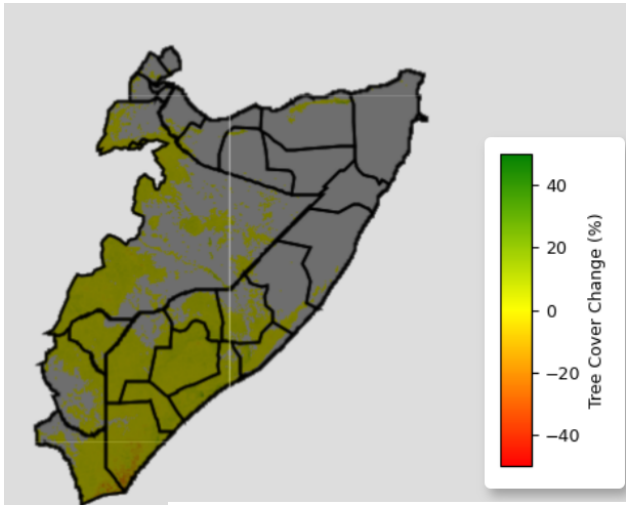

Fig. 9 Tree cover change between 2000-2022

Figure 10 presents a bivariate analysis of temperature and precipitation patterns, revealing strong correlations with vegetation distribution across the region. Areas characterized by high precipitation and high temperature (indicated in green) correspond closely with regions of substantial tree and non-tree vegetation cover. Similarly, areas displaying low temperature and high precipitation (shown in blue) also demonstrate significant vegetation coverage. Conversely, regions experiencing either low precipitation and low temperature, or high temperature and low precipitation, consistently exhibit minimal vegetation cover. This spatial correlation between climatic variables and vegetation patterns underscores the critical role of both temperature and precipitation in determining the distribution of plant life across the landscape.

Conflict data

The figure 11 illustrates the spatial distribution and frequency of various conflict events in Somali territories from 1997 to 2024, using data from the Armed Conflict Location & Event Data Project (ACLED). The map on the left in figure 12 depicts the geographical spread of different event types, revealing significant concentrations in the southern and central regions of Somalia, while the accompanying bar chart on the right provides a quantitative breakdown of these event types.

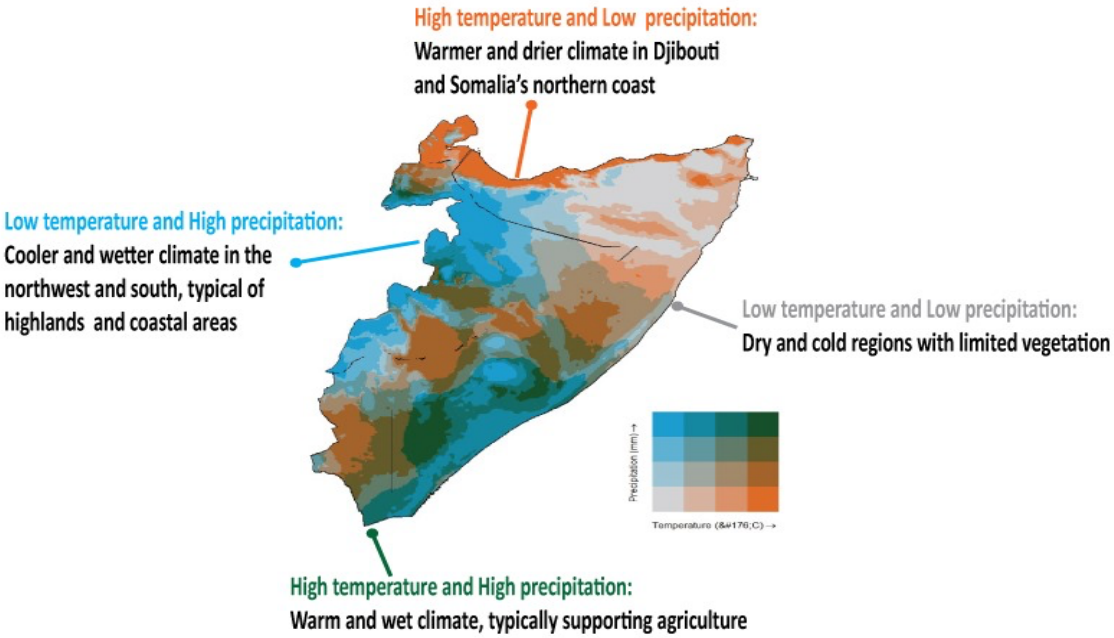

Fig. 10 stacked climate map

The presence of battles is particularly prominent, indicating that these areas have been the focal points of armed conflict over the years. The density of events around major urban centers, especially in the coastal regions, suggests that these locations have experienced sustained conflict, likely due to their strategic importance.

In addition to battles, the map also shows the distribution of other types of violence, including explosions and remote violence, which are primarily concentrated in urban areas. This pattern underscores the prevalence of insurgent activities and the use of asymmetric warfare tactics, which often target populated regions. Violence against civilians is another widespread event type, reflecting the severe impact of the conflict on non-combatants, particularly in areas with limited state control. The map further highlights the occurrence of strategic developments, protests, and riots, though these events are less frequent and more localized, typically associated with specific episodes of political or social unrest.

The bar chart on the right provides a quantitative breakdown of these event types, with battles emerging as the most frequent, accounting for over 20,000 occurrences. This dominance underscores the ongoing-armed conflicts within the region, where battles between various factions have been a major source of violence. Explosions and remote violence, along with violence against civilians, also feature prominently, reflecting the persistent threats posed by non-state actors who employ such tactics to destabilize the region. While strategic developments, protests, and riots are less common, their presence in the data indicates moments of significant political and social tension.

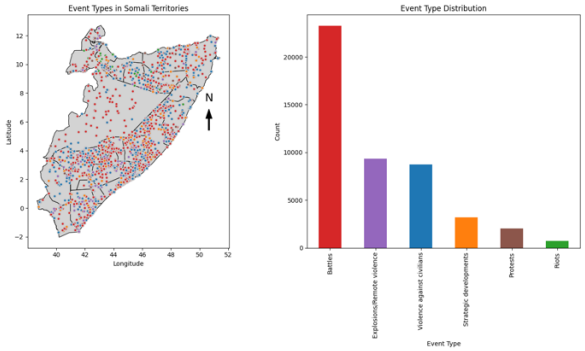

Fig. 11 Event types and event type distributions in greater Somali territories

Figure 12 illustrates the distribution of disorder types across Somali territories from 1997 to 2024, reinforcing the patterns observed in the first figure. The map shows that political violence is the

most widespread form of disorder, with a high concentration of incidents, particularly in southern and central Somalia, as well as along the coast. This aligns with the earlier map, which identified these regions as conflict hotspots.

The bar chart on the right confirms that political violence overwhelmingly dominates, with over 40,000 incidents, far outpacing other forms of disorder such as strategic developments and demonstrations. This dominance indicates that political violence is the primary driver of conflict in Somalia, overshadowing other types of unrest. Together, these figures highlight that the conflict in Somalia is largely driven by political violence, which is pervasive and concentrated in key regions. The prevalence of political violence underscores the deep-rooted instability and the challenges in achieving lasting peace and governance in the country.

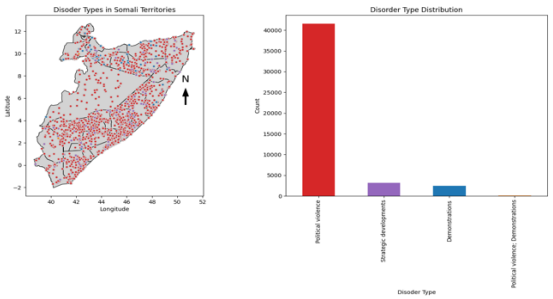

Fig. 12 Disorder types and disorder type distributions in greater Somali territories

The 13 figure depicts the nature of violence in Somali territories by analyzing the top 15 sub-event types from 1997 to 2024. The map on the left displays the spatial distribution of these sub-events, revealing a complex and varied landscape of conflict. While armed clashes are widely dispersed across the region, they are particularly concentrated in southern and central Somalia, consistent with the earlier findings on political violence.

The accompanying bar chart on the right quantifies the occurrence of these sub-events, showing that armed clashes are by far the most prevalent, with over 20,000-recorded incidents. This dominance of armed clashes underscores their critical role in the ongoing conflict. Other sub-events, such as attacks and the use of explosives/IEDs, also contribute significantly to the violence but at much lower frequencies. These sub-event patterns further highlight the intensity and diversity of conflict in Somalia, where armed clashes not only dominate but also coexist with a variety of other violent acts.

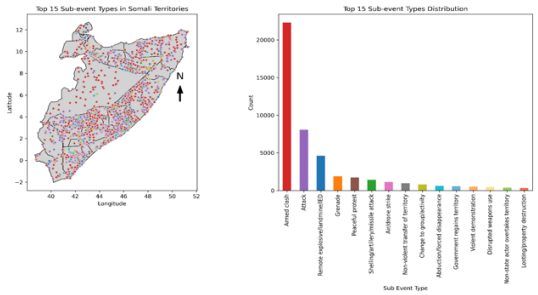

Fig. 13 Sub-event types and sub-event type distributions in greater Somali territories

Figure 14 focuses on the distribution and trend of fatalities in Somali territories. The map on the left illustrates the geographical spread of these fatalities, marked by red dots across the region, while the bar chart on the right presents the annual count of fatalities, revealing a concerning upward trend over the years. The distribution shows a high concentration of fatalities in southern and central Somalia, with notable clusters in areas like Mogadishu and its surroundings, reflecting the intense and persistent violence in these regions.

The bar chart indicates that the number of fatalities has significantly increased since the late 1990s, with particularly sharp rises in recent years, peaking in 2024. This trend highlights the escalating conflict and its devastating human toll, underscoring the need for urgent interventions to address the ongoing violence in Somalia.

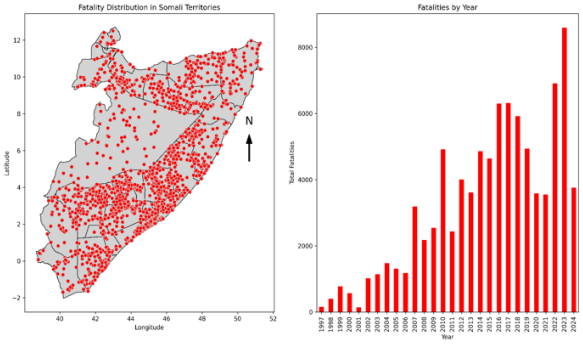

Fig. 14 Fatalities distributions in greater Somali territories and fatalities per year

Figure 15 highlights the top 10 actors involved in violence within Somali territories. The map on the left illustrates the geographic distribution of these actors, represented by different colors, whereas the bar chart on the right breaks down the count of violent incidents attributed to each actor. It reveals that the activities of these actors are widespread across the region, with distinct clusters in various parts of the country.

Unsurprisingly, Al Shabaab, marked in red, stands out as the most dominant actor, responsible for the highest number of violent incidents in Somalia. This is followed by Unidentified Armed Groups (Somalia) and various factions of the Military Forces of Somalia, which have also been significantly active over the years. Other actors include protesters, rioters, and external military forces, each contributing to the complex and multifaceted conflict landscape in Somalia. Ethiopian military is among the actors mainly in the Somalia region in Ethiopia as well as the Somali republic. Furthermore, AMISOM, which is the peace keeping forces in which Ethiopian military is part of is also among the top 10 actors in Somalia conflict. The data shows varied and persistent nature of violence in the region, driven by a mix of insurgent groups, military forces, and other actors.

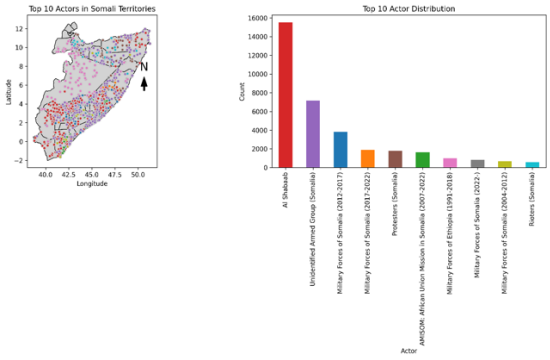

Fig. 15 Main actors involving conflicts in greater Somali territories.

The data reveals that the conflict in Somali territories involves a broad range of actors, with Al Shabaab being the most prominent. The distribution of fatalities highlights that violence is widespread across the Somali Republic and extends to Somali-inhabited regions in Ethiopia, Kenya, and Djibouti. Army clashes, political violence and battles are the main events and drivers that dominate the Somali conflict over the years, the conflict has escalated, with recent years showing an increase in fatalities. Research suggests that climate-induced stressors such as drought and resource scarcity can reshape armed group behavior by intensifying competition over livelihoods and authority (Raleigh et al. 2010; von Uexkull 2016). In the Somali context, Al-Shabaab has strategically exploited these stresses by embedding itself within affected communities through taxation, dispute resolution, and the provision of selective assistance, thereby expanding its recruitment base. Environmental shocks also weaken state and clan governance structures, creating openings for armed groups to consolidate territorial control and enforce parallel systems of rule. Rather than acting as a direct cause of violence, climate stress functions as a threat multiplier that enhances the organizational capacity and local legitimacy of actors such as Al-Shabaab.

Table 1: Regression Results for Baseline and Lagged Models (M1 to M6)

	M1: Baseline	**M2: 1 Month Lag**	**M3: 3 Month Lag**	**M5: All Lags**
Dependent Variable: Conflcit				
Constant	4.617	0.915	3.240	4.875
	(3.051)	(3.705)	(5.579)	(7.767)
Temperature	0.192	1.877	0.488	2.181
	(0.918)	(1.297)	(1.024)	(1.489)
Precipitation	0.0049	0.0085**	0.0067*	0.0087*
	(0.0033)	(0.0039)	(0.0035)	(0.0051)
Temperature (lag 1)		2.827**		2.362
		(1.431)		(1.717)
Precipitation (lag 1)		0.0006		0.0026
		(0.0036)		(0.0039)
Temperature (lag 3)			0.776	0.110
			(0.993)	(1.243)
Precipitation (lag 3)			0.0062	0.0066
			(0.0039)	(0.0043)
Temperature (lag 6)				0.444
				(1.146)
Precipitation (lag 6)				0.0009
				(0.0047)

*Note: Robust standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.*

Table 2: Results for Anomalies and Non-linear Models

	M6: Seasonal Anomalies
Panel A: Conflict Count	
Constant	17.802***
	(0.807)
Temperature (or Anomaly)	1.572*
	(0.863)
Precipitation (or Anomaly)	0.275
	(0.851)
Temperature squared	
Precipitation squared	
R squared	0.010
Adjusted R squared	0.005
N	348
Panel B: Fatalities	
Constant	113.035***
	(6.041)
Temperature (or Anomaly)	7.231
	(6.416)
Precipitation (or Anomaly)	7.886
	(5.108)
Temperature squared	
Precipitation squared	
R squared	0.010
Adjusted R squared	0.004
N	348
Panel C: ln(1+Fatalities)	
Constant	3.841***
	(0.099)
Temperature (or Anomaly)	0.042
	(0.113)
Precipitation (or Anomaly)	0.182
	(0.121)
Temperature squared	
Precipitation squared	
R squared	0.009
Adjusted R squared	0.003
N	348

*Note: * p < 0.10, ** p < 0.05, *** p < 0.01.*

As Table 1 shows baseline Model (M1): The contemporaneous only specification yields no statistically significant relationships between climate and conflict (all p values greater than 0.10). This null result mirrors findings from earlier meta-analyses questioning the universality of climate conflict linkages (Buhaug, 2010) and highlights the limitations of linear, contemporaneous models.

Lagged Effects (M2): When incorporating one month lagged climate variables, significant patterns emerge for log transformed fatalities. Current precipitation shows a negative association ($\beta = -0.0085, p = 0.029$), while one month lagged temperature exhibits a positive relationship ($\beta = 2.827, p = 0.048$). Model fit improves, suggesting that temperature affects conflict with a one month delay consistent with mechanisms operating through crop failure and pastoral stress (von Uexkull et al., 2016; Fjelde & von Uexkull, 2012). The negative precipitation coefficient aligns with research showing that rainfall alleviates resource scarcity in pastoral economies (Maystadt & Ecker, 2014).

Table 2 extends Lag Structure (M3 to M5): Models with 3 month and 6 month lags yield mixed results. The 3 month lag specification shows marginally significant negative effects of current precipitation on log fatalities ($\beta = -0.0067, p = 0.057$), though lagged temperature effects dissipate. The full distributed lag model (M5) combining all lags produces coefficient estimates consistent with delayed effects but loses statistical power (no individual coefficients reach $p < 0.05$). This suggests climate impacts operate primarily in the near term (1 to 3 months) rather than longer horizons. Seasonal Anomalies (M6): When using standardized deviations from month specific climate norms, temperature anomalies show a marginally significant positive effect on conflict incidence ($\beta = 1.572, p = 0.069$). This supports the hypothesis that unusually hot conditions rather than absolute temperatures trigger violence, consistent with findings from Hsiang et al. (2013) and Burke et al. (2015).

Conclusion

The eruption of the Somali civil war and its proliferation to the neighboring countries where Somalis inhabit is empirically attributed to the disruptions of livelihoods occasioned by drastic and abrupt changes to the climatic pattern in the Somali peninsula. Somalia and the whole region of Horn of Africa witnessed horrendous droughts and famines in the 1980s: The Ethiopian famine of 1982 being

emblematic of how famines ravaged the whole region. Somalia witnessed recurring dry spell and famines since the 1960s with the infamous "Abaarti Dabadheer" famines of the early 1970s being prominent in political, economic and poetic discourses. Climate change has led to the shrinking of the grazing lands and the drying of water wells which are consequential for the Somali pastoralists. *Ipso facto* this has led to violent contestations over the remaining pasturelands and water wells. A close of examination of the patterns of violence in Somalia and in the Somali inhabited regions in Ethiopia, Kenya and Djibouti correlate with the increasing aridity and the shrinking grazing lands in Greater Somalia. This study documented how changing climatic patterns have consequential effects on state collapse and the proliferations of both weapons and political violence over resources.

Declarations

Funding: The authors declare that this research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflicts of Interest: The authors declare that there is no conflict of interest regarding the research, authorship, and/or publication of this article.

Ethical Approval: This study does not involve human participants, clinical trials, surveys, interviews, or experiments. Therefore, according to national and international research ethics guidelines, ethical committee approval was not required.

Informed Consent: Not applicable.

Data Availability: The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Author Contributions: Conceptualizations A.D.K, A.D.H, M.M.I; introduction, conceptual analysis, A.D.K; investigation, data analysis, A.D.H, M.M.I; writing – original draft preparation, A.D.K; writing – review and editing, A.D.K, A.D.H, M.M.I.

AI Disclosure: The authors declare that no artificial intelligence–based tools or applications were used in the study design, data collection, data analysis, or manuscript preparation.

References

Abate, T. (1994). Climate and the collapse of civilization. *BioScience*, 44(8), 516–519. https://doi.org/10.2307/1312276

Abdi, C. M. (2007). Convergence of Civil War and the Religious Right: Reimagining Somali Women. Signs, 33(1), 183–207. https://doi.org/-10.1086/518393

Ayittey, B. N. (1994). The Somali crisis: Time for an African solution. *Cato Institute*. http://www.-jstor.org/stable/resrep04968

Bahgat, K., & Medina, R. M. (2013). An Overview of Geographical Perspectives and Approaches in Terrorism Research. *Perspectives on Terrorism*, *7*(1), 38–72. http://www.jstor.org/stable/26296908

Besteman, C. (1996). Representing violence and "othering" Somalia. *Cultural Anthropology*, 11(1), 120–133. http://www.jstor.org/stable/656211

Buhaug, H. (2010). Climate not to blame for African civil wars. Proceedings of the National Academy of Sciences, 107(38), 16477 to 16482.

Buhaug, H., Benjaminsen, T. A., Sjaastad, E., & Theisen, O. M. (2014). Climate variability, food production shocks, and violent conflict in Sub-Saharan Africa. Environmental Research Letters, 10(12), 125015.

Burke, M., Hsiang, S. M., & Miguel, E. (2015). Climate and conflict. Annual Review of Economics, 7(1), 577 to 617.

Burns, J. J. (2017). *Preventing the World's Next Refugee Crisis: Famine, Conflict, and Climate Change in Nigeria, South Sudan, Somalia, and Yemen*. American Security Project. http://www.jstor.org/stable/resrep06035

Busby, J. W., Smith, T. G., White, K. L., & Strange, S. M. (2013). Climate change and insecurity: Mapping vulnerability in Africa. *International Security*, 37(4), 132–172. http://www.jstor.org-/stable/24480622

Carey, M. (2014). Science, models, and historians: Toward a critical climate history. *Environmental History*, 19(2), 354–364. http://www.jstor.-org/stable/24690569

Clark, J. (1992). Debacle in Somalia. Foreign Affairs, 72(1), 109–123. https://doi.org/10.2307-/20045500

Detges, A. (2017). Droughts, state citizen relations and support for political violence in Sub-Saharan Africa. Political Geography, 61, 88 to 98.

Eklow, K., & Krampe, F. (2019). Climate impacts on the United Nations Assistance Mission in Somalia. In Climate-related security risks and peacebuilding in Somalia (pp. 18–31). *Stockholm International Peace Research Institute*. http://www.jstor.org/stable/resrep20064.10

Fjelde, H., & von Uexkull, N. (2012). Climate triggers: Rainfall anomalies, vulnerability and communal conflict in Sub-Saharan Africa. Political Geography, 31(7), 444 to 453.

Golledge, R., Marsh, M., & Battersby, S. (2008). A Conceptual Framework for Facilitating Geospatial Thinking. *Annals of the Association of American Geographers*, *98*(2), 285–308. http://www.jstor.org/stable/25515122

Hagmann, T., & Hoehne, M. V. (2009). Failures of the state failure debate. Journal of International Development, 21(1), 42 to 57.

Hendrix, C. S., & Salehyan, I. (2012). Climate change, rainfall, and social conflict in Africa. *Journal of Peace Research*, 49(1), 35–50. http://www.jstor.org/stable/23141278

Hsiang, S. M., Burke, M., & Miguel, E. (2013). Quantifying the influence of climate on human conflict. Science, 341(6151), 1235367.

Jayawardhan, S. (2017). Vulnerability and climate change induced human displacement. *Consilience*, 17, 103–142. http://www.jstor.org/stable/26188784

Johnson, S. (2014). When good climates go bad: Pivot phases, extreme events, and the opportunities for climate history. *Environmental History*, 19(2), 329–337. http://www.jstor.org/stable/24690566

Kalmoy, A. D. (2019, August 5). The African Anthropocene: The making of a Western environmental crisis. *Politics Today*. https://politicstoday.org/the-african-anthropocene-the-making-of-a-western-environmental-crisis/

Kalmoy, A. D. (2025, June 12). Türkiye-Somalia partnership: A blueprint for development in Africa. *Daily Sabah*. https://www.dailysabah.com/opinion/op-ed/turkiye-somalia-partnership-a-blueprint-for-development-in-africa

Klarevas, L. J. (2000). Trends: The United States Peace Operation in Somalia. *The Public Opinion Quarterly*, *64*(4), 523–540. http://www.jstor.org/stable/3078741

Koubi, V., Schaffer, L., Spilker, G., & Böhmelt, T. (2019). The role of environmental perceptions in migration decision making. Global Environmental Change, 61, 102035.

Le Billon, P. (2015). *Environmental conflict*. In T. Perreault, G. Bridge, & J. McCarthy (Eds.), *The Routledge Handbook of Political Ecology*. Routledge.

Libiszewski, S. (1992). *What is an environmental conflict?* Center for Security Studies, ETH Zürich.

Malone, E. L. (2013). Climate change and national security. *Weather, Climate, and Society*, 5(1), 93–95. http://www.jstor.org/stable/24907507

Marangio, R. (2012). *The Somali Crisis: Failed State and International Interventions*. Istituto Affari Internazionali (IAI). http://www.jstor.org/stable/resrep09823

Marchal, R. (2007). Warlordism and Terrorism: How to Obscure an Already Confusing Crisis? The Case of Somalia. *International Affairs (Royal Institute of International Affairs 1944-)*, *83*(6), 1091–1106. http://www.jstor.org/stable/4541912

Martínez-Alier, J. (2002). *The environmentalism of the poor: A study of ecological conflicts and valuation*. Edward Elgar Publishing.

Maystadt, J. F., & Ecker, O. (2014). Extreme weather and civil war: Does drought fuel conflict in Somalia through livestock price shocks? American Journal of Agricultural Economics, 96(4), 1157 to 1182.

Menkhaus, K. (2014). State failure and ungoverned space. In Ending Wars, Consolidating Peace (pp. 171 to 188). Routledge.

O'Leary, R., & Bingham, L. B. (Eds.). (2004). *The promise and performance of environmental conflict resolution*. Resources for the Future Press.

O'Regan, D. (2018). *Civil Society and Civil War Onset: What is the Relationship?* Center for International & Security Studies, U. Maryland. http://www.jstor.org/stable/resrep20425

Oli, B., Anne, H., & Robert, M. (2007). Climate change as the "new" security threat: Implications for Africa. *International Affairs*, 83(6), 1141–1154. http://www.jstor.org/stable/4541915

Oyedotun, T. D. T., Hamer, E., Nedd, G. A., & Burningham, H. (2024). Advancing Coastal Monitoring: Integrating Spatiotemporal Analyses and Machine Algorithms in G-CAS. *Journal of Coastal Research*, *113*, 315–320. https://www.jstor.org/stable/48835670

Patman, R. G. (1997). The disintegration of the Somali state. In Securing Somalia: A comparison of US and Australian peacekeeping during the UNITAF operation (pp. 5–7). *Norwegian Institute for Defence Studies*. http://www.jstor.org/stable/resrep20303.5

Raleigh, C., Linke, A. M., Hegre, H., & Karlsen, J. (2010). *Introducing ACLED: An armed conflict location and event dataset*. *Journal of Peace Research, 47*(5), 651–660. https://doi.org/10.1177/0022343310378914

Samatar, A. I. (Ed.). (1994). *The Somali challenge: From catastrophe to renewal?* Rienner.

Schraeder, P. J. (1986). Involuntary Migration in Somalia: The Politics of Resettlement. *The Journal of Modern African Studies*, *24*(4), 641–662. http://www.jstor.org/stable/161243

Shultz, R. H. (1995). State Disintegration and Ethnic Conflict: A Framework for Analysis. *The Annals of the American Academy of Political and Social Science*, *541*, 75–88. http://www.jstor.org/stable/1048276

Thakur, R. (1994). From Peacekeeping to Peace Enforcement: The UN Operation in Somalia. *The Journal of Modern African Studies*, *32*(3), 387–410. http://www.jstor.org/stable/161981

Von Uexkull, N., Croicu, M., Fjelde, H., & Buhaug, H. (2016). Civil conflict sensitivity to growing-season drought. *Proceedings of the National Academy of Sciences of the United States of America*, *113*(44), 12391–12396. https://doi.org/10.1073/pnas.1607542113

von Uexkull, N., Croicu, M., Fjelde, H., & Buhaug, H. (2016). Civil conflict sensitivity to growing season drought. Proceedings of the National Academy of Sciences, 113(44), 12391 to 12396.

Von, S. C. (2020). A heated debate: Climate change and conflict in Africa. *German Institute of Global and Area Studies* (GIGA). http://www.jstor.org/stable/resrep24787