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Vicious Circles: Violence, Vulnerability, and Climate Change

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Abstract

Climate change threatens core dimensions of human security, including economic prosperity, food availability, and societal stability. In recent years, war-torn regions such as Afghanistan and Yemen have harbored severe humanitarian crises, compounded by climate-related hazards. These cases epitomize the powerful but presently incompletely appreciated links between vulnerability, conflict, and climate-related impacts. In this article, we develop a unified conceptual model of these phenomena by connecting three fields of research that traditionally have had little interaction: (*a*) determinants of social vulnerability to climate change, (*b*) climatic drivers of armed conflict risk, and (*c*) societal impacts of armed conflict. In doing so, we demonstrate how many of the conditions that shape vulnerability to climate change also increase the likelihood of climate–conflict interactions and, furthermore, that impacts from armed conflict aggravate these conditions. The end result may be a vicious circle locking affected societies in a trap of violence, vulnerability, and climate change impacts.

Contents

1. INTRODUCTION

Climate change is widely recognized as the greatest societal challenge of our time (1, 2). The reason for that judgment is twofold. On the one hand, it reflects a recognition of the potential for widespread, escalating, and possibly irreversible human, material, and ecological impacts of climate change (3, 4). On the other, it acknowledges the overwhelming challenges entailed by mitigating anthropogenic climate change in accordance with agreed-upon temperature targets and adapting to those climatic hazards that cannot be avoided (5, 6).

Impact: adverse consequences of climatic hazards on social cohesion and wellbeing

Hazard: climate-driven physical event that constitutes a risk to social cohesion and wellbeing

Armed conflict: militarized disputes between organized actors over political disagreements resulting in at least 25 battle-related deaths in a year

Risk: potential for adverse consequences where something of value is at stake and the outcome is uncertain

Vulnerability: propensity to be adversely affected by a climatic hazard

Plausible social impacts of climate change include adverse health effects, loss of income and livelihood, and growth in forced migration within and across state borders (1). Perhaps most worryingly, research suggests that climate change potentially increases armed conflict risk, partly through adverse intermediate socioeconomic effects (7, 8). A climate change–driven increase in global prevalence of armed conflict would be devastating given armed conflict is robustly associated with a range of societal ills, including loss of lives, economic contraction or collapse, social polarization or disintegration, and mass displacement, thus directly and indirectly further accentuating the social cost of carbon.

This article sheds new light on the relationship between climate change, vulnerability, and armed conflict by connecting three literatures that hitherto have existed mostly in isolation from each other: (*a*) determinants of social vulnerability to climate change, (*b*) climatic drivers of armed conflict risk, and (*c*) societal impacts of armed conflict. We demonstrate how many of the conditions that heighten social vulnerability also increase climate-related security risks and, moreover, that drivers of social vulnerability to climate change also are highly sensitive to impacts from armed conflict. The implication of these connections is a significant risk of being trapped in a vicious circle of violence, vulnerability, and adverse climate change impacts.

We begin by outlining an overarching conceptual framework for how vulnerability, climate change impacts, and armed conflict are related and how they may forge mutually destructive links in a vicious circle (Section 2). In Sections 2.1–2.3, we substantiate this framework by reflecting on current knowledge on each link, including moderating factors affecting the strength of associated causal relationships. Our aim is not to provide exhaustive reviews of all relevant literatures but rather to synthesize key findings, highlight commonalities in causes and effects, and document relevant trends across these processes.[1] Having discussed the individual elements of the

[1]We refer to recent reviews of the scientific literatures combined here for a more extensive discussion of research findings and gaps in the respective fields. For vulnerability to climate change, see, for example, References 9 and 10; for climatic drivers of armed conflict risk, see References 7 and 8; and for armed conflict impacts, see Reference 11.

conceptual model, we next bring them together by considering empirical evidence for how vulnerability, conflict, and underdevelopment relate to each other (Section 3). We end by reflecting on implications for future research priorities and climate change adaptation policy (Section 4).

Human security: human security exists when the vital core of human life is protected, including freedom, safety, and dignity

2. VIOLENCE, VULNERABILITY, AND CLIMATE CHANGE

In line with the approach of the United Nations Intergovernmental Panel on Climate Change (IPCC), we understand climate-related risk (and materialized impact) to be a product of interactions between hazards, exposure, and vulnerability (12–14). Risk in this context is usually interpreted broadly to cover any potential adverse consequence for nature or society where something of value is at stake and the outcome is uncertain (15). However, in this article the term risk (and impact) is limited to the possibility of (or manifested) severe and widespread impacts on human security, especially those impacts that may have a detectable knock-on effect on the likelihood or severity of armed conflict (16).

In this risk framework, climatic hazards refer to physical triggers from the climate system, which range from rapid-onset extreme weather events (e.g., heatwaves, tropical storms) to gradually shifting means in climatic conditions (e.g., warming, sea-level rise). Although climatic hazards are attributable to human activities in the long term, we treat them as exogenously given events, whose impacts depend on the level of exposure and vulnerability in society.[2]

Exposure is shaped largely by demographic factors, such as population size and settlement patterns, but also by changes in these through population growth, urbanization, and migration toward, or away from, areas with high hazard frequency. With notable exceptions for human mobility, these determinants are largely inert and therefore of limited relevance to a dynamic model of endogenous nature–society interactions that we explicate here.

Vulnerability refers to the propensity to be adversely affected by a climatic hazard and explains observed variation in impacts for different societies exposed to the same hazard. Vulnerability is highly endogenous to social actors' choices, actions, and capacities, and thus (at least in principle) is highly malleable to internal and external input (e.g., policy changes, development assistance) even on short time scales. The related concept of adaptive capacity captures the ability to adjust to anticipated future hazards to minimize harmful impacts, while resilience is understood here as the capacity to cope with hazardous events or trends in ways that maintain actors' essential function and wellbeing.

The conceptualization of impacts as a function hazard, exposure, and vulnerability is both intuitive and insightful. Importantly, it highlights the crucial role of social vulnerability in determining human and material costs of climate variability and change. However, the association between vulnerability and impact is not unidirectional but endogenous, where past climatic impacts inform subsequent levels of vulnerability to future hazards. A crucial element in this reciprocal process, critically underacknowledged in contemporary climate change impact assessments, is armed conflict. Armed conflict is a major driver of vulnerability: It is widely seen as the

[2]Virtually all empirical research on climate-conflict connections is limited to considering short-term climatic changes, such as discrete events or anomalous weather conditions measured at a monthly or yearly scale, due to inherent methodological challenges of attributing sudden changes in human behavior to slowly moving processes. Inferring about security implications of climate change (e.g., warming) based on observed responses to climate variability (e.g., heatwave) is nontrivial and should only be conducted with great caution, due to unknown levels of adaptation as well as potential nonlinearities and tipping points in future human–nature interactions (compare with 17). For the conceptual model discussed here, the distinction between variability and change is less central, as long as an endogenous and mutually reinforcing relationship between vulnerability, violence, and climate-related impacts (at certain time scales) can be established.

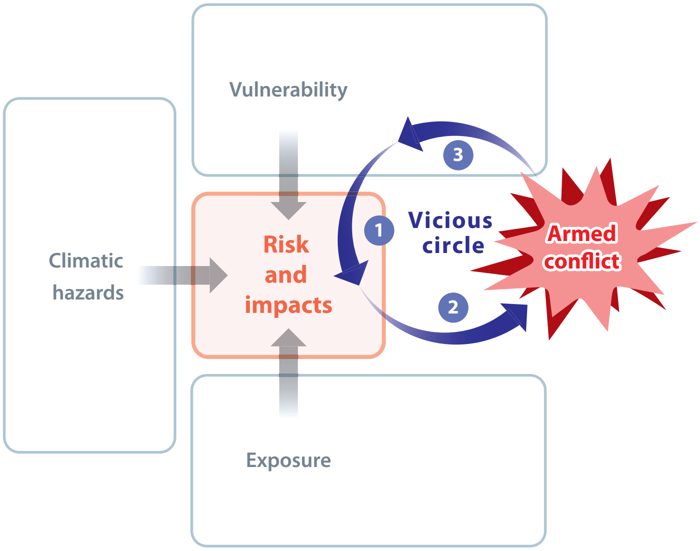

Figure 1

Conceptual diagram illustrating the following three interrelated processes: ● Vulnerability shapes risks and impacts from climatic hazards (see Section 2.1); ● climate-related impacts shape armed conflict risk (Section 2.2); and ● armed conflict shapes vulnerability to future climatic hazards (Section 2.3). The devastating societal impacts of armed conflict mean that conflict often constitutes the entry point to the vicious circle, threatening to trap affected societies in a destructive process of violence, vulnerability, and climate change (Section 3).

primary cause of development failure (18), it is a dominant cause of forced migration (19), and it frequently triggers hunger crises (20). However, armed conflict also is a potential consequence of climatic hazards (7, 16). The result may be a vicious circle, locking affected societies in a trap of violence, vulnerability, and climate change impacts. Appreciating these potentials for vicious circles is important to fully grasp the complex challenge at hand when working to minimize future climate change impacts in currently conflict-affected vulnerable regions.

Figure 1 illustrates the envisioned conceptual model. Incorporating core elements from the IPCC risk framework (21), it highlights the endogenous forces that work from high vulnerability to adverse climate-related impacts, from climate-related impacts to increased armed conflict risk, and from armed conflict to increased vulnerability. Although armed conflict is not a necessary condition for high vulnerability, the massive destruction caused by severe conflict makes it a sufficient condition for high local vulnerability in war zones.

The notion of a vulnerability-violence trap that shapes—and is shaped by—impacts of climatic hazards rests on the shoulders of earlier work on poverty-and-conflict traps (22–24). Even within studies of climate security, endogenous linkages between poverty, vulnerability, and conflict have occasionally been acknowledged (e.g., 25–27). However, these phenomena tend to be treated as discrete challenges with distinct drivers and unique solutions—usually discussed in separate, discipline-specific fora—thereby failing to recognize that they are integral parts of a whole, endogenous system. The literature on societal vulnerability to climate change often downplays the devastating consequences of armed conflict, for example, by bundling violence and conflict together with more general governance and institutional considerations (which usually are regarded secondary to socioeconomic and environmentally determined drivers of vulnerability) or by providing "siloed" or disciplinary-specific views on vulnerability (9, 28). The empirical climate-conflict literature is mostly preoccupied with exploring climatic hazards as drivers of conflict risk without thoroughly engaging with research on determinants of vulnerability or considering how conflict might increase social sensitivity to climate events.[3] Separately, research on consequences of armed conflict rarely adopts an environmental lens and remains largely detached from vulnerability science, despite both literatures seeking to understand processes that disrupt social coherence and wellbeing (see 31 for a rare exception).

Vicious circles may exist on different social scales, from the community to the country at large, characterized by different types of conflict that vary by actor types, fatality level, and degree of harmful externalities. The most severe contemporary conflict type, civil war, typically affects most or all of a country—and occasionally neighboring countries as well—and has devastating impacts on virtually all aspects of life.[4] Syria, Yemen, and Afghanistan are contemporary examples of this type. Subnational regions trapped in a vicious circle frequently host separatist ethnonational insurgencies or terrorist organizations, increasingly with transnational ties. Northern Nigeria (Boko Haram) and southern Philippines (Abu Sayyaf Group) provide examples of this kind. The more fragmented territorial scope of these conflict types implies that large parts of the affected countries, including the functioning of the central state and the national economy, usually are less impacted by the violence. Lastly, vicious circles may materialize at a local level, marked by sites of pervasive violence in an otherwise stable society. Armed repression against small minority groups and everyday communal violence, as found in, e.g., northern Kenya and Kurdish territories in Turkey, fit this category. Although these and other sites of endemic violence obviously are not constantly impacted by climatic extremes, the protracted nature of armed conflict and the unavoidable damaging effects on social resilience and adaptive capacity mean that these societies often are poorly equipped to manage risks when disaster strikes.

2.1. Societal Vulnerability to Climate-Driven Impacts

A core element in climate-driven risk is the affected population's vulnerability to climatic hazards (**Figure 1**). Vulnerability is a function of both biophysical and social factors and varies by outcome category as well as social scale, from the individual to the society at large. Factors that increase vulnerability to one type of hazard (e.g., heatwaves) need not be important in shaping sensitivity to another (e.g., sea-level rise), although many core societal features affect social resilience to any environmental hazard. Moreover, there are important dependencies in vulnerability levels across scale. For example, a household's ability to cope with drought depends partly on the enabling environment of the local community as well as degree of assistance from the regional or national government (33–36).

2.1.1. Socioeconomic determinants of vulnerability. Complex cross-scale interactions among factors influencing populations' climate sensitivity and adaptive capacity defy a simple and exhaustive classification of causes of vulnerability. Even so, numerous generic factors have

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[3] Recent IPCC assessments provide a similar, restricted understanding of the role of conflict. The Summary for Policymakers from the special report on land mentions conflict twice, both times as examples of a potential outcome of climatic hazards, whereas it remains silent on the link from conflict to vulnerability (29). The Summary for Policymakers from the 1.5°C report does not mention conflict (30).

[4] The empirical trends and evidence provided in this article cover state-based (civil) armed conflict, non-state (communal) conflict, and one-sided (terrorist/repression) conflict—by some margin the dominant forms of contemporary conflict (32).

been identified in the scientific literature (for recent reviews, see 10, 12, 37–41). Arguably the most frequently discussed vulnerability condition is socioeconomic marginalization. At the individual and household level, socioeconomic marginalization manifests itself in poverty, poor resource access, food insecurity, illiteracy and incomplete education, poor health, unavailability of microcredit and affordable insurance, barriers to mobility, and other economic constraints that limit agency in the face of disaster (42–47). For rural populations, climate-sensitive mode of livelihood and insecure land tenure represent other crucial socioeconomic drivers of vulnerability, whereas the urban poor, who often reside on hazard-prone land, are particularly sensitive to flooding and extreme heat exposure as well as unpredictable hikes in living costs (48–51). These factors not only increase the risk of adverse impacts from a given climatic hazard, they also limit the ability to adapt successfully in anticipation of future shocks (45, 52). Complementary socioeconomic markers of vulnerability at higher levels of social aggregation include widespread inequality, poor infrastructure, lack of early warning systems for extreme weather conditions, corrupt and inefficient markets, a large rainfed agricultural sector, and import dependence of basic foodstuffs (53, 54). Structural drivers of these deficits frequently include conflict and instability (Section 2.3).

2.1.2. Political determinants of vulnerability. Poor governance constitutes another key driver of vulnerability. This broad category encompasses lack of representation or outright discrimination, rampant political corruption, underdeveloped property rights, unsustainable resource management, formal institutions founded on clientelism, weak rule of law, and widespread violence (55–57). One early study that sought to rank the relative importance of generic vulnerability factors concluded that aspects of governance, notably effectiveness and accountability, were the most decisive in determining disaster-related loss of human lives (35). A recent analysis of global cyclone mortality similarly found that impacts were more severe in areas marked by weak political institutions and poor public goods delivery (58). These results are not surprising, considering the weight of evidence showing that inclusive democracies protect individual rights and freedoms, including for minority groups; ensure a fair and transparent legal system; enable socioeconomic development through investments in human capital and rule of law; and—crucially—minimize armed conflict risk through norms and institutions conducive to peaceful dispute resolution. Distributional policies, accountable decision makers, and a free press ensure that starvation in democracies does not evolve into famine (59, 60). Democracies also are associated with superior environmental protection (61). In fragile or nondemocratic systems, unsustainable resource management and land-use practices and discriminatory property rights increase climate-driven impacts on human security (62–65). One relevant case in point can be deduced from disaster impacts in Haiti and the Dominican Republic. Being neighbors on the Hispaniola island in the Caribbean, these countries share many underlying physical, environmental, and ecological features. However, the Dominican Republic has enjoyed a more stable and peaceful political development, fostered a more prosperous socioeconomic growth (the ratio of these economies is 10:1 in per capita terms today; 66), and also been better at preserving vegetation as a natural protection against seasonal tropical hurricanes than its peer. One outcome of the diverging development trajectories is a much higher average human cost of extreme weather events in Haiti than in the Dominican Republic (67–69). Despite clear connections between peace, stable and democratic institutions, and resilience to environmental hazards, global vulnerability assessments commonly overlook the disruptive effect of armed conflict on coping and adaptive capacity.

2.1.3. Other generic determinants of vulnerability. Societal vulnerability to climate change and weather extremes is also determined by a range of demographic, social, and cultural factors.

Central drivers under this heading include gender inequality, rapid population growth and unmanaged urbanization, sparse social networks, inadequate informal community support systems, unsustainable consumption habits and preferences, language barriers and lack of information, and biases in risk perception (12, 39, 70, 71). Because these conditions are less important in shaping conflict risk and they also tend to be less impacted by climatic shocks and armed conflict than socioeconomic and political conditions, they are not considered in further detail here.

2.1.4. Trends in vulnerability. The Notre Dame Global Adaptation Initiative (ND-GAIN) provides a relevant global quantitative assessment of vulnerability to climatic hazards. The ND-GAIN vulnerability index classifies countries according to their performance on 36 indicators that jointly capture extent of adaptive capacity, exposure, and climate sensitivity for six distinct sectors: health, food, ecosystem services, human habitat, water, and infrastructure (72). The aggregate vulnerability score gives the unweighted arithmetic mean of the six sector-specific scores, normalized on a scale from 0 to 1, and is updated annually for 181 countries for all years between 1995 and 2018. Although this index does not capture all elements of vulnerability equally well—for example, the underlying indicators give prominence to socioeconomic and environmental conditions over political ones, and characteristically, information about peace and security is not included—it still gives a reasonable representation of the extent to which a severe climatic hazard in a particular location would be expected to result in widespread harm.

According to this index, climate vulnerability is the lowest in high-income countries in Western Europe, with Norway (index score 0.267) being considered the least vulnerable country in 2018, followed by Switzerland (0.270) and Luxembourg (0.292). The other end of the scale is dominated by low-income countries. Nine of the 10 most vulnerable countries in 2018 were located in sub-Saharan Africa, the tenth being Afghanistan, and all ten countries have a recent history of armed conflict (31). Despite the highly uneven distribution of resilience across the world, vulnerability levels have generally declined in recent decades, aided by notable progress toward common development goals (73, 74) (**Figure 2**).

Although the downward trend in vulnerability is encouraging, we acknowledge two caveats. First, these country-level statistics mask critical subnational variation in vulnerability. Notably, whereas global between-country income inequality has dropped as a consequence of (slow) economic convergence, within-country inequality is on the rise in virtually every country (75, 76). Even in societies considered generally highly resilient and capable of coping with environmental shocks, climatic hazards may produce devastating impacts if vulnerable populations are exposed (as evidenced when Hurricane Katrina swept across New Orleans, Louisiana, in 2005). A second reason for concern is the still-ongoing COVID-19 (coronavirus disease 2019) pandemic and its knock-on impacts on fragile economies, livelihoods, and health and living conditions in the Global South. According to the UN, these impacts have in some countries "turned back decades of progress" toward sustainable development (73, p. 3), by implication increasing social vulnerability to climate and weather extremes.

2.2. Climate-Related Drivers of Armed Conflict Risk

Over the past decade, research on the impact of climate-related hazards on conflict risk, in particular the likelihood and severity of internal armed conflict, has rapidly expanded. A growing number of studies explore how climate variability influences armed conflict indirectly via shocks to rural living conditions (e.g., 77–81) or through causing food and livestock price changes (e.g., 82–85). There is also a vivid academic debate about whether climate-related migration

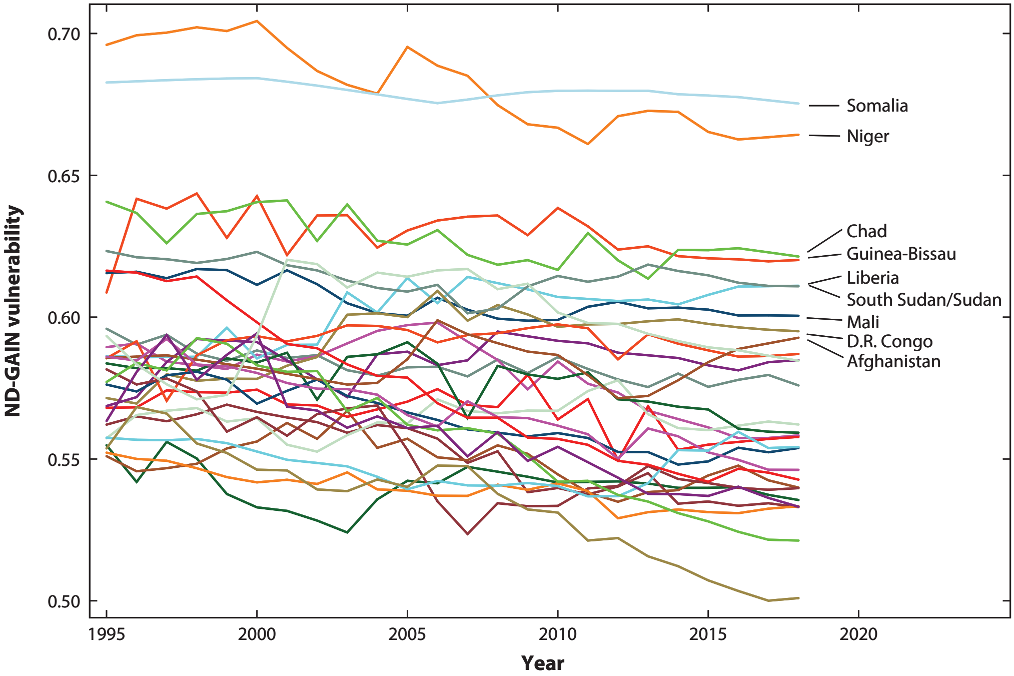

Figure 2

Trend in vulnerability score for the most vulnerable countries between 1995 and 2018, based on data from the Notre Dame Global Adaptation Initiative (ND-GAIN) (72). Each country is represented by a separate line. The Y-axis has a theoretical range from 0 (no vulnerability) to 1 (complete vulnerability), although observed values in the global dataset extend from around 0.3 to 0.7. The list of the most vulnerable countries is dominated by low-income countries; nine of the 10 highest-ranking countries in 2018 (*labeled*) were part of sub-Saharan Africa. Small Island Developing States and other microstates are excluded from this figure.

can act as a driver of conflict (e.g., 86, 87).[5] A key observation is that climate effects on conflict vary across space and time, and that socioeconomic development and the quality and strength of political institutions shape this variation.[6] This is not a coincidence; in both economic and political domains, major drivers of vulnerability are found (Section 2.1). At the same time, conflict risk in general tends to be high in economically poorly performing, nondemocratic, and highly discriminatory regimes (95–98).

2.2.1. Socioeconomic factors moderating the climate-conflict link. In general, factors that increase negative impacts of disasters on economies and livelihoods (hazard magnitude, social vulnerability, physical exposure) also are expected to increase conflict risk. Indeed, recent studies provide empirical evidence that countries or subnational regions with higher dependence on the climate-sensitive agricultural sector (99–101), lower adaptive capacities (102), or lower human development (103) are more likely to see climatic shocks translate into security risks. Public goods

[5]Few empirical studies seek to evaluate empirical evidence for the entire climate-migration-conflict link (although see 88–91).

[6]For relevant examples, see the 2021 special issue of the *Journal of Peace Research* (8) and recent scientific reviews (7, 92–94).

provision, such as well-functioning infrastructure, may mitigate adverse climate effects on conflict (104, 105). Studies that report significant links between climate variability and conflict tend to be from developing or middle-income countries, such as Somalia, the Philippines, Indonesia, and India (77, 82, 84, 106), where average vulnerability and exposure levels are higher than in the developed world.

Although vulnerability and hazard impact magnitude in general increase conflict potential, severe hazards may have the opposite effect in some instances. Those who take up arms need the capacity to do so (107). Large-scale shocks, such as major storms, may wipe out rebel capacities or hinder the movement of troops. At least in the short term, major disasters could therefore also lead to dips in conflict activity (107–109).

2.2.2. Political factors moderating the climate-conflict link. The quality and strength of state institutions is a key condition shaping societies' conflict risk in response to a climatic hazard. The reasons for this pattern are multiple and relate to not only determinants of vulnerability but also the motives and capacity of societal groups to take up arms.

At different levels of analysis, patterns of exclusion from political power and government discrimination, often along ethnic lines, have been shown to condition the relationship of climatic hazards and conflict (99, 101, 103, 105, 110). The spatial clustering of ethnic groups in specific areas of a country leads to shared exposure when a climate-related disaster strikes, which can combine with a common experience of political grievances for marginalized groups. The absence of such discriminatory politics is connected to inclusive governance, rule of law, and democratic structures. Democracy is a system for the peaceful resolution of societal conflicts of interest—the inclusion of population groups by way of free electoral processes—while it simultaneously puts constraints on the government and assuring accountabilities of leaders (111–113). There is some evidence that countries with a relatively low level of democracy that are hit by a drought are more prone to civil war than countries with a relatively high level of democracy (114). Democracies seem also more likely to agree to ceasefires and negotiations in the wake of major natural disasters, which may again be testimony of greater public accountability (109).

Next to governmental institutions, (neo-)traditional institutions, such as chiefs and customary rules, fulfil important functions in many parts of the developing world, including regulating access to land and water resources (115, 116). Where such institutions are well-functioning there is evidence that they can contribute to dampening the risk of violence in the wake of climate-related shocks (117–119). For example, a survey-based study of rural Kenya (117) found that formal and informal management of local-level natural resource use has a moderating effect on support for violence in the wake of drought shocks.

Although environmental or other grievances may motivate societal groups to challenge the status quo, whether the use of violence is a viable option depends critically on state capacity to uphold the monopoly on the legitimate use of physical force. In well-ordered states, the use of violence is deterred by the potential reprisals of the government (120). For example, the rarity of violence between Bedouin herders and Jewish farmers in Israel during the most severe drought of the twentieth century was partly attributed to effective state interventions, such as patrols preventing the encroachment of herds on fields (121). Here political and economic factors connect, as a government's capacity to exercise territorial control also depends on state income (122).

2.2.3. Trends in armed conflict. After an encouraging decline in the frequency and severity of state-based (civil) armed conflicts in the first decade of the Post–Cold War era, the downward trend flattened in the early 2000s and rapidly increased again with the outbreak of the Arab Spring

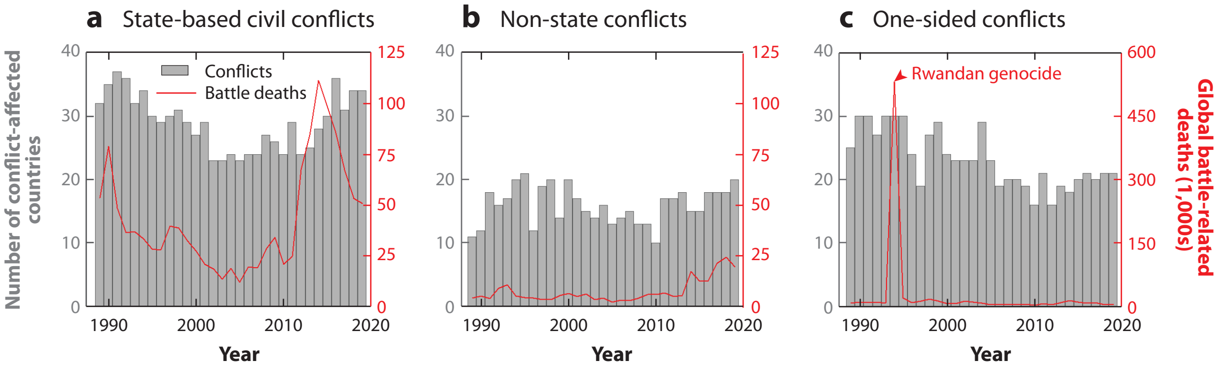

Figure 3

Temporal trends in (*a*) state-based civil conflict, (*b*) non-state conflicts, and (*c*) one-sided conflicts, generated from statistics provided by the Uppsala Conflict Data Program (32). The bars show global number of countries hosting the given conflict type per year, whereas the red trend lines denote the global number of reported battle deaths in each year. The battle-deaths scale for one-sided conflict (*c*) extends much farther than the other panels in order to capture the devastating impact of the 1994 Rwandan genocide.

uprisings in 2011 (**Figure 3*a***). Escalating levels of violence in Syria, Afghanistan, and Iraq have made the most recent decade the deadliest period of armed conflict since the Soviet invasion of Afghanistan and the Iran-Iraq war of the 1980s. Non-state conflicts (**Figure 3*b***) and one-sided violence against unorganized civilians (**Figure 3*c***) generally claim much fewer lives and have weaker socioeconomic and political externalities, but here, too, there is little evidence of a move to more peaceful conditions in recent years.

2.3. Armed Conflict as a Driver of Vulnerability

Armed conflict has a range of well-documented impacts on affected societies. Several of these impacts involve factors that also increase the risk of conflict outbreak, reflecting endogenous conditions that jointly comprise a conflict trap (22). In the following, we discuss the most important ones, paying particular attention to those factors that also have been found to affect societal vulnerability to climatic hazards (Section 2.1) and increase the likelihood of a climate-conflict link (Section 2.2).

2.3.1. Socioeconomic impacts of armed conflict. Just like economic performance is a common explanation for armed conflict, conflict also has profound socioeconomic implications. Among other effects, conflict is robustly and negatively associated with economic development and growth, it increases inflation and price shocks, and it creates a need for costly reconstruction (18, 95, 123, 124), all of which reduce social actors' (from individuals to state governments) pool of resources at their disposal to cushion a climate-driven economic shock. Armed conflict also hurts domestic as well as international trade, deters long-term investments and development assistance, and triggers capital flight (125–128). Moreover, conflict-affected countries often have a large traditional agricultural sector, whose reduced output as a consequence of violence and insecurity can be devastating to local wellbeing (124, 129–131) as well as to domestic food security (132, 133). In mineral-rich conflict-affected countries, securing control over resource deposits (oil fields, artisanal gemstone mines) often becomes an end in itself, creating a distinct war economy that prolongs the fighting (134–136).

Adverse social and health impacts of armed conflict, beyond direct loss of lives on the battlefield, commonly include nutrition-related child stunting and wasting, increased disease exposure, reduced availability and use of health clinics, loss of schooling, mental trauma, and lowered life satisfaction (137–142). Physical and institutional damages to the education system coupled with displacement-induced brain drain are especially damaging to a society, due to loss of human capital for a generation of war-affected individuals that makes them less prepared to cope with current and future climate-driven hazards to lives and livelihoods.

2.3.2. Political impacts of armed conflict. Armed conflict is a manifestation of political failure. Among other things, severe violence impedes the state's ability to maintain rule of law and collect and redistribute taxes and revenues. The longer-term institutional implications of armed conflict are less clear-cut. Oftentimes, ongoing armed conflict inspires more stringent central rule, epitomized by implementation of an indefinite state of emergency and restrictions on, e.g., media freedom and civil liberties, as well as more covert aspects of repression, discrimination, and exclusion (143–146). There is mixed evidence for civil conflict impacts on the stability and longevity of regimes, however. Empirical findings on the risk of military coups and state collapse following conflict diverge (147–149). At the same time, the effect of conflict on subsequent institutional and political reforms toward more democracy and liberalization is weak and seemingly quite short-lived (150–153). Overall, the inconsistent findings reflect the heterogeneous character of wars and the diverse contexts within which they are embedded.

2.3.3. Other generic impacts of armed conflict. Beyond socioeconomic and political implications of armed conflict, several core demographic, normative, and cultural effects have been detected. A common denominator of most conflicts, especially those that generate high casualty figures, is widespread forced migration (154–157). Individuals' motivations for mobility are inherently complex and hard to separate into distinct drivers, but direct threat of physical harm and indirect effects of conflict that work via loss of livelihood and, occasionally, increased vulnerability to environmental hazards, are common explanations. The global number of people forcibly displaced by conflict and persecution is at an all-time high (19), reflecting a deterioration of security conditions in many conflict-affected countries (**Figure 3**). However, similarly to how disasters sometimes curb migration (42), conflict-related destruction also may erode people's ability to use mobility as a coping mechanism.

Armed conflict also is associated with an array of other societal ills, including an increase in sexual and criminal violence, loss of generalized trust, increased acceptance for use of violence, military socialization, and polarization of society, but conflict sometimes also may foster more positive societal change, such as mobilization of civil society and transformation of gender roles (although the latter may be prone to reversal when fighting ends) (158–162). Common environmental impacts of conflict include abandonment of agricultural land and other land-use changes, illegal logging of tropical timber (but also occasional decline in deforestation), and increases in general environmental stress (163–166).

3. CLOSING THE CIRCLE: SOCIAL VULNERABILITY, CLIMATIC IMPACTS, AND ARMED CONFLICT

Reviewing and connecting the (mostly) separate bodies of literature on climate change vulnerability, climatic drivers of armed conflict, and societal consequences of armed conflict, we observe striking overlaps: Armed conflict increases poverty, leads to economic decline, and damages the functioning of the state. These political and socioeconomic impacts, in turn, fundamentally increase vulnerability to climate change. How conflict and hazards interact with devastating results is epitomized time and again in humanitarian emergencies. During 2019, nine of the 10 most severe food crises globally took place in regions that were sites of endemic violence and instability:

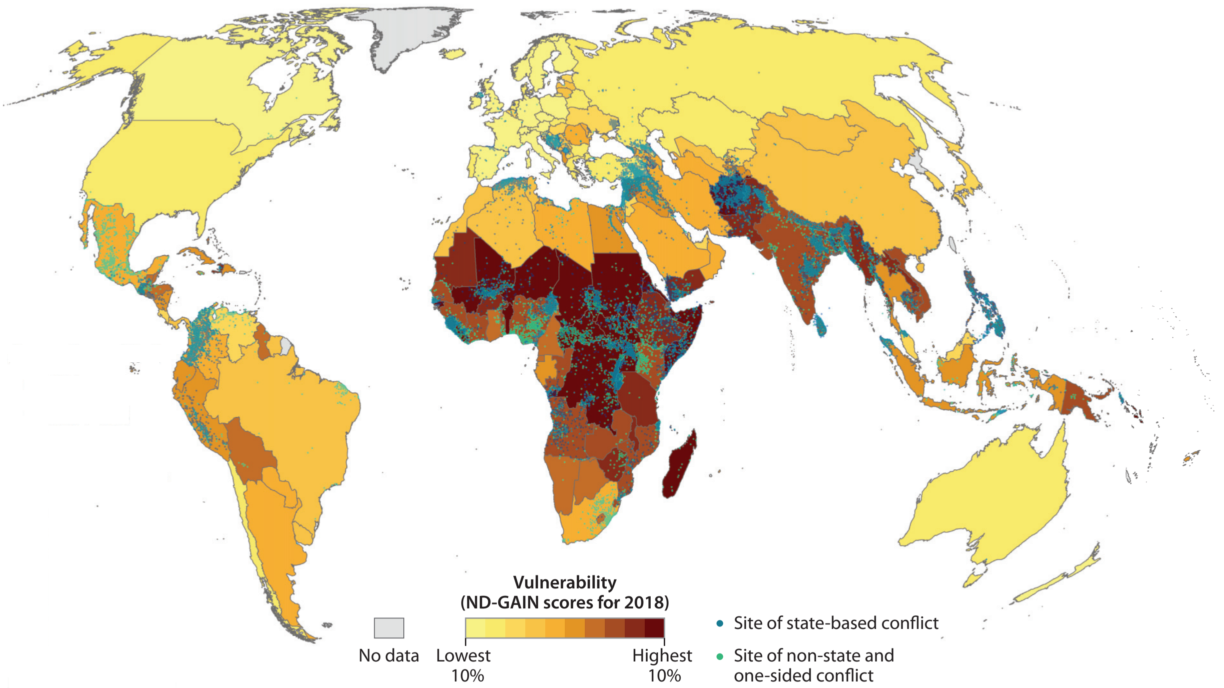

Figure 4

Spatial overlay of country-level vulnerability (ND-GAIN scores for 2018) (72) with location of preceding armed conflict events between 1989 and 2017. Blue dots denote sites of state-based conflict events, whereas green dots represent non-state and one-sided conflict events. Conflict data based on UCDP GED (168). Abbreviations: ND-GAIN, Notre Dame Global Adaptation Initiative; UCDP GED, Uppsala Conflict Data Program Georeferenced Event Dataset.

Yemen, the Democratic Republic of the Congo, Afghanistan, Ethiopia, South Sudan, Syria, Sudan, northern Nigeria, and Haiti (167). Weather-related extremes were identified as the second most important driver of food insecurity (after conflict) that year and reportedly contributed to worsening the situation in all of these cases (167).

Armed conflict has a plethora of adverse effects on societies' socioeconomic conditions, political behavior, and social norms and perceptions. Although some of these effects may be limited mostly to sites and periods directly exposed to military fighting, others have much more lasting imprints on society at large. Crucially, these impacts undermine local as well as national capacities to cope with and adapt to climate and weather extremes. This is visualized in **Figure 4**, which shows the location of armed conflict events between 1989 and 2017, derived from the Uppsala Conflict Data Program Georeferenced Event Dataset (168), overlaid with the ND-GAIN vulnerability index for 2018. Some of the apparent overlap between high historical density of conflict events and high present vulnerability may be reflecting a spurious relationship where exogenous background factors such as colonial legacy influences both outcomes (169), but part of the visually striking association also denotes causal pathways from underdevelopment to conflict as well as from conflict to developmental stagnation.

The spatially overlapping factors visualized in the map reflect mutually reinforcing and long-lasting processes. **Figure 5** provides additional empirical evidence of the powerful links between armed conflict, vulnerability, disaster-related impacts, and underdevelopment. High historical

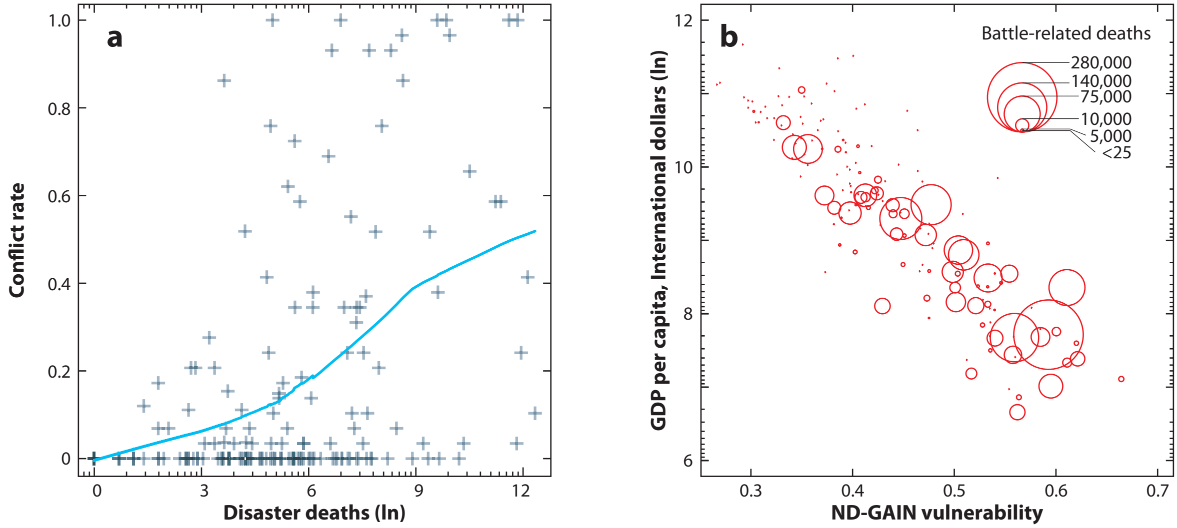

Figure 5

Association between vulnerability, disaster impact, conflict history, and underdevelopment. Panel *a* plots countries' historical conflict rate (i.e., share of years with active state-based conflict between 1989 and 2017, based on data from the UCDP (32) against reported total number of natural disaster deaths between 1990 and 2018 from EM-DAT (170), rescaled via natural logarithm (ln). Each data point (plus symbol) represents a country. A score of 1 on the Y-axis implies that the country hosted one or more state-based armed conflict(s) in every year in the period, whereas Y = 0 denotes countries at peace throughout. The blue line reveals the smoothed average association between conflict rate and disaster deaths. Panel *b* visualizes the association between GDP per capita [log-transformed purchasing power parity-adjusted international dollars from the World Bank (171)] and ND-GAIN vulnerability score (72) in 2018. The X-axis has a theoretical range from 0 (no vulnerability) to 1 (complete vulnerability), although observed values in the global dataset extend from around 0.3 to 0.7. Each data point (*circle*) represents a country, with the size of the circle reflecting the total number of battle deaths in state-based conflict in the country between 1989 and 2017, based on data from the UCDP (168). Consistent with the logic of the vicious circle conceptual model, prevalence and severity of conflict are positively correlated with higher levels of vulnerability. Abbreviations: EM-DAT, Emergency Events Database; GDP, gross domestic product; ND-GAIN, Notre Dame Global Adaptation Initiative; UCDP, Uppsala Conflict Data Program.

conflict rates (i.e., share of years since 1989 with state-based armed conflict) correlate strongly with contemporaneous disaster mortality (Pearson's $r = 0.45$) (**Figure 5*a***). Similarly, average macroeconomic performance [gross domestic product (GDP) per capita] is strongly negatively related to social vulnerability (Pearson's $r = -0.88$ in 2018), and both GDP and vulnerability are linked to historical conflict severity, denoted by the size of the circles (**Figure 5*b***). These plots jointly depict an endogenous relationship between underdevelopment and armed conflict (22, 95) that increases social vulnerability to climatic hazards (Section 2.1), conflict sensitivity to climatic impacts (Section 2.2), and vulnerability effects of armed conflict (Section 2.3). The overall implication of these relationships is not only that current conflict-affected regions are disproportionally hit by climate-related hazards but also that the legacy of violence and the resulting vulnerability potentially become a breeding ground for further conflict and fragility.

How strong is this feedback loop? To our knowledge, no empirical study to date has explicitly brought together all parts of the vicious circle in a coherent analytical framework, so systematic evidence across several cases is lacking at this point. However, indicative empirical findings are consistent with the existence of such reciprocal processes. Notably, studies that report a relationship between climate and conflict typically focus on the spatial distribution or incidence (as

DETECTING AN INTERACTION BETWEEN CONFLICT, VULNERABILITY, AND CLIMATE CHANGE: THE BOKO HARAM INSURGENCY IN NORTHERN NIGERIA

In 2009, the Nigerian Islamist rebel group commonly referred to as Boko Haram started an insurgency in the politically and economically marginalized areas of northern Nigeria. The insurgency spread to neighboring countries around Lake Chad, resulted in thousands killed, and has had severe economic impacts in the region where agriculture is the mainstay of the economy. Among other things, it led to massive displacement, restricted access to fields and markets, and lowered overall agricultural output and working opportunities (130, 179).

In its 2017 resolution, the United Nations Security Council explicitly recognized a role of climate change for stability in the Lake Chad region (180). The role of climate change in this ongoing conflict is more complex, however. Contrary to common views, Lake Chad has not been shrinking in the past 20 years (181). However, the double exposure to conflict and natural hazards, compounded by increased exposure through, e.g., population growth, plausibly generated incentives for supporting local armed actors. Interviews with former members of Boko Haram indicate that economic factors were among the top three most important reasons for joining the Islamist group, whereas religion was far less important (182). Another indirect conflict-environment link manifested itself in local herdsmen moving further South due to the insurgency and drought-related loss of grassland in the North. Their movement added to existing environmental and societal pressures in host regions and resulted in increasing conflicts with local sedentary farming communities. Communal conflicts of this kind have resulted in thousands of deaths in recent years in Nigeria (183, 184).

opposed to outbreak) of ongoing violence (7), where conflict thus may be both a consequence and a determinant of social impacts of climatic hazards:[7]

- The conflict-affected population is vulnerable and suffers in the wake of climate-related shocks, as normal coping mechanisms are unavailable, including peace-time opportunities for employment and alternative livelihoods. The widespread presence of armed actors offers, for some, a viable coping strategy and alternative mode of livelihood (175).
- At the same time, warfare hampers trade flows and thus increases the strategic importance of local food production and storage. A climate-related hazard, such as a drought or flood, may contribute to local scarcity and further elevate the strategic relevance of controlling food resources, potentially resulting in battles between armed actors (176) as well as civilian targeting (177, 178) in order to gain access to the scarce resource.
- Conflict-related displacement might add additional pressures, including by contributing to diffusion of violence, increasing the availability of arms, and—potentially—instigating violent or nonviolent host-newcomer conflict in areas already suffering from environmental marginalization. This dynamic is exemplified in the case of northern Nigeria (see the sidebar titled Detecting an Interaction Between Conflict, Vulnerability, and Climate Change: The Boko Haram Insurgency in Northern Nigeria).

The processes identified in the northern Nigerian case are more acute in the midst of conflict; however, the legacy of violence also puts post-conflict countries at risk. Many civil wars flare up

[7]In contrast, most studies of outbreak of armed conflict typically find only weak climate effects (e.g., 94, 101, 172, 173). We emphasize, however, that conflict onset is notoriously difficult to predict in general as it is a very rare event (174), providing an additional explanation for why onset studies yield weaker results in this field of inquiry.

again within the first couple of years of termination, to the extent that the best predictor of war for any given country is that the country was engaged in war the previous year (22, 24). High risk of renewed violence after conflict may be explained by a range of factors, including insufficient addressing of the original causes of conflict, the existence of profiteers of violence, high availability of arms and knowhow for staging a rebellion, and commitment problems due to low trust among the former adversaries. Combined with the many adverse structural impacts of conflict discussed above (Section 2.3), actors who have incentives to initiate violence will find the conditions more conducive to radicalization and mobilization in poor, post-conflict societies (22, 185). Climate-related shocks that put the fragile society under an even greater socioeconomic pressure may thus make it even more difficult to sustain peace.

4. DISCUSSION AND OUTLOOK

Climate change will have adverse impacts on a range of human security outcomes, but not all countries are equally vulnerable to climatic hazards. Current humanitarian crises illustrate the complex coupling of causes and consequences of armed conflict and social vulnerability, but scholarly work too often focuses on either of these phenomena in isolation. In this article, we have connected the literatures on social vulnerability to climate change, consequences of armed conflict, and security implications of climate change. We demonstrate striking overlaps and the potential of entrapment of regions in vicious circles of vulnerability and violence.

These findings have implications for both future scholarly work and policy and practice. Our results suggest that greater attention to armed conflict as a driver of vulnerability is warranted. For example, the Shared Socioeconomic Pathways, which are widely used in climate change impact assessments to explore societal implications of alternative climate change and development trajectories (186–188), are tacitly founded on the assumption that the future will be devoid of economic growth distortions, political instability, and armed conflict. Consequently, these projections provide overly optimistic estimates of adaptive capacity and resilience, especially for the poorest and most vulnerable countries in the Global South, resulting in an underestimation of likely climate-related impacts of stability and growth in the future (189).

Relatedly, it is impossible to assess long-term security implications of climate change without accounting for the legacy of violence. Current conflict hotspots very likely will remain challenged by violence and instability in the near and mid-term future. Given that vulnerability in these areas will remain high, climate change also is more likely to aggravate the humanitarian situation further. This may include increasing the risk of renewed violence after peace, thus generating additional layers of challenge to governments and civil society alike. Future research should systematically assess these feedback processes to facilitate more plausible risk assessments.

Lastly, there are clearly overlaps between capacities to adapt to climate change and factors that promote peace and sustainable development. In general, this means that addressing one of these challenges very likely contributes to reducing risks from other challenges as well. There are two caveats to this statement, however: First, more knowledge is needed on the impact of interventions, which may themselves carry adverse or unintended security implications for some social actors (8, 93). The sparse literature on connections between climate adaptation and mitigation projects and local security points to a potential for an increase rather than decrease in local tensions in some contexts, notably related to access and use of land (190–192). Second, given the mutually reinforcing dynamics we outline here and the fundamentally destructive power of armed conflict in ruining economic activity, political functioning, and social coherence—often with substantial spillovers across sectors and regions—breaking the conflict trap should be seen as the prioritized entry point for development assistance and climate change adaptation in conflict-affected communities (27). Without institutional capacity, human capital, and social relations conducive to peaceful cooperation, efforts to reduce risks from climate-related hazards are unlikely to succeed.

SUMMARY POINTS

1. Climatic hazards affect societies unevenly, where vulnerable populations bear the brunt of adverse impacts.
2. Central drivers of vulnerability to climatic hazards also increase adverse climatic effects on armed conflict.
3. Armed conflict has devastating consequences for socioeconomic development and political stability, thereby increasing vulnerability to future climatic hazards.
4. The most severe humanitarian crises are found in countries exposed to both armed conflict and climate-related shocks.
5. Conflict-affected countries may be trapped in a vicious circle of violence and vulnerability that is further exacerbated by climate change.

FUTURE ISSUES

1. Conduct systematic empirical studies on the mutual association between armed conflict and vulnerability to climate change: This implies exploring empirically how fluctuations in violence and security interact with shifting socioeconomic and climatic conditions in a coherent, comparative manner where endogenous links are explicitly accounted for.
2. Improve data collection on social impacts of climatic hazards in conflict-affected regions: In addition to household surveys, more extensive use of mobile phone assessments, satellite-based remote sensing, and stakeholder involvement may facilitate novel data and information from challenging research environments that currently impede our understanding of how violence shapes vulnerability (e.g., 193, 194).
3. Account for conflict exposure in climate change vulnerability and impact assessments: Conflict not only causes vulnerability, but it also impedes adaptation to a changing climate. Endogenous processes between conflict and vulnerability are insufficiently reflected in extant socioeconomic projections and scenarios frameworks, implying that risk assessments are likely to underestimate adverse outcomes of unmitigated warming for the most vulnerable societies (189).
4. Assess security implications of societal responses to climate change: Few studies have investigated how climate change adaptation and disaster risk reduction interventions influence local conflict risk (8). Lack of complete understanding of the pros and cons of alternative interventions challenges the identification of best practices and may inadvertently motivate projects that do more harm than good.

DISCLOSURE STATEMENT

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