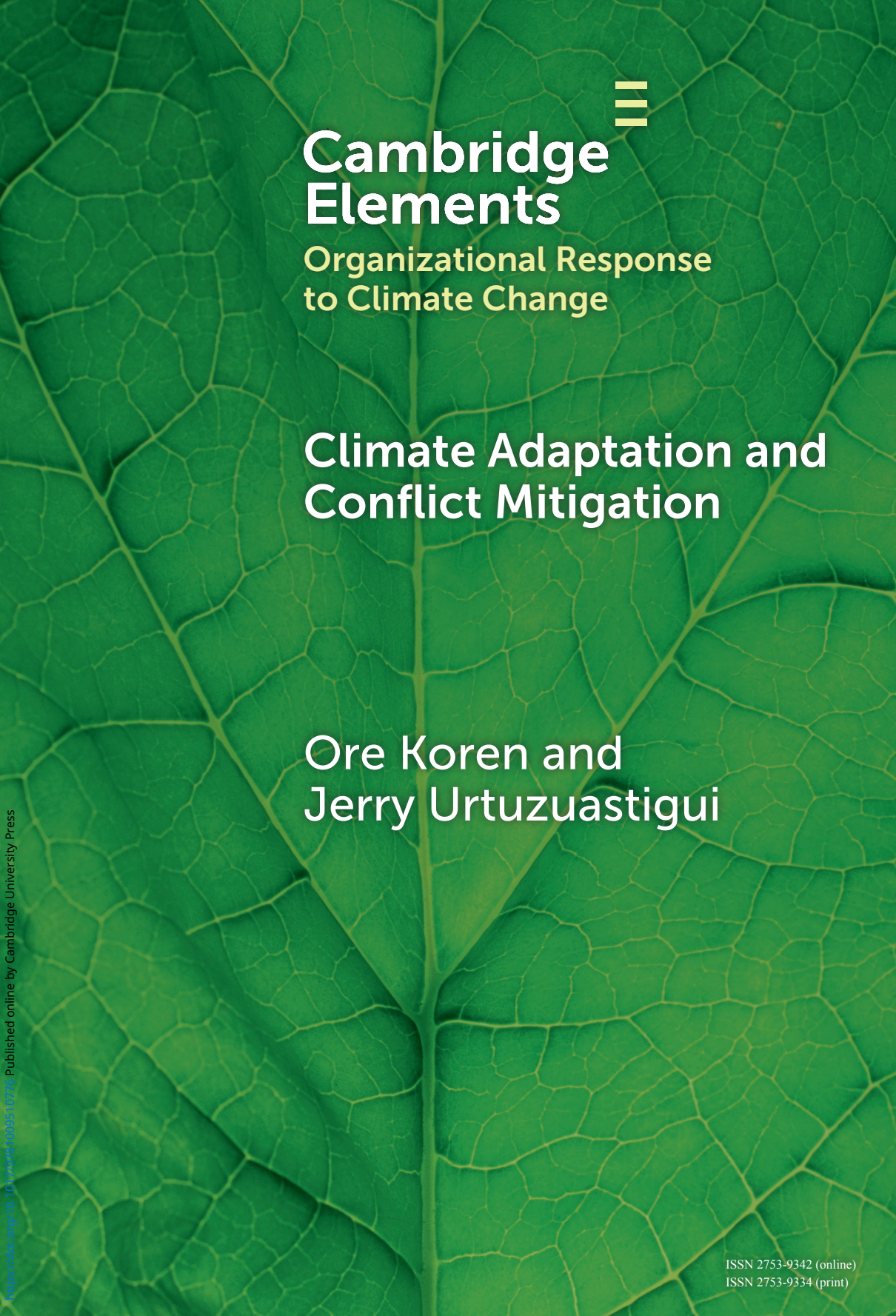

Cambridge Elements

Organizational Response to Climate Change

Climate Adaptation and Conflict Mitigation

Ore Koren and Jerry Urtuzuastigui

ISSN 2753-9342 (online)
ISSN 2753-9334 (print)

Cambridge Elements

Elements in Organizational Response to Climate Change

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CLIMATE ADAPTATION AND CONFLICT MITIGATION

The Case of South Sudan

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Shaftesbury Road, Cambridge CB2 8EA, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314–321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre,
New Delhi – 110025, India

103 Penang Road, #05–06/07, Visioncrest Commercial, Singapore 238467

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www.cambridge.org
Information on this title: www.cambridge.org/9781009510769

DOI: 10.1017/9781009510776

When citing this work, please include a reference to the DOI 10.1017/9781009510776

First published 2025

A catalogue record for this publication is available from the British Library

ISBN 978-1-009-51076-9 Hardback
ISBN 978-1-009-51073-8 Paperback
ISSN 2753-9342 (online)
ISSN 2753-9334 (print)

Additional resources for this publication at www.cambridge.org/ORCC_Koren

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Abstract: As climate change intensifies, conflict-prone tropical regions face heightened vulnerabilities, yet little is known about how climate adaptation and food security efforts affect conflict dynamics. Using South Sudan – a country highly susceptible to climate stress and conflict – as a test case, this Element analyzes how international nongovernmental organizations' (INGO) climate adaptation interventions influence civil war and local social conflicts. It develops a theoretical framework linking climate adaptation to conflict, positing both positive and negative externalities. Drawing on original high-resolution data on INGO-driven adaptation and food security efforts, alongside climate, conflict, and development data, findings are substantiated with interviews from policy workers in South Sudan. The results indicate that while adaptation generally does not reduce conflict, interventions that promote preparedness and are implemented during periods of high climate stress can mitigate social conflicts between militias, pastoralists, and farmers. These insights provide guidance for designing climate adaptation strategies that reduce conflict risks.

Keywords: climate adaptation, civil war, social conflict, food security, Nongovernmental organization

ISBNs: 9781009510769 (HB), 9781009510738 (PB), 9781009510776 (OC)
ISSNs: 2753-9342 (online), 2753-9334 (print)

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1 Introduction

1.1 Overview

With the growing unpredictable risks of climate change (IPCC 2018), climate adaptation policies and interventions by international organizations and non-governmental organizations (INGO) are poised to increase dramatically in the coming decades. Yet, our understanding of the impact of these activities in local settings within regional conflict zones is extremely limited, despite the fact that climate change's impacts are expected to be the greatest in conflict-afflicted countries around the tropics (Gilmore and Buhaug 2021; Schon et al. 2023). Therefore, a key question for researchers and policymakers is: How should climate adaptation response strategies be customized for local conditions in conflict settings?

This Element shows that climate adaptation and food security interventions, which we term CAFSI for short, often exacerbate rather than reduce conflict. We interpret these results to mean that CAFSI in most cases produce violent incentives for sourcing and rapacity. However, our analysis also shows that in specific contexts, climate adaptation and food security interventions can reduce social conflicts that arise between local militias, pastoralists, and farmers. Unlike civil war, an event involving formal state forces and antigovernment rebels that is the main focus of research on domestic war, social conflict arises in areas where state capacity and reach are often low. Its key distinction from civil war is in the types of actors involved – political and identity militias (including civil defense forces and paramilitaries), vigilantes, traditional self-help groups, and even mercenaries (see, e.g., Raleigh and Kishi 2020; Koren and Schon 2023) – as well as in covering a wider range of violent actions, including not only armed battles, but also cattle theft, community clashes, and attacks on civilians, among others.

Empirically focusing on South Sudan – a conflict-susceptible country that is also ranked among the top ten countries most vulnerable to climate change in Africa (e.g., Germanwatch 2019) – in this Element, we conduct the first (to our knowledge) subnational mixed methods assessment of the impact of conflict adaptation on armed conflict. We develop a theory that incorporates local-level climate adaptation by international nongovernment organizations (INGOs) and conflict dynamics, creating – to this end – a typology of relevant adaptation features and their expected impact on different types of conflict. Not that adaptation differs from *mitigation*, namely, "addressing the tragedy of the global commons … [primarily] … by assigning national level emissions targets, which countries are expected to translate into their domestic policies" (Dolšak and Prakash 2018, 318). By *adaptation*, our study "refers to policies,

proactive or reactive, that seek to reduce the biophysical, social, and economic vulnerability (or enhance resilience) of a given area, organization, population group, or individuals to climate change" (Dolšak and Prakash 2018, 319).

Whereas mitigation efforts – which emphasize, for example, reducing carbon emissions and employing carbon-capturing technologies – work primarily at the national and international levels (Greenhill et al. 2018), adaptation strategies are implemented locally, and are designed to provide communities and households with means to cope with the specific immediate effects of climate change, including food insecurity, systems instability, and resource depletion (Greenhill et al. 2018). Building on relevant research on the climate–conflict nexus (e.g., Hendrix and Salehyan 2012; Von Uexkull and Buhaug 2021; Ide et al. 2021; Schon et al. 2023), we adopt a broad definition of "climate adaptation," which covers not only attempts to improve general resilience to weather shocks, but also efforts to promote food security and facilitate environmental protection and resource sharing and management. Theoretically, we explicate the different relevant aspects of climate adaptation (broadly defined to also incorporate food security improvement efforts) to conflict reduction, discussing several testable pathways. Accordingly, in focusing on adaptation, we highlight the role of the *externalities* that such interventions can produce for war and peace. By "externalities," we refer to the unintended second-order impacts of adaptation not directly related to their immediate impacts on food security, and in our case, as these specifically relate to conflict mitigation. This contrasts with past research that considered the role of adaptation in a more general manner (e.g., Regan and Kim 2020).

We theorize that adaptation could potentially help in reducing conflict rates at the local level by helping to build resilience and smooth the impact of harsh weather. Moreover, in line with our evaluation philosophy, we also make sure to distinguish adaptation's impacts on civil war, often analyzed in climate–conflict studies (e.g., Burke et al. 2009; Buhaug 2010; Regan and Kim 2020), from social conflicts between a variety of actors less traditionally studied in civil war research, which more recently suggests are especially likely to be affected by climate stress (e.g., Van Weezel 2015, 2019; Koren and Schon 2023). Building on our theoretical and typological framework, we then identify specific features of adaptation projects that we expect to have a positive impact on conflict prevention, differentiating these expectations across civil war events involving government and rebel forces, and social conflict events involving political militias, civil defense forces, vigilantes, and other identity militias (see, e.g., Raleigh and Kishi 2020; Koren and Schon 2023). In these regards, we hypothesize that there are three climate and food security adaptation-related mechanisms that could shape conflict prevention.

The first is by emphasizing *general preparedness*, which can help these interventions address (even if imperfectly) multiple potential climate stressors, for example, by planting more climate and pest resistant crops or establishing general local governance arrangements, as opposed to implementing specialized preparedness designed to address only one specific issue (see, e.g., Ide 2023). For example, one INGO (Caritas Switzerland) educated inhabitants of Torit and trained locals to harness unexpected torrential rain by regularly "planting climate-resistant crops, using efficient irrigation systems and applying environment-friendly soil treatment techniques" (Caritas Switzerland 2021, 4–5). These efforts were supplemented by developing sophisticated drip irrigation that utilized mountains and rock formations to harvest rainwater during unexpected heavy rainfalls. Together, these interventions facilitated both higher crop productivity and healthier livestock, increasing incomes across different communities with different lifestyles.

We argue that considering climate change's unpredictable and often counterintuitive effects, increasing general – even if imperfect – preparedness to a host of potential adverse impacts rather than focusing on one specific outcome is more likely to increase resilience to its impacts, improving capacity, which can translate into reducing intercommunal conflicts.

The second mechanism is whether interventions that implement *community building* initiatives can help to reduce conflict. This argument builds on research that suggests that by creating a common challenge, weather shocks and natural diseases can lead to positive peace outcomes (Ide et al. 2021; Sharifi et al. 2021; Ide 2023; Simangan et al. 2023). Correspondingly, we suggest that adaptation interventions that mobilize the community or emphasize community-building arrangements can have externalities that lower the risk of localized conflict. For example, an intervention spearheaded by the World Food Programme (WFP), designed and carried out by local actors and the Adventist Development and Relief Agency (ADRA) in Tonj South in 2018, incorporated several measures to both provide general adaptation and reduce tensions among farmers and between farmers and pastoralists within the Malual Mok and Thony communities. The intervention diversified, expanded, and increased the productivity of agricultural harvests, but it also created protection and standardized access to water for both farmers and cattle herders (Awad 2022). According to one member of the Malual Mok community, before this intervention, the two communities "'used to fight one another, raid cattle, loot crops and belongings . . . But since we began farming and producing, we stopped fighting. Our fight is now against hunger and poverty, not each other" (Awad 2022).

The final mechanism we explore is whether CAFSI are more effective during harsh climate times, distinguishing their general effects from their more

immediate impacts on conflict during times of high climate stress. In these regards – building on research that links more immediate climate shocks, including droughts, floods, and heatwaves – to conflict (e.g., Burke et al. 2009; Hendrix and Salehyan 2012; Maystadt and Ecker 2014; Ide and Kristensen 2021; Sarbahi and Koren 2022), we posit that INGO climate interventions should have a stronger effect on reducing civil war and social conflict during times of high climate stress compared with regular stress periods. The reason is straightforward: if INGO interventions are designed to mitigate the effect of climate stress, then their impact will be felt strongly in high-stress times, which can translate into reducing conflict incentives.

For example, evidence indicates that OCHA-funded dikes built in Bentiu were overwhelmingly successful in mitigating the catastrophic effects of South Sudan's 2022 floods: "[a]head of the floods, partners used the funds to construct and reinforce over 55 kilometers of dikes to protect vital access to roads, homes and the airstrip. These dikes would prove to be critical, preventing 100,000 people from having to be evacuated and further displaced . . . [while] protection of the airstrip allowed humanitarian operations to continue throughout the rainy season (Katch 2024). Building on the logic developed earlier and such evidence, we additionally expect that any mitigating effect of CAFSI on social conflict should be especially noticeable, again, with interventions that emphasize general preparedness and community building, where the relevant dynamics related to pacification should be the most acute (see, e.g., Ide et al. 2021; Sharifi et al. 2021).

Having derived several expectations based on our theoretical and typological frameworks, we then test them empirically using original high-resolution geographic data on INGO interventions and social conflict. The INGO data cover all climate adaptation and food security interventions and projects that started or were ongoing in South Sudan between Jan. 2012 and Dec. 2020 and are measured at the 0.5-degree grid cell (a square grid where the cells are about 55 km × 55 km at the equator) as was done in past climate–conflict nexus studies (e.g., Schon et al. 2023; Koren and Schon 2023). We control for the effect of interventions specifically designed for conflict prevention and peacebuilding (hereon, CPP), as well as socioeconomic and climate confounders, all measured at the same level of resolution. Any relationships are assessed both using standard linear regression techniques, recommended by extant econometric research (e.g., Angrist and Pischke 2009), and specialized models specifically designed to address potential simultaneous relationships and serial correlations (Blundell and Bond 1998).

As mentioned earlier, we generally find that CAFSI projects do not reduce civil war and social conflict incidence. However, we also find that CAFSI that include general preparedness can reduce social conflict rates. We discuss these

findings, potential explanations, and their research and policy implications in detail in Section 5. Briefly, we believe that the lack of a positive impact on reducing civil war is due to the fact that civil war is more sensitive to national-level political divisions and elite dynamics that unfold in the capital. As one of the policy experts interviewed explains, "South Sudan is a complex crisis country, conflict is one of the crises, both from a political angle because there is a transitional non-elected government, and security is a big issue."[1] Or as another summarized it, "you cannot just ask for a local solution and detach national politics from the local issues."[2]

For social conflicts, while they involve community-based groups and informal organizations that are more dependent on local conditions and resources, and whose behaviors may be more sensitive to shocks to these local features (Ide et al. 2021; Koren and Schon 2023), it also seems that in most cases, adaptation does not address the key issues that could lead to violence. However, CAFSI that ensure to address general preparedness are presumably more effective in reducing aspects of climate stress that could potentially lead to fighting across these groups. For CAFSI that emphasize community building measures, while we do not find that their effect on social conflict in our models is statistically significant according to any meaningful threshold, it is negative, suggesting that that such measures may also help in reducing social conflict, although more research is needed to verify whether this is indeed a meaningful relationship.

Disaggregating the impact of CAFSI across regular stress and high climate stress periods adds nuance to these results. Moving on to the final stage of our quantitative analysis, we find that all CAFSI as well as only CAFSI with general preparedness and community building emphases are all significantly associated with a reduction in social conflict rates during times of high stress, while the effect of the latter two is much weaker during regular stress months (and even positive in the case CAFSI in general). We also find that of the three CAFSI types we examine, CAFSI with community building measures have the greatest impact on reducing social conflict during high climate stress periods, which is in line with the findings reported in research studies (e.g., Ide et al. 2021; Sharifi et al. 2021). We hence believe that the results show that CAFSI measures that address a wider range of possible climate shock impacts can improve stability by reducing this sensitivity, which can – considering adaptation's success depends, in large part, on stable socioeconomic conditions, including low conflict incidence – improve long-term climate adaptation outcomes as well.

[1] Interview 2 (an INGO program manager), Bloomington IN (remote), October 27, 2023.
[2] Interview 3 (an ethnographer who has worked for multiple INGOs), Bloomington IN (remote), November 16, 2023.

1.2 Motivation

Studies into the causes of internal conflict highlighted a variety of drivers and inputs. Key explanations as to why civil war starts and spreads often emphasize features such as variations in state capacity (e.g., Hendrix 2010; Koren and Sarbahi 2018), "greed" and natural resources (e.g., Collier and Hoeffler 2004; Ross 2004), political grievances (e.g., Cederman et al. 2013), geographic features (e.g., Lujala et al. 2005), relative state and rebel capacities (e.g., Cunningham et al. 2009), the supply and demand of politics (e.g., Kalyvas 2003; Uzonyi and Koren 2024), among others.

The climate–conflict nexus emerged from these broader bodies of research, emphasizing a variety of possible conflict drivers, including not only features that are sensitive to climate change, but also primary commodities and natural resources (especially agricultural ones), grievances resulting from declining resources and politicized state responses, and state and rebel capacities (von Uexkull and Buhaug 2021). This is in line with some of Findley's (2018) conclusions on whether foreign aid fosters peace, which finds that while aid can promote stability by addressing economic grievances and strengthening institutions, it may also exacerbate tensions if misallocated or perceived as biased. There is support for this notion in South Sudan. For instance, the lack of broad community involvement in interventions in Maban and the Greater Upper Nile region more generally enmeshed aid workers "in violent struggles between armed groups over access to vital relief supplies," because INGO workers' "role as supporters of large networks of extended family can make them targets of so-called 'revenge killings' – a retaliatory form of violence typically carried out along community lines" (Ettelbrick 2024).

Because these different approaches each suggest different – sometimes even potentially opposing – mechanisms, researchers were engaged in a heated debate until relatively recently. Some argued that by harming agricultural productivity and fueling resentment and grievances, climate change will increase conflict risk (e.g., Burke et al. 2009; Maystadt and Ecker 2014; Kelley et al. 2015; Crost et al. 2018; Eastin and Zech 2023). Others argue that climate change is, at best, a weak predictor of conflict, and that political and socioeconomic factors are far more important determinants (e.g., Buhaug 2010; Theisen et al. 2013; O'Loughlin et al. 2012; Van Weezel 2020). Yet others find that rather than resource scarcity, and in line with greed-based approaches, conflict is more often driven by resource abundance, as fighting and violence follow rapacity-based incentives (e.g., Hendrix and Salehyan 2012; Koren and Bagozzi 2017; Koren 2018; Linke and Ruether 2021).

While most research focuses on civil war, other researchers sought to understand how shifting climate might impact social conflict and communal violence,

which we define in Section 2 as violence involving political and ethnic militias, local defense forces, pastoralists and agriculturalists, vigilantes, mercenaries, and independently acting communities. Considering that within the most climate change susceptible regions, such actors are often the most dependent on locally sourced resources and hence the most vulnerable to weather shocks, the expectation is that social conflicts are more likely to be driven by climate change and its potential effects (e.g., Adano et al. 2012; Fjelde and Von Uexkull 2012; Döring 2020; Detges 2014; Scheffran, Ide, and Schilling 2014; Scheffran et al. 2012; Caruso et al. 2016; Petrova 2022; Theisen 2012; Van Weezel 2019; Koren and Schon 2023).

By focusing on adaptation and conflict, this Element investigates a social response to climate change and its second-order effects on conflict, rather than the direct impact of a weather variability and climate shocks, including the way policies are implemented and monitored, in addition to the second-order effects of adaptation on complex conflict risks (Buhaug et al. 2023; Gilmore and Buhaug 2021). Indeed, despite the research progress made on different aspects of the climate–conflict nexus, two key gaps remain.

First, extant studies rarely link climate change to conflict impacts, relying instead on weather shocks as proxies, and then assuming that long-term trends should reflect these contemporaneous impacts (a statement often observed in such studies is something along the lines of "if climate trends hold true, then . . . "). Considering that climate is usually defined as long-term weather trends, and climate change as variations away from these trends (IPCC 2022), researchers must do a more effective job at identifying more effective proxies of climate change and its potential impacts, or else risk problematic inferences. For instance, within the context of South Sudan, until about 2016 or so, literature on these relationships emphasized the impact of droughts, but over the last half a decade or so, flooding – related both to rainfall and to potentially other causes – has become a much bigger problem in many regions, with many areas experiencing greening (Zeng et al. 2023).

A second issue relates to the fact that research on the climate–conflict nexus focuses almost exclusively on impacts of climatic events (e.g., droughts) on conflict or peacebuilding (e.g., Ide et al. 2021; Schon et al. 2023), meaning scholars paid little attention to the second-order effects (or, as we refer to them earlier, "externalities") of climate adaptation strategies. Where researchers do consider climate strategies, they identify the need for more targeted research into their impacts on violence. Gilmore and Buhaug outline this research agenda, emphasizing that "[c]oupling research with careful monitoring and evaluation of the intermediate societal effects at early stages of policy implementation will be a critical part of learning and moderating potential conflict

risks" (2021, 1). Similarly, Buhaug et al. (2023, 10) outline three scenarios for how climate change and mitigation will affect conflict risk, underscoring that "scholars should invest more in understanding the second- and third-order effects of climate change for security outcomes that arise from adaptation and mitigation efforts, as well as ways to manage such complex risks." Yet, while past research attempted to empirically evaluate broader linkages between adaptive capacities, climate change, and civil war (Regan and Kim 2020), no study assessed specifically and systematically how climate strategies shape conflict trends at the *local* (village or district) level, which is crucial considering climate stressors often operate locally (e.g., Thiesen et al. 2013).

In these regards, this Element helps to overcome both limitations, allowing for more effective policymaking by directly addressing these research deficiencies, shedding new light on climate change's second-order effects on conflict within a highly susceptible world region while using proxies that better capture one aspect of climate change (as opposed to weather shocks) and its potential impacts in the future. The local (rather than country-)-level analysis provides a more nuanced assessment of climate adaptation–conflict relationships and specific targeted INGO policy interventions. Accordingly, INGOs are key actors in this assessment. Comparing the impact of CAFSI and CPP programs and how different aspects of these CAFSI projects shape externalities with respect to conflict will inform practitioners' understanding of the exact impacts of outcome-driven approaches to climate adaptation, localizing and maximizing their impacts in ways that not only facilitate achieving their intended aims, but also help reduce conflict risk.

Evaluating how different intervention features shape civil war and social conflict, two types of conflicts that are prevalent not only in South Sudan but in many other countries that are most susceptible to climate change and its impacts, will create new ways to design and implement more effective CAFSI projects, especially considering that reducing conflict enables economic development, which can indirectly assist with improving preparedness to climate stress over the long term.

1.3 Case Selection: Why South Sudan?

1.3.1 Case Selection Rationale

Our case selection relies on Seawright and Gerring's (2008, 301) "extreme" case selection approach, whereby the analysis focuses on "an observation that lies far away from the mean of a given distribution; that is to say, it is *unusual*." For this study, we are interested in (1) micro-analyzing a country that meets our scope conditions, namely that it incorporates variability in CAFSI and CPP

interventions across multiple geographic locations over time, and which (2) can be seen as a harbinger of the future cases that exhibit relationships along both climate and conflict adaptation, while at the same time (3) holding key confounders constant to help verify the stipulated mechanisms are responsible for observed variations in conflict.

South Sudan provides a compelling case study for examining the intertwined dynamics of protracted conflicts and climate stress, highlighting significant gaps in understanding how these factors interact in fragile states. The country's history of conflict, including the pre-2011 civil war and persistent disputes following independence, underscores the entrenched challenges in building sustainable peace. Violence often spills across borders, complicating regional stability and necessitating international interventions.

The origins of conflict in South Sudan are deeply rooted in its colonial and post-colonial history, as well as its complex ethnic, political, and economic landscapes. During the colonial period, British authorities pursued policies that marginalized the southern region, exacerbating ethnic and regional divisions. After Sudan's independence in 1956, these divisions deepened, leading to the First Sudanese Civil War (1955–1972) and the Second Sudanese Civil War (1983–2005). Both conflicts were driven by disputes over political representation, resource allocation, and cultural identity between the predominantly Arab and Muslim north and the diverse, largely Christian and animist south. The signing of the Comprehensive Peace Agreement (CPA) in 2005 marked the end of the second war and paved the way for South Sudan's independence in 2011. However, unresolved issues, including border disputes, resource sharing, and governance structures, persisted, undermining the prospects for lasting peace (Rolandsen 2015).

The optimism surrounding South Sudan's independence was short-lived. In December 2013, political tensions within the ruling Sudan People's Liberation Movement (SPLM) escalated into a full-scale civil war between forces loyal to President Salva Kiir and those aligned with former Vice President Riek Machar. The conflict took on ethnic dimensions, primarily pitting the Dinka and Nuer communities against each other, although alliances have often shifted based on political and economic interests. The war has been marked by widespread atrocities, including mass killings, sexual violence, and the recruitment of child soldiers. Efforts to mediate the conflict, such as the 2018 Revitalized Agreement on the Resolution of the Conflict in South Sudan (R-ARCSS), have yielded only fragile and inconsistent ceasefires, with key provisions for governance reform and security arrangements remaining largely unimplemented (Pinaud 2022).

Social conflicts (which we conceptually and empirically define in the ensuing sections) in South Sudan often manifest as localized disputes over land, water,

and cattle, which are central to livelihoods in the predominantly agro-pastoral economy. These conflicts frequently escalate into violent clashes, exacerbated by weak state institutions and the proliferation of small arms. Seasonal migration patterns, particularly during droughts and floods, bring different communities into competition over scarce resources, intensifying tensions. For example, disputes over grazing lands and water sources between pastoralist groups like the Dinka, Nuer, and Murle have led to recurring cycles of violence, cattle raiding, and retaliatory attacks. These localized conflicts are not isolated but interwoven with broader dynamics of political instability and economic collapse, further complicating their resolution (Schomerus and de Vries 2014).

Efforts to address social conflict in South Sudan have often been undermined by the top-down approaches of international actors, which prioritize political power-sharing among elites while neglecting grassroots dynamics. A policy ethnography expert interviewed as part of this analysis critiques the United Nations' approach to peacekeeping in South Sudan, highlighting a lack of cultural understanding and analytical depth: "[d]ecision-making at the UN level is seriously lacking [in] understanding [of] South Sudan, how they [UN policymakers] operate, how they understand local cultures, conflict, analytical capacities. They have a militarized understanding of a landscape because it's a peacekeeping mission. I think there are more useful ways to understand South Sudan, at least based on a combination of things."[3] Critical peacebuilding scholars similarly argue that by prioritizing short-term security objectives over long-term structural transformation, the UN's understanding of a landscape may hinder efforts to address the underlying drivers of conflict (Autesserre 2014).

Community-level peacebuilding initiatives, such as inter-communal dialogues and traditional conflict resolution mechanisms, have shown promise but remain underfunded and poorly integrated into national strategies. Moreover, there is no clear evidence as to whether such mechanisms do better than formal initiatives in promoting conflict prevention (Mustasilta 2019, 2021). The lack of access to education, healthcare, and economic opportunities further fuels grievances, particularly among youth, who are often drawn into cycles of violence as both perpetrators and victims. Gender-based violence, exacerbated by traditional patriarchal norms and the stresses of prolonged conflict, also represents a pervasive social challenge.

For illustration, Figure 1 reports a map of the total number of civil war (a) and social conflict (b) events in South Sudan between January 2012 and December 2020 (more detail on the creation of these variables is provided in Section 4). From this map, it can be clearly seen that South Sudan is still a

[3] Interview 3.

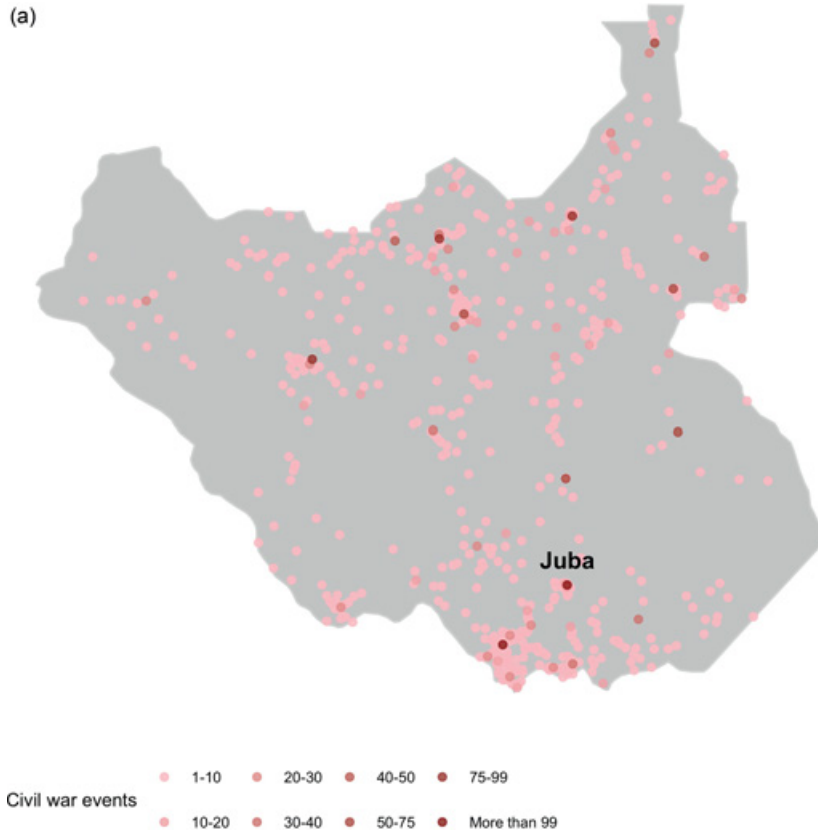

Figure 1 Civil war (a) and social conflict (b) frequencies by location in South Sudan, totals for January 2012–December 2020 (the location of capital is designated by "Juba")

conflict-afflicted country, but also that there is sufficiently high variation in terms of spread and intensity, which provides room for exploration on the causes of violence.

Presumably, many of these conflicts are compounded by the country's vulnerability to climate change. According to Germanwatch (2021), South Sudan ranks among the ten most climate-vulnerable nations in Africa, with local climate impacts such as droughts and flooding posing additional risks to already fragile livelihoods and economic systems. Some studies on climate–conflict linkages frequently point to resource competition as a critical driver. In South Sudan, policy reports suggest that disputes over access to grazing lands and water, as well as the destruction of crops by livestock, have been identified as triggers for local-level violence (CSRF 2024). This aligns with some broader

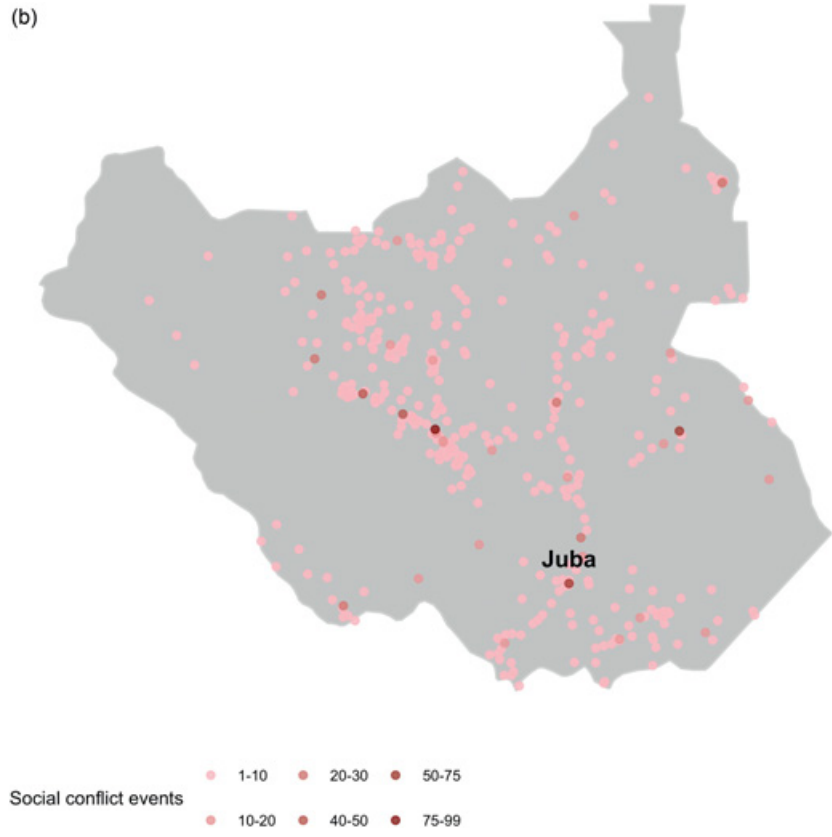

Figure 1 (cont.)

claims in the climate-security literature, which suggest that environmental degradation exacerbates existing sociopolitical tensions, particularly in regions with weak governance and limited adaptive capacities (Rüttinger et al. 2020). However, this framing often overlooks the heterogeneity of climate impacts, which studies suggest are far more affected by adaptive capacity, development, and poverty/income levels (e.g., Buhaug 2010; Koren and Schon 2023). For instance, while some areas in South Sudan experience recurring violence tied to climate stress, others remain relatively peaceful despite facing similar environmental pressures. This phenomenon challenges simplistic narratives and calls for more nuanced explanations of climate–conflict dynamics.

In addition to exhibiting variability in both civil war and social conflict (the dependent variables) and CAFSI and conflict prevention and peacebuilding interventions (the key explanatory variables), the South Sudan case offers constancy with other states in the region across key confounders, including

political structures and openness, GDP, health, and military expenditures. Considering the number of local level indicators included in and added to AfroGrid (Schon and Koren 2022), which we use as our framework for empirical analysis (see Section 4), we are able to control for a host of alternative local-level explanations that vary over space and time, including local population densities, internal displacement, and climate stressors.

1.3.2 The Climate Adaptation INGOs in South Sudan

With respect to our key independent variable (climate adaptation and food security), note that the intersection of climate adaptation and food security in South Sudan is a critical focus area for INGOs, given the country's extreme vulnerability to climate change and chronic food insecurity. The nation's dependence on subsistence farming and pastoralism leaves rural populations especially susceptible to climate-induced shocks. INGOs were instrumental in addressing these challenges, though their interventions often face significant structural and operational hurdles (OCHA 2022).

A diverse group of INGOs is actively engaged in climate adaptation initiatives in South Sudan, reflecting a variety of operational approaches, geographical origins, and institutional perspectives. These INGOs originate from a mix of Western donor countries, emerging economies, and global coalitions, each bringing distinct priorities and methodologies to their work.

The INGOs operating in South Sudan can be broadly divided into three categories: (1) global humanitarian organizations (e.g., Oxfam, MerciCorps), (2) development-focused agencies (e.g., USAID, GYZ), and (3) smaller specialized groups (VSM). These INGOs are supported by networks of smaller partners with niche expertise in climate resilience, food security, and water management. For instance, Danish Refugee Council (DRC) and Norwegian Refugee Council (NRC) focus on integrated programming that combines adaptation with displacement support, while ACTED and Tearfund specialize in localized, community-driven approaches to building resilience.

Most INGOs working in South Sudan originate from Western countries, with a significant number based in the United States, the United Kingdom, and European nations such as France, Germany, and the Nordic countries. For example, CARE International and Action Against Hunger have strong European roots, while World Vision and the IRC are headquartered in the United States. Some regional INGOs from Africa and the Middle East also operate in South Sudan and are involved with adaptation projects. Organizations such as Africa Development Solutions (ADESO) and Islamic Relief often collaborate with local NGOs and community-based organizations to enhance the cultural relevance and sustainability of their interventions.

The perspectives of INGOs on climate adaptation in South Sudan are shaped by their institutional missions, donor priorities, and operational contexts. Some humanitarian INGOs (e.g., IRC, Oxfam) prioritize immediate responses to climate-induced crises, including flood relief, water access, and emergency food distribution. Their perspective is often shaped by the need to stabilize vulnerable populations and prevent further displacement or conflict. Development-oriented INGOs, such as CARE International and World Vision, emphasize long-term climate resilience, focusing on sustainable livelihoods, agricultural adaptation, and water resource management. Their perspective aligns with a development-as-adaptation approach, aiming to address the structural vulnerabilities exacerbated by climate change. These organizations often follow top-down priorities, which often include protecting previous modes of livelihood (e.g., pastoralism) and promoting climate-neutrality.

Smaller INGOs and regional actors bring a more localized and often community-driven perspective to their work. Some of these organizations prioritize participatory adaptation strategies that incorporate indigenous knowledge and address the social dynamics of resource use, including gender equity and conflict resolution. For instance, organizations like ACTED emphasize empowering local communities to lead their adaptation processes, viewing climate resilience as a pathway to greater self-reliance and peacebuilding.

In terms of climate adaptation, INGOs have prioritized initiatives aimed at increasing community resilience to extreme weather events. Programs focusing on sustainable agricultural practices, such as climate-resilient crops, agroforestry, and soil conservation techniques, have shown promise. For instance, organizations like World Vision and CARE International have introduced drought-tolerant crop varieties and promoted water harvesting techniques to improve agricultural sustainability in arid regions. Additionally, projects emphasizing capacity-building, such as training farmers in climate-smart agricultural practices, aim to enhance long-term adaptive capacities (USAID 2021).

Food security interventions by INGOs have largely centered on emergency food aid and livelihood support, reflecting the acute and recurrent nature of food crises in South Sudan. The World Food Programme (WFP), alongside INGOs such as Save the Children and Action Against Hunger, has been instrumental in providing food distributions to vulnerable populations during times of crisis. Simultaneously, many INGOs have sought to transition from short-term aid to sustainable solutions by supporting income-generating activities, livestock restocking programs, and the establishment of farmer cooperatives. Despite these efforts, food security remains precarious, with millions of people facing acute food insecurity as of 2024 (IPC 2024). This ongoing crisis illustrates the importance of stronger integration of food security and climate adaptation

strategies to address both immediate needs and systemic vulnerabilities regardless of their conflict impacts.

As is the case with conflict prevention interventions, a key challenge for INGOs operating in South Sudan is the lack of coordination among stakeholders and the limited inclusion of local knowledge in program design. Critics argue that many interventions adopt a one-size-fits-all approach, failing to account for the sociocultural and ecological diversity of South Sudan's regions. Community engagement in program development has been inconsistent, leading to mismatches between intervention strategies and local needs. Furthermore, the militarized and insecure operating environment restricts the mobility of INGOs, undermining their capacity to implement comprehensive and equitable programs. These challenges underscore the importance of fostering collaborative frameworks that integrate local voices, regional expertise, and adaptive learning processes to enhance the effectiveness of climate adaptation and food security initiatives (MacGinty and Firchow 2016).

Again, for illustration, Figure 2 reports a map of CAFSI in 150 locations in South Sudan in January 2012–December 2020 period (the guidelines and procedures used for coding these data are discussed in detail in Section 4). Note the great variability over space and intervention type, which – again – we can exploit to understanding the relationship between adaptation and conflict in the country.

1.4 Objectives

As mentioned earlier, several past studies have considered the effect of adaptation and mitigation. These studies, however, focused more on the conceptual and theoretical aspects of adaptation's effects (e.g., Gilmore and Buhaug 2021; Buhaug et al. 2023). Other studies use country-level adaptative capacity measures (Regan and Kim 2020), which past research suggests are less than effective in capturing the local impacts on conflict (e.g., Theisen et al. 2013). To this end, this Element seeks to achieve four key objectives that improve on past work.

First, it develops a comprehensive typology that not only helps in answering our key question, but also provides tools for researchers and policymakers to more specifically conceptualize and operationalize the relationships between climate adaptation and conflict. To this end, Section 2 creates a typology of relevant conflict and CAFSI-related features that can correlate and explains how some of these CAFSI features might reduce conflict risk, differentiating across civil war and social conflict. For evaluating the viability of this typology, we develop a comprehensive theoretical framework that leverages a wide range of relevant research, then derive research hypotheses and test them empirically.

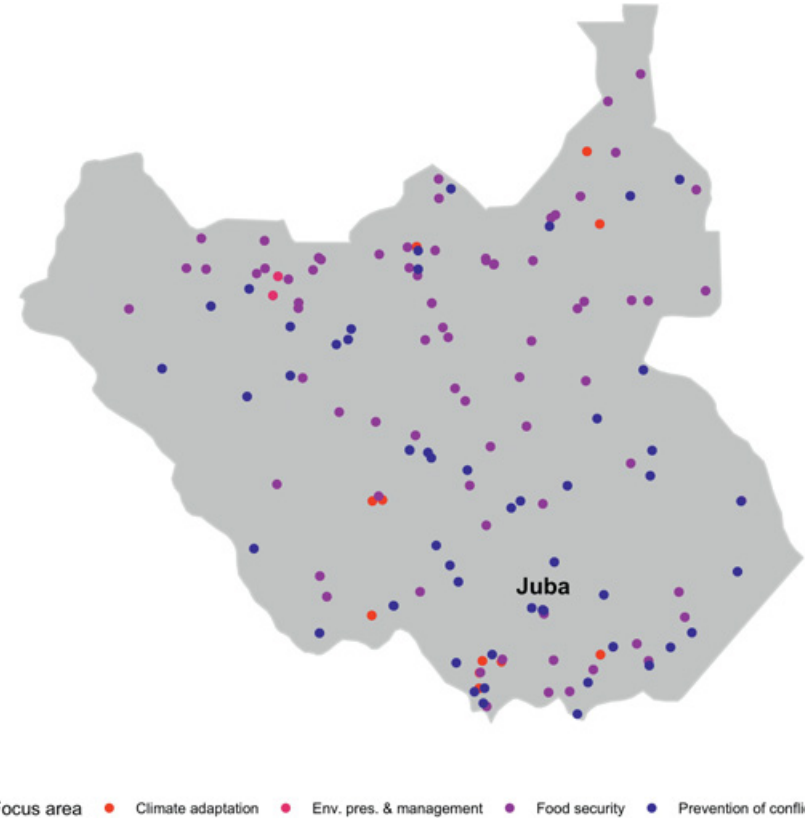

Figure 2 A location map of all INGO CAFSI and CPP projects (by general category) in South Sudan, January 2012–December 2020 (the location of capital is designated by "Juba")

Second, we conduct the first (to our knowledge) local level, monthly comparative quantitative analysis of CAFSI and CPP's impact on civil war and social conflict in a politically volatile region. In these regards, a key contribution of this Element is in providing openly available, geographically stamped, longitudinal data on such interventions and their specific features in South Sudan. Additionally, our theoretical development draws on interviews and evidence from secondary sources to ensure the mechanisms and hypotheses are context driven. Using this approach, we aim to provide a clear and accurate interpretation of the impact of CAFSI on armed conflict that will assist in propelling forward new agendas on the linkages between climate adaptation and conflict and the climate–conflict nexus research more broadly.

Third, in addition to discussing the research implications of these findings, we build on our results to provide actionable recommendations to policymakers.

As part of Section 5, we create a concise policy "toolkit," with recommendations that cover a range of customized climate change responses for various settings and in response to specific stressors, taking into account how climate change and its impacts might vary unexpectedly in future years. We specifically highlight how INGOs that seek to maximize and diversify their positive impact on both climate adaptation and conflict will fare compared with INGOs that follow a normative "top-down" approach. This knowledge is greatly useful for international and regional actors seeking to better understand and respond to intersections of climate change and conflict across multiple affected countries.

Finally, the complexity of the relationship among climate change, climate adaptation, and conflict has engendered vast and distinct bodies of literature covering a variety of aspects, issues, and approaches. Often, relevant research remains segmented, with many studies speaking primary to others that share the same empirical, theoretical, or ontological view. In these regards, our fourth objective is to synthesize as much of these bodies of literature as possible within the span of this Element, providing a common ground to facilitate research, analysis, and policymaking. We hope that combining this synthesis with a practical and an empirical focus that leverages our new data and typologies will open doors for future collaborations and new ways of thinking about these complex relationships as we move deeper into the twenty-first century.

1.5 Roadmap

This Element is organized as follows. Section 2 develops a relevant typology of INGO projects in South Sudan. This section incorporates explanations of climate adaptation, perspectives on how to define it, as well as different aspects of INGOs that can determine the type of project implemented and its relevant aspects. As part of this typology, we also discuss two types of conflict (civil war and social conflict) relevant in the context of South Sudan and other countries that lie in the climate–conflict nexus.

Having derived a conceptual typology, in Section 3 we turn to develop a comprehensive set of theoretical explanations linking climate adaptation to the two types of conflict. In this section, we highlight the different pathways linking adaptation and food security improvements with conflict variability, leveraging multiple bodies of research and vast research literature in support of each contention. We discuss three pathways that past research uses to link conflict and climate stressors, with adaptation working: (1) to lower the role of stressors as threat multipliers, intensifying grievances against the regime and other groups; (2) to reduce the role of stressors in reducing opportunity costs for violence, increasing the ability of individuals to act on their grievances;

and (3) to increase the value of agricultural resources in primary agricultural economics, shaping actor incentives to engage in violence for resource appropriation. We also identify potential corollaries to the relationships hypothesized. Finally, we explain how the adaptation–conflict relationships are likely context dependent and vary across times of normal and high climate stress.

Moving to our quantitative analysis, Section 4 then empirically tests our hypotheses using original data and geospatially disaggregated empirical framework. Here, we begin by describing our unit of analysis and how we operationalize our dependent variables. We then explain how we collected and coded our adaptation and food security intervention data, as well as our choice of controls. We also discuss the methods used to identify the relationships of interest. Our results are obtained in three stages of analysis: (1) linear ordinary least squares models, (2) linear system generalized method of moments models; and (3) moderated ordinary least squares models. We discuss the results from each analysis stage and interpret them substantively.

Having completed our empirical assessments, we then discuss our findings' implications systematically and meticulously in Section 5. We begin by discussing the implications of our findings for research on civil war and the link between civil war and climate change, highlighting how our results might contradict some of the trends expected by research in these regards. We then discuss the implications for research on social conflict and how it is impacted by a varying climate and other related stressors. The second part of the section then derives policy lessons based on our findings. We discuss four relevant issues: (1) the importance of considering more than one outcome (e.g., adapting to climate and mitigating conflict); (2) the role of general preparedness and community building in CAFSI to achieve the strongest implications with respect to conflict mitigation; (3) explaining why optimizing adaption to handle the most extreme climate stress scenarios might be especially beneficial for conflict prevention; and (4) emphasizing that, at least at this time, any solutions to conflict – especially civil war – should ultimately focus on improving socioeconomic and political resilience rather than emphasizing climate change. Finally, in Section 6, we discuss how these lessons might be applied to other countries.

2 Typology and Definitions

The intersection of climate stress and conflict is an example of a "complex crisis."[4] Therefore, examining if and how climate adaptation intersects with

[4] Interview 2.

conflict first requires defining exactly what we mean by climate adaptation as well as identifying some of the relevant features of adaptive interventions. Moreover, it requires us to identify specific pathways that can link adaptation interventions to pacification. This, in turn, requires us to also identify and explain exactly what kinds of conflict are relevant in the context of climate and climate adaptation.

In this section, we develop these theoretical definitions, creating a typology of climate adaptation and food security interventions that highlights relevant aspects, such as donor type and focus area as well as features that translate these interventions into conflict. We also derive the definitions of relevant conflict in South Sudan as it pertains to climate shocks and climate adaptation as well as their impacts across other susceptible countries.

2.1 Climate Change–Related Terminology

The IPCC's definition of "climate" refers to weather trends measured over thirty years or more, with "climate change" being defined as how these long-term weather patterns diverge from earlier periods (IPCC 2022). Considering our reliance (like many other studies) on shorter time periods, we often refer to weather-related shocks. However, considering our focus on weather adaptation, we also often refer to "climate stressors" when discussing their potential impact on conflict. For clarity, we provide several definitions of the terms we use throughout this Element:

- **Climate change:** Per the IPCC (2022), climate change refers to long-term (over a period of thirty years or more) changes in weather patterns.
- **Climate stressors:** The term we use for defining extreme weather conditions. We use this definition to cover major events such as droughts, floods, and heatwaves, which can directly disturb the well-being of individuals and their livelihoods. Accordingly, a key distinction of climate stressors from natural disasters is that they are *exogenous* to conflict, development, and other socioeconomic features, and constitute random shocks to well-being and conflict. Other definitions often used in the extant research to cover exogenous climate stressor are weather shocks, climate shocks, and natural shocks (see, e.g., Kreutz 2012; Bagozzi et al. 2023). Natural *disasters*, in contrast, have an endogenous component that shapes their severity – among others, because conflict makes it harder to provide assistant to affected populations, thereby harming state support and increasing the intensity of violence, as happened, for instance, in the Cabo Delgado region of Mozambique (Bagozzi et al. 2023).

2.2 Defining Climate Adaptation and Food Security Interventions

The IPCC defines adaptation as "the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities" (IPCC 2024). Research highlights that climate variability exacerbates existing socioeconomic inequalities in sub-Saharan Africa, including in South Sudan, particularly in sectors like agriculture, water management, and urban planning. The region's reliance on rain-fed agriculture makes agriculture especially susceptible to droughts and floods, which have cascading effects on food security, income stability, and rural livelihoods. Scholars argue that climate adaptation strategies must go beyond technical solutions, embedding social equity, governance, and capacity-building at the core of adaptation efforts (Nadiruzzaman et al. 2022).

One emerging research focus is on the role of community-based adaptation (CBA) approaches, with an emphasis on the importance of local knowledge and participatory decision-making for the success of climate adaptation initiatives. For example, Tschakert at al. (2016) argue that inclusive adaptation strategies that engage marginalized groups, such as women and youth, yield more sustainable outcomes by addressing the social dimensions of vulnerability. It is important to note that, in these regards, researchers also critiqued the role of international funding and development aid in climate adaptation. In many sub-Saharan African nations, including South Sudan, bureaucratic and technical barriers limit access to securing adaptation financing and the capacity to implement large-scale projects. Moreover, there is growing concern about the focus on short-term project outcomes over long-term resilience-building. Some researchers (e.g., Eriksen et al. 2021) suggested a paradigm shift in adaptation financing is needed, with an emphasis on approaches that prioritize transformative adaptation, namely measures that address structural vulnerabilities and foster systemic change in climate-vulnerable societies.

Because efforts to adapt to climate change often include a variety of possible approaches, we extend our definition to cover a wider range of potential impacts. As Owen explains, "[a]daptation is always contingent upon the events or conditions to which it is reacting or anticipating" (2020, 2). For instance, adapting to climate change could include efforts to implement governance and management of nonrenewable resources and environments (Okereke et al. 2009; Henstra 2016) and improve households' access to resources (Adger 2006). By instituting such measures, nonrenewable resources such as water or pasturelands can be preserved for longer periods of time, reducing or smoothing the risk of shocks that can potentially feed into conflict, at least in some cases (e.g., Maystadt and Ecker 2014).

Another way to adapt to climate change is by improving food security and agricultural input. One relevant aspect is the possibility that climate stressors can increase the variability in production and agricultural output. As Burke and Lobell (2010) explain, adapting to the effects of climate change will require not only switching to more resilient crops, but potentially also making larger investments in crop breeding and infrastructure required to meet the needs of a global population. Based on these and other studies (e.g., Di Falco et al. 2011; Kabubo-Mariara 2019; Sanga et al. 2021), we included projects designed to improve food security as part of our conceptualization of climate adaptation. A third relevant aspect of climate adaptation relates to efforts directly intended to improve local populations' ability to deal with immediate weather impacts, including floods, droughts, and heatwaves (e.g., Mertz et al. 2009; Mathew et al. 2012). Here, we focus on efforts such as building dams and dikes, implementing cooling measures, planting drought or flood resilient crops, and providing socioeconomic safety nets to smooth the impact of these shocks.

We recognize that taking such a broad view might contribute to what Lobell (2014) calls "the adaptation illusion," namely the lack of a clear baseline on what defines "adaptation" and the inclusion of projects that might improve adaptation indirectly, if at all, which can lead to false inferences concerning its impacts. Considering Lobell's focus on how climate adaptation impacts agricultural productivity, specifically, this concern makes sense. However, because this Element focuses on conflict, with a much broader set of potential drivers and impacts, we believe that taking a broader perspective is valid, considering the relevant implications of multi-hazard effects to resilience (Formetta and Feyen 2019) to conflict and violence.

Temporally and geospatially, adaptation projects can vary greatly. Some adaptation measures are implemented at the country level and have no designated timeline, while others are deployed only in one village over the span of few weeks. Conflict research increasingly emphasizes the importance of analyses that are disaggregated over space and time, seeing this approach is crucial in understanding determinants and triggers (e.g., Tollefsen et al. 2012; Theisen et al. 2013; Schon and Koren 2022). To ensure that our operationalization of climate adaptation and food security measures adheres to this recommendation, we specifically identify a set of relevant *policy interventions*. We define interventions as the targeted implementation of projects designed to improve climate adaption and food security (as defined earlier), with a clear beginning date (at least a month and a year) and, if relevant, end year, that are executed at the subnational (district or lower) level. Accordingly, our phenomenon of interest is climate adaptation and food security interventions (CAFSI).

2.3 INGOs as the Key CAFSI Implementer

CAFSI can be implemented by a variety of actors, including states, international (governmental) organizations, and INGOs. States often do not implement projects directly, but rather do so by providing aid to governmental and nongovernmental organizations to implement them. In the context of climate adaptation, an IO refers to a formal, multilateral entity comprising member states, established to address global or regional challenges through cooperation and collective action. IOs like the United Nations Framework Convention on Climate Change (UNFCCC) and the World Bank play pivotal roles in coordinating climate adaptation efforts by providing policy frameworks, technical expertise, and financial resources to member countries. These organizations often focus on large-scale strategies and governance mechanisms to enhance resilience to climate impacts while facilitating collaboration among states and other actors. INGOs, in contrast, are voluntary associations operating at the international, transnational, or global level, with members or participants from one or multiple countries (Bloodgood and Schmitz 2013). Their key purpose is to promote a set of policies designed to achieve a given end or multiple ends (e.g., facilitating climate adaptation or improving human rights). INGOs might be not-for-profit or for-profit organizations (Hadden and Bush 2021), ranging from sizeable established organizations (e.g., MerciCorps) to small startups.

We recognize that there are several reasons for why focusing on both IOs and INGOs when studying climate adaptation and its impacts. In this Element, we empirically focus on interventions employed by INGOs for several reasons. However, considering that our focus is on the specific characteristics of different CAFSI and their impact on conflict, we believe our findings are valid for projects implemented by IOs and local state bureaucracies as well.

First, INGOs are often tasked with implementing the policies of formal government organizations such as USAID (U.S.A.) and GIZ (Germany) practically (Kang et al. 2012; Bush and Hadden 2019). As such, INGOs are the actor most likely to have CAFSI projects on the ground, which has direct practical implications for conflict and peace. Second, INGOs are especially likely to be involved with implementing climate adaptation and other environmental projects (Allan and Hadden 2017). This means they can identify specific issues that might be relevant and communicate these concerns to donors, which allows them to optimize CAFSI in a way that can, again, contribute to shaping conflict and peace outcomes. Finally, from a more practical perspective, identifying via open sources relevant CAFSI INGOs as well as the different projects they implemented and dates of implementation in South Sudan was feasible and relatively easy. More specifically, distinguishing between INGOs can be done across several features and dimensions, summarized in Table 1.

Table 1 Typology of CAFSI-implementing INGOs by key features

Feature	Description
Focus Area	• Directly focus on climate change • Improve food security • Early warning and conflict prevention • Community building, social cohesion INGOs that are more focused on climate change and food security might have less specialties in reducing violence or building social cohesion, affecting the CAFSI's efficacy with respect to conflict prevention.
Funder type	• State/government funder (e.g., USAID) • Nonstate/private funds (e.g., Gates Foundation) • Mixed (government and private funds) INGOs that fall in the second and third category might be more focused on continuously seeking new funding sources, which affect project time horizons and efficacy. For government funded INGOs, budget cycles and the need to show results at specific deadlines might be key project drivers.
Preparedness type	• General preparedness: CAFSI specifically designed to cover a variety of potential outcomes of climate change, even if imperfectly, rather than address one specific problem (e.g., improving physical structure robustness, creating positive social arrangements, expanding, food storage capacity, planting high-resistant and high-yielding crops). • Specialized preparedness: CAFSI designed to address one specific outcome of climate change and food insecurity (e.g., building dikes that do not include irrigation capacities or reservoirs). General preparedness is more likely to indirectly or inadvertently address a variety of potential climate-food-conflict linked drivers.
Community focus	CAFSI that emphasize community building measures such as setting up local councils and forums, resource sharing mechanisms, etc., which can address the underlying causes of intra- and inter-communal rivalry.

2.4 CAFSI Features with Conflict Relevance

The top feature in Table 1 (focus area) serves as the empirical distinction of our phenomena of interest, as we elaborate upon in Section 4. The bottom two CAFSI features in Table 1, we argue, are the one that can influence both civil war and social conflict in South Sudan. Because of this, it is worth expanding on these features in more detail.

2.4.1 CAFSI That Emphasize General Preparedness

For our purposes, we consider general preparedness as measures specifically designed to cover a variety of potential outcomes of climate change, even if imperfectly, rather than address one specific problem. For instance, within the field of direct climate adaptation, improving the robustness of physical structures or creating social arrangements that can facilitate effective responses would be considered as CAFSI that emphasize general preparedness (Ide 2023). For food security, relevant efforts would include, for instance, measures designed to improve food storage capacity or plant high-resistant and high-yielding crops (Burke and Lobell 2010; Sterrett 2011). The reason we consider general preparedness to be important is directly related to the fact that climate change's effects are highly variant (Formetta and Feyen 2019; Schon et al. 2023), and so in attempting to address one specific outcome, the intervention may end up failing to address new challenges that emerge over time. For instance, in eastern Africa, including South Sudan, where droughts used to be (and, in some parts, remain) a key concern, in many regions, flooding has emerged as an even greater concern (Mayen et al. 2022; Zeng et al. 2023). This means that CAFSIs that seek to address solely the effects of droughts might be rendered irrelevant, while interventions that develop more general solutions may end up being relevant. As we discuss next, by addressing a wider range of potential climate and food insecurity issues, general preparedness might also be able to address how these stressors reinforce conflict, leading to reduction in its rates.

One example of a general preparedness CAFSI is from a project by Caritas Switzerland. This INGO trained the inhabitants of Torit and Ikotos to thrive in drought by harnessing unexpected torrential rain for a wide variety of uses. Rural inhabitants more effectively responded to droughts by regularly "planting climate-resistant crops, using efficient irrigation systems and applying environment-friendly soil treatment techniques" (Caritas Switzerland 2021, 4–5). However, they were also trained to prepare for flooding by building small dams and developing sophisticated drip irrigation and were trained to utilize mountains and rock formations to harvest rainwater during unexpected heavy rainfalls. These interventions facilitated both higher crop productivity

and healthier livestock, increasing incomes across different communities with different lifestyles, thereby disincentivizing, rather than intensifying, violent competition over territory.

Another example is the project carried in Pibor County by Vétérinaires Sans Frontières Germany (VSFG) between 2017 and 2019 (VSFG 2018). This project sought to provide communities with farming tools, seeds, and agricultural training, in addition to resource-sharing mechanisms designed to protect and strengthen small-scale fishing. To incentivize shifts toward more sustainable and climate-resilient livelihoods, VSFG also allocated resources for young men and women to assist with starting small businesses, such as bread bakeries and tea shops. It also financed vocational training in a variety of areas, including – among a number of other fields – animal health care, welding, motor vehicle maintenance, electrical and solar installation, carpentry, and borehole pump maintenance. Rather than focusing on one aspect (e.g., increasing food-crop yields), VSFG recognized the need to address multiple underlying aspects of vulnerability to improve the success of their CAFSI.

Similarly, since 2021, several USAID-funded INGOs implemented diversification projects that sought to simultaneously improve agricultural productivity as well as financial literacy in Western Equatoria and the Lakes States. These interventions increased the number of small businesses and created jobs for a large number of unemployed young men, traditionally being considered a conflict catalyst, thereby increasing the stakes individuals have in the local economy (USAID 2024). In line with our expectation that such general preparedness approaches can reduce conflict risk, a United Nations Development Program (UNDP) analysis indicates that income diversification measures across South Sudan have not only contributed to improving community resilience, but also promoted peace by minimizing historic hatreds and horizontal grievances, promoting "trust through cooperation, reduc[ing] cultural barriers, and promot[ing] cross societal understanding" (Hansohm 2018, 36).

2.4.2 CAFSI That Emphasize Community Building

Community building measures are designed to address climate adaptation and food security issues by improving internal and across-community cohesion. The emphasis here is on maximizing the chances of adaptation by ensuring most community members are brought in as local stakeholders. Examples of community building approaches include mobilizing the community to build a structure or a road and creating community-level mechanisms for resource sharing (e.g., overgrazing land) (Ostrom 2009). The logic behind emphasizing community building is that improving community level cohesion, both within

and across specific communities, can give rise to local institutions that help mediate instability and conflict (Firchow and Mac Ginty 2017; Ide et al. 2021; Sharifi et al. 2021).

For example, an intervention spearheaded by the World Food Programme (WFP), designed and carried out by local actors and the Adventist Development and Relief Agency (ADRA) in Tonj South in 2018, incorporated several measures to address the effect of droughts and flooding, while also incorporating measures to reduce tensions between local communities. A specific concern was the potential friction both among farming communities and between farmers and pastoralists within the Malual Mok and Thony communities. A set of measures have helped to diversify, expand, and increase the productivity of agricultural harvests as well as protect and institutionalize access to water for both farmers and cattle herders (Awad 2022). According to one member of the Malual Mok community, before this intervention, the two communities "used to fight one another, raid cattle, loot crops and belongings . . . But since we began farming and producing, we stopped fighting. Our fight is now against hunger and poverty, not each other" (Awad 2022). The intervention therefore may have played a strong role in reducing the need to appropriate resources as well as smoothing cycles of grievance-induced retaliation and violence committed by both sides.

Another example is a CAFSI by ACTED in South Sudan, which – as part of its agricultural assistance – sought to "encourage cooperation between farmers of different ethnic groups thus preventing conflicts related to land and/or resources" (ACTED 2012, 18). Some INGOs seek to reduce social conflict by directly working with local governing bodies to implement policies that invest in community-building activities to mitigate the impacts of extreme weather events (IIRR 2018). Moreover, some INGOs directly incorporate conflict risk analysis into their CAFSI projects, keeping some aspects of the intervention that reduce conflict while discarding of features that are ineffective and potentially aggravating (Cordaid 2019). Other INGOs developed a deep understanding of context-specific climate-stressors and construct their interventions accordingly (CRS 2013).

2.5 Civil War and Social Conflict in South Sudan

Within the climate–conflict nexus, researchers distinguish between several types of conflict, each affected by environmental and resource-centric drivers in different ways and for different reasons. For instance, some studies find that natural resource variability can contribute to rebellion by providing rebels with both the willingness and opportunity to act against government forces (e.g., Collier and

Hoeffler 2004; Ross 2004). Within the climate–conflict nexus, scholars linked similar incentives to agricultural resource scarcity due to environmental degradation and food insecurity (e.g., Miguel et al. 2004; Burke et al. 2009; Maystadt and Ecker 2014). The emphasis in these cases is on armed conflicts with many combatant (i.e., not civilian) casualties involving two types of actors, namely, state (military) and rebel forces.

As more studies explored the potential intersections across climate, weather, and conflict, growing evidence emerged that some types of actors – and some types of violent behaviors – are more likely to be affected by environmental variations. One reason is that military organizations and – in some cases – stronger rebel groups are more resilient to shocks and have greater logistical capacities, which means that their strategic calculations are less likely to be affected by climate issues, at least up to a certain level of severity that overwhelms these capacities (e.g., Buhaug 2010; Koren and Bagozzi 2016). When these forces lack such capacities, researchers often find that rather than fueling conflict between combatants, environmental stressors lead to attacks perpetrated specifically against noncombatant civilians, presumably as a means to facilitate appropriating agricultural resources, cash, and other types of loot (Bagozzi et al. 2017; Koren and Bagozzi 2017).

In addition to having varying effects on different conflict types, different types of environmental stress can also shape the behavior of a variety of warring actor types, including political (e.g., nonstate groups and organizations that work for or support a political party or a faction, mercenary) and identity (e.g., ethnic and tribal defense forces, vigilantes) militias (Van Weezel 2019; Raleigh and Kishi 2020; Koren and Schon 2023). Often, the term used to discuss conflict involving these actors, especially violence happening outside the context of ongoing civil wars, is *social conflict* (Van Weezel 2015; Koren and Schon 2023). While state militaries and strong rebel forces may be relatively unaffected by climate stressors, other actors heavily depend on locally sourced support, and are therefore more likely to be sensitive to climate change and more likely to shift their activities to compensate for these issues or to secure agricultural and other types of resources.

Researchers linked variabilities in agricultural resources – including valuable crops and access to water – to higher rates of social conflict involving political and identity militias and other civil defense forces (Raleigh and Kniveton 2010; Butler and Gates 2012; Döring 2020; Koren and Schon 2023). In South Sudan, identity militias representing local communities as well as political militias founded to protect the interest of the elites are prevalent (Koos 2014; Stringham and Forney 2017), underscoring the importance of accounting for how weather shocks and climate adaptation could shape conflict involving these actors.

Indeed, in line with these research claim, the program manager interviewed specially highlighted this issue, stating that "flooding and drought have led to massive displacements, pushing actors into new geographies, and conflict scenarios increase. Many of those are pastoral ecosystems, so farmers move into these areas and start farming while pastoralists need movement and water, creating local social conflict and insecurity."[5] Building on these logics, we distinguish between two types of conflict in our theoretical development and corresponding empirical analysis.

2.5.1 Civil War

The "civil war" category includes all conflict and violence incidents initiated by the types of actors traditionally analyzed in research and policy on civil war, namely formal state (military and police) and rebel (anti-government nonstate groups) actors. Note that there are several ways to define civil war, including, for instance, conflict involving at least 25 (Gleditsch et al. 2002) or at least 1,000 (Burke et al. 2009) casualties. Our decision to rely on the type of actors rather than the number of casualties for defining conflict type might appear untraditional, but we believe it is valid for at least two reasons. First, there is precedence of such an approach being employed in extant research, especially at the subnational level (e.g., Koren and Bagozzi 2017; Schon et al. 2023; Koren and Schon 2023; Urtuzuastigui and Koren 2024). Second, in the context of South Sudan, the civil war intensified over a relatively distinct historical period, even though civil war actors are still present and active across the country, including in Juba, the capital. At the same time, social conflict has been more relevant in many parts of South Sudan, and evidence suggests it may have intensified in recent years (Bark and Raleigh 2024). Accordingly, relying on the types of actors to define conflict types makes more empirical sense within our mono-country, subnational level analysis.

2.5.2 Social Conflict

Social conflict is defined as a broad category of violence, which covers, in addition to incidents of warfare between armed combatant militias, also incidents of conflict between pastoralists, pastoralist-agriculturalist conflicts, and community clashes (e.g., over politics, ethnicity, or resources). As mentioned earlier, this form of conflict is prevalent in South Sudan and east Africa more generally. Social conflict often does not include direct intervention of military forces (e.g., Fjelde and Von Uexkull 2012; Döring 2020; Detges 2014; Theisen 2012;

[5] Interview 2.

Van Weezel 2019; Petrova 2022). Examples of violent social conflict events include cattle theft raids (Adano et al. 2012; Detges 2014; Schilling et al. 2014; Döring 2020), clashes between different political parties (Fjelde and Von Uexkull 2012; Caruso et al. 2016; Petrova 2022), or ethnic communities and pastoralist-agriculturalist social conflicts (Theisen 2012; Schilling et al. 2014).

3 Pathways to Conflict and Conflict Mitigation

3.1 Weather Shocks, Climate Adaptation, and Civil War

The first relevant pathway views climate change-induced stressors acting as a "threat multiplier" where socioeconomic and political features already enable anti-regime sentiment (e.g., Ide et al. 2020; Raleigh et al. 2015; von Uexkull et al. 2016; Scheffran et al. 2012; Scheffran 2020). The growing stress from climate change over time can hence increase political and economic inequalities, contributing to the different actors' and communities' willingness to start or join ongoing rebellions (von Uexkull et al. 2016; Regan and Kim 2020; Schon et al. 2023). This situation can become even more acute in cases where state responses to these stressors are politicized or otherwise botched. For instance, the ability of the government to implement irrigation schemes and build dams to address water shortages has been shown to reduce the impact of such stressors on conflict (e.g., Regan and Kim 2020; Döring 2020). Similarly, in states that do not provide social safety nets or other protection against the adverse impacts of weather shocks, grievances fester and contribute to individuals' decision to support violence (e.g., Petrova and Rosvold 2024). Under these contexts, aid provision – including for combating climate change – can also be politicized and lead to intensified violence (Findley 2018). Climate prevention may also suffer in high-fragility contexts, as implementing aid in environments characterized by weak institutions and political instability is challenging (Hoeffler and Justino 2024).

The second pathway focuses on how the impact of climate stressors can lower the opportunity costs of individuals for joining a rebellion (e.g., Miguel et al. 2004; Burke et al. 2009; Fjelde 2015; Guardado and Pennings 2025; Eastin and Zech 2023; DiGiuseppe et al. 2024). The key distinction from the first pathway is that whereas the threat multiplier perspective emphasizes *grievances* as providing motivation for violence, the opportunity cost perspective emphasizes *when* actors will *choose to act* on these grievances and engage in violence (Schon et al. 2023; Koehnlein et al. 2024). The focus here is also on individual rather than group-based incentives – as farm output decreases, households' quality of life decreases. This means individuals have less to lose from joining a rebel group, even if the chances of winning the civil war are low, facilitating rebel recruitment

(e.g., Fjelde 2015). Correspondingly, when the opportunity cost is higher – for example, during times of harvest – conflict and violence decrease (Guardado and Pennings 2025). A related perspective highlights how environmental variability could impact the strategic environment, providing rebels more opportunity to engage in violence to weaken the state (e.g., Bagozzi et al. 2023).

The third pathway emphasizes how climate stressors could impact agricultural resources, which in many conflict-susceptible countries serve as important inputs of rebellion. Primary agricultural commodities (cash crops such as coffee, tea and oil, cereals, and fruit) are valuable source of revenue in countries where the economy is heavily dependent on such commodities, which also (and not necessarily by accident) tend to be vulnerable to civil war (e.g., Collier and Hoeffler 2004; Ross 2004). In line with this logic, several studies find that agricultural commodities have provided crucial revenue streams for rebel groups in Iraq and Syria (Jaafar and Woertz 2016), the Philippines (Crost et al. 2018; Eastin and Zech 2023), and Somalia (Urtuzuastigui and Koren 2024), to name a few examples. Similarly, research on the role of aid in conflict finds that long-term aid dependence – including dependence induced by climate change – can provide nonstate actors with bargaining power with respect to the government, contributing to prolonged conflict (Nielsen et al. 2011). By providing opportunities for looting and presenting challenges to rebel authority, aid also encourages rebel violence, as well as state violence by augmenting rebel capabilities or providing rebels a resource base (Wood and Sullivan 2015). On a more practical level, rebels (and armies) cannot operate without logistical support, which includes the necessity to have regular availability of food (Koren and Bagozzi 2016, 2017). If climate stress reduces the availability of these resources or impedes access, this can shape the intensity and spatial coverage of the competition over these resources and how actors actively fight over agriculturally important territories.

Often, such stressors can lower fighting intensity and open opportunities for peace. Kreutz (2012), for example, finds that peace negotiations become significantly more likely after major natural disasters. More specifically, Walch (2014) finds that following the 2004 tsunami in the Philippines, while the New People's Army (NPA) used the disaster to broaden its base of support and attack the government, the Moro Islamic Liberation Front (MILF) sought instead to collaborate with the government in order to achieve diplomatic gains. And Beardsley and McQuinn (2009) found that while the same storm had no effect on reducing LTTE violence, the Free Aceh Movement (GAM) in Indonesia used the opportunity to collaborate with aid providers and make compromises with the government to advance, again, its own diplomatic goals. Moreover, by reducing the level of resources available for harvesting, climate stress can

also reduce fighting intensity by obviating the sourcing- and appropriation-based incentives of warring actors to shift their fighting patterns (Koren and Schon 2023; Schon et al. 2023).

How should climate adaptation affect civil war? In the first pathway, by reducing anti-government grievances via building resilience, climate adaptation can mitigate the risk multiplier impacts of climate change. If CAFSI helps locals to adapt to the impact of climate change, reducing its effect on their lives, communities have less incentives to support rebel groups, and the demand for the latter's politics will be reduced. By providing assistance that helps in redistributing the impacts of climate change, improving capacity and deterrence, and creating local stakeholder engagement (Findley 2018), CAFSI-related aid can additionally reduce grievances that can feed into conflict patterns.

Similarly, if agricultural productivity in heavily primary commodity-dependent economies suffers less under climate change's conditions, then this increases the opportunity costs of individuals for joining a rebellion, meaning rebels should not favor these areas over others in their search for recruits (Guardado and Pennings 2025; Eastin and Zech 2023; DiGiuseppe et al. 2024). By increasing resilience, CAFSI can also smooth the effect of environmental variability, thereby lowering the opportunity of rebels to challenge the government (Schon et al. 2023). For the third pathway, while sourcing dynamics will still likely shape how both states and rebels make their operational plans – these resources provide revenues even if the level of productivity is unaffected by climate change – CAFSI could still reduce volatility in the prices of these commodities (e.g., if they increase after a drought or a flood that destroys crops). This makes these sources potentially less desirable, creating – all else equal – less of a need to source at least some agricultural commodities. Due to the wide-scale deployment of CAFSI, the state and the rebels' strategic incentives will be less likely to be affected by climate stress, again, all else equal. Implementing wide-scale CAFSI also improves local resilience, which reduces the possibility that climate stressors will impact the tactical needs of groups to immediately replenish resources. These logics lead to this Element's first research hypothesis:

- **Hypothesis H1a:** More CAFSI are associated with *lower* monthly rates of civil war events locally in South Sudan.

Civil war, importantly, is heavily defined by political dynamics occurring at the national level. In other words, its onset, intensity, and spread, are more likely to be the result of competition between political elites in the capital, low state capacity and administrative penetration, and economic stagnation, rather than driven by climate stress-related issues and – by extension – climate adaptation (Buhaug 2010; Theisen et al. 2013). Moreover, both militaries and strong rebel

groups may have better, well-established logistical supply chains and arrangements they can rely on for supporting the troops as well as for revenue generation (Koren and Bagozzi 2017; Koren and Schon 2023). This, by extension, means such actors would be less impacted by climate stress and its effect on resource availability. There are a variety of mechanisms and pathways that might explain how civil war operates under these conditions (see Section 5 for more discussion on this issue). Nevertheless, the primacy of political features in determining whether civil war happens and how it unfolds suggests – for the general CAFSI (i.e., before we discuss specific features that could improve the chance CAFSI will contribute to conflict reduction) and general conflict (i.e., not accounting for high-stress contextual impact) cases – a corollary hypothesis:

- **Hypothesis H1b:** More CAFSI will have *no noticeable association* with civil war events locally in South Sudan.

3.2 Weather Shocks, Climate Adaptation, and Social Conflict

Some of these dynamics apply to social conflict. For instance, climate stressors could work as a threat multiplier by aggravating horizontal – that is, inter-community (as opposed to vertical/anti-government) – grievances (Ide et al. 2020; Schon et al. 2023) or exacerbating marginalization (Von Uexkull et al. 2016).

Climate stressors can also shape the opportunity cost of and opportunities for social conflict. In these regards, these stressors increase strains on food and herding systems, often in areas where state presence is limited or concentrated to specific regions (Adano et al. 2012; Döring 2020; Koren and Schon 2023). These strains lower individuals' opportunity costs of engaging in communal raids – for instance, between pastoralists (nomad and semi-nomad populations) and agriculturalists (farmers and other sedentary populations) or pastoralists and pastoralists – which often involves violence (Adano et al. 2012; Detges 2014; Van Weezel 2019). More generally, stressors might create more opportunity for social conflict by limiting resources and increasing the rate of interactions and resource competition between different local actors (who have their own militias and defense forces) (Adano et al. 2012; Detges 2014; Koren and Schon 2023).

The dependence on locally grown resources (crops and cattle) means that climate shocks can impact the availability of and access to these resources and induce shifts in farming or roaming habits (Adano et al. 2012; Theisen 2012; Detges 2014; Van Weezel 2019; Döring 2020; Ide et al. 2020). This can lead to land grabs by state-backed producers, raiding, and competition over more abundant resources leading to social conflict between raiding and defending

actors for the purpose of sourcing and appropriating these resources or the revenues provided by selling them (Theisen 2012; Detges 2014; Koren and Schon 2023).

However, according to numerous studies, social conflict is more likely to be affected by stressors resulting from climate change (e.g., Adano et al. 2012; Fjelde and Von Uexkull 2012; Döring 2020; Detges 2014; Scheffran, Ide, and Schilling 2014; Scheffran et al. 2012; Petrova 2022; Theisen 2012; Van Weezel 2019). Social conflict actors are also more likely to compete over agricultural resources within low development, high climate change susceptibility contexts (e.g., Koren and Schon 2023; Ubilava et al. 2023). As Van Weezel (2019, 515) explains, "[c]ommunal conflict is commonly linked to climate as there are fewer constraints in engaging in violence with other groups compared to the state." This suggests two key distinctions between social conflict and civil war.

First, social conflict actors are more dependent on and more sensitive to precipitous declines in locally produced resources. Even compared to rebel groups, militias and other social conflict actors often directly form or recruit in rural agricultural areas, where individuals are heavily dependent on locally sourced agriculture and livestock for survival and income (Detges 2014; Bukari et al. 2018; Van Weezel 2019; Koren and Schon 2023; Ubilava et al. 2023). For instance, Eastin and Zech (2023) find that individuals living in areas affected by climate disasters have shown noticeably greater willingness to join the Civilian Armed Forces Geographical Units (CAFGU), a local militia in the Philippines. They argue that this outcome "reflects the impact of climate change on the opportunity costs of conflict participation, especially in regions dependent on agriculture for income and food production, as diminished livelihood opportunities and subsistence resource access increase the viability of conflict participation as a strategy for livelihood diversification" (Eastin and Zech 2023, 489). Similarly, Ubilava et al. (2023) find that in sub-Saharan Africa, greater harvest productivity translates into more violence involving militias but, interestingly, not rebel or state forces.

Second, social conflict actors often organize in areas where there is no formal protection of property rights or state security, and where violent political contestation is considered normal. More directly in line with Weezel (2019), social conflict is a feature in areas where the government is unable or unwilling to provide basic protection to the civilians, or where trust in the government is especially low (Petrova and Rosvold 2024). In these situations, militias and vigilantes may arise to provide protection that state cannot or will not. For instance, the Arrow Boys, a community militia in South Sudan, was formed to protect locals against attacks from the violent Lord's Resistance Army (LRA) rebels, because "[b]oth the South Sudanese army and the South Sudanese police

lacked the resources to protect the local population from LRA violence" (Koos 2014, 1040). Similarly, in Nigeria during the COVID-19 outbreak (which harmed the state's ability to govern and provide protection), "abduction rates by armed groups increased by 169%. Due to the poor performance of the state's security forces, vigilante militias emerged as the key alternative security force across all states to protect people against rebel groups and kidnappings" (Koren and Bukari 2024). Considering that countries in high climate risk regions, such as the African Sahel (e.g., Raleigh 2010; Benjaminsen et al. 2012; Schon et al. 2023; Koren and Schon 2023), will also exhibit very limited government presence, the probability that militias, civil defense forces, and other vigilantes will arise and engage in violence due to weather shocks or to appropriate agricultural resources is also correspondingly higher. Finally, without effective state governance, horizontal inequalities (the most important inequality-based driver of conflict, see Cederman et al. 2013) more likely to arise, creating additional incentives for self-defense forces to use violence as a means of protection against exploitation.

While social conflict may be more sensitive to climate-induced stress and agricultural resource competition, like in the case of civil war, climate stressors may also lead to peaceful outcomes. The greater dependence on locally sourced agriculture and livestock, which make relevant actors more sensitive to the effect of climate stress, and the fact that government protections are often unavailable, means that local communities (and, by extension, their local defense forces) may also be more likely than civil war actors to successfully cooperate to address the effects of climate stressors, adopting a similar view as "communities of sufferers" (Ide 2023; see also, Ide et al. 2021; Sharifi et al. 2021; Simangan et al. 2023).

In these regards, one possibility is that CAFSI may help to reduce social conflict by creating a local framework for solutions that facilitate peace outcomes over conflict. Next, we discuss two features that can specifically contribute to this possibility (bolstering general preparedness to climate change and supporting community building). More generally, however, CAFSI could also facilitate peace by creating both top-down and bottom-up policy channels. Top-down approaches are often ways by which INGOs implement CAFSI as well as conflict prevention and early warning (CP) interventions.

Such approaches, however, generally exclude locals and their specific concerns from the CAFSI design process (Mac Ginty and Firchow 2016). Therefore, allowing local communities to communicate their needs with respect to climate adaptation and manage agricultural and natural resources to governmental and nongovernmental policymakers can open a door to addressing other concerns,

including conflict prevention (Ide et al. 2021). A second way (discussed in greater detail in Section 5) – is for CAFSI to directly incorporate conflict sensitive programming, which will increase these interventions' impacts on both adaptation and social conflict prevention. As Ide et al. (2021, 9) explain, "environmental and development organizations have historically often designed and implemented environmental projects in the same ways in both conflict-affected contexts and those not affected by conflict." From this perspective, CAFSI that incorporate local understandings of social conflict into their operative environment are more likely to succeed in reducing climate change-induced social conflict.

Beyond these points, CAFSI can – as we explained in our discussion on civil war – help in reducing the risk of social conflict by helping to smooth the impact of weather shocks and climate stressors on productivity and reduce the variability in agricultural output. By reducing price volatility and increasing opportunity costs, CAFSI can mitigate the incentives for resource competition across different communities and hence lower the risk of social conflict. This leads to our second hypothesis:

- **Hypothesis H2a:** More CAFSI are associated with a *lower* monthly rate of social conflict events locally in South Sudan.

This hypothesis, again, has a corollary. Here, a key concern is that bolstering resilience and increasing agricultural output can reinforce rather than reduce incentives for rapacity and looting. This is more of a concern in the case of social conflict than civil war considering research has repeatedly shown that social conflict actors are at a higher risk of engaging in violence to appropriate and loot agricultural resources and the revenues they provide (e.g., Ubilava et al. 2023; Koren and Schon 2023). For instance, Bukari et al. (2018, 161) show that in Ghana, "despite climate variability, there were basically no major changes in rainfall figures," so weather therefore did not appear to be a social conflict driver. Rather, it was "the abundance of resources and increases in the value of land in Agogo were major drivers of conflicts between farmers and pastoralists" (Bukari et al. 2018, 161). If this argument in correct, then we expect that the improvements in livelihood conditions resulting from adaptation will increase the incentives of political and identity militias, civil defense forces, and other vigilantes to engage in violence. This suggests – again, for the general CAFSI and general conflict cases – a corollary hypothesis:

- **Hypothesis H2b:** More CAFSI are associated with a *higher* monthly rate of social conflict events locally in South Sudan.

3.3 General Preparedness CAFSI and Conflict Mitigation

Are there CAFSI features that can help increase the probability of a positive impact on conflict? To answer this question, it is useful to first consider some of the potential downsides of CAFSI. For instance, Sovacool (2018, 33) highlights that "adaptation projects transfer public assets, shift costs, or redistribute risk," which can generate adverse outcomes via exclusion (limiting access to resources to specific populations), encroachment (intruding on land and producing land-use and land-cover shifts), and entrenchment (aggravating the disempowerment of women and minorities and worsening income inequality). Factors such as demand for new resources for supporting "green" technologies, financing adaptation, lack of effective implementation, poor coordination, and limited actions can all lead to adverse socioeconomic outcomes, including conflict (Buhaug et al. 2023). To consider all CAFSI as having a uniform (on average) impact on civil war and social conflict risk therefore oversimplifies some of the complex issues that adaptation – especially when driven by top-down policy making – can produce.

As discussed in Section 2, we believe that one aspect that may shape CAFSI's impact on conflict is whether the intervention involves measures designed to improve general preparedness to climate change's effects. As part of this discussion, we included some examples of interventions in South Sudan that involved such measures. Briefly, attempts to improve general preparedness to climate disasters include "measures to natural hazards, early warning systems, and disaster risk management strategies" (Formetta and Feyen 2019, 7), as well efforts to plant more resistant or higher-yielding crops, invest in productivity-improving technologies and training, implement more effective cooking and cooling technologies, construct resilient storage and housing, provide locals with training on how to improve household level food security, improve local living conditions in ways that can absorb forced migrants and displaced persons, limit land use changes, and reduce corruption, among others. These approaches have been shown to systematically reduce vulnerability and the number of people adversely affected by these events (Formetta and Feyen 2019). Interestingly, Formetta and Feyen (2019, 7) find that the impact of effective preparedness is "strongest for the lowest ranges of GDP per capita and weakens as income levels become higher." This suggests that within the context of the most susceptible countries, which – like South Sudan – also tend to be on the lower end of the income development spectrum, CAFSI that maximize the viability of shock preparation will get the best "bang for buck" in improving resilience and smoothing the effects of climate change on local communities, including with respect to conflict.

Considering the complexity of climate change and the large uncertainty around how weather patterns will shift in the coming decades (IPCC 2022), the types of weather outcomes that might be relevant in different contexts as well as their impacts are subject to great variability (Trenberth 2005; Collier and Webb 2021). As a result, trying to predict specific stressor types and then preparing to address their impact (i.e., specialized preparedness) is less likely to be effective in adapting to the inherent variability of climate change. In these regards, as Hürlimann et al. (2022, 277) emphasize, "[a] limited understanding of climate change preparedness across these sectors may limit capacity to achieve global goals … and to be well adapted to the changes that will occur." For example, in South Sudan, one example of CAFSI that emphasize specific (as opposed to general) preparedness includes attempts to re-incentivize pastoralism in communities that have become largely sedentary due to civil war. Yet, these attempts ignore the broader context of disturbed livelihood in South Sudan, which – as an ethnographer interviewed explains, "due to the civil war, changed so drastically that it is unclear if the entire idea of going back to this lifestyle over the long run is even still on the table … And then climate change is changing these landscapes so much so cattle might not even be a viable possibility? Is it feasible to imagine these societies can keep millions of cows even if we fix the political issues?"[6] Such specific preparedness measures are more likely to "miss their mark" if the intended outcome they seek to prevent or the particular scenario they seek to adapt to fails to materialize in this context or if unrelated problems arise, which can exacerbate the conflict pressures.

Therefore, we argue that by covering a wider set of climate stressors and potential impacts, CAFSI that emphasize general preparedness are more likely to address (even if imperfectly) their adverse effects at the local level while offering locals and INGO workers more flexibility. Such interventions are also more adaptable and can be reconfigured to address different impacts if local pressures change due to unpredicted weather patterns as well as problems that might arise from their implementation, such as corruption and rapacity incentives. This, in turn, can help smoothing the changes in local socioeconomic and political patterns that might arise due to climate change – such as the loss of farm subsistence, marginalization and horizontal inequalities, consumer vulnerability, the prevalence of corruption and displacement, etc. (Gilmore and Buhaug 2021, 3) – that can feed into civil war and conflict. As such, these interventions should push the baseline of civil war and social conflict incidence downward compared with CAFSI in general. General preparedness interventions are hence a subset of all CAFSIs that is most

[6] Interview 3.

likely to mitigate conflict while minimizing the adverse effects, both with respect to civil war and social conflict, which suggests the following hypotheses:

- **Hypothesis H3a:** More CAFSI that emphasize general preparedness will be associated with a *lower* monthly rate of civil war events locally in South Sudan.
- **Hypothesis H3b:** More CAFSI that emphasize general preparedness will be associated with a *lower* monthly rate of social conflict events locally in South Sudan.

3.4 Community Building CAFSI and Conflict Mitigation

Improving general preparedness is one way that CAFSI may help in reducing civil war and social conflict rates. Another pathway is the impact CAFSI on reducing intercommunity tensions. There are several reasons why community issues can be linked to conflict, particularly to environmental violence. The first relates to horizontal inequalities (Cederman et al. 2013) and how they can fuel inter-community tensions in areas with marginalized populations (von Uexkull et al. 2016; Hendrix 2023; Schon et al. 2023). From this perspective, inter- and intra-communal tensions allow political entrepreneurs to mobilize individuals based on shared grievances and hence are a key explanation for the willingness of individuals to partake in armed conflict.

Second, ethnic, religious, and political communities define the fracture lines and hence the warring sides to be. As Hendrix (2023, 418) explains, "in societies with high groupness, individuals are already embedded in in communities and networks of action; it is easier to identify one's 'team' and facilitate cooperation and coordination, including coordinating to engage in violent activities." These factors make recruitment to rebel groups or local militias easier and can exacerbate ongoing conflicts. Moreover, with resource pressures potentially creating incentives for violent competition over nonrenewable resources, including water and food, as well as over livelihoods, climate stressors can intensify inter- and intra-community tensions and directly feed into rapacity-driven violence.

Considering the importance placed on community-based groupness in extant research, scholars correspondingly suggested that addressing community-related tensions can help in reducing conflict risk. This notion has empirical support. For instance, focusing on northern Liberia, Fearon et al. (2009, 288) find that aid schemes that emphasized improving community-focused reconstruction were "quadrupling the social rate of return on a private

investment." Similarly, in their study on community water resources management in the Democratic Republic of Congo, Afghanistan, and Liberia, Burt and Joy Keiru (2011) find that empowering local communities contributed to achieving better "public-health improvement, good water governance, economic revitalization, and restoration of peace" outcomes (Burt and Joy Keiru 2011, 232). Focusing on the importance of the acacia gum tree for trade and as a promising source of local revenue, Kalilou (2021, 201) finds that in Niger, "[b]y facilitating ecological improvement, social inclusion and poverty alleviation, the promotion of gum arabic [*sic*] production, despite other issues such as bad natural resource governance, is a critical environmental peacebuilding strategy."

Finally, community building interventions can facilitate conflict mitigation is by opening bottom-up policy channels. This allows locals to articulate issues that are specifically relevant to their communities, which can help to optimize policymaking to address these issues. For example, MacGinty and Firchow (2016) conducted research in four sub-Sahara African countries, and found that, when given the opportunity, local communities emphasized different issues and highlighted different narratives than those emphasized by INGOs with respect to politics and security needs. Considering this, implementing community building measures as part of the deployment of CAFSI can increase the probably that the second-order effects highlighted by local communities (including with respect to conflict) are considered as part of the project's design over time.

Based on relevant case-specific research (e.g., Fearon et al. 2009; Burt and Joy Keiru 2011; Kalilou 2021), we define CAFSI with community building as adaptation projects that include measures to mobilize the community to complete a big project (e.g., build a dam), create a resource sharing mechanism (e.g., over water or grazing land), and create local mechanisms for conflict resolution and cooperation, among others. The potential importance of local mechanisms that empower the community are highlighted by a policy researcher, who explains that "in South Sudan, the issue in terms of formal governance is that the peripheries are highly detached from any centralized form of government, so the extent to which formal policy arrangements can have an effect on conflict is minimal. You end up with informal governance systems having a much more important role in conflict management."[7] The impact of community building may also reinforce that of preparedness in general. For example, agricultural diversification and climate adaptation projects by WFP incentivized farmers in

[7] Interview 1 (an INGO researcher and implementer), Bloomington IN (remote), September 15, 2023.

the Malual Mok and Thony communities – which experienced numerous communal clashes over the last couple of decades – to collaborate on expanding their farming "beyond groundnut and sorghum to include growing sukuma (collard greens), cowpeas, beans, sweet potatoes, cassava and even rice – making use of the floodwaters [collected due to newly constructed dikes] . . . [and] working together for mutual benefit" (Awad 2022).

Considering this evidence, we expect CAFSI that incorporate community building to be a more likely to promote conflict prevention. We also believe that the ameliorative effect of community building should be more notable not only in social conflicts, but also during civil war. First, there is empirical evidence to suggest that community building helps in reducing inter- and intra-community tensions in post-civil war contexts (e.g., Fearon et al. 2009). Second, during civil war, prewar enmities within and across communities often serve as social fracture lines along which violence unfolds (Kalyvas 2003) because the war both allows locals to settle old scores and facilitates the ability of local political entrepreneurs to consolidate power (Kalyvas 2003; Hendrix 2023). As a result, and building on the discussion in this section, we derive the following hypotheses:

- **Hypothesis H4a:** More CAFSI that emphasize community building will be associated with a *lower* monthly rate of civil war events locally in South Sudan.
- **Hypothesis H4b:** More CAFSI that emphasize community building will be associated with a *lower* monthly rate of social conflict events locally in South Sudan.

3.5 The Importance of Context: Distinguishing CAFSI's Conflict Impacts across Times of Normal and High Stress

The discussion up to this point sought to identify several pathways that link climate stressors and weather shocks to conflict, explain why climate adaptation and food security interventions should ameliorate these impacts (including delineating potential corollaries to these linear relationships), and identify specific CAFSI features that make this effect most likely to be observed. Accordingly, the argument so far focused on the general impact of CAFSI via their ability to improve societal preparation and reduce vulnerability, both of which have implications for reducing the risk of civil war and social conflict.

An important factor we have yet to discuss relates to the role of *timing*. Weather varies throughout the year – floods happen primary in the wet season, droughts happen in the dry season – and, as Bukari et al. (2018) highlight,

climate variability across different months changes even if average annual or multi-annual levels remain unchanged. Moreover, even if seasons shift due to climate change, these shifts will be captured at the monthly, weekly, or daily, but not the annual, level (Koren and Schon 2023; Schon et al. 2023). For adaptation, this means that there are certain time periods when these projects are more likely to smooth the impacts of climate change, and certain time periods when they will not matter at all. For instance, a dam might not be relevant until there is a flood. Making specific crops resilient to harsh climate will not matter until a drought or a heatwave occurs. From this perspective, we seek to distinguish between the immediate effect of CAFSI on conflict intensification by addressing the relevant stressor and its general mitigative impact on conflict at large by helping to create general social resilience. For this purpose, as part of our analysis, we add a moderating constraint, which defines – for each location in South Sudan – two relevant period types.

The first type is *high climate stress periods*, which we conceptualize as times when the weather in the region is at its extremes to such a level that it constitutes a natural shock with respect to local livelihoods, agricultural stability, and physical wellbeing (Formettaa and Feyen 2019). Building on extant research on the link between environmental variability and civil war and social conflict in high climate change risk regions (e.g., Burke et al. 2009; Theisen et al. 2013; Hendrix and Salehyan 2012; Raleigh and Kniveton 2010; Maystadt and Ecker 2014; Kelley et al. 2015; Von Uexkull et al. 2016; Bagozzi et al. 2017; Detges 2014; Van Weezel 2020; Ide et al. 2021(b); Petrova 2022; Sarbahi and Koren 2022; Schon et al. 2023), we specifically define times of high climate stress as all periods when the region clearly experienced at least one severe stressor, defined as a flood, a drought, or a heatwave (we discuss how we operationalized these phenomena empirically in the next section).

By extension, we define *normal climate periods* as times when high climate stress was not recorded. During these (more prevalent) times, regions might still experience higher or lower than average levels of temperature and water surpluses or deficits, but these deviations are not large enough to be considered extreme. Accordingly, normal climate times serve as the baseline for testing if the effect of CAFSI on civil war and social conflict is more general, or whether such impacts shift as the region experiences high climate stress.

Again, there is evidence to suggest that such a distinction matters. For example, a policy program director explained that:

> running the peacebuilding programs in the Horn of Africa, when you look at the traditional ways of conflict management, there were ways in which communities negotiated terms, e.g., over grazing rights by asking permission

> . . . As climate change made drought more frequent, ecosystems were devastated. The number of cycles of movement increased, and a cycle takes two-to-three years, during which pastoralists are unable to come back to the land, and the few grazing areas they have are not enough. So, this started breaking the traditional fabric.[8]

In another interview, a policy ethnographer emphasized that:

> [i]t seems very obvious that they [climate stressors] have some multiplying effects, but the underlying causes for why these instances of violence happen are already there . . . One of the issues that it is 'easy' to come up with pathways to violence because each location and year will have its own issues, but I think what's undeniable is that a lot of climate related events are coming year to year – a year of flooding followed by drought followed by year of extreme droughts in South Sudan.[9]

Relatedly, CAFSI that sought to address the impact of extreme stress may have had more notable impact. For example, recent evidence indicates that OCHA-funded dikes built in Bentiu were overwhelmingly successful in mitigating the catastrophic effects of South Sudan's 2022 floods. Ahead of the floods, partners used the funds to construct and reinforce over 55 kilometers of dikes to protect vital access to roads, homes and the airstrip. These dikes would prove to be critical, preventing 100,000 people from having to be evacuated and further displaced . . . [While] protection of the airstrip allowed humanitarian operations to continue throughout the rainy season (Katch 2024).

Other CAFSIs incorporated systems designed to provide forecasts and early warning on the risk of extreme weather events and potentially reduce conflict, as highlighted by local policy experts: "[e]arly-warning systems are most effective when wider contextual analysis and meaningful community engagement are integrated throughout . . . shoring up the capacity of communities to build resilience to the effects of climate change and conflict" (Pech and Chan 2024). For example, the Community Managed Disaster Risk Reduction (CM-DRR), a community-led intervention to address climate-induced resource-driven pastoralist and agriculturalist conflicts within the Baidit community, established a climate-related early warning system, allowing the Baidit community "to monitor seasonal early warning indicators, such as water levels and the movement of livestock to pasture . . . and mobilize [trained] community members to undertake new initiatives as needed" (CRS 2013, 34). This effort was complemented by training local communities in methods for constructing dikes and ponds to prevent flooding and store water, as well as methods for rangeland management, reforestation techniques, and livestock disease prevention.

[8] Interview 2. [9] Interview 3.

Building on this evidence, we add a moderating condition to some of our CAFSI–conflict link assessments. This distinction provides an important test. If we find that the results hold or are the strongest only in times of high stress, this will be directly in line with the argument that climate stressors help to drive conflict and – correspondingly – that CAFSI helps to reduce conflict by smoothing their effects. This logic has some support in extant research via the pathways discussed earlier. For instance, if high climate stress leads to resource scarcity that creates immediate incentives for violent competition (e.g., Schon et al. 2023), then this suggests that CAFSI should have more immediate effects on reducing the resulting conflict. Similarly, if high climate stress lowers the opportunity costs of engaging in violence in specific times that otherwise would occupy individuals (e.g., no harvests due to drought) (Guardado and Pennings 2025; Eastin and Zech 2023; DiGiuseppe et al. 2024), then this suggests CAFSI should have an immediate impact on raising these opportunity costs by making harvests more likely.

Even with respect to threat multiplier-based arguments, if high climate stress makes such intensification more likely (e.g., Ide et al. 2020; Raleigh et al. 2015; von Uexkull et al. 2016; Scheffran et al. 2012; Scheffran 2020), then CAFSI should mitigate this effect on conflict by reducing the severity of this multiplier with respect to conflict. While this mitigating effect might be more pronounced for social conflict – considering the higher vulnerability of social conflict actors and the communities to these shocks – we can still reasonably assume that, by reducing the degree of these risk factors, CAFSI will also have more of an impact on reducing civil war rates during high climate stress times compared with normal climate periods. Combined, these possibilities suggest the following two hypotheses:

- **Hypothesis H5a:** The effect of CAFSI on *lowering* the monthly rate of civil war events locally in South Sudan will be stronger during periods of high climate stress.
- **Hypothesis H5b:** The effect of CAFSI on *lowering* the monthly rate of social conflict events locally in South Sudan will be stronger during periods of high climate stress.

Relatedly, building on the logic discussed in Section 3.3, we expect this effect to be more noticeable in projects that emphasize general preparedness, for the same reasoning underlying hypotheses H3a and H3b:

- **Hypothesis H6a:** The effect of CAFSI that emphasize general preparedness on *lowering* the monthly rate of civil war events locally in South Sudan will be stronger during periods of high climate stress.

- **Hypothesis H6b:** The effect of CAFSI that emphasize general preparedness on *lowering* the monthly rate of social conflict events locally in South Sudan will be stronger during periods of high climate stress.

Similarly, as discussed in Section 3.4, we may expect the impact of CAFSI on mitigating conflict during high climate stress times to be more noticeable in CAFSI that emphasize community building, again due to the reasons outlined earlier with respect to H4a and H4b:

- **Hypothesis H7a:** The effect of CAFSI that emphasize community building on *lowering* the monthly rate of civil war events locally in South Sudan will be stronger during periods of high climate stress.
- **Hypothesis H7b:** The effect of CAFSI that emphasize community building on *lowering* the monthly rate of social conflict events locally in South Sudan will be stronger during periods of high climate stress.

These interactive relationships are evaluated with respect to the impact of the CAFSI baseline in normal climate periods (i.e., its constitutive term). If we do not find a robust interactive effect on conflict mitigation across one or more of these hypotheses and the constitutive CAFSI coefficient is negative, then this will suggest that the notion that CAFSI impacts conflict by broadly improving general resilience and cohesion, rather than by directly addressing the impact of climate stressors on civil war and social conflict, is more valid. If we find that the interaction terms are associated with conflict reduction, but the constitutive CAFSI term's coefficient is positively associated with conflict, this suggests support for the corollary (depending on conflict type) as well as hypotheses H5a – H7a and/or H5b – H7b, namely that CAFSI helps to place constraints on conflict when there is an acute need to address the effects of stressors during times of high climate stress.

It is also possible that the reverse might happen: CAFSI generally help to reduce the incentive for conflict, or at least may have no impact, but during times of high stress, as resources become more valuable by improving productivity and resilience, CAFSI provide more opportunity to engage in rapacity during these high climate stress times (Schon et al. 2023). Or, alternatively, it might be that by improving resilience during both normal and high climate stress, CAFSI simply create more opportunity for actors to engage in intensified conflict (e.g., Koren 2018; Linke and Ruether 2021; Koren and Schon 2023). For simplicity, the possible substantive interpretations of the moderated CAFSI–conflict relationships are summarized in Table 2. We discuss the empirically supported interpretation in more detail in Section 4, when discussing and visualizing our interactive models.

https://doi.org/10.1017/9781009510776 Published online by Cambridge University Press

Table 2 Possible moderated CAFSI–conflict relationship pathways

		Interaction term		
		Negative	**Zero**	**Positive**
Constitutive CAFSI term	Negative	Generally *reduces* conflict rates with *additional reduction* in high climate stress periods (*Conflict mitigation*)	Generally *reduces* conflict rates, regardless of whether it is a normal/high-stress period (*Conflict resilience*)	Generally *reduces* conflict rates, but *increases conflict rates* in high climate stress periods (*Punctuated rapacity*)
	Zero	No impact on conflict generally, but *reduces conflict* only during high climate stress periods (*Crisis mitigation*)	No CAFSI effect in either normal or high climate stress periods	No impact on conflict generally, but *increases conflict* during high climate stress periods (Threat multiplier)
	Positive	Generally *increases* conflict rates but *reduces* it during high climate stress periods (*Constraints on conflict*)	Generally *increases* conflict rates, regardless of whether it is a normal/high-stress period (*Sourcing conflict*)	Generally *increases* conflict with additional *increases* in high climate stress periods (*Intensified rapacity*)

4 Empirical Analysis

4.1 Data and Variables

We test our hypotheses using spatially and temporally disaggregated data on South Sudan measured at the 0.5-degree cell (~55 km × ~55 km at the equator) month level. These data were obtained from AfroGrid, a monthly dataset incorporating a wide variety of conflict, development, and climate variables (Schon and Koren, 2022). Our sample is constrained to January 2012–December 2020, which corresponds both to the period over which we collected data on INGO climate adaptation and food security interventions (CAFSI) and the empirical availability of our key dependent and independent variables. Our South Sudan empirical sample hence includes 202 0.5-degree grid cells measured over the span of 108 months, for a total of 21,816 grid 0.5-degree grid cell months. A key advantage of using this grid-month approach is that due to its disaggregation, it allows us to assess both the general impacts of CAFSI on civil war and social conflict and their immediate impacts specifically during periods of climate stress.

4.1.1 The Dependent Variables: Civil War and Social Conflict

We operationalize our two key dependent variables for civil war and social conflict events using actor-oriented data from the Armed Conflict Location and Event Data ACLED (Raleigh et al. 2010), which is in line with past research that used similar definitions (e.g., Koren and Schon 2023; Koren and Bukari 2024). Our decision to use ACLED rather than other conflict datasets is motivated by two advantages it offers. First, it records only events where subnational information was available at least to the province level and temporal information was available at least to the monthly level, making it comparable to the most fundamental levels of our CAFSI data (as discussed next). Second, ACLED codes information on conflict involving civil war actors traditionally analyzed in conflict research (state forces and rebel groups) and social conflict actors as defined in Section 2. These features, combined with its high level of geospatial and temporal coverage, make ACLED data especially useful for the purpose of analyzing the impact of INGO interventions on conflict trends at the subnational and monthly level.

Based on the conflict typology discussed in Section 2, our first dependent variable measures *civil war*, namely, events initiated by rebel (i.e., anti-government nonstate organizations) or state (military and police) forces. This variable helps capture incidents of violence more directly related to the civil war that has engulfed the country between 2011 and 2018. Our second

dependent variable measures all *social conflict* events initiated by nonaligned or pro-government nonstate actors, such as political (e.g., vigilantes, party affiliated, community focused) and identity (e.g., civil defense forces, tribal, agriculturalist, and pastoralist) militias, as well as inter- and intra-community clashes. These latter forms of conflict are prevalent in South Sudan and in eastern Africa generally (e.g., Raleigh 2010; Raleigh and Dowd 2013; Koren and Schon 2023). The lag of each dependent variable (which we include as a control in our models) was created by using conflict values from the previous month (recall that Figure 1 in Section 1 plots the total rates of civil war and social conflict events in South Sudan between January 2012 and December 2020).

4.1.2 Measuring Climate Adaptation and Food Security Interventions (CAFSI)

Our definition of climate adaptation and food security interventions (discussed in detail in Sections 1 and 2) covers all projects designed to improve local adaptability to a range of potential climate change impacts at the local level. This includes projects designed to: (1) facilitate environmental and natural resource management and environmental preservation; (2) promote food security, including boosting food and crop availability, improving production and output, and increasing food access equity; and (3) improve general resilience to climate/weather shocks and natural disasters (e.g., floods, droughts). To ensure that we capture the effect of CAFSI specifically, rather than interventions that might have been deployed alongside CAFSI to directly assist with conflict mitigation, we also coded information on interventions carried out for conflict prevention, peace building, and early warning interventions (CPP). As CPP are specifically implemented with the aim of reducing conflict, they serve as a baseline for the CAFSI effects. We also (as discussed next) include the number of CPP as controls in all our empirical models.

For each CAFSI and CPP project, we recorded information on the location (at the exact location, the village, or at least the district level) and time (exact date where available or, at the very least, the month and year during which the project was implemented or ongoing). To collect this information, we relied on policy reports and specific INGO websites. Using our conceptual and empirical definitions, we identified a total of 8,469 INGO project-months in South Sudan in 150 locations within the January 2012–December 2020 period. Of these, 6,350 intervention months had a CAFSI dimension, 1,351 had a CPP dimension, and 768 involved both CAFSI and CPP approaches (again, map of all CAFSI and CPP interventions in South Sudan for January 2012–December 2020 is provided in Figure 2, Section 1).

To test Hypotheses H3a–H7b, we coded whether each CAFSI included measures designed to facilitate adaptation by promoting *general preparedness* and *community building*. We discussed our definition of general preparedness and how it differs from specialized preparedness in Sections 2 and 3.

For illustration, Figure 3 breaks down the primary program focus/category for CAFSI and CPP intervention months (plot a) and whether general preparedness or community building measures were employed in each CAFSI intervention month (plot b). Examining the plot (a), we can see that of the 7,118 CAFSI program months, the majority (5,831) focused primarily on improving food security, 1,191 emphasized broader climate adaptation, and only a small portion (60) focused on environmental management and resource preservation. Of the CPP programs, the majority (1,043) emphasized peacebuilding, 224 focused on

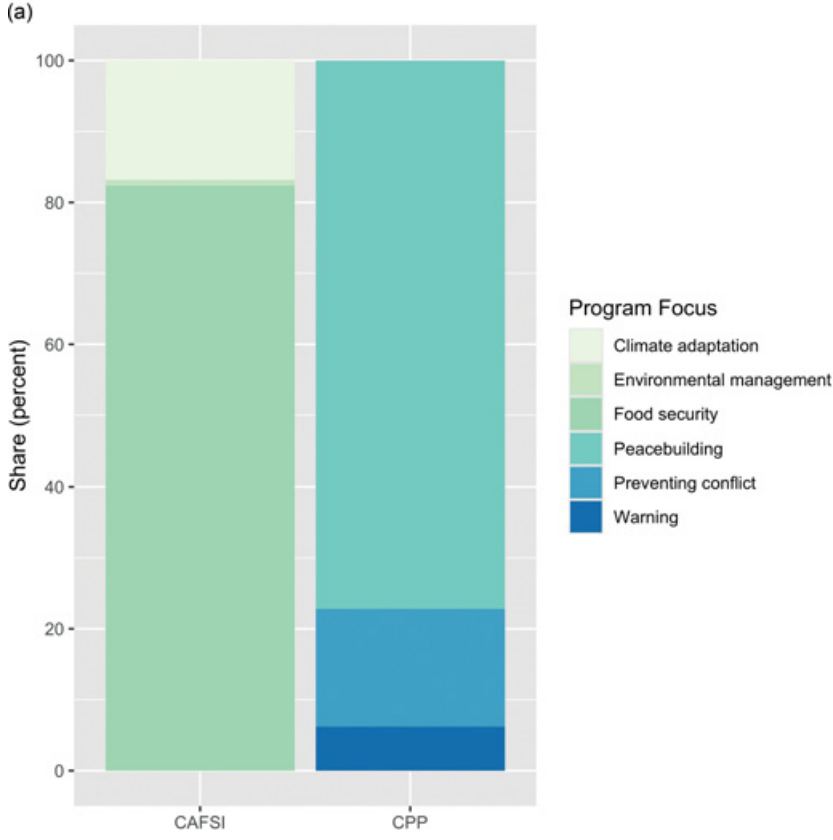

Figure 3 Each program category's share in CAFSI and CPP projects (a) and the share of CAFSI that emphasized community building and general preparedness across the three CAFSI categories (b)

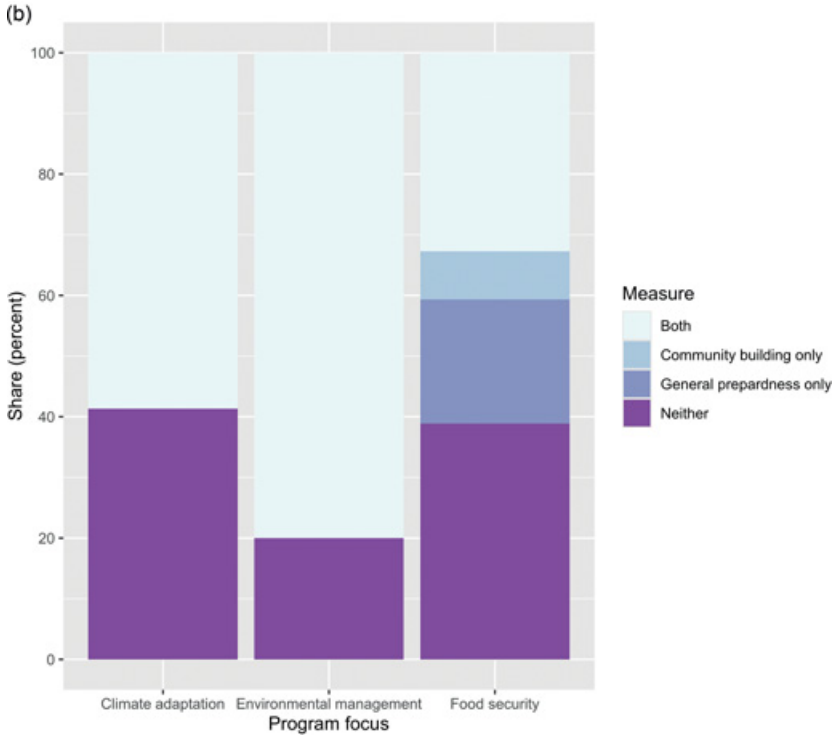

Figure 3 (cont.)

general conflict prevention, and 84 focused on early warning. Looking at the plot (b), we can see that most climate adaptation and environmental management program months (which constitute a minor share of CAFSI project months) involved both general preparedness and community building measures. In contrast, food security projects, which contribute more than 80% of the CAFSI project months, include 1,191 project months that involved only general preparedness measures and 464 project months that included only community building measures, in addition to project months that involved both or neither one of these measures.

To provide a better understanding of the INGO CAFSI and CPP landscape in South Sudan, it is also useful to report some additional descriptive statistics. In terms of scale, these projects range from targeted short-term interventions to multi-year, multiple-outcome operations. We sought to code projects discretely and independently of each other to the extent possible, However, at least for big INGOs, there could be some project overlap. Moreover, some projects could include both CAFSI and CPP aspects. As a result, our variables look at projects

type and features as distinct variables, which allows us to evaluate their distinct impact on conflict, while taking empirical steps including clustering standard errors by locations to account for potential heterogeneous effects.

Another aspect that might be of interest is how long different CAFSI and CPP projects last, which could affect their efficacy mitigating conflicts. The plot (a) in Figure 4 reports the average length of a project across each of the program focus types. The longest average running projects in our sample are environmental management CAFSI and early warning interventions, which makes sense, considering these types of interventions seek to establish long-term mechanisms. Straightforward climate adaptation projects run for about 6.5 years on average, while food security and conflict prevention projects run for about 5 years, on average. Interestingly, peacebuilding projects are the shortest, on average, although this might be because they did not start until after the civil war ended.

Additionally, recall from Table 4, that while program focus our key interest, the type of funder could also be relevant, at least to future researcher seeking to better understand climate adaptation and its relationship to socioeconomic development (including conflict) in South Sudan. The plot (b) in Figure 4 plots the share of each type of donor (state, nonstate, or mixed state and nonstate) for each program category. This plot suggests some interesting interpretations. For instance, climate adaptation and environmental management are all state or mixed funded, suggesting that these issues have a strong top-down policy structure, with states heavily pushing to address climate change and environmental issues (even if this might not be at the best interest of local populations). Food security projects exhibit a variety of different funder types, suggesting this issue is high across many developmental agendas. Finally, CPP programs have a large portion of nonstate donors, suggesting these issues are mostly the interest of nonstate organizations (IOs and INGOs).

4.1.3 Distinguishing between General and Immediate Impacts of CAFSI

To distinguish these general effects from the immediate impacts of CAFSI on conflict during high climate stress times, as hypotheses H5a–H7b propose, we must treat CAFSI's effect as conditional, distinguishing between the impact of CAFSI on conflict during normal climate stress periods times of high climate stress. This distinction is in line with research that highlights that environmental security moderates conflict dynamics (Schon et al. 2023), suggesting (as discussed in the detail in the previous section) that any conflict-ameliorating impacts might also be moderated. Accordingly, the climate stress moderator should capture months when and locations where high levels of climate stress

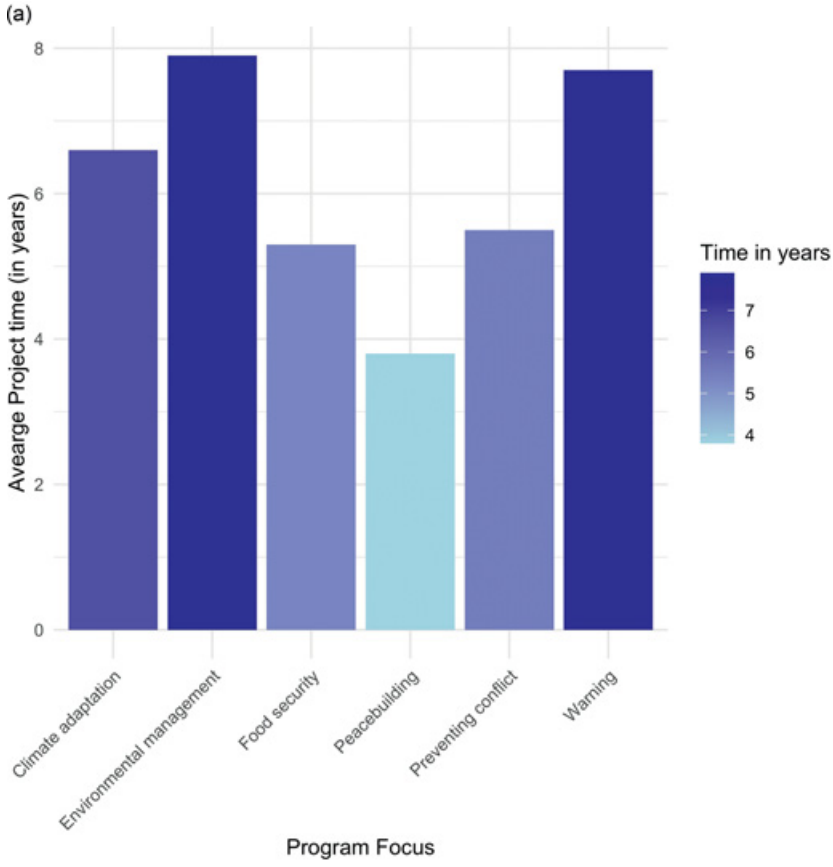

Figure 4 Average project length (a) and donor type share (b) for each program focus

were experienced. In line with past research (e.g., Burke et al. 2009; Hendrix and Salehyan 2012; Maystadt and Ecker 2014; Ide and Kristensen 2021; Sarbahi and Koren 2022), we conceptualize high climate stress as the occurrence of drought, floods, and heatwaves.

Here, we construct a 0.5-degree cell-month indicator that specifically operationalizes high climate stress months at this geospatial resolution in two steps. We first define, for each cell-month, whether it experienced a natural shock, namely a flood, which we define as months when the Standardised Precipitation Evapotranspiration Index (SPEI) – recommended by the extant research as the most effective measure of water surpluses and deficits (Schon and Koren 2022) – was above the 95th percentile; a drought, which we operationalize as months when SPEI was below the 5th percentile; and/or a heatwave, which we operationalize as months when temperature anomalies where above the 95th percentile. In the second step, we then

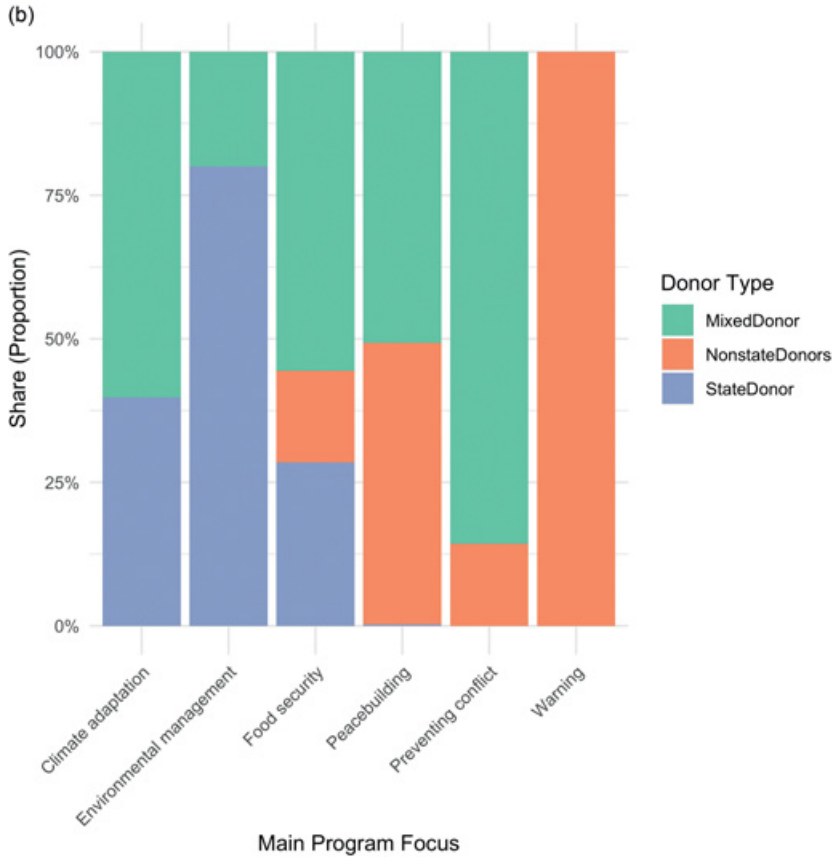

Figure 4 (cont.)

code "high climate stress" locations as cells that experienced at least one of these natural shocks during a given month (=1, =0 if no shock occurred). The resulting variable records 1,400 cell-months that experienced high climate stress, compared with 15,574 that did not and 4,842 observations with missing information on the underlying SPEI and temperature anomaly variables. Because we are interested in the immediate lagged impact of CAFSI, we did not lag this indicator by one month, unlike our other variables.

4.1.4 Accounting for Key Confounders

All our models also include several variables to account for alternative confounders that might drive the results. Building on empirical research recommendations (e.g., Schrodt 2014), we only account for the most likely explanations, rather than include too many variables that can lead to inferential problems and biases.

Here, we first add our 0.5-degree cell-month CPP variable mentioned earlier to ensure that the results are not driven by interventions specifically designed to reduce conflict risk by promoting conflict prevention, peacebuilding, and early warning programs. Second, we include a control for population densities within each 0.5-degree cell during a given year to account for the potential linkages between resource pressures and conflict, especially within weather-shock susceptible areas as well as the broader availability of recruits. This indicator was derived from WorldPop's 0.08 degree (1 km) annual population data (Yin et al. 2021) and included in AfroGrid (Schon and Koren 2022). Third, we include a variable measuring the local number of internally displaced persons (IDPs) to account for the possibility that greater numbers of IDP can be linked to conflict via a variety of mechanisms (Lichtenheld and Schon 2021). Information for constructing this variable – which measures the total number of IDPs in each 0.5-degree cell annually – was obtained from yearly IDP reports on South Sudan available on the UN Institute of Migration's website (IOM 2022). Note that this indicator exhibits limited variability over time with respect to climate stress, which caused to its omission from the interactive models.

Finally, we sought to control for the impact of climate stressors via other types of general weather variability, which is directly affected by climate trends, and which thereby accounts for the potential impacts of climate change on conflict via changing weather patterns. Here, we included controls for local mean temperature and mean precipitation levels at the 0.5-degree cell-month level. Information for constructing this variable was obtained from the CRU TS monthly high-resolution gridded multivariate climate dataset (Version 4) (Harris et al. 2020), and both variables were included in AfroGrid (Schon and Koren 2022). Summary statistics for all variables are provided in Table 3.

4.2 Empirical Framework

To identify the impact of CAFSI on civil war and social conflict, we conduct two stages of analysis, each using a different estimator. We begin by employing a set of linear models accounting for time-specific trends and local level heterogeneities as recommended by extant econometric research (e.g., Angrist and Pischke 2009). These models are mathematically formalized as:

$$y_{it} = \beta_0 + \beta_1 a_{it-1} + \beta_2 c_{it-1} + \beta_3 \ln p_{it-1} + \beta_4 \ln i_{it-1} + \beta_5 \ln r_{it-1} + \beta_6 h_{it-1} + \beta_7 \ln y_{it-1} + \beta_8 t_t + \boldsymbol{m_t} + \epsilon_i \quad (1)$$

Table 3 Summary statistics of all variables

Variable	Min.	Median	Mean	Max	SD
$Civil\ war_{it}$	0	0	0.133	38	0.900
$Social\ conflict_{it}$	0	0	0.086	18	0.623
$CAFSI_{it-1}$	0	0	0.353	11	1.014
$CAFSI\ (GP)_{it-1}$	0	0	0.151	5	0.564
$CAFSI\ (CB)_{it-1}$	0	0	0.122	8	0.516
CPP_{it-1}	0	0	0.098	4	0.394
$Population_{it-1}{}^{1}$	0	0	0.983	11.87	2.727
$IDPs_{it-1}{}^{1}$	3.032	4.644	4.577	5.790	0.471
$Precipitation_{it-1}{}^{1}$	0	4.357	3.592	6.119	1.694
$Temperature_{it-1}$	20.60	27.50	27.67	34.20	2.097
$High\ stress_{it}$	0	0	0.083	1	0.275

Here, for each 0.5-degree grid cell i and time unit t, y_{it} is a vector measuring one of our two conflict types (civil war and social conflict) and y_{it-1} their lag; a_{it-1} is the number of CAFSI projects; c_{it-1} is the number of CPP projects; ln p_{it-1} is the (natural log of) population densities; ln i_{it-1} is the (natural log of) the number of IDPs; ln r_{it-1} is the monthly level of rainfall; h_{it-1} is monthly mean temperature; t_t is the time trend of each time period in the data; $\boldsymbol{m_t}$ are monthly fixed effects (with January treated as the baseline category); and ϵ_i are standard errors clustered by 0.5-degree cell to account for repeated measurement values and over-time heterogeneities. All independent variables are lagged by one month to account for the length of time that it might take for any impacts on conflict to unfold. Statistical significance is assessed based on whether the results achieved at least a $p < 0.1$ threshold using two-tailed tests (which are akin to a $p < 0.05$ for a one-tail test). Equation 1 is first identified using ordinary least squares (OLS) estimator.

One empirical concern in our data relates to the potential impact of endogeneity and serial correlation. For instance, CAFSI might be more likely to be implemented in areas where there is less conflict, considering it is safer for INGO workers to work in these regions. This means that a negative relationship between conflict and CAFSI might reflect an impact of the dependent on the independent variable. For instance, in his analysis of the relationship between aid and conflict, Findley (2018, 374) emphasizes "endogeneity stemming from anticipation effects: Governments or rebels may form expectations about future aid and try to anticipate its allocation." This means that even the INGO decision of where to implement CAFSI might follow conflict reduction rather than the

other way around, as governments or local armed actors who would like the resources to flow into the region might actively lower their conflict. This is even truer for CPP projects, which are especially likely to be implemented in regions that are more conflict susceptible. These issues necessitate an approach that ensures that the findings reflect only the impact flowing from CAFSI (and all other independent variables) to conflict rather than the other way around.

To address this concern, in the second stage, we estimate Equation 1 using a set of generalized method of moments (GMM) dynamic models, specifically the more robust system GMM estimator (Blundell and Bond 1998). Briefly, these models use lagged values of the dependent variable to instrument in contemporaneous values. The models are identified using as a system of (per period) equations, where the instruments applicable to each equation differ due to varying values on the lagged dependent variables at each period and location. Building on research recommendations, which emphasize that in system GMM models, instruments should be capped at shorter lag periods (Roodman 2009), we use lag dependent variables values from t–2 to t–7. We ensure this number is adequate by conducting and reporting Hansen tests, which test whether the models are overidentified. To ensure convergence in these models, we consider individual effects, which are akin to cross-sectional unit (in our case, 0.5-degree cell) fixed effects in standard linear models, while adding monthly fixed effects (the use of the system of equations over time method required us to omit the time trend). Finally, to further ensure any results we identify reflect a true relationship, in each model, we estimate robust two-stage standard errors rather than the less constricting one-step standard errors.

Equation 1 is used to test hypotheses H1a–H4b. For testing hypotheses H5a–H7b and the role of the conditional high climate stress moderator, we required to adjust this equation to identify an interactive relationship. Accordingly, for estimating our interactive models, where we distinguish between general and immediate stress CAFSI impacts, we modify Equation 1 as follows:

$$y_{it} = \beta_1 a_{it-1} + \beta_2 d_{it} + \beta_3 a_{it-1}\text{x}\ d_{it} + \beta_4 c_{it-1} + \beta_5 \ln p_{it-1} + \beta_6 \ln r_{it-1} + \beta_7 h_{it-1} + \beta_8 \ln y_{it-1} + \beta_9 t_t + \boldsymbol{m_t} + \epsilon_i \quad (2)$$

This equation is similar to Equation 1 with three key differences. First, as required by our moderated hypothesis, we added d_{it} as our indicator of whether cell i experienced high climate stress during month t, interacting it with CAFSI the previous month as $a_{it-1}\text{x}\ d_{it}$. Second, due to high overlap between lag IDPs and our high environmental stress indicator and the relatively low variability on the former, the lag IDP variable is (automatically) omitted from the models due to constancy. Third, as we rely on the "lfe" package in R (Gaure 2024),

specifically designed for estimating fixed effects regression, there is no constant, seeing that the package uses an algorithm that averages impacts across different units to expedite the fixed effects estimation part, which is often time consuming in large datasets (this has no impact on the size, direction, magnitude, and significance of the results). Like in the first step of analysis, we relied on OLS for estimating Equation 2. Unlike in Equation 1, we only relied on OLS and did not use GMM models, considering the potential consistency problems that might arise in such models when interaction terms are used (see, e.g., Hayakawa 2016). As we ensure the results in Equation 1 are robust to endogeneity, and considering the added constraint imposed by including an exogenous moderator, we do not believe this is an overriding empirical concern.

4.3 Results

4.3.1 The General CAFSI Impacts on Civil War and Social Conflict

Table 4 reports the results from six OLS models assessing the conflict rates in South Sudan. The first three models assess the impact of each variable on civil war (hypothesis H1a and its corollary H1b), examining CAFSI both without distinguishing between the two key traits of interest, and then analyzing only CAFSI with general preparedness (hypotheses H3a) and community building (hypotheses H4a), respectively. The ensuing three models then do the same, looking at social conflict (hypotheses H2a–H2b, H3b, and H4b).

Looking at the civil war models, the existence of CAFSI is associated with an increased and statistically significant risk of civil war. While this effect cannot be interpreted as causal, it does suggest that CAFSI does not have an ameliorating impact on civil war, which is in line with hypothesis H1b and potentially indicative of an even stronger positive relationship with conflict. We also do not find confirmation for hypotheses H3a (regarding CAFSI with general preparedness) and H4a (regarding CAFSI with community building). This might not be surprising – as mentioned in Section 1, civil war in South Sudan is driven by major historical political, socioeconomic, and ethnic factors, and the activity of state forces and rebels vying for the control of the state is less likely to be determined by weather shocks and climate adaptation. As was discussed in introducing the corollary hypothesis H1b, several studies posit that in the case of civil war, socioeconomic and political factors provide the most effective explanations for civil war (e.g., Buhaug 2010; O'Loughlin et al. 2012). We also do not find that CPP interventions are clearly associated with civil war reduction – the coefficient varies across these interventions and does not reach any meaningful threshold of statistical significance.

https://doi.org/10.1017/9781009510776 Published online by Cambridge University Press

Table 4 Determinants of civil war and social conflict in South Sudan (OLS)

	Civil war			Social conflict		
	All	**GP**	**CB**	**All**	**GP**	**CB**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$CAFSI_{it-1}$	0.052**	0.041*	0.082*	0.022*	−0.021**	−0.015
	(0.022)	(0.024)	(0.042)	(0.012)	(0.010)	(0.013)
CPP_{it-1}	−0.008	0.032	0.025	0.065***	0.097***	0.093***
	(0.041)	(0.046)	(0.051)	(0.020)	(0.029)	(0.028)
$Population_{it-1}{}^{1}$	0.113***	0.121***	0.120***	0.060***	0.068***	0.067***
	(0.024)	(0.027)	(0.026)	(0.012)	(0.014)	(0.014)
$IDPs_{it-1}{}^{1}$	−0.007***	−0.005***	−0.006***	0.007**	0.009***	0.009**
	(0.002)	(0.002)	(0.002)	(0.004)	(0.003)	(0.003)
$Precipitation_{it-1}{}^{1}$	−0.006	−0.007	−0.007	−0.007	−0.008	−0.008
	(0.011)	(0.011)	(0.011)	(0.006)	(0.006)	(0.006)
$Temperature_{it-1}$	−0.006	−0.006	−0.006	0.002	0.001	0.002
	(0.008)	(0.008)	(0.008)	(0.004)	(0.004)	(0.004)
DV_{it-1}	0.419***	0.424***	0.421***	0.243***	0.248***	0.248***
	(0.046)	(0.045)	(0.044)	(0.051)	(0.051)	(0.051)

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Table 4 (cont.)

	Civil war			Social conflict		
	All	**GP**	**CB**	**All**	**GP**	**CB**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Time trend	−0.0002	−0.0001	−0.0001	0.0005***	0.001***	0.001***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0001)
Constant	−0.185	−0.239	−0.204	−0.447***	−0.467***	−0.474***
	(0.184)	(0.187)	(0.189)	(0.112)	(0.114)	(0.113)
Observations		21,614			21,614	
R^2	0.195	0.193	0.195	0.070	0.069	0.069
Adjusted R^2	0.195	0.193	0.194	0.069	0.068	0.068

Standard errors clustered on grid cell in parentheses; fixed effects by month were included in each regression, although none are reported here. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.[1] Natural log.

Moving on to the social conflict models, the results become more interesting. Examining the impact of CAFSI generally, we observe – again – a positive and statistically significant association ($p < 0.1$) with social conflict events. This confirms the corollary hypothesis H2b and might suggest that improving productivity and resilience facilitates social conflict-hospitable conditions, as some studies have suggested (Koren 2018, 2019; Linke and Ruether 2021; Schon et al. 2023).

However, in line with hypothesis H3b, when we only look at CAFSI that have general preparedness measures, the relationship reverses – CAFSI that emphasize general preparedness are associated with a decrease in social conflict rates, a coefficient that is statistically significant ($p < 0.05$). Substantively, the expected rate of monthly social conflicts is associated with a decrease (from an average monthly social conflict rate of 0.0858) of about 24% for every additional implementation of a CAFSI project that emphasizes general preparedness measures.

We also find that CAFSI that include community building measures are negatively associated with social conflict rates, but as this effect is not significant according to any statistical threshold, we cannot confirm hypothesis H4b. Interestingly, we find that CPP are positively and significantly associated with more social conflict across all models, although considering that CPP might be more likely to be implemented where and when there is more conflict, the risk of endogeneity should be accounted for before these results are interpreted.

Finally, we find that both civil war and social conflict rates are higher where there is more population; that civil war is negatively and significantly associated with IDPs (unsurprisingly, seeing most IDPs in South Sudan have been displaced by civil war and move away from combat zones) and positively and significantly associated with social conflict in the relevant models; and that weather trends do not have a statistically significant impact on civil war or social conflict, which might suggest that CAFSI should yield an impact on conflict that is distinct from its impact via weather and climate channels, although we must first ascertain their conditional impact on conflict during high climate stress times to fully ascertain this claim.

In Table 5, we reevaluate these models, accounting for serial correlation and simultaneity due to potential endogenous policy responses using two-step system GMM models. Even after accounting for these concerns, our findings remain largely unchanged, suggesting endogeneity is not driving the results. Examining CAFSI in general, we again find a positive relationship with civil war (which goes beyond the corollary hypothesis H1b to suggest CAFSI may actively drive civil war risk), although the coefficient on CAFSI that emphasizes general preparedness, while positive, is no longer statistically significant.

https://doi.org/10.1017/9781009510776 Published online by Cambridge University Press

Table 5 Determinants of civil war and social conflict in South Sudan (GMM)

	Civil war			Social conflict		
	All	**GP**	**CB**	**All**	**GP**	**CB**
	(7)	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
$CAFSI_{it-1}$	0.045**	0.034	0.068*	0.019*	−0.012*	−0.009
	(0.022)	(0.023)	(0.039)	(0.011)	(0.007)	(0.008)
CPP_{it-1}	0.004	0.041	0.029	0.057***	0.088***	0.084***
	(0.036)	(0.042)	(0.047)	(0.021)	(0.030)	(0.029)
$Population_{it-1}{}^{1}$	0.062***	0.064***	0.067***	0.043***	0.046***	0.046***
	(0.016)	(0.017)	(0.017)	(0.009)	(0.009)	(0.009)
$IDPs_{it-1}{}^{1}$	−0.004**	−0.002	−0.003**	0.008***	0.009***	0.009***
	(0.002)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)
$Precipitation_{it-1}{}^{1}$	−0.009	−0.009	−0.010	−0.008*	−0.008	−0.008
	(0.007)	(0.007)	(0.007)	(0.005)	(0.005)	(0.005)

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$Temperature_{it-1}$	−0.007***	−0.008***	−0.008***	−0.006***	−0.006***	−0.006***
	(0.003)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)
DV_{it-1}	0.425***	0.429***	0.427***	0.256***	0.260***	0.260***
	(0.046)	(0.045)	(0.045)	(0.051)	(0.051)	(0.051)
Observations		21,614			21,614	
Sargan test	106.78	112.77	104.39	109.52	106.85	110.14
AR(1)	−3.112***	−6.048***	−3.062***	−5.967***	−3.141***	−6.001***
AR(2)	0.832	3.616***	0.865	3.643***	0.858	3.974***

Two-step robust standard errors in parentheses; fixed effects by month were included in each regression, although none are reported here. Internal instruments for all GMM models are DV $t-2$ to $t-7$ lags. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. [1] Natural log.

Moving to social conflict, we find that the CAFSI coefficients maintain their sign and significance, although the coefficient in the general preparedness model – while still negative – is only statistically significant to the $p < 0.1$ (two-tail test) level, which still supports hypothesis H3b. We also find that – once serial correlation is empirically accounted for – temperature's coefficient is now significantly and negatively associated with civil war and social across all models, suggesting conflict intensifies during cooler periods.

Overall, Table 5 supports the results in Table 4, suggesting that CAFSI with general preparedness – and potentially CAFSI with community building – measures can reduce social conflict, but that otherwise CAFSI is, if anything, more likely to contribute to conflict intensity. However, as these results do not distinguish between the levels of climate stress, they might mask some of CAFSI's more immediate and specific impacts, which we ascertain next.

4.3.2 Differentiating CAFSI Impacts across High and Regular Stress Periods

In Table 6, we distinguish the impact of CAFSI on civil war and social conflict across the levels of climate stress. This assessment hence allows us, in effect, to estimate whether CAFSI's impacts are due to their ability to mitigate stress or via alternative means such as building social cohesion and residence. Examining CAFSI's effects during periods of normal climate stress, the constitutive coefficient of CAFSI is now positive across all models, and statistically significant for all CAFSI and CAFSI with community building measures in the case of civil war, and for all CAFSI in the case of social conflict. While most of these results are in line with Tables 4 and 5, Table 6 also suggests that the impact of CAFSI with general preparedness might not lead to lower social conflict rates during months of normal climate stress, as the coefficient in these models is practically nil; rather, the effect might be mostly confined to high-stress periods.

However, during periods of high climate stress, we find that CAFSI are associated with reduced risks of both civil war and social conflict across all models, as illustrated by the negative $CAFSI_{it-1}$ X $High\ stress_{it}$ coefficient across all models. The coefficient is statistically significant across all social conflict models, which is in line with hypotheses H5b, H6b, and H7b, and suggests that CAFSI can noticeably contribute to reducing social conflict rates during high climate stress periods, although we must ascertain this effect visually before interpreting it substantively. Nevertheless, the results do suggest that CAFSI's impacts are greater during periods of high climate stress compared with normal stress months, underscoring the important externality these features might have regarding conflict and its determinants.

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Table 6 Determinants of civil war and social conflict in South Sudan (interactive models)

	Civil war			Social conflict		
	All (13)	**GP (14)**	**CB (15)**	**All (16)**	**GP (17)**	**CB (18)**
$CAFSI_{it-1}$	0.075**	0.055	0.113**	0.033**	0.003	0.015
	(0.032)	(0.039)	(0.056)	(0.013)	(0.010)	(0.019)
$High\ stress_{it}$	0.017	0.007	0.011	−0.016	−0.022	−0.021
	(0.024)	(0.024)	(0.023)	(0.016)	(0.016)	(0.016)
$CAFSI_{it-1}$ X $High\ stress_{it}$	−0.051	−0.032	−0.072	−0.042**	−0.048*	−0.079***
	(0.033)	(0.046)	(0.070)	(0.020)	(0.028)	(0.030)
CPP_{it-1}	−0.003	0.047	0.047	0.035**	0.064**	0.063***
	(0.045)	(0.058)	(0.061)	(0.017)	(0.025)	(0.024)
$Population_{it-1}{}^{1}$	0.123***	0.132***	0.131***	0.070***	0.076***	0.075***
	(0.026)	(0.029)	(0.028)	(0.014)	(0.015)	(0.015)
$Precipitation_{it-1}{}^{1}$	−0.018	−0.019	−0.019	−0.003	−0.004	−0.004
	(0.012)	(0.012)	(0.012)	(0.006)	(0.006)	(0.006)
$Temperature_{it-1}$	−0.004	−0.004	−0.005	−0.001	−0.002	−0.002
	(0.009)	(0.009)	(0.009)	(0.004)	(0.004)	(0.004)
DV_{it-1}	0.412***	0.417***	0.415***	0.196***	0.203***	0.202***
	(0.047)	(0.045)	(0.045)	(0.051)	(0.052)	(0.052)

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Table 6 (cont.)

	Civil war			Social conflict		
	All (13)	**GP (14)**	**CB (15)**	**All (16)**	**GP (17)**	**CB (18)**
Time trend	0.0005	0.001**	0.001*	0.001***	0.001***	0.001***
	(0.0004)	(0.0004)	(0.0003)	(0.0002)	(0.0002)	(0.0002)
Observations	16,772	16,772	16,772	16,772	16,772	16,772
R2	0.192	0.190	0.191	0.060	0.058	0.058
Adjusted R^2	0.191	0.189	0.190	0.059	0.056	0.057

Standard errors clustered on grid cell in parentheses; fixed effects by month were included in each regression, although none are reported here. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. [1] Natural log.

Referring to Table 2 from Section 3, these results suggest that in the case of CAFSI in general, the dynamics are in line with the constraints on conflict pathway (positive constitutive term, negative interaction, bottom left cell). For the specialized cases (CAFSI that emphasize general preparedness and community building), these results are in line with the crisis mitigation pathway from Table 2 (center left cell), where CAFSI is only relevant in helping to reduce social conflicts that result from extreme stress. As we discuss in Section 5, these results are interesting because they suggest that the most effective way CAFSI addresses social conflict is by directly addressing the impact of climate stressors in this regard, rather than building more general resilience and cohesion.

Finally, examining the constitutive term's *High stress*$_{it}$ coefficient, we observe that locations and months without CAFSI are positively associated with civil war and negatively associated with social conflict across all models, although never crossed any meaningful threshold of statistical significance. Accordingly, we cannot conclude that we identify any support for hypotheses H5a, H6a, and H7a.

In Figure 5, we ascertain the exact magnitude and impacts of each CAFSI on social conflict across regular and high climate stress periods. Beginning with the plot (a) (all CAFSI), we observe that during regular stress periods, a CAFSI is associated with an expected increase in social conflict rates of about 0.03 conflict events (from a mean of 0.086 events in a given cell-month, or about 35% increase). However, during periods of high climate stress, CAFSI's contribution is to bring these higher social conflict levels back to a level corresponding to the sample's baseline. Hence, while CAFSI projects do not necessarily lower social conflict rates below sample average during periods of high stress, they do – in line with the constraints on conflict pathway from Table 2 in Section 3 – nevertheless help in reducing social conflict rates compared with periods of normal climate stress.

Examining CAFSI with general preparedness and community building measures, we find more interesting results. Looking at the effect of CAFSI that emphasize general preparedness (plot b), we find that such measures are not associated with greater than average social conflict rates during regular stress periods (the center practically sits on the zero axis). However – and again, in line with the crisis mitigation pathway from Table 2 – a CAFSI that emphasizes general preparedness is associated with a reduction of 0.049 (or about 57%), on average, in expected social conflict rates for a one-intervention change, although as the 95% confidence bars of both effects overlap (considering this coefficient was only significant to the $p < 0.1$ level, two-tail test), however, we cannot safely conclude this effect.

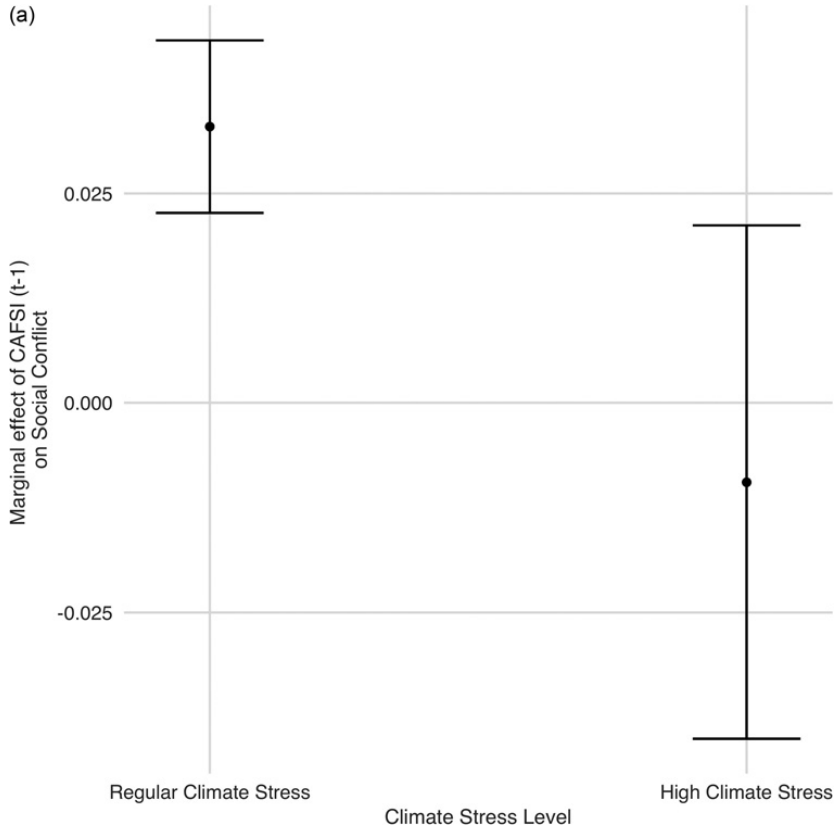

Figure 5 Change in CAFSI's coefficient across regular and high climate stress periods for all CAFSI (a), CAFSI with general preparedness measures (b) and CAFSI with community building measures (c)

The strongest – and potentially most interesting – effect of CAFSI across regular and high climate stress periods is observed in the case of CAFSI with community building measures (plot c). Here, CAFSI projects that emphasize community building are associated with an increase of about 0.02 (or 24%), on average, in expected social conflicts rates during periods of regular stress. However – and again, in line with the crisis mitigation pathway from Table 3 – during periods of high climate stress, a one-project increase in CAFSI that emphasize community building is associated with an expected decrease of 0.06 events (or about 70%), on average, in social conflict rates. We also observe that in this plot, the 95% error bars do not overlap across regular and high climate stress periods, suggesting we can safely conclude this effect of CAFSI with community building measures. This finding is in line with the idea that community building can help in reducing conflict

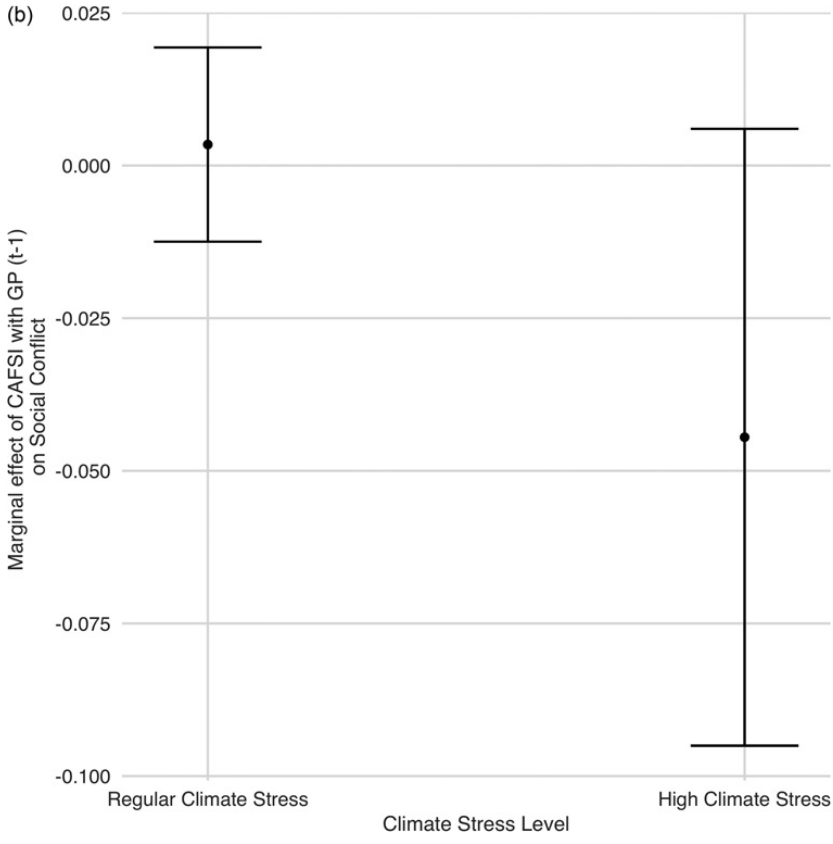

Figure 5 (cont.)

resulting from high climate stress, which is in line with the expectations of research on environmental peacebuilding (e.g., Ide et al. 2021; Sharifi et al. 2021), seeing this effect is clearly distinct across normal and high climate stress periods.

5 Lessons for Climate- and Climate Adaptation–Conflict Research and Policy

Building on the previous sections, our key findings are that (1) CAFSI that focus on general preparedness are robustly linked to social conflict reduction, (2) all CAFSI help in reducing social conflict during high climate stress times, but (3) otherwise, CAFSI is plausibly linked to more civil war and social conflict. In this section we delineate several suggestions that can help in advancing research on, and policy related to, the intersection of climate change and adaptation and conflict.

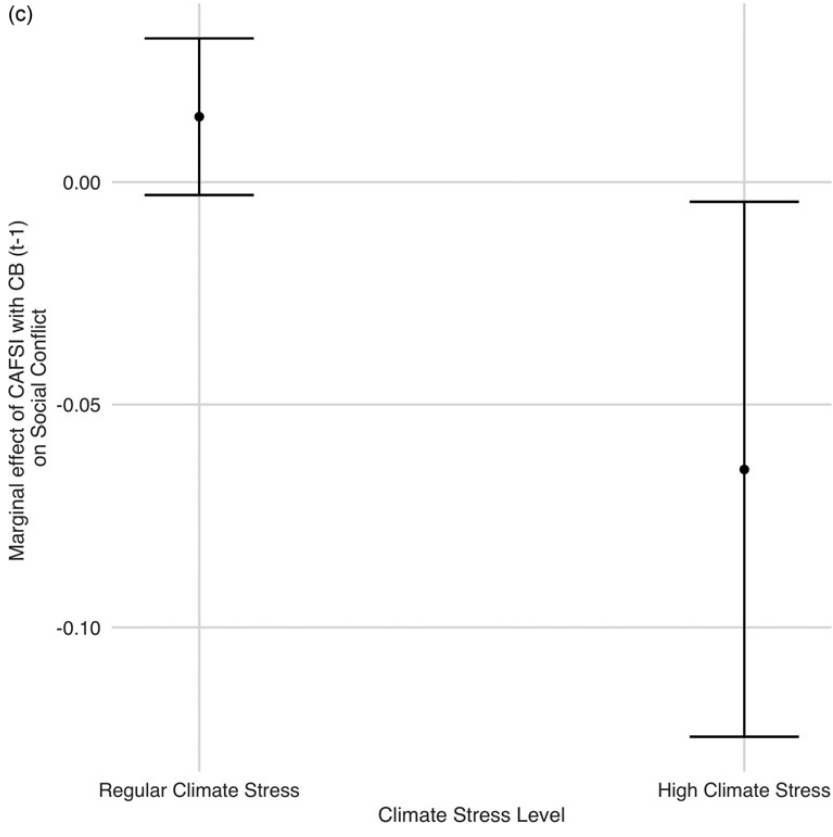

Figure 5 (cont.)

5.1 Implications for Research and Future Directions of Inquiry

5.1.1 Implications for Research on Civil War and Climate Change

For civil war, several of our models point to the possibility of a positive association with CAFSI. Granted, as the interactive models suggest, that CAFSI may help in reducing civil war rates during high climate stress periods (as illustrated by the negative coefficient on the interactive term in Table 6 across all CAFSI types analyzed), but seeing that the relationship is not significant, we cannot conclude that this is the case. This confirms, at the very least, the corollary hypothesis H1b – that CAFSI should not noticeably impact civil war – is correct. Moreover, considering the relatively robust positive associations (excluding in the general preparedness models), CAFSI may actively drive civil war rates in South Sudan. What might explain these findings?

One possibility is that civil war might intensify when CAFSI provide an opportunity for actors to engage in violence. This perspective is similar to the claim made by Schon et al. (2023) that civil war patterns follow an opportunity and willingness framework: harsh climate gives actors the willingness to engage in violence, but they will follow up on these incentives only when the opportunity comes along, namely during more environmentally secure times and (per the CAFSI logic) locations. If CAFSI improves local conditions, this suggests such conditions provide more opportunity for civil war to unfold.

A second related logic emphasizes sourcing conflicts (the bottom-center cell in Table 2 of Section 3). We discussed this pathway when we derived our social conflict corollary (hypothesis H2b), but it is possible that rebels and potentially state forces are more sensitive to logistical considerations and the need to secure local resources for revenue. From this perspective, these actors will engage in conflict to source (or prevent the other side from sourcing) agricultural resources for consumption and trade (e.g., Koren and Bagozzi 2017; Linke and Ruther 2021; Koren and Schon 2023). Additionally, if CAFSI implementation is more likely in areas where there is some level of state presence, then rebels might move into locations with CAFSI projects to source produce and related revenues, leading to more interactions (and hence more conflict) with state forces. Controlling CAFSI locations may also appeal to both rebels and state forces compared with controlling non-CAFSI areas, leading to more fighting over these areas.

Finally, if CAFSI increase local resilience and help in strengthening local livelihoods, they can impact the balance of capabilities between those who control these regions and their (rebel or state) adversaries. This, in turn, may affect the likelihood of civil conflict involving these actors. This is true if regions under the control of rebels are the beneficiaries of CAFSI, as an increase in the relative strength of rebels is "more likely to produce high intensity violence, significantly challenge core government interests, and fundamentally threaten the survival the regime" (Clayton 2013, 611). Regardless of what explains the results, however, the ultimate conclusion is that they contradict the logic that adaptation should uniformly lead to pacification across all types of conflict, as suggested by past research (e.g., Regan and Kim 2020). The fact that this does not seem to be the case with civil war thereby illustrates the usefulness of using more localized adaptation data to assess these relationships.

Future research could explore the viability of these different relationships, focusing on other countries and contexts. One possibility is that if more information is collected across more countries, the signal regarding the moderating effect of CAFSI on civil war during high climate stress times will become clearer. To this end, we recommend extending the data collection effort on

CAFSI, building a cross-national, geolocated dataset of such interventions across all regions susceptible to climate change. Such data will open new avenues for research and help to improve our understanding of these dynamics.

A related future research direction would be to identify specific cases in which areas where CAFSI were implemented extensively were subjected to attacks by rebels or state forces. Building on interviews with locals and analysis of the types of attacks and their focus, scholars will identify what motivations seem to be driving such dynamics, and whether they are driven by rapacity, resilience (which provides more infrastructure and capacities for fighting as suggested, e.g., by Schon et al. 2023), or other motivations. Researchers can also make use of secondary cases and reports of such incidents, as done by past mixed-methods research into the motivations of rebels to engage in violent behaviors related to natural and agricultural resources (e.g., Urtuzuastigui and Koren 2024). At this point, however, our results suggest that any pacification of civil war is more likely to be determined by socioeconomic and political dynamics, especially ones happening at the country level (e.g., Kalyvas 2003; Thiesen 2013; Buhaug 2010; van Weezel 2020). If this is the case, then the results suggest that future studies should explore what role political institutions play, and in what context. Incorporating the role of climate adaption into frameworks that look at the relationship between climate stress and political institutions, for instance, can yield new understandings in these regards.

Another future research direction involves understanding the broader socio-political adaptation and mitigation dynamics that could create socioeconomic opportunities that can alleviate conflict as well as the stress that leads to more civil war (Gilmore and Buhaug 2021; Buhaug et al. 2023). Here, an especially important aspect relates to how mitigation efforts (as opposed to adaptation) can shape civil war and even international conflict dynamics. As mitigation happens primarily at the national and international level, its interactions with local level violence are more complex and require careful thinking and effectively modeling the exact pathways that link these different hierarchies. From this perspective, future research should consider the long-term effects of climate (as defined, e.g., by the IPCC 2022) on war and then incorporate the role of mitigation and adaptation therein. Considering the importance of understanding the punctuated shift changing climate could induce on local environments, we believe this is an especially valuable direction for future research.

5.1.2 Implications for Research on the Climate–Social Conflict Nexus

The finding that climate adaptation with specific features can reduce social conflict rates in specific stress contexts is possibly the most important finding of

our study. Future work can focus more on specific pathways that link climate adaptation to social conflict. This includes improving our understanding of what kinds of demands shape the behavior of social conflict actors that exist in local contexts and how adaptation can better address these issues. Here, specifically exploring how having projects that seek to address multiple outcomes – especially with respect to addressing both the effects of climate change and the risk of conflict – can yield important understandings of building general resilience in local communities. Our results suggest that such projects could be more likely to achieve their aims compared with projects that focus only on adaptation. This conclusion is supported by studies on environmental peacebuilding that highlight the importance of incorporating multiple matrixes into project design (e.g., Peters and Kelman 2020) as well as studies that illustrate the efficacy of environmental approaches to peacebuilding (e.g., Ide et al. 2021; Shariffi et al. 2021).

Future work can improve our understanding of these parallel relationships. Moreover, this Element provides two potential explanations as to why environmental peacebuilding via improved adaptation and food security improvements is viable. First, improving preparedness increases resilience to shocks, reducing the need for competition. Second, there might be an added conflict resolution effect of community building to that of CAFSI in general. More research can explore these intersections – resilience, community building, adaptation, and peace. Yet, as with the case of civil war, more data on CAFSI is needed, considering environmental peacebuilding studies tend to rely primarily on case studies. Another data-driven direction is to create more specialized datasets on social conflict, for instance, by leveraging local UN reports on social conflicts and attempting to identify their causes. While open-source dataset such as ACLED (Raleigh et al. 2010) code a variety of conflict types, relying on local policy reports from policymakers in the field (including UN and INGO workers), creating a specialized dataset can help in testing which events are being recorded by such openly available datasets and which ones might be omitted, improving data calibration.

The finding that the effect of CAFSI on social conflict are driven by their impact during high climate stress periods first supports studies linking such shocks to violence in agrarian areas (Bagozzi et al. 2017; Koren and Bagozzi 2017). The results also suggest that both during and outside of high climate stress periods, resource demand incentives may play an important role in the decision of social conflict actors to engage in violence, which is in line with past research (e.g., Link and Ruther 2021; Schon et al. 2023; Koren and Schon 2023). In these regards, future research will benefit from considering how to improve agricultural productivity via adaptation while simultaneously lowering

the incentives of social actors to engage in violent looting. Finally, as is the case with research on the climate-civil war nexus, such work will also benefit from incorporating the role of political institutions at both the local and national levels on moderating these adverse impacts, while maximizing the success of adaptation.

5.2 Policy Lessons for Designing CAFSI

The results also help us parcel out exactly which aspects of CAFSI are most relevant in addressing, at the very least, social conflict. We build on the insights from our study to suggest four potential ways to design adaptation intervention that can both improve chances of adaptation success and help in reducing conflict risks.

5.2.1 Incorporating a Multiple-Outcome Perspective

One important lesson from our findings is the value of designing CAFSI to address multiple outcomes, such as climate adaptation and conflict mitigation, simultaneously. A key aspect often overlooked in climate adaptation efforts is the role of externalities – unintended second-order impacts of interventions – on downstream phenomena like armed conflict (Buhaug et al. 2023). In our analysis, we find that some CAFSI features, while directly improving climate adaptation, also reduce social conflict. This suggests that integrating multiple objectives into CAFSI design can optimize their overall efficacy. For example, addressing broader goals, such as improving general preparedness rather than narrowly targeting specific outcomes, can enhance resilience to climate variability and simultaneously reduce conflict risks by mitigating competition for scarce resources (Nadiruzzaman et al. 2022; Buhaug et al. 2023).

Considering multiple outcomes also benefits donors and local communities. For donors, designing CAFSI with synergistic impacts on conflict and adaptation offers greater "bang for buck," as interventions with broader positive externalities may yield more sustainable resilience over time. This aligns with our findings that general preparedness measures, even if imperfect, can reduce the likelihood and severity of climate-related shocks while fostering peacebuilding and development. Furthermore, integrating local concerns – such as balancing the priorities of adaptation, security, and livelihoods – ensures that CAFSI are not only technically robust but also contextually relevant and inclusive. By optimizing interventions to address these interconnected goals, implementers and donors can enhance the effectiveness of CAFSI in achieving long-term resilience and stability.

5.2.2 Ensuring That Conflict-Mitigating Features Are Included in CAFSI

Our findings demonstrate that two key features of CAFSI – promoting general preparedness and fostering community building – are instrumental in mitigating social conflict. When either of these features is present, the baseline impact of CAFSI on conflict during periods of regular climate stress aligns with the sample's baseline levels, while during high-stress periods, such CAFSI significantly mitigate conflict. As we mentioned in Sections 1 and 2, CAFSI interventions that integrate these features, such as the WFP-financed 2018 initiative in Tonj South, show how addressing multiple climate-induced stressors (e.g., planting climate-resistant crops, building water conservation infrastructure) can enhance both adaptation and conflict mitigation outcomes. This intervention simultaneously improved harvests, safeguarded water access, and fostered cooperation between previously warring communities, illustrating the dual benefits of such designs.

The key takeaway is that improving CAFSI's ability to address both adaptation and conflict does not require drastic changes to current intervention designs. For CAFSI emphasizing general preparedness, incorporating measures like early disaster warning systems, climate-resistant technologies, and locally tailored political institutions can address a range of stressors and shocks. For those focusing on community building, fostering intra- and inter-community cohesion and creating institutional arrangements to improve information flow and engagement are crucial. Evidence supports that collaborative community responses to climate stressors not only enhance adaptation but also reduce conflict by protecting livelihoods and preserving essential resources (Ostrom 2009; Ide et al. 2021; Ide 2023). These approaches highlight the value of leveraging existing tools to achieve integrated outcomes in adaptation and peacebuilding efforts.

5.2.3 Optimizing Adaptation for Addressing High Climate Stress

Another policy relevant finding is that CAFSI are more likely to mitigate social conflict more effectively during times of high climate stress. This finding is in line with past studies (e.g., Regan and Kim 2020) that similarly find that adaptive capacities can reduce the effect of climate stress on conflict. From a conflict-centric perspective, this suggests that CAFSI that focus on countering high extreme stress – rather than improving resilience more generally – can achieve greater conflict mitigation impacts. Because climate change is predicted to raise the frequency of extreme weather events (e.g., severe floods, prolonged droughts, major storms, heatwaves, etc.) (IPCC 2018), optimizing CAFSI to specifically address the impact of such stressors also makes sense from a straightforward disaster damage control perspective (Formetta and Feyen 2019).

Our results show that optimizing CAFSI to effectively respond to high-stress scenarios can be especially helpful in mitigating conflict. This approach – focusing on weather extremes – is different from considering the relationship between CAFSI and climate change based on its average effects. The latter involves, for instance, facilitating or allowing individuals to resume earlier livelihood styles, and improving food outputs. Per our findings from the first two tables in Section 4 as well as past research on the link between improved output and violence under climate change conditions (e.g., Koren 2018, 2019; Schon et al. 2023), there is a risk that such approaches could lead to a potential increase in conflict rates. In contrast, trying to reduce the effect of extreme climate stressors can help – with interventions effectively designed with conflict mitigation in mind – in removing incentives for violence, thereby promoting the chance of peaceful intercommunal interactions (Ide 2023). Emphases on reducing the effect of extreme climate stress, specifically, can also lower the chance that such shocks serve as a threat multiplier (e.g., Von Uexkull et al. 2016; Ide et al. 2020; Scheffran 2020; Von Uexkull et al. 2023).

5.2.4 Remembering the Primacy of Political and Socioeconomic Solutions

Ultimately, however, the impact of CAFSI on conflict mitigation is akin to the Dutch boy who stuck his finger in the dike to stop the flood. CAFSI, in other words, are not a solution to the underlying causes of social conflict – and certainly not of civil war. Our findings suggest that for donors who want to improve the ability of individuals to adapt to the effects of climate change in areas of high climate risk, considering and adjusting the interventions to address the risk of conflict is valuable. However, just like adaptation is not a replacement for mitigation for organizations and nations seeking to tackle climate change, it is not a solution for conflict (and neither is mitigation, for that matter). Our results provide ample evidence to suggest that, beyond CAFSI that emphasize general measures or their impact during times of high climate stress, climate and CAFSI have no effect and might even exacerbate conflict. Our sole focus on South Sudan precludes us from analyzing the effects of political and socioeconomic factors on conflict, but what we observe in our analyses is directly in line with findings from studies that demonstrate that these features are ultimately the most important drivers of conflict (e.g., Buhaug 2010; O'Loughlin et al. 2012; Von Uexkull et al. 2016).

Yes, we believe that our findings strongly suggest that adjusting CAFSI in ways that will improve their climate mitigation impacts is worth the effort. But we also recognize that completely mitigating conflict and its drivers ultimately requires political solutions – including providing better representation, reducing

elite competition, improving rule of law, enhancing administrative capacities, and reducing ethnic tensions – as well as socioeconomic solutions – including improving development, facilitating trade, and increasing income levels.

5.2.5 Key Takeaways for INGO Implementers

To summarize, the findings suggest some specific guidelines for INGO CAFSI implementers, which emphasize practical strategies for implementation, highlighting four key approaches: designing interventions with multiple outcomes in mind, conducing regular evaluations to assess the impact of the intervention, optimizing for high-stress scenarios, and aligning with broader political and socioeconomic solutions.

A. **Design Interventions with Multiple Goals in Mind:** Rather than narrowly focusing on a single outcome, CAFSI should address multiple climate resilience outcomes as well as incorporate conflict-sensitive measures. For example, early warning systems can be used to alert against both natural disasters and conflict. These can be combined with strategies to reduce resource competition, such as building shared water infrastructure. INGOs should also conduct pre-project assessments to identify opportunities for synergy between climate adaptation and peacebuilding goals. This approach ensures that interventions simultaneously strengthen livelihoods, reduce vulnerabilities, and prevent conflicts.
B. **Conduct Regular Evaluation to Assess Efficacy:** Having established multiple outcomes, regular monitoring and evaluation across all these outcomes is crucial for ensuring the ongoing effectiveness of CAFSI. As an INGO evaluator explains,

> in terms of research, in a typical evaluation design, we are specifically focused on measuring performance against objectives which is not great. We need to be much more focused on measuring externalities and potential negative effects as well as positive ones on broader systems . . . Occasionally, we get the opportunity to be more inclusive but most often the focus is on . . . impact vs. objectives because of the way programs are funded. We advocate for more support to conduct more holistic assessments, but in the evaluation space, it is fairly rare.[10]

Such evaluation schemes can include tracking indicators such as climate adaptation goals, community cooperation, and conflict-related incidents simultaneously. Periodic evaluations, especially those that engage local communities in the evaluation process, enable implementers to identify potential issues early, allowing for the timely adjustment of strategies.

[10] Interview 1.

C. **Focus on High-Stress Scenarios:** Interventions should prioritize regions and periods of high climate stress, such as during droughts or floods, where conflict risks are amplified. Some INGOs can even deploy rapid-response teams to address immediate stressors while implementing longer-term measures like flood defenses or water-sharing agreements. For example, the International Crisis Group (ICC), which has been using our data to inform its own early warning models in South Sudan, implements different schemes to intervene during extreme droughts. Other measures could include, among others, creating temporary resource-sharing pacts between communities, which can reduce tensions while maintaining critical livelihoods specifically during extreme weather events, thereby ensuring projects remain effective under shifting conditions.

D. **Align CAFSI with Broader Governance and Economic Initiatives:** While CAFSI can mitigate climate-related conflict risks, their long-term success depends on complementary political and economic reforms. INGOs should collaborate with local governments to strengthen governance structures, improve the rule of law, and enhance resource management systems. At the same time, supporting projects that create economic opportunities – such as vocational training or market access initiatives – can address root causes of instability.

6 Conclusion

In theorizing and testing the effect of climate adaptation and food security INGO interventions on civil war and social conflict, this Element concludes that in most cases, we must reject the assumption that CAFSI reduce conflict rates. Indeed, the evidence suggests CAFSI might even intensify it – with two crucial exceptions: (1) CAFSI that focus on general preparedness are robustly linked to social conflict reduction (meaning we cannot reject the hypothesis that such CAFSI do not lead to reduction); and (2) all CAFSI help in reducing social conflict during high climate stress times. To summarize our findings in more detail, our key results are as follows:

A. **General Preparedness Reduces Social Conflict:** CAFSI projects emphasizing general preparedness address a range of unpredictable climate stressors, reducing incentives for violence by enhancing community cohesion and resilience. Unlike other CAFSI types, general preparedness interventions consistently show statistically significant negative effects on social conflict, even when accounting for endogeneity and serial correlation.

B. **Generic CAFSI May Exacerbate Social Conflict:** Without targeted measures like general preparedness, CAFSI can unintentionally increase social conflict. Interventions that improve local resources without addressing horizontal grievances or resource competition risk inflaming tensions, increasing looting, and escalating violence. This finding highlights the need for conflict-sensitive design to prevent the unintended exacerbation of tensions.
C. **CAFSI Is Most Effective during High Climate Stress:** During periods of extreme climate stress, CAFSI interventions – particularly those focused on general preparedness and community building – significantly reduce social conflict. Specialized CAFSI designs produce below-average conflict rates, while generic CAFSI help restore baseline conflict levels. These findings underscore the importance of tailoring interventions to address severe climate stressors, leveraging crisis mitigation pathways for greater impact.
D. **Potential for Civil War Intensification:** CAFSI projects are not effective in mitigating civil war and may even intensify it. Civil war actors often target climate-adapted areas and INGO resources, increasing conflict risks. Additionally, resource-focused interventions may inadvertently drive land disputes or food price volatility. While CAFSI may reduce civil war rates during high climate stress periods, broader political and economic reforms are crucial to addressing civil war dynamics comprehensively.

How valid are the findings and the implications discussed in Section 5 to other countries? The remainder of this section discusses the applicability of the results to other countries and world regions that share relevant similarities with South Sudan, extrapolating relevant lessons, before proceeding to discuss future research implications.

6.1 East Africa

South Sudan's lessons are perhaps best applicable to other countries in East Africa. While the region has been analyzed in past research (e.g., O'Loughlin et al. 2012), it is worth considering some countries with potentially relevant climate-adaptation conflict linkages.

6.1.1 Sudan

A coup d'état that deposed President Omar al-Bashir ushered in a transitional government to install civilian rule before the military reasserted power. The country is (at the time of writing) in the grips of a major civil war. It is also, due to its reliance primarily on rainfed agriculture, at risk of experiencing strong economic decline due to climate change (Siddig et al. 2020). As such, Sudan

shares several similarities with South Sudan, where many households also rely on rainfed agriculture, although it is located closer to the Sahara Desert (much of the country's territory is desert). Our findings regarding a potentially positive link between CAFSI and civil war would suggest that – in the current context – CAFSI treated areas might attract a higher-than-average share of related conflict events, which have implications for project design and implementation. However, as social conflict is also a major source of contestation in Sudan (Bark and Raleigh 2024), our results suggest that focusing CAFSI on addressing extreme forms of climate stress while emphasizing general preparedness or community building can help in achieving both adaptation goals and facilitating social conflict mitigation. Another possibility, which should be evaluated as part of a broader set of considerations designed to maximally facilitate adaptation's success while minimizing the risk from conflict, is to deploy CAFSI further away from the front line. This could help in reducing the possibility that the improvements to productivity and resilience provided by successful adaptation and food security improvements attract violence by civil war actors seeking, among others, to appropriate resources.

6.1.2 Ethiopia

Between 2020 and 2022, Ethiopia experienced a civil war between the government and Tigray People's Liberation Front (TPLF) rebels, which focused primarily on the regions of Amhara and Afar, as rebels made it less than 400 kilometers from the capital, Addis Ababa (Nyadera and Osedo 2023). Climate change may also impact Ethiopia's economy, seeing that people in many regions of the country also rely on rainfed agriculture, although it appears that there were no changes in rainfall trends, suggesting complex climate–conflict and social–climate interactions (Conway and Schipper 2011). Again, in line with our findings, periods of civil war intensification might impact CAFSI locations, considering that the ethnic divisions and competing elites as drivers of civil war in Ethiopia also exist in South Sudan.

Ethiopia has also been a large regional producer of biofuel crops such as castor. For growing biofuel crops, large swaths of lands were dedicated, which may have induced social conflict between pastoralists and the companies and growers who use the land (e.g., Tufa et al. 2018). There were also concerns that the conversion of some farmer land to biofuels – which could potentially be considered as CAFSI – could induce food insecurity, which could potentially contribute to conflict (e.g., under the lower opportunity costs for conflict mechanism), although evidence suggests that if anything, castor production improved food security and farmer income (Negash and Swinnen 2013).

However, if this is true, then – as our findings suggest – it is possible that biofuels production could contribute to more social conflict due to sourcing or intensified rapacity dynamics (see Table 2), as armed actors engage in violence to loot or secure revenues from biofuels production. Thinking of biofuel production as CAFSI, our results suggest that supplementing biofuel crop substitution with measures such as diversifying the types of crops grown on the land (general preparedness) or some forms of community building can help in reducing the risk of biofuels being associated with social conflict.

6.1.3 Uganda

While Uganda has experienced several devastating civil wars, currently social conflict is arguably the most likely form of violence in some of its regions most susceptible to climate change, including Karamoja and Turkana. To this end, it attracted attention from climate–conflict nexus and climate-peacebuilding nexus scholars (e.g., Ide et al. 2014; Abrahams 2020; von Uexkull et al. 2023). Considering that these regions are both potentially subject to strong climate stressors (Ide et al. 2014) and an increased frequency of social conflict, our findings point to ways that CAFSI can help in achieving both adaptation and conflict mitigation. Per our results, focusing on addressing high climate stress periods combined with adding general preparedness and/or community building measures into these CAFSI could hence be a beneficial approach to designing adaptation and food security interventions in these regions.

6.2 West Africa

On the other side of the continent, climate stress, conflict history, and war dynamics in Mali, Burkina Faso, and Nigeria share some similarities with South Sudan's. The civil wars in the region have involved several extremist Islamist groups – including Boko Haram in Nigeria and Al Qaeda-related groups in Mali and Burkina Faso – as well as ethnic groups such as the Tuareg Movement for the Liberation of Azawad (Diallo 2017). Our findings offer limited usefulness for these conflicts, beyond the perspective on the primacy of political and economic solutions and the possibility that CAFSI might attract civil war actors, which – again (as discussed in the case of Sudan) – might suggest the location of where CAFSI are deployed should be decided with these civil war dynamics in mind. However, social conflict – including between pastoralists and agriculturalists and between local communities – is arguably even more prevalent in the region. From this perspective, while agricultural productivity in the Sahel (the band of land below the Sahara Desert that crosses the continent), which includes conflict-afflicted parts of the three states, may have been increasing (Zeng et al. 2023), CAFSI may still have relevant implications.

For instance, in their study of the Sahel, which focuses heavily on Mali, Benjaminsen et al. (2012, 97) argue that social conflict in the region is driven by three key factors, namely "agricultural encroachment that obstructed the mobility of herders and livestock, opportunistic behavior of rural actors as a consequence of an increasing political vacuum, and corruption and rent seeking among government officials." Construction of irrigation schemes have improved agricultural productivity in the country and may have lowered the risk of some types of conflict (BenYishay et al. 2023). However, such CAFSI, which focus on specific outcomes (e.g., irrigation schemes), could further affect pastoralist mobility and engender opportunism, both of which can create more pressures and potentially lead to increases in some types of social conflict. Considering design choices that reduce the risk of CAFSI creating such pressures – for instance, along the lines of focusing on both building irrigation schemes and providing open water areas that enable pastoralist mobility and access – could help in reducing the risk of social conflict.

In Nigeria, social conflict often follows political and religious divisions, especially around election periods (Angerbrandt 2018). Other social conflict actors often follow sourcing and rapacity dynamics over agricultural resources (Koren and Schon 2023). Our findings regarding the usefulness of CAFSI – especially those that emphasize general preparedness and community building – during high-stress periods show some ways for designing adaptation and food security improvement projects in a way that might help to break this cycle by both lowering incentives for social conflict and improving the chances of adaptation's success.

6.3 South Asia

Moving beyond African states, the results offer lessons for other world regions. For instance, scholars linked food appropriation-based dynamics resulting from climate stress to violence in India (Wischnath and Buhaug 2014; Sarbahi and Koren 2022), Indonesia (Caruso et al. 2016), and The Philippines (Crost et al. 2018). Considering that the level of rainfall and therefore of severe stressors in the region is expected to increase due to climate change (e.g., Mirza 2011; Zahan et al. 2021), these countries have been experiencing their own share of CAFSI interventions (Sterrett 2011). Indeed, civil war and social conflict still plague many regions in South Asia, suggesting that taking features that could reduce the risk of social conflict into account in CAFSI design would be useful. For instance, in India, climate-stress-related violence is often focused on marginalized and vulnerable communities, such as scheduled castes and tribes (Sarbahi and Koren 2022). At the same time, as Sarbahi and Koren (2022)

find, the existence of electoral competition and local level democratic procedures not only help to neutralize the effects of climate stress, but also allow these stressors to produce a pacifying impact. Similarly, making sure that CAFSI is implemented in areas that are likely to experience high climate stress and ensuring that these interventions include measures to promote general preparedness or community building could help in reducing the risk of violence against these vulnerable populations.

6.4 Future Implications

Climate adaptation has become a key feature of efforts to combat climate change. Considering that many areas that require adaptation are also vulnerable to conflict, exploring the intersections of the two – as was done in this Element, and as future work should continue to do – is useful. In line with this, future research should explore how other INGO features could shape the impact of their climate-related work on conflict. For example, referring back to Table 1 (Section 2), research can explore how INGO sources of funding shape the design and effectiveness of CAFSI. INGOs with a specific emphasis on climate adaptation may possess greater expertise in implementing projects that address adaptation needs and mitigate associated challenges, including conflict, compared to INGOs focusing on broader goals like conflict prevention or gender equality. This distinction is critical for assessing the causal pathways and outcomes of adaptation interventions, as highlighted by the "adaptation illusion" (Lobell 2014), which underscores the importance of a clear adaptation focus for meaningful impact evaluation.

Similarly, the type of funder – whether government, private, or a mix of government and private – may influence intervention priorities and constraints. Government-funded projects, such as those supported by USAID, may face pressures due to funding cycles and policy directives, while privately funded INGOs, like those backed by the Gates Foundation, might contend with top-down donor priorities and the need for sustained funding. Understanding how these dynamics affect project implementation and outcomes could provide valuable insights into optimizing CAFSI interventions for greater adaptability and conflict mitigation.

At the same time, it is important to again reiterate that CAFSI are not a solution to conflict, or – for that matter – climate change. It is likely that the latter can only be resolved through a combination of long-term mitigation and geoengineering schemes (IPCC 2022; Kravitz and MacMartin 2020). For adaptation, approaches that address the root cause of the conflict – usually, along the lines of improving state capacity, reducing opportunity costs from

conflict, and creating stakeholder interests via promoting robust and transparent political institutions (Hendrix 2010; Koren and Sarbahi 2018), combined with building a robust economy (Collier and Hoeffler 2004) – are by far the most viable solution.

That the complexities involved with the big challenges of the twenty-first century, including a changing climate and the reality of political conflict that involves more actors, actor types, and realms than ever before, is sobering. As such, making sure projects can address more than one outcome – in our case, ensuring that interventions designed to promote climate adaptation and improve food security also consider how they can mitigate some forms of conflict, or at least not exacerbate others – is crucial. Such a combined-outcomes approach can help in promoting long-term resilience by ensuring an endogenous relationship between conflict and adaptation, for instance because adaptation projects shape conflict trends while armed conflict destroys and harms adaptation, thereby increasing the probability that adaptation will remain successful – rather than be disrupted by violence – over the long term.

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Data Availability Statement

All replication materials are openly available on Harvard Dataverse at: https://doi.org/10.7910/DVN/LJRR3R.

Acknowledgments

Koren's work was supported by Cross-Border Conflict Evidence, Policy and Trends (XCEPT) research programme, funded by UK aid from the UK government; the Harry Frank Guggenheim Foundation; and NSF Grant No. SAP 2149053 and Grant No. SES #2342105. Koren's opinions do not reflect those of the UK government, the Harry Frank Guggenheim Foundation, or the NSF.

We would like to thank Johsnon Nkem Ndi for his helpful support and John Mayom Akech for his crucial help with obtaining relevant information.

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Organizational Response to Climate Change

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