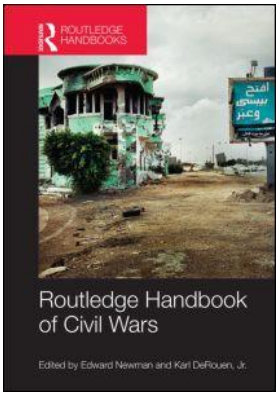

Routledge Handbook of Civil Wars

Edward Newman, Karl DeRouen

Environmental Change and Armed Conflict

Publication details
https://www.routledgehandbooks.com/doi/10.4324/9780203105962.ch16
Halvard Buhaug, Hanne Seter
Published online on: 18 Feb 2014

16
ENVIRONMENTAL CHANGE AND ARMED CONFLICT

Halvard Buhaug and Hanne Seter

In response to the collapse of the Cold War system's apocalyptic nuclear rivalry, the late 1980s and early 1990s saw a gradually increasing acceptance within policy as well as academia for a broad interpretation of the term "security." The release of the 1987 UN-commissioned report *Our Common Future*, better known as the Brundtland Report, was arguably the first significant step toward including environmental concerns in the widened security concept. This report emphasized the need for sustainable development and a more equitable distribution of the world's wealth and resources. A further landmark was the 1994 *Human Development Report*, which outlined a facet of threats – not only to states but also to social groups and individuals – that jointly defined the term human security. These reports and the accompanying security discourse have laid the foundation for two decades of scientific research on environmental change and armed conflict.

This chapter takes stock of the state of the art on research on the relationship between the environment and political violence, with particular emphasis on civil war. This literature is commonly referred to as environmental security research.[1] The first half of the chapter reviews theoretical and empirical work on resource scarcity and environmental stress, and the second half focuses on the more recent subset of studies on climate change and conflict. Overall, the assessment reveals that there is little evidence for a robust *general* causal relationship between environmental change and civil war. There is more evidence that a link may exist for less severe forms of political violence under certain conditions, although studies have not converged on the exact shape and importance of this relationship. The chapter ends with a few recommendations for future research.

Environmental change and conflict: the Malthusian legacy

Classic environmental security thinking is highly influenced by the writings of Thomas Malthus, an English professor in history as well as political economy. In his famous *An Essay on the Principle of Population*, published anonymously in 1798 (Malthus 1989: xlvii [1798]), Malthus argued that unconstrained human population grows exponentially whereas food production can only grow linearly. Population growth is held in check by famine, disease, and war, and based on projections of future population growth Malthus predicted that these mechanisms would become more prevalent in the near future (Malthus 1997 [1798]). The Malthusian argument has

to a large extent been proven wrong as food production has increased more rapidly than anticipated by Malthus due to technical innovations, whereas population growth has been slower (Urdal 2005: 418). Even so, the crux of Malthus' thesis – that sustained human population growth at some point will reach and exceed the carrying capacity of the earth – is still influencing scholars and policy makers alike today.

In the 1960s and 1970s, a new scholarly literature emerged claiming that rapid population growth would cause environmental destruction and eventually lead to violent conflict. These so-called neo-Malthusians accepted Malthus' causal mechanisms and main conclusions, and added moral constraints which focused on how to slow down population growth in poor developing countries. Malthus himself was an opponent of contraception (along with most others at his time) and believed that population was part of a larger equilibrium which was self-regulating (Caldwell 1998). One prominent contributor to the neo-Malthusian literature is Paul Ehrlich, whose 1968 bestseller *The Population Bomb* argued that the world would undergo mass starvation within the next decade (Ehrlich 1968). Another central writer is Garrett Hardin, an US ecologist who coined the term "the tragedy of the commons," referring to the process whereby common goods, such as the environment, would suffer from over-utilization and eventually cause ecological collapse (Hardin 1968). Many neo-Malthusian arguments and predictions are also found in the report *The Limits to Growth*, which projected that exhaustion of natural resources will lead to a significant drop in living standards in the twenty-first century (Meadows *et al.* 1972).

Malthusian and neo-Malthusian work has greatly influenced later thinking on population growth. One example is China's 1979 one-child policy, which emphasized the limited availability of land and natural resources as a rationale for limiting the population size (Li and Zhang 2007). Neo-Malthusian arguments today are often applied to rural societies in developing countries as these populations are highly dependent on renewable resources while being considered less equipped to adapt to environmental changes. Poor adaptation among the poor, rural population is seen as contributing to increased competition and eventually violent conflict (Ohlsson 1999).

Cornucopianism

Malthusian thinking has not remained unchallenged. Even during Malthus' time the French writer Marquis de Condorcet (1995: 160 [1795]) predicted that "more goods will be obtained for a small outlay, the manufacture of articles will be achieved with less waste of raw materials and will make better use of them." Condorcet's forecast corresponded well with the development over the next two centuries as the ratio of global food production to population growth vastly exceeded the Malthusian forecast (Lomborg 2001).

Resource optimists, often referred to as neoclassical economists or cornucopians (from cornucopia: horn of plenty), point to several reasons why the Malthusian argument failed. Bjørn Lomborg (2001) argues that humans are able to adapt through technological innovation and the application of knowledge. Agricultural economist Ester Boserup shows that increased agricultural output in a given area is in most cases determined by an increase in available labor. She argues that the Malthusian perspective suffers from reverse causality, and that population growth is the major independent variable determining food production (Boserup *et al.* 2005). Furthermore, resource optimists argue that most renewable resources are not scarce, at least not in a global perspective. Humankind continues to develop new resources, more efficient ways to use and recycle resources, and new substitutes for resources that are depleted. Following this logic, Lomborg (2001) sees little evidence that food supplies, energy materials, and water will become scarce in the future.

Resource scarcity

Despite vocal objections from resource optimists, neo-Malthusian thinking has continued to inform dominant non-governmental organizations and policy makers. For example, the UN's Intergovernmental Panel on Climate Change (IPCC) promotes slowing population growth as a way to increase food security (Easterling *et al.* 2007) whereas a report by the United Nations Environmental Programme (UNEP 2007: 8) emphasizes "exponential population growth and related environmental stress" as causes of the social breakdown in Darfur.

Within academia, the notion of environmental security developed rapidly during the 1990s with the pioneering work of the research group often referred to as the Toronto school. Located at the University of Toronto and led by Thomas Homer-Dixon, the Toronto school focuses on how complex social and environmental processes, notably scarcity of renewable resources, can lead to violent conflict (see Homer-Dixon 1999). Three main types of resource scarcity can be identified. Demand-induced scarcity arises when resources are decreasing in quantity or the quality is degraded. Supply-induced scarcity may be a result of population growth or increasing per capita consumption. Structural scarcity refers to unequal resource distribution, which often is a result of powerful groups' disproportionate access to the resources.

Acute resource scarcity may cause chronic poverty, which in turn can lead to violence through two social effects; resource capture and ecological marginalization. Resource capture occurs when increased resource consumption is combined with resource degradation. Powerful groups, anticipating future resource scarcity, take control over the resources by shifting the laws and institutions in their favor, thereby increasing resource scarcity among the weaker groups in society (Homer-Dixon 1999). The civil violence in South Africa during the apartheid regime has been promoted as a classic conflict where the resource capture mechanism was at play (Percival and Homer-Dixon 1998). At the time of violence outbreak the South African society was struggling with high population growth, lack of water and fuelwood, soil erosion, and a racist policy for resource allocation, all of which contributed to poverty, marginalization, migration, and disrupting institutions.

The second social effect of resource scarcity, ecological marginalization, occurs when structural scarcity joins with rapid population growth, which in turn may force weaker groups to migrate to ecologically fragile areas. Homer-Dixon illustrates this mechanism with the Philippines, where environmental degradation, in conjunction with unequal access to resources, population growth, and migration, "contributed to economic hardship that spurred insurgency and rebellion" (Homer-Dixon 1999: 77).

The Toronto school has had a major influence in policy circles, perhaps especially during early years of the Clinton administration (Hartmann 2010: 236). The research team's policy recommendations have brought forward curbing population growth as one of the most important preventive measures of conflict due to resource scarcity. In an article from 1994 Homer-Dixon and colleagues give the following policy recommendation: "rich and poor countries alike must cooperate to restrain population growth, to implement a more equitable distribution of wealth within and among their societies, and to provide for sustainable development" (Homer-Dixon *et al.* 1994: 45).[2]

Another noteworthy research group within the broad environmental security tradition is the Environment and Conflicts Project (ENCOP) led by Gunther Baechler. This research group conducted forty case studies, which largely supported the conclusions of the Toronto school about a correlation between environmental degradation and violent conflicts (Baechler 1999: xv). One of the major differences between the Toronto school and ENCOP is that ENCOP put more emphasis on the role of political institutions, which are brought forward as the main explanation for why conflicts become violent in some cases and not in others (Baechler 1999: 221).

A third and complementary perspective is offered by Colin Kahl (2006). Emphasizing the active role of the state in curbing or fueling conflicts, he points out that demographic and environmental stress (DES) is not entirely nature given but is endogenous to social, political, and developmental systems. Kahl identifies two state-centric pathways to violent conflict. On the one hand, state failure conflicts can emerge as a result of an interaction between DES and state weakness and thereby produce an "internal security dilemma" (2006: 211). Alternatively, the state may deliberately play up intergroup competition and amplify DES-related grievances and stir so-called state exploitation conflicts that serve elite interests (2006: 218).

Few scholars today claim that there is a direct relationship between environmental scarcity and violent conflict. Accordingly, empirical research increasingly discusses and attempts to identify plausible intervening variables, notably social, political, demographic, or economic mechanisms that together with environmental scarcity may increase the risk of violent conflict. One such condition is fragile or unfair political institutions, as emphasized by the ENCOP group and Kahl's work. Other frequently suggested intervening variables include food security and migration (Barnett and Adger 2007). For instance, in sub-Saharan Africa, where inter- and intra-annual rainfall variation is extensive, almost 90 percent of total food production comes from rain-fed agriculture (Cooper *et al.* 2008: 25), implying high social and economic vulnerability to volatile resource supplies. Migration is closely related to food security; lack of access to food or pasture, as well as deteriorated environments more generally, might force people to migrate to more promising locations (Reuveny 2007). A widely cited example where land pressure and environmental deterioration contributed to human mobility is the large influx of migrants from Bangladesh to India during the 1970s, which stirred violent conflicts between natives and newcomers (Homer-Dixon 1999; Swain 1996).

Early critique of environmental security research

The qualitative environmental security literature quickly attracted criticism along several dimensions, especially related to case selection and overly complex causal frameworks that inhibit systematic empirical testing. For example, Levy (1995) emphasizes that choosing cases on the dependent and main independent variables makes finding environmental conflict probable. By not including null-cases, Homer-Dixon and colleagues were unable to observe how some countries avoid violent conflict even though significant environmental degradation and other conflict-promoting conditions are present. Gleditsch (1998) joins this critique, arguing that the complex resource-scarcity models are virtually untestable. To demonstrate this point, he cites Howard and Homer-Dixon's (1998) case study of the rebellion in Chiapas, which involved seven independent variables that acted through nine intervening variables. Other problematic aspects brought forward by Gleditsch include reverse causality; overlooking important explanatory variables; operationalization of conflict; and the level of analysis.

Peluso and Watts (2001: 20) further criticize the environmental scarcity literature for overgeneralization and lack of operational clarity, as the studies fail to explain how "the rhythms of environmental change and accumulation shape the processes of exclusion, disenfranchisements, and displacement." Moreover, the independent variables are often underspecified, use vague concepts such as elites and powerful groups, and thus blur the concepts and causal pathways linking resource scarcity with conflict.

Political ecology

Political ecology represents one of the major perspectives challenging the traditional resource scarcity approach. Consisting of in-depth case studies, often based on long-term fieldwork or

household surveys, political ecology is concerned with understanding the larger context and historical background of conflicts, in contrast to a simplistic resource–conflict model (Robbins 2004). Political ecology puts particular emphasis on how institutional and socioeconomic constraints shape local coping capacity and adaptation (O'Brien *et al.* 2007), and studies often highlight how people respond to the ecological variability with diversity and flexibility. For example, Bogale and Korf (2007) in their survey of non-violent conflict in Ethiopia show how farmer–herder communities develop sharing mechanisms on pastures in dry years, which ultimately give asset-poor households opportunities to stabilize and enhance their asset base in dry years. In this case, the dry-season in-migration of pastoralists usually does not result in violence due to traditional institutional arrangements. Bogale and Korf conclude that the notion of scarcity cannot properly explain whether and when violent conflict will emerge between competing resource users. Turner (2004: 866), investigating farmer–herder conflicts in West Africa, adds to this argument by observing that "struggles over resources are often superficially so" as they reflect broader tensions between and within different groups. Similar arguments are made by de Waal (2005) and Dafinger and Pelican (2006), which jointly indicate that the Malthusian trap can be mitigated if local conditions and institutions are favorable for cooperation.

The political ecology approach in general considers current development policy as unfit (Turner 2004). One of the most common critiques is aimed at the so-called modernization policy, which emphasizes changing land rights, decentralization processes, and marginalization of customary practices. Modernization policy is common throughout sub-Saharan Africa (Dafinger and Pelican 2006: 128). However, Benjaminsen and Ba (2009) describe how large-scale conversion of pastures into agricultural fields in the Inner Niger Delta of Mali increasingly has put pastoral production under pressure. The focus on technological fixes has also received critique (Mortimore 1998). Those advocating such solutions assume that new solutions, such as inorganic fertilizers and irrigation schemes, will increase agricultural output and eventually progress into a green revolution, similar to the Asian green revolution (Scoones *et al.* 2005: 2). Political ecologists instead recommend social response measures such as poverty reduction, income diversification, protection of common property resources, and strengthening collective action to help increase the adaptive capacity of the most vulnerable members of society (Kelly and Adger 2000: 346).

Quantitative studies

Despite partly different theoretical approaches between the different schools of thought surveyed above, they all rely almost exclusively on in-depth qualitative analyses for empirical substantiation. Since such studies are normally unsuitable for drawing general conclusions about a link between the environment and conflict, a separate group of studies emerged, building on the critiques of Levy (1995) and Gleditsch (1998). A pioneering study in this regard is Hauge and Ellingsen (1998). Their statistical analysis provides a more general substantiation of the scarcity argument by showing that deforestation, land degradation, and scarce supply of freshwater alone and in combination with other factors increase the risk of violent conflict. However, a replication analysis by Theisen (2008) failed to reproduce the original results and thus supports the report by State Failure Task Force (Esty *et al.* 1998), which relied partly on similar data to Hauge and Ellingsen but did not find any direct relationship between resource scarcity and state failure.

More recent studies have produced mixed evidence. For example, de Soysa (2002) tests both the resource scarcity hypothesis, measured as per capita stock of total renewable resources and the "resource curse hypothesis" and only found support for the latter. The resource curse hypothesis argues that it is the abundance of valuable natural resources (such as diamonds,

petroleum, drugs cultivation, and tropical timber) that makes people engage in violence, not the scarcity of natural resources. Indeed, Binningsbø *et al.* (2007) even find higher levels of accumulated consumption of renewable resources to be associated with lower risk of civil war. Raleigh and Urdal (2007) argue that the lack of a robust relationship between population growth, environmental factors, and violent conflict may be due to high levels of aggregation. They conducted a sub-national study using grid-cells as units of observation and found a robust relationship for the demographic indicators, indicating more conflict in densely populated areas, but the effects for the environmental indicators were weak or negligible. Gizelis and Wooden (2010) investigate how intervening variables such as institutions affect the relationship between water resource scarcity and conflict. They find evidence for both direct and indirect relationships in support of the scarcity argument. Diverse and sometimes conflicting findings are usually a result of different samples being studied; differences in measurements and quality of the underlying data; and different estimation techniques being employed. Inconsistent results may also reflect a generally fragile statistical association.

Quantitative studies on population pressure and violent conflict also have produced weak and inconclusive evidence. Cincotta *et al.* (2003: 54) report that countries with urbanization growth rates above 4 percent per year during the 1990s have twice the risk of civil conflict outbreak as countries with slower urbanization rates. However, the bivariate nature of their analysis leaves a lot to be desired. Urdal's (2005) multivariate analysis of effects of demographic and cropland scarcity on the risk of violent conflict reveals little evidence for a strong connection. In a recent study, Buhaug and Urdal (2013) conclude that urban population growth is unrelated to the frequency and severity of social disorder in major cities in Asia and sub-Saharan Africa.

To summarize, political ecology, qualitative studies on resource scarcity, and the quantitative literature on environment and conflict differ in their focus, assumptions, and main conclusions. Accordingly, recommendations for policy makers with respect to the relevance of resource scarcity for human security and what policy prescriptions are considered most promising for building and ensuring lasting peace will depend critically on which research community one asks. This observation is particularly pertinent when considering the increased political prominence given to climate change in recent years and the increasing demands for knowledge on how climate change-induced resource scarcity may create and accentuate insecurity hotspots around the world.

Climate change and conflict

Studies on resource scarcity and environmental security, broadly construed, have waned in recent years. This is less a reaction to (perceived) reduced opportunities for further scientific progress than a response to shifting political realms. Whereas the widening of the security concept during the 1990s coincided with widespread concerns of pollution, deforestation, desertification, population growth, and other general processes as potential ecological threats, the new millennium has witnessed an increasing awareness of a special subset of environmental change, namely anthropogenic climate change. For instance, several influential voices have argued that the 2003 civil war in Darfur was linked to climate change (see Ki Moon 2007; Sachs 2006; for contrasting views, see Kevane and Gray 2008 and Brown 2010).

This academic shift of focus is especially evident within the quantitative literature, aided by increasing availability of meteorological statistics and the introduction of high-resolution remote sensing data. Unlike earlier quantitative comparative empirical studies of environmental change and conflict (de Soysa 2002; Binningsbø *et al.* 2007; Esty *et al.* 1998), which had to rely on mostly static indicators of freshwater availability and environmental degradation, recent investigations into climate–conflict connections have been able to draw on relatively long time-series of

meteorological data, or very long paleoclimatic data. Having temporally varying data is important in this context as it permits investigating whether sudden changes in environmental conditions affect the timing of conflict outbreak or escalation. In contrast, static environmental data may at best only explain why some areas or countries see more conflict than others but are unable to inform us on consequences of environmental change. This new quantitative literature can be divided into three groups: (1) research on climate variability and conflict; (2) research on climatic disasters and conflict; and (3) research on long-term climate change and conflict.[3]

Climate variability and conflict

In contrast to how the academic debate on climate security is usually framed, most relevant quantitative research is concerned with climate variability and not change. Climate *variability* is qualitatively different from climate *change* in that the former describes short-term (intra- and inter-annual) changes in the weather whereas the latter concerns long-term changes in climate patterns, lasting several decades or longer. Even so, climate variability is relevant within the context of climate change and security because global warming is projected to increase the frequency and severity of extreme weather events (variability) in large parts of the world. Indeed, such anomalies, which may take the form of extreme weather phenomena that develop into natural disasters, may constitute a greater threat to livelihood security and social stability than gradual changes in means of temperature and rainfall.

Likely mechanisms that might translate adverse climatic conditions into violent conflict resemble those proposed for the scarcity–civil war linkage: migration, food insecurity, economic shocks, and loss of livelihood and infrastructure to extreme weather events. Particularly critical is the suggested negative impact of increasing climate variability on vegetation and agricultural production among developing countries (Roudier *et al.* 2011). One relevant case here is Ethiopia, where agriculture forms the basis for 85 percent of all employment and an estimated 10 percent of the population suffers from chronic food insecurity (Conway and Schipper 2011: 227). Even though political and socioeconomic factors are likely to remain major underlying causes of political violence and civil war, climate variability and extremes might thus act as a precipitating factor or trigger of future conflict (Barnett and Adger 2007: 641).

The first comparative statistical study of climate variability and civil war was presented by Miguel *et al.* (2004). Using data on inter-annual changes in rainfall across sub-Saharan African as an instrument for economic shocks, they found that substantial loss of rainfall may be an important driver of conflict. Later investigations using partly different data and analytical designs have produced mixed results. For example, Jensen and Gleditsch (2009) show that the original results weaken if one disregards conflict participation in neighboring countries whereas Ciccone (2011) argues that the negative rainfall–civil war correlation is an artifact of how climate variability, in this case growth, is measured (see also response by Miguel and Satyanath 2011). More recently, Koubi *et al.*'s (2012) global analysis reveals little evidence that rainfall deficit is a robust indirect determinant of conflict risk, whereas Theisen *et al.*'s (2011/12) spatially disaggregated study fails to uncover a robust effect of rainfall on local conflict risk. Differences in methods and measurements are certainly an important explanation for this inconsistency although it may also be an indication of a generally feeble relationship between rainfall and civil war.

If research on rainfall and civil war provides inconclusive evidence, empirical studies of temperature and conflict are not much different. Burke *et al.* (2009) found that conflict risk in sub-Saharan Africa is significantly higher during warmer years, but this result has since been criticized for not being robust to small changes in sample size and variable operationalization (Buhaug 2010). A somewhat different approach is presented by Hsiang *et al.* (2011), who report

that global civil war frequency in the tropics is affected by El Niño-Southern Oscillations (ENSO) cycles. In contrast to other studies, this analysis suggests a systemic (i.e. global) effect, which prevails even when controlling for country-level climate variability. Accordingly, this finding is not immediately compatible with dominant environmental security theory, which tends to emphasize local explanations for violent conflict (Homer-Dixon 1999; Kahl 2006).

Beyond the quantitative cross-national civil war literature surveyed above, recent advances in data collection have resulted in a surge of studies on how climate variability affects the frequency of violent events of various kinds, including insurgency, cattle raiding, inter-ethnic rioting, and land disputes. Again, the results between studies differ, owing partly to differences in samples and measurements. For example, Meier *et al.* (2007) could not establish a statistically significant relationship between rainfall and communal conflict in East Africa but the analysis provided indicative evidence that environmental changes related to rainfall, notably vegetation density, are positively related to the frequency of cattle raids. Other studies reporting a positive correlation between rain and conflict events include Adano *et al.* (2012), Theisen (2012), and Witsenburg and Adano (2009). In contrast, Bohlken and Sergenti (2010), Fjelde and von Uexkull (2012), Hidalgo *et al.* (2010), and O'Loughlin *et al.* (2012) all show conflict events to be more frequent during relatively dry periods. Hendrix and Salehyan (2012) and Raleigh and Kniveton (2012) find both positive and negative deviations from normal rainfall conditions to increase conflict intensity, although the shape of this bimodal relationship varies with the type of conflict. Lastly, Benjaminsen *et al.* (2012) and Böhmelt *et al.* (2013) argue that climate variability is of little importance for land-use disputes and instead conclude – in line with most other studies cited here – that political and economic structures, as well as opportunistic behavior, are fundamental factors contributing to conflict (and cooperation) over land, water, and resources.[4]

Climatic disasters and conflict

Substantial and durable deviations from normal rainfall can result in droughts, floods, and slides; extreme temperatures characterize inhospitable heat and cold waves, and can trigger wildfires; and windstorms may literally uproot the affected ecological environment. What determines whether such extreme climatic events turn into natural disasters depend on their material and human consequences. The Centre for Research on the Epidemiology of Disasters (CRED), the leading international provider of disaster statistics, applies a consequence-based definition of a disaster as "a situation or event which overwhelms local capacity, necessitating a request to a national or international level for external assistance; an unforeseen and often sudden event that causes great damage, destruction and human suffering" (Guha-Sapir *et al.* 2012).

In this sense, research on the security implications of climate-related natural disasters provides a more precise investigation of how environmental change affects societies than studies of variations in meteorological statistics, which may be poor proxies for the true ecological impact of climatic anomalies. At the same time, disasters may be endogenously related to conflicts in the sense that past and ongoing conflicts may make countries and communities more vulnerable to extreme weather events (including whether or not they end up as "disasters") whereas a severe disaster may eradicate social bonds and material structures and lay the foundation for future societal instability. For instance, Eriksen and Lind (2009:817) observe in their study of Kenya that "conflict can generate vulnerability [to droughts] by damaging human and social capital and limiting adaptation options."

A handful of recent studies have investigated the general empirical association between climate-related disasters and armed conflict. The first to provide a global assessment, Nel and Righarts (2007) found that natural disasters increase the short-term risk of civil conflict but further testing revealed that this finding was driven primarily by rapid-onset geological disasters,

which the authors explain by the scale of material destruction incurred by such events. Climatic disasters, too, were positively associated with conflict incidence but the size and significance of the effect was sensitive to model specification. More recent analyses have reinforced the impression of a weak association between weather-related disasters and conflict. For example, Bergholt and Lujala (2012) conclude that climate-related natural disasters do not increase civil conflict risk while Slettebak's (2012) analysis indicates that, if anything, the effect is more likely to be negative. Moreover, Omelicheva (2011) reports that the effect of disasters on political instability diminishes once structural characteristics of states are accounted for, suggesting that disasters might trigger instability only in those countries already at considerable risk of conflict.[5] Natural disasters and extreme weather events continue to dominate political discourse on climate change and security, however (for a recent exposition, see Tipson 2013). Important security challenges in this regard are how to accommodate rapidly increasing populations in vulnerable regions and how to make coastal societies and infrastructure more resilient to sea-level rise and extreme environmental events.

Long-term climate change and conflict

A third group of studies look more squarely into how long-term climate change, notably cooling, affects temporal fluctuations in conflict patterns and other forms of societal instability. These studies are strictly longitudinal, meaning that they lack the comparative perspective of conventional large-N studies of contemporary events, but they are better suited to capture inert and gradual social responses to shifting environmental conditions. The first such study to be published found that long-term fluctuations of war frequency and population growth across Europe and China since AD 1400 followed cycles of temperature change (Zhang *et al.* 2007). More specifically, unusually cool periods were associated with higher war density, lower population growth, and lower food production. A similar pattern has been reported and explicated in further depth by Tol and Wagner (2010) and Zhang *et al.* (2011). All these studies point to durable harvest failures and epidemics as central intermediate responses linking climate change with war, famine, migration, and societal misery.

The extent to which insight gained from studies of the pre-modern era can inform us of likely consequences of future climate change is debatable. However, even though state building, technological innovation, and international interdependence may make societies more resilient to adverse environmental conditions – for example through trade, substitution, and relief aid – the agricultural sector in large parts of the contemporary world remains sensitive to climate variability and change.

Unresolved issues and research gaps

Despite rapid scientific progress in research years, aided by increasing public and policy awareness of anthropogenic global warming, the issue of whether and how political violence and armed conflict relate to environmental change remains at the fringe of academic security discourse. Instead, research on conflicts and wars continues to focus on classic themes such as military power, alliances, trade, economic development, and democracy and human rights. Indeed, even the IPCC has been remarkably vague on the security implications of climate change, and relevant statements in the first four Assessment Reports are mostly limited to unsubstantiated claims and scattered references to non-peer reviewed reports (Nordås and Gleditsch 2013).[6] This near ignorance of environmental security among large parts of the contemporary scholarship might imply that environmental issues, including climate change, are of little relevance for peace and conflict. We believe such a conclusion

would be premature, partly because there are still a number of relevant issues that have not been subject to scientific scrutiny and partly because of theoretical and methodological limitations with existing research. This section expands on some of these research gaps.

First, there is a need to bridge the gap between qualitative and quantitative research. Presently, much of the conceptual and single case-based research describes or presupposes very complex causal chains, often with multiple layers of indirect and contextual factors and feedback mechanisms, that do not lend themselves to empirical evaluation in a large-N comparative fashion. In contrast, statistical studies are largely limited to testing direct or simple interactive effects of the environment on conflict risk. Future research should move beyond the habitual one-size-fits-all approach and exploit the rich qualitative literature to better specify the conditions under which certain environmental or climatic conditions can plausibly affect dynamics of political violence. Possible intermediate impacts of environmental change that should receive further scrutiny include agricultural production, food insecurity, economic shocks, and human displacement. Similarly, the available pool of detailed case studies should inspire further theory building with particular emphasis on actors and motives, which remain conspicuously under-communicated in extant mechanistic environmental security models.

Second, future research should draw on recent advances in the development of georeferenced data and spatial research designs. Conflicts rarely affect entire countries and are often confined to a limited geographical area, and the same applies to resource scarcity and weather events (Buhaug 2007; O'Lear and Diehl 2007). Rainfall statistics, when aggregated by country and year, may disguise extreme events of limited spatial and/or temporal extent and thereby result in false negatives (erroneously deducing a lack of association between two factors). Similarly, overly aggregated analyses may cause false positives (erroneously deducing a causal association between two factors), for example in cases where observed acute resource scarcities and violent conflicts affect different populations in a country. A limited number of recent empirical studies make use of geographical information systems (GIS) (Fjelde and von Uexkull 2012; O'Loughlin *et al.* 2012; Theisen *et al.* 2011/12) but more research of this kind is needed to provide a comprehensive insight into environment–conflict connections across scales.

A third priority for future research relates to the type of violent conflict being studied. Thus far quantitative work has focused almost exclusively on the most severe forms of violent conflict, civil war. In contrast, case studies and narratives of environment-driven conflicts tend to concern inter-ethnic communal violence, land-use disputes, and non-violent protests. Recent developments in the collection of events data that cover a broader spectrum of conflict, including cooperative events, offer great promise for further advances in this regard (Bernauer *et al.* 2012b; Hendrix and Salehyan n.d.; Raleigh *et al.* 2010).

Conclusion

Six years after the Nobel Peace Prize was awarded to the IPCC and former US Vice President Al Gore, climate change is still high on the political agenda. However, the heated debate on the relevance of human activities for global warming has been superseded by questions relating to likely impacts of future climate change and how best to mitigate these. Among the many proposed dire social consequences we find violent conflicts over dwindling resources, large-scale migration and resulting host–newcomer tensions, and societal collapse (Dyer 2008; Welzer 2008). To what extent are such prophesies backed by empirical evidence? This chapter has surveyed academic research on historical links between environmental change and conflict. Taken together, this broad literature offers mixed evidence for a causal relationship. The majority of studies of civil wars and major armed conflict conclude that resource scarcity, population

pressure, and weather patterns exhibit weak influences on conflict risk, compared to structural economic and institutional features. Moreover, those that report a significant correlation disagree on the direction and magnitude of the effect. The literature offers more – but not entirely consistent – empirical evidence that nature affects the risk and dynamics of small-scale conflict, especially among marginalized and poor populations in sub-Saharan Africa. Thus far, there is little systematic research on plausible indirect and long-term consequences of extreme weather events, increasing resource scarcities, and other forms of environmental change.[7]

Empirical research on environmental security has made significant progress in recent years. At the same time, this chapter has highlighted several notable limitations with extant studies and provided some guidelines for future research in the field. Considering the obvious policy relevance of this research, it is important that the academic community continues to produce ever more fine-grained knowledge on nature–society connections. Preventing violent conflict should be the ultimate ambition of peace and conflict research, and improving our ability to offer accurate predictions of future conflict hotspots under changing environmental conditions is an important task.

Notes

1 Environmental security is a broad concept that is subject to individual interpretation and preference, and we certainly cannot claim to cover all relevant dimensions here. Instead, we give priority to recent theoretical and empirical work that considers the likely consequences of environmental change for violent conflicts and civil wars.
2 For an overview of policy recommendations see Homer-Dixon (1994).
3 Due to space constraints, we leave out the issue of whether and how climate may affect international conflict. There is also a considerable literature on individual-level aggression in response to thermal stress which will not be covered here.
4 Some of these studies focus on how violence differs between wet and dry seasons, which is interesting in its own right but arguably less relevant within the context of climate change and security.
5 In addition, there are a number of qualitative case studies on how extreme weather events and natural disasters have triggered and affected specific conflicts but these are less suitable for generalization.
6 In the IPCC's fifth Assessment Report, human security will for the first time be treated explicitly in a designated chapter, including a section on armed conflict.
7 For supplementary reviews of the climate-conflict literature, see Bernauer *et al.* (2012a), Gleditsch (2012), and Salehyan (2008).

References

Adano, W. R., Dietz, T., Witsenburg, K., and Zaal, F. (2012) Climate Change, Violent Conflict and Local Institutions in Kenya's Drylands, *Journal of Peace Research*, 49(1), 65–80.

Baechler, G. (1999) *Violence through Environmental Discrimination: Causes, Rwanda Arena, and Conflict Model*, Dordrecht: Kluwer Academic Publishers.

Barnett, J., and Adger, W. N. (2007) Climate Change, Human Security and Violent Conflict, *Political Geography*, 26(6), 639–655.

Benjaminsen, T. A. and Ba, I. (2009) Farmer–Herder Conflicts, Pastoral Marginalisation and Corruption: A Case Study from the Inland Niger Delta of Mali, *Geographical Journal*, 175(1): 71–81.

Benjaminsen, T. A., Alinon, K., Buhaug, H., and Buseth, J. T. (2012) Does Climate Change Drive Land-Use Conflicts in the Sahel? *Journal of Peace Research*, 49(1), 97–111.

Bergholt, D. and Lujala, P. (2012) Climate-Related Natural Disasters, Economic Growth, and Armed Civil Conflict, *Journal of Peace Research*, 49(1), 147–162.

Bernauer, T., Böhmelt, T., and Koubi, V. (2012a) Environmental Changes and Violent Conflict, *Environmental Research Letters*, 7(4), 015601.

Bernauer, T., Böhmelt, T., Buhaug, H., Gleditsch, N. P., Tribaldos, T., Weibust, E. B., and Wischnath, G. (2012b) Water-Related Intrastate Conflict and Cooperation (WARICC): A New Event Dataset, *International Interactions*, 38(4), 529–545.

Binningsbø, H. M., de Soysa, I., and Gleditsch, N. P. (2007) Green Giant or Straw Man? Environmental Pressure and Civil Conflict, 1961–99, *Population and Environment*, 28(6), 337–353.

Bohlken, A. and Sergenti, T. (2010) Economic Growth and Ethnic Violence: An Empirical Investigation of Hindu-Muslim Riots in India, *Journal of Peace Research*, 47(5): 589–600.

Bogale, A. and Korf, B. (2007) To Share or Not to Share? (Non-)violence, Scarcity and Resource Access in Somali Region, Ethiopia, *Journal of Development Studies*, 43(4), 743–765.

Böhmelt, T., Bernauer, T., Buhaug, H., Gleditsch, N. P., Tribaldos, T., and Wischnath, G. (2013) Demand, Supply, and Restraint: Determinants of Domestic Water Conflict and Cooperation, unpublished manuscript.

Boserup, E., Abernethy, V. D., and Kaldor, N. (2005) *The Conditions of Agricultural Growth: The Economics of Agrarian Change under Population Pressure*, New Brunswick, NJ: Aldine Transaction.

Brown, I. A. (2010) Assessing Eco-scarcity as a Cause of the Outbreak of Conflict in Darfur: a Remote Sensing Approach, *International Journal of Remote Sensing*, 31(10), 2513–2520.

Buhaug, H. (2007) The Future is More than Scale: A Reply to Diehl and O'Lear, *Geopolitics*, 12(1), 192–199.

Buhaug, H. (2010) Climate Not to Blame for African Civil Wars, *Proceedings of the National Academy of Sciences of the USA*, 107(38), 16477–16482.

Buhaug, H. and Urdal, H. (2013) An Urbanization Bomb? Population Growth and Social Disorder in Cities, *Global Environmental Change*, 23(1), 1–10.

Burke, M. B., Miguel, E., Satyanath, S., Dykema, J. A., and Lobell, D. B. (2009) Warming Increases the Risk of Civil War in Africa, *Proceedings of the National Academy of Sciences*, 106(49), 20670–20674.

Caldwell, J. C. (1998) Malthus and the Less Developed World: The Pivotal Role of India, *Population and Development Review*, 24(4), 675–696.

Ciccone, A. (2011) Economic Shocks and Civil Conflict: A Comment, *American Economic Journal: Applied Economics*, 3(4), 215–227.

Cincotta, R., Engelman, R., and Anastasion, D. (2003) *The Security Demographic: Population and Civil Conflict After the Cold War*, Washington, DC: Population Action International.

Condorcet, M. (1995 [1795]) Condorcet on Human Progress, *Population and Development Review*, 21(1), 153–161.

Conway, D. and Schipper, E. L. F. (2011) Adaptation to Climate Change in Africa: Challenges and Opportunities Identified from Ethiopia, *Global Environmental Change*, 21(1), 227–237.

Cooper, P. J. M., Dimes, J., Rao, K. P. C., Shapiro, B., Shiferaw, B., and Twomlow, S. (2008) Coping Better with Current Climatic Variability in the Rain-Fed Farming Systems of sub-Saharan Africa: An Essential First Step in Adapting to Future Climate Change? *Agriculture, Ecosystems and Environment*, 126(1/2), 24–35.

Dafinger, A. and Pelican, M. (2006) Sharing or Dividing the Land? Land Rights and Farmer–Herder Relations in Burkina Faso and Northwest Cameroon, *Canadian Journal of African Studies/Revue Canadienne des Études Africaines*, 40(1), 127–151.

de Soysa, I. (2002) Ecoviolence: Shrinking Pie or Honey Pot? *Global Environmental Politics*, 2(4), 1–34.

de Waal, A. (2005) *Famine That Kills: Darfur, Sudan*, Oxford: Oxford University Press.

Dyer, G. (2008) *Climate Wars*, Toronto: Random House.

Easterling, W. E., Aggarwal, P. K., Batima, P., Brander, K. M., Erda, L., Howden, S. M., Kirilenko, A., Morton, J., Soussana, J. F., Schmidhuber, J., and Tubiello, F. N. (2007) Food, Fibre and Forest Products, in M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. van der Linden and C. E. Hanson (eds.), *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge: Cambridge University Press, 273–313.

Ehrlich, P. R. (1968) *The Population Bomb*, New York: Buccaneer Books.

Eriksen, S. and Lind, J. (2009) Adaptation as a Political Process: Adjusting to Drought and Conflict in Kenya's Drylands, *Environmental Management*, 43(5), 817–835.

Esty, D. C., Goldstone, J. A., Gurr, T. R., Harff, B., Levy, M., Dabelko, G. D., Surko, P., and Under, A. N. (1998) *State Failure Task Force Report: Phase II Findings*, McLean, VA: Science Applications International, for State Failure Task Force.

Fjelde, H. and von Uexkull, N. (2012) Climate Triggers: Rainfall Anomalies, Vulnerability and Communal Conflict in sub-Saharan Africa, *Political Geography*, 31(7), 444–453.

Gizelis, T.-I. and Wooden, A. E. (2010) Water Resources, Institutions and Intrastate Conflict, *Political Geography*, 29(8), 444–453.

Gleditsch, N. P. (1998) Armed Conflict and the Environment: A Critique of the Literature, *Journal of Peace Research*, 35(3), 381–400.

Gleditsch, N. P. (2012) Whither the Weather? Climate Change and Conflict, *Journal of Peace Research*, 49(1), 3–9.

Guha-Sapir, D., Vos, F., Below, R., and Ponserre, S. (2013) *Annual Disaster Statistical Review 2011*, Brussels: Centre for Research on the Epidemiology of Disasters.

Hardin, G. (1968) The Tragedy of the Commons, *Science*, 162, 1243–1244.
Hartmann, B. (2010) Rethinking Climate Refugees and Climate Conflict: Rhetoric, Reality and the Politics of Policy Discourse, *Journal of International Development*, 22(2), 233–246.
Hauge, W. and Ellingsen, T. (1998) Beyond Environmental Scarcity: Causal Pathways to Conflict, *Journal of Peace Research*, 35(3), 299–317.
Hendrix, C. S. and Salehyan, I. (2012) Climate Change, Rainfall, and Social Conflict in Africa, *Journal of Peace Research*, 49(1), 35–50.
Hendrix, C. S. and Salehyan, I. (n.d.) Social Conflict in Africa Database (SCAD) available at: www.scaddata.org.
Hidalgo, D. F., Naidu, S., Nichter, S., and Richardson, N. (2010) Occupational Choices: Economic Determinants of Land Invasions, *Review of Economics and Statistics*, 92(3): 505–523.
Homer-Dixon, T. (1994) Environmental and Demographic Threats to Canadian Security, *Canadian Foreign Policy Journal*, 2(2), 7–40.
Homer-Dixon, T. (1999) *Environment, Scarcity and Violence*, Princeton, NJ: Princeton University Press.
Homer-Dixon, T., Boutwell, J. H., and Rathjens, G. W. (1994) Environmental Change and Violent Conflict, in L. A. Mazur (ed.), *Beyond the Numbers: A Reader on Population, Consumption, and the Environment*, Washington, DC: Island Press, 391–400.
Howard, P. and Homer-Dixon, T. (1998) The Case of Chiapas, Mexico, in T. Homer-Dixon and J. Blitt (eds.), *Ecoviolence: Links Among Environment, Population, and Security*, Lanham, MD: Rowman and Littlefield, 19–65.
Hsiang, S. M., Meng, K. C., and Cane, M. A. (2011) Civil Conflicts are Associated with the Global Climate, *Nature*, 476(7361), 438–441.
Jensen P. S. and Gleditsch K. S. (2009) Rain, Growth, and Civil War: The Importance of Location, *Defence and Peace Economics*, 20(5), 359–372
Kahl, C. H. (2006) *States, Scarcity, and Civil Strife in the Developing World*, Princeton, NJ: Princeton University Press.
Kelly, P. M. and Adger, W. N. (2000) Theory and Practice in Assessing Vulnerability to Climate Change and Facilitating Adaptation, *Climatic Change*, 47(4), 325–352.
Kevane, M. and Gray, L. (2008) Darfur: Rainfall and Conflict, *Environmental Research Letters*, 3(3), 1–10.
Ki Moon, B. (2007) A Climate Culprit in Darfur, *Washington Post* 16 June. Retrieved from: www.washingtonpost.com/wp-dyn/content/article/2007/06/15/AR2007061501857_pf.html.
Koubi, V., Bernauer, T., Kalbhenn, A., and Spilker, G. (2012) Climate Variability Economic Growth, and Civil Conflict, *Journal of Peace Research*, 49(1), 113–127.
Levy, M. A. (1995) Is the Environment a National Security Issue?, *International Security*, 20(2), 35–62.
Li, H. and Zhang, J. (2007) Do High Birth Rates Hamper Economic Growth? *Review of Economics and Statistics*, 89(1), 110–117.
Lomborg, B. (2001) *The Skeptical Environmentalist: Measuring the Real State of the World*, Cambridge: Cambridge University Press.
Malthus, T. (1997 [1798]) *An Essay on Population*, 6th edition, London: Routledge/Thoemmes Press.
Malthus, T. (1989 [1798]) *Principles of Political Economy*, J. Pullen (ed.), Cambridge/New York: Cambridge University Press.
Meadows, D. H., Meadows, D. L., Randers, J., and Behrens W. W. (1972) *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind*, New York: Universe Books.
Meier, P., Bond, D., and Bond, J. (2007) Environmental Influences on Pastoral Conflict in the Horn of Africa, *Political Geography*, 26(6), 716–735.
Miguel, E. and Satyanath, S. (2011) Re-examining Economic Shocks and Civil Conflict, *American Economic Journal: Applied Economics*, 3(4), 228–232.
Miguel, E., Satyanath, S., and Sergenti, E. (2004) Economic Shocks and Civil Conflict: An Instrumental Variables Approach, *Journal of Political Economy*, 112(4), 725–753.
Mortimore, M. (1998) *Roots in the African Dust: Sustaining the Saharan Drylands*, Cambridge: Cambridge University Press.
Nel, P. and Righarts, M. (2008) Natural Disasters and the Risk of Violent Civil Conflict, *International Studies Quarterly*, 52(1), 159–185.
Nordås, R. and Gleditsch, N. P. (2013) The IPCC, Human Security, and the Climate–Conflict Nexus, in M. Redclift and M. Grasso (eds.), *Climate Change and Human Security*, London: Elgar, in press.
Ohlsson, L. (1999) *Environmental Scarcity and Conflict: A Study of Malthusian Concerns*, PhD dissertation (12. February), Department of Peace and Development Research, University of Göteborg.
O'Brien, K., Eriksen, S., Nygaard, L. P., and Schjolden, A. N. E. (2007) Why Different Interpretations of Vulnerability Matter in Climate Change Discourses, *Climate Policy*, 7(1), 73–88.

O'Lear, S. and Diehl, P. F. (2007) Not Drawn to Scale: Research on Resource and Environmental Conflict, *Geopolitics*, 12(1), 166–182.

O'Loughlin, J., Witmer, F. D. W., Linke, A. M., Laing, A., Gettelman, A., and Dudhia, J. (2012) Climate Variability and Conflict Risk in East Africa, 1990–2009, *Proceedings of the National Academy of Sciences of the USA*, 109(45), 18344–18349.

Omelicheva, M. Y. (2011) Natural Disasters: Triggers of Political Instability? *International Interactions*, 37(4), 441–465.

Peluso, N. L. and Watts, M. (2001) *Violent Environments*, Ithaca, NY: Cornell University Press.

Percival, V. and Homer-Dixon, T. (1998) Environmental Scarcity and Violent Conflict: The Case of South Africa, *Journal of Peace Research*, 35(3), 279–298.

Raleigh, C. and Urdal, H. (2007) Climate Change, Environmental Degradation and Armed Conflict, *Political Geography*, 26(6), 674–694.

Raleigh, C. and Kniveton, D. (2012) Come Rain or Shine: An Analysis of Conflict and Climate Variability in East Africa, *Journal of Peace Research*, 49(1), 51–64.

Raleigh, C., Linke, A., Hegre, H., and Karlsen, J. (2010) Introducing ACLED: An Armed Conflict Location and Event Dataset, *Journal of Peace Research*, 47(5), 651–660.

Reuveny, R. (2007) Climate Change-Induced Migration and Violent Conflict, *Political Geography*, 26(6), 656–673.

Robbins, P. (2004) *Political Ecology: A Critical Introduction*, Malden, MA: Blackwell.

Roudier, P., Sultan, S., Quirion, P., and Berg, A. (2011) The Impact of Future Climate Change on West African Crop Yields: What Does the Recent Literature Say?, *Global Environmental Change*, 21(3), 1073–1083.

Sachs, J. (2006) Ecology and Political Upheaval, *Scientific American*, 26 June, 295(1): 37. Retrieved from: www.scientificamerican.com/article.cfm?id=ecology-and-political-uph.

Salehyan, I. (2008) From Climate Change to Conflict? No Consensus Yet, *Journal of Peace Research*, 45(3), 315–326.

Scoones, I, Devereux, S., and Haddad, L. (2005) Introduction: New Directions for African Agriculture, *IDS Bulletin*, 36(2), 1–12.

Slettebak, R. T. (2012) Don't Blame the Weather! Climate-related Natural Disasters and Civil Conflict, *Journal of Peace Research*, 49(1), 163–176.

Swain, A. (1996) Displacing the Conflict: Environmental Destruction in Bangladesh and Ethnic Conflict in India, *Journal of Peace Research*, 33(2), 189–204.

Theisen, O. M. (2008) Blood and Soil? Resource Scarcity and Internal Armed Conflict Revisited, *Journal of Peace Research* 45(4), 801–818.

Theisen, O. M. (2012) Climate Clashes? Weather Variability, Land Pressure, and Organized Violence in Kenya 1989–2004, *Journal of Peace Research* 49(1), 81–96.

Theisen, O. M., Holtermann, H., and Buhaug, H. (2011/12) Climate Wars? Assessing the Claim that Drought Breeds Conflict, *International Security*, 36(3), 79–106.

Tipson, F. S. (2013) Natural Disasters as Threats to Peace, Special Report 324, Washington, DC: United States Institute of Peace, available at: www.usip.org/category/publications/special-reports.

Tol, R., and Wagner, S. (2010) Climate Change and Violent Conflict in Europe over the Last Millennium, *Climatic Change*, 99(1), 65–79.

Turner, M. D. (2004) Political Ecology and the Moral Dimensions of "Resource Conflicts": The Case of Farmer–Herder Conflicts in the Sahel, *Political Geography*, 23(7), 863–889.

UNEP (United Nations Environmental Programme) (2007) *Sudan: Post-Conflict Environmental Assessment*, Nairobi: UNEP.

Urdal, H. (2005) People vs. Malthus: Population Pressure, Environmental Degradation, and Armed Conflict Revisited, *Journal of Peace Research*, 42(4), 417–434.

Welzer, H. (2008) *Klimakriege: Wofür im 21. Jahrhundert Getötet Wird*, Frankfurt am Main: S. Fischer.

Witsenburg, K. M. and Adano, W. R. (2009) Of Rain and Raids: Violent Livestock Raiding in Northern Kenya, *Civil Wars*, 11(4), 514–538.

Zhang, D. D., Brecke, P., Lee, H. F., He, Y.-Q., and Zhang, J. (2007) Global Climate Change, War, and Population Decline in Recent Human History, *Proceedings of the National Academy of Sciences of the USA*, 104(49), 19214–19219.

Zhang, D. D., Lee, H. F., Wang, C., Li, B., Pei, Q., Zhang, J., and An, Y. (2011) The Causality Analysis of Climate Change and Large-scale Human Crisis, *Proceedings of the National Academy of Sciences of the USA*, 108(42), 17296–17301.