

Climate, Conflict and Coping Capacity

The Impact of Climate Variability
on Organized Violence

Nina von Uexkull



UPPSALA
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Abstract

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Understanding the conflict potential of climate variability is critical for assessing and dealing with the societal implications of climate change. Yet, it remains poorly understood under what circumstances – and how – extreme weather events and variation in precipitation patterns affect organized violence. This dissertation suggests that the impacts of climate variability on organized violence are conditional on specific climate patterns, the sensitivity of livelihoods, and state governance. These theoretical conjectures are subjected to novel empirical tests in four individual essays. Three essays investigate the relationship between climate variability and communal and civil conflict through sub-national quantitative analysis focusing on Sub-Saharan Africa. The fourth essay sheds light on causal mechanisms leading to participation in land-related conflict based on interview material on 75 ex-participants in violence from Mt. Elgon, Kenya. Essay I suggests that the exposure of vulnerable agricultural livelihoods to sustained drought increases the risk of civil conflict violence. Essay II indicates that rainfall anomalies increase the risk of communal violence, an effect which is amplified by political marginalization. Essay III finds support for the proposition that volatility in resource supply increases the risk of communal conflict over land and water in remote regions, which tend to have limited state presence. Essay IV proposes that individuals depending on agriculture are prone to participate in land-related conflict as they face impediments to leaving a conflict zone, and additionally have high incentives to partake in fighting for land. Taken together, the dissertation furthers our understanding of the specific economic and political context under which climate variability impacts armed conflict. This knowledge is important for conflict-sensitive adaptation to climate change and conflict prevention efforts.

Keywords: civil conflict, communal conflict, climate change, climate variability, Sub-Saharan Africa, Kenya, geo-referenced event data, agricultural dependence, vulnerability

Nina von Uexkull, Department of Peace and Conflict Research, Box 514, Uppsala University, SE-75120 Uppsala, Sweden.

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To Selma and Linnea

List of Essays

This thesis is based on the following essays, which are referred to in the text by their Roman numerals.

- I Von Uexkull, N. (2014). Sustained Drought, Vulnerability and Civil Conflict in Sub-Saharan Africa. *Political Geography*, 43,16–26.
- II Fjelde, H., & von Uexkull, N. (2012). Climate Triggers: Rainfall Anomalies, Vulnerability and Communal Conflict in Sub-Saharan Africa. *Political Geography*, 31(7), 444–453.
- III Von Uexkull, N. (2016). Volatile Environments: Climate, State Reach and Communal Conflict in Sub-Saharan Africa. Unpublished manuscript.
- IV Von Uexkull, N. (2016). Flight, Fight or Farm? Agricultural Dependence and Participation in Land-related Conflict. Unpublished manuscript.

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Nina von Uexkull

Introduction

Mitigating climate change is an enormous political and economic challenge; preventing further warming entirely is impossible (IPCC, 2014). Hence, today, and in even more so in the future, societies face the consequences of a warming world and increasing climate variability, including more frequent and severe natural disasters (Denton et al., 2014). In policy circles, these developments are increasingly seen as a significant threat to social stability (NATO Parliamentary Assembly, 2015; US National Security Strategy, 2015).

In recent years, the relationship between climate variability and armed conflicts has been put under scientific scrutiny. Overall the findings of this burgeoning research field are mixed, suggesting that there is no universal strong relationship (Bernauer, Böhmelt, & Koubi, 2012; Buhaug, 2015; Salehyan, 2014; Scheffran et al., 2012; Theisen, Gleditsch, & Buhaug, 2013). Yet dismissing any connection between the two would be premature. Clearly, the political and economic context crucially determines the range of available responses of populations to natural hazards (Barnett & Adger, 2007). While some individuals, societal groups and countries are remarkably peaceful and resilient to changes in their environment, others appear vulnerable. The paucity of studies specifying and systematically testing plausible conditional effects indicates a disconnect between existing research on climate variability and conflict on the one hand, and theories on causes of armed conflict and disaster risk reduction on the other.

Addressing this gap, the overall purpose of this dissertation is to specify theoretically, and to test systematically, under what circumstances – and how – climate variability affects organized violence. Three essays address the question of how adverse climate-impacts on rural livelihoods, in particular farming and pastoralist systems, affect the risk of organized violence. The fourth essay contributes to understanding the micro-foundations of this linkage by addressing the question of why individuals participate in land-related violence.

The dissertation makes theoretical and empirical contributions to the study of the climate-conflict relationship by developing nuanced arguments of conditional effects and by subjecting these arguments to tests using novel disaggregated data introducing new empirical distinctions. Taken together, the essays in this dissertation suggest that the impacts of climate variability on organized violence are conditional on specific climate patterns, the sensi-

tivity of livelihoods, and state governance. Essay I suggests that the exposure of vulnerable agricultural livelihoods to sustained drought increases the risk of civil conflict violence. Essay II indicates that rainfall anomalies increase the risk of communal violence, an effect which is amplified by political marginalization. Essay III finds support for the proposition that even in the absence of acute scarcity, volatility in resource supply increases the risk of communal conflict over land and water in remote regions, which tend to have limited state presence. Essay IV proposes that individuals depending on agriculture are prone to participate in land-related conflict as they face impediments to leaving a conflict zone, and additionally have high incentives to partake in fighting for land. The dissertation thus helps identify the specific contexts and the mechanisms through which climate variability – via its adverse effects on livelihoods – impacts civil and communal conflicts.

As empirical contributions, the dissertation introduces novel data on contentious issues in non-state conflicts and individual level data on participation in land-related violence. It also includes the hitherto most comprehensive spatially disaggregated studies on communal violence and civil conflict violence covering the whole of Sub-Saharan Africa 1989-2008.

This dissertation focuses on Sub-Saharan Africa, a part of the world that is particularly vulnerable to climate change, due to agriculture being the main economic activity, the widespread poverty and weak state institutions that characterize the region (Niang et al., 2014). At the same time, a number of armed conflicts, and in particular communal conflicts, are clustered in this region (Pettersson & Wallensteen, 2015; Sundberg, Eck, & Kreutz, 2012). This makes it particularly important to identify the effect of climate variability on organized violence in Sub-Saharan Africa, as future climate change will likely enhance the salience of this link. In particular, contributing to understanding the political and economic context under which climate variability impacts organized violence, as this dissertation does, can inform efforts that make societies more resilient and avert the potential security implications of increased climate variability.

This is an introduction to the dissertation as a whole. I start by introducing key concepts. Next, I present previous research and situate the dissertation in the overall developments of the research field. The subsequent sections introduce the theoretical framework and the methodological approach. I then move on to present the four essays. The final section concludes with implications for policy and suggestions for future research.

The central concepts

The overarching phenomena of interest are ‘climate variability’ and ‘organized violence’. The four essays contribute to understanding different facets of the relationships between these two broader phenomena.

Climate variability is defined as variations in the mean state and other statistics (such as standard deviations and the occurrence of extremes) of the climate at all spatial and temporal scales beyond that of individual weather events (IPCC 2013). Studying climate variability is important for two reasons. Already today, climatic extremes such as droughts and related natural hazards present major humanitarian challenges. One implication of climate change is a further increase in variability and the occurrence of extremes in many regions. For example, there is now a consensus among climate researchers that heat waves will likely occur more often and last longer, and that extreme precipitation events, both droughts and extreme downpours, will become more intense and frequent in many regions by the end of the century (IPCC, 2013). Especially many subtropical arid and semi-arid regions, like Southern Africa, will likely experience less precipitation and more frequent drought (IPCC, 2013; Seneviratne et al., 2012). Another observed change in climatic pattern is increased variance of rainfall levels in equatorial regions (Dore, 2005). Studying different dimensions of variability such as the volatility of rainfall patterns (Essay III), droughts and rainfall anomalies (Essays I and II), as this dissertation does, helps us understand what implications these anomalies and volatility have today. This may in turn form the basis of understanding their future implications.

The other key concept for this dissertation is organized violence. Climate variability and change may have implications for different aspects of human security ranging from the incidence of food riots to implications for the downfall of empires and major wars (Hsiang, Burke, & Miguel, 2013). Yet, the analyses presented in this dissertation delimit the dependent variable to organized violence between two organized actors that results in a minimum of 25 battle-related deaths in at least one year, as captured by the Uppsala Conflict Data Program (UCDP) (Melander, 2016). The study of organized violence is particularly relevant to understanding determinants of social stability. Involving organized actors and deadly fighting means that these conflicts constitute threats to the stability of states and have grave human security consequences. At the same time, the fatality threshold of 25 battle-related deaths is low enough to capture protracted crises below the often-assumed threshold of “war” defined as 1000 deaths in a year (Gleditsch et al. 2002).

One outcome that is examined in this dissertation is communal conflict, defined as fighting between non-state groups that are identified along the lines of a shared communal identity that claims at least 25 battle-related deaths during at least one calendar year (Sundberg et al., 2012). These

groups self-identify, for example, along the lines of a common ethnicity, tribe, livelihood and/or religion. In Essay III, I further delimit this form of violence and focus on communal conflicts fought over land and water specifically. The other outcome of particular interest is civil conflict violence (Essay I). Civil conflict is here synonymously used with state-based intrastate armed conflict. Following the definitions of UCDP it is fought between the government of a state and a non-state group with an incompatibility either over territory or government claiming at least 25 battle-related deaths during one year (Gleditsch, Wallensteen, Eriksson, Sollenberg, & Strand, 2002; Pettersson & Wallensteen, 2015). In the last essay focusing on participation in violence, I choose the empirical context of a land-related conflict in Mt. Elgon, Kenya, that combines both elements of communal and civil conflict.

Different forms of organized violence share some common structural causes and often occur together in the same country (Brosché & Elfverson, 2012; Cunningham & Lemke, 2011, 2013). Yet, there are differences that are important to distinguish for theorizing causal mechanisms. For example, conflicts with different issues involve different actors, behaviors and causes (Buhaug, 2006; Diehl, 1992; Von Uexkull & Pettersson, 2013). Access to economic and political power affects the kind of violence societal actors engage in (Raleigh, 2014). In order to take into account these differences, the essays in this dissertation each focus theoretically and empirically on a different dependent variable.

Situating the dissertation in existing research

The young research field investigating the relationship between climate variability and organized violence has expanded rapidly over the past years, spurred by a growing concern about climate change and facilitated by increasing data availability (Hsiang, Burke, & Miguel, 2013; Theisen, Gleditsch & Buhaug, 2013). Reflecting the interdisciplinary nature of the research question, researchers from various disciplines, such as natural sciences, economics and political science, have made important contributions. In the following, I describe the most important developments in this debate and elaborate on how the essays in this dissertation have contributed to them. I focus the literature review around studies on climate variability, resource scarcity, civil conflict and other forms of organized violence within states, such as communal violence, one-sided violence, and protests. Emphasis has been placed on comparative, mostly large N, studies.

The research agenda on the security implications of climate change largely builds on key theoretical contributions of the environmental security literature (Homer-Dixon, 1999; Kahl, 1998, 2006). These contributions still form the main theoretical building blocks of this research field. The environmental

security literature posits that resource scarcity, for example a decrease in freshwater and available farmland due to climate variability, leads to conflict in combination with other factors (Homer-Dixon, 1999; Kahl, 1998, 2006). When initially made, these claims were met with skepticism. Critics argued that a focus on resource scarcity over-predicts conflict, with scarcities in natural resources being very widespread, but armed conflict still extremely rare. They called for rigorous empirical testing of the hypothesized linkages (Diehl & Gleditsch, 2000; Gleditsch, 1998). Since then, in particular in the past ten years, the systematic evaluation of these claims has rapidly expanded.

The first wave of systematic comparative studies focused on the direct, unconditional effects of climate variability, or scarcity in land and water resources, on the risk of civil conflict, fought between the government and an armed opposition. While most of this early work relied on the assumption that climate variables, such as natural disasters, would work via their impact on livelihoods and migration, these potential causal mechanisms were not measured empirically. In addition, they largely ignored the effect of conditioning variables that describe the context under which the adverse impacts of climate change would realistically translate into motivations or opportunities for violence. These earlier studies relied on data at the country level for statistical evaluation. The empirical focus on civil conflict and the research design was likely a conscious choice to focus on the most devastating form of violence, but was also a result of a lack of data on other forms of organized violence. Overall, this strand of research has failed to produce a consensus on the link between climate and conflict (Salehyan, 2008). Some studies have found that climate variables increase conflict risks (Burke et al., 2009; Hauge & Ellingsen, 1998; Hendrix & Glaser, 2007; Hsiang, Meng, & Cane, 2011; Miguel, Satyanath, & Sergenti, 2004), while others refuted these claims based on insignificant results (Böhmelt et al., 2014; Buhaug, 2010; Raleigh & Urdal, 2007; Theisen, 2008; Urdal, 2005).

Today there remain disagreements about appropriate statistical models, definitions and not least the interpretation of the overall findings in the literature (Buhaug, 2010, 2014; Buhaug et al., 2014; Burke et al., 2009; Hsiang et al., 2013; Hsiang & Meng, 2014; O'Loughlin, Linke, & Witmer, 2014b). Yet, especially over the course of the past five years, coinciding with the research comprising this dissertation, the research field has made several important steps in evaluating empirically the complex theoretical linkages between climate variability and organized violence in a systematic manner. This development has been greatly aided by technological progress and increasing data availability; both with regard to the independent variables, such as satellite data on precipitation and croplands, but also the dependent variable, with the publication of a variety of data on different forms of conflicts and unrest (Salehyan et al. 2013; Raleigh, Linke, Hegre, & Karlsen, 2010; Sundberg & Melander, 2013). Research has begun investigating con-

ditional and indirect effects and introducing more precise and nuanced measures of independent variables. It has also started examining a broader range of collective violence, ranging from protest to communal conflict fought between identity groups, state-based conflict against the government and interstate conflict. The essays in this dissertation have contributed to these developments.

First, more nuanced measures of climate variability and change have been introduced to better match theoretical expectations. Early systematic studies began by studying the scarcity of renewable resources at the country level (De Soysa, 2002; Hauge & Ellingsen, 1998; Raleigh & Urdal, 2007; Theisen, 2008; Urdal, 2005), natural disasters in general (Nel & Righarts, 2008; Slettebak, 2012), or temperature and rainfall deviations at the country level (Burke et al., 2009; Hsiang et al., 2011; Salehyan & Hendrix, 2014). Cognizant of the great variation of both climate, conflict and conditioning variables within countries, recent research has moved to spatial and even temporal disaggregation, for example on intra-annual drought observations at the local level (De Juan, 2015; Detges, 2014; Fjelde & Von Uexkull, 2014; O'Loughlin et al., 2012; O'Loughlin, Linke, & Witmer, 2014a; Raleigh & Kniveton, 2012; Theisen, 2012; Theisen, Holtermann, & Buhaug, 2011). Essay I and Essay III in this dissertation introduce and test novel operationalizations of climate variability at the local level. These measures match more precisely theoretical arguments taking into account local coping capacities and the effect of climate-driven resource volatility on adaptation and intergroup bargaining.

Another development of the past years has been theoretical and empirical attention to the dependent variable, including the investigation of different forms of conflict short of civil war. Sub-state violence such as communal conflict or riots arguably better fit the theoretical expectations of the literature (Theisen, 2012). Yet, early research focused on state-based conflict only. Cognizant of the fact that the state government is not always the primary opponent of societal groups affected by climate variability, the research agenda was broadened to a wider set of violent and non-violent outcomes. Research has started studying communal violence systematically (Benjaminsen, Alinon, Buhaug, & Buseth, 2012; Detges, 2014; Meier, Bond, & Bond, 2007; Raleigh & Kniveton, 2012; Theisen, 2012). In addition, less organized forms of violence and non-violent resistance, such as riots and protests have started to receive attention (Hendrix & Salehyan, 2012; Smith, 2014). Contributing to the study of organized violence beyond civil wars, Fjelde and Von Uexkull (2012) – Essay II in this dissertation – provides the hitherto most comprehensive study on communal violence covering Sub-Saharan Africa. Essay III in this dissertation goes further in the way of conceptual disaggregation. It presents a novel theoretical argument for conflicts over land resources and tests this based on data on non-state conflict disaggregated by conflict issues.

Like earlier studies on civil conflict, research on communal conflict has continued to focus on the effects of short-term climate variability. Among the existing studies some find a curvilinear effect with both particularly wet and dry periods seeing more conflict (Hendrix & Salehyan 2012; Raleigh & Kniveton 2012). Others find only an effect of dry years (Bohlken & Sergenti, 2010; Fjelde & von Uexkull, 2012). Still others only find more conflict during wet periods, using data on Eastern Africa and Kenya in particular (Meier, Bond, & Bond, 2007; Theisen, 2012; Witsenburg & Adano, 2009). A recent study on violent and non-violent water conflict in the Mediterranean and the Sahel does not find any evidence for an effect of short-term variations in climate variables (Böhmelt et al., 2014). A study on Indonesia finds low-level conflict more prevalent in villages that have experienced a natural disaster in the previous three years (Barron, Kaiser, & Pradhan, 2009). Overall, the existing research agrees that communal violence is affected by climatic conditions, but there is not a consensus emerging across all regions and samples studied on whether wetter or dryer periods are generally more at risk.

The lack of a consensus about direct and unconditional linkages between climate variability, civil conflict and even communal violence is not surprising. Conditional effects have always been important in theoretical arguments on how climate and conflict are related (Homer-Dixon, 1999; Smith & Vivekananda, 2007). As Homer-Dixon (1999) points out: *“Environmental scarcity is never a sole or sufficient cause of large migrations, poverty, or violence; it always joins with other economic, political, and social factors to produce its effects”* (Homer-Dixon 1999, p. 16). Yet, in spite of the importance of context, studies systematically investigating conditional effects were extremely rare only a couple of years ago (Bernauer et al., 2012). Only in the past few years, in parallel with this dissertation, have a handful of studies explicitly investigated the relevant economic and political context that conditions the relationship between climate and conflict.

In particular, some studies have investigated the effect of climate variability conditional on the existence and quality of formal and informal institutions. The existence of local intercommunity dialogue has been found to reduce conflict risks in the wake of drought in Kenya, while official resource governing rules do not have such an effect (Adano, Dietz, Witsenburg, & Zaal, 2012; Linke et al., 2015). Case studies and theoretical accounts also point to the importance of state bias against groups for conflict risks in the context of environmental pressures (Brosché & Rothbart, 2013; Butler & Gates, 2012). Fjelde & Von Uexkull (2012) – Essay II in this dissertation – provide the first empirical study on how ethnic exclusion conditions drought effects on communal violence across Sub-Saharan Africa in the post-cold war period. Essay III in this dissertation finds climate effects on communal conflicts over land and water resources to be conditional on state reach into rural areas.

While these studies suggest that the local institutional context is crucial for the risk of communal violence, there is little evidence for institutions conditioning the effect of environmental scarcities on civil war onset. There is no evidence for climate variability effects on the risk of civil conflict onset conditional on regime type (Klomp & Bulte, 2013; O’Loughlin et al., 2012). Neither is there evidence that drought increases the risk of civil war onset by politically marginalized groups (Theisen et al., 2011; Wischnath & Buhaug, 2014a). Similarly, a country level assessment suggests no significant effect of food price shocks on different forms of violence in discriminatory regimes (Buhaug, Benjaminsen, Sjaastad, & Theisen, 2015). In sum, existing research agrees that the inclusiveness and strength of institutions are important determinants of civil and communal conflicts. There is little evidence, however, that civil wars break out following climate extremes, even in the presence of poor or discriminatory governance. In contrast, climate variability may increase the risk of communal violence in politically marginalized regions.

Another important conditioning variable pertains to the sensitivity of livelihoods to climate variability. Country-level assessments were less supportive of an indirect link between climate variability, shocks to economic growth or food production and conflict (Bergholt & Lujala, 2012; Buhaug et al., 2015; Koubi, Bernauer, Kalbhenn, & Spilker, 2012). Yet, many recent subnational studies demonstrate a link between shocks to agricultural production and organized violence. The hitherto geographically most comprehensive subnational study of the link between drought and civil conflict violence Von Uexkull (2014) – Essay I in this dissertation – finds that drought increases the risk of civil conflict violence in areas with rainfed agriculture in Sub-Saharan Africa in the post-cold war period. Subsequent research has provided more evidence that the incidence of violence is influenced by shocks to agricultural production at the local level and has added nuance. For example, Maystadt et al. (2015) find that temperature anomalies magnify civil conflict risks in Sudan in areas with dominantly pastoralist livelihoods. A study on colonial Nigeria, (Papaioannou, 2016) shows that deviations from normal rainfall patterns correlated with higher intensity of violence where food crops are grown. Several recent studies suggest indirect effects of climate variables on the incidence and severity of civil conflict violence via agricultural production levels and food prices at the sub-national level (Caruso, Petrarca, & Ricciuti, 2016; Maystadt & Ecker, 2014; Raleigh, Choi, & Kniveton, 2015; Wischnath & Buhaug, 2014b). For example, a study on Indonesia finds that more violent events are recorded following temperature shocks to rice production in the previous growing season (Caruso et al., 2016). In contrast, there is little evidence for an elevated risk of civil conflict onset following climate shocks to croplands (Von Uexkull, Buhaug, Croicu, & Fjelde, 2016; Wischnath & Buhaug, 2014a). Thus, existing research indicates that climate-related agricultural shocks may contribute to sustaining

ongoing civil conflict violence thus making it more severe. In contrast, there is currently little evidence for increased risks of the onset of civil conflict, even taking into account subnational vulnerability.

As this review indicates, there is some evidence that in specific subnational political and economic contexts, climate variability increases the risk of communal violence. It also contributes to fuelling civil conflict, making it more severe or longer lasting. Yet, there is currently little insight into micro-level mechanisms. An exception is Linke et al. (2015), a survey-based study on individual support for violence in Kenya. They find that in areas with reported worsening drought conditions inter-community dialogue between ethnic groups reduced the support for the use of violence. There is some micro-level research on participation in organized violence more generally from select civil wars (Arjona & Kalyvas, 2011; Guichaoua, 2010, 2014; Humphreys & Weinstein, 2008; McDoom, 2013; Pugel, 2007; Ugarriza & Craig, 2013; Verwimp, 2005), and protests (Mueller, 2013; Rosenfeld, 2016; Scacco, 2012). However, it is unclear whether these findings are generalizable to the debate on climate variability and conflict specifically, such as conflicts over water or land resources and conflicts in regions with climate-induced environmental stress. Addressing this gap, Essay IV develops an argument for why individuals participate in land-related violence, drawing on comprehensive individual-level material on participants in violence from the Mt. Elgon region of Kenya. It thus adds to the understanding of the micro-foundations of a form of conflict often hypothesized to result from increasing climate variability.

In sum, this literature review points to progress but also existing shortcomings of previous work with regards to both theory and empirical testing. The theories and hypotheses about environmental change and conflict point to the importance of the local context. The first country-level examinations of these relationships were ill suited to test these hypotheses. A handful of recent studies have started to study conditional effects at the subnational level. This dissertation has contributed to this emerging sub-field. The essays in this dissertation advance our understanding of vulnerability, and findings point to the importance of agricultural livelihoods, political marginalization and the role of state reach. The theoretical arguments are underpinned by some of the first systematic empirical tests at the subnational level.

While recent research has made progress in identifying conditions under which climate variability affects organized violence, causal mechanisms remain underdeveloped, particularly with regard to the circumstances under which violence is a likely outcome following contractions in livelihoods. The contributions in this dissertation, specifically Essays III and IV, address this gap by advancing novel and more nuanced arguments for this crucial step in the causal chain. Lastly, and relatedly, little attention has been paid to specific processes driving different forms of conflict, involving different actors and issues. Addressing this issue, the dissertation develops distinct

theoretical arguments for different forms of organized violence and introduces nuanced climate variables matching the theoretical accounts (Essays I-III).

Theoretical framework

The essays in this dissertation make distinct theoretical arguments that are presented in more detail in each individual study. Yet, all essays are connected in contributing to understanding specific parts on the pathway from climate variability to organized violence via impacts on rural livelihoods. In order to show how their individual contributions add to understanding the whole causal chain in focus in this dissertation, the following sections outline an overall theoretical framework.

In many rural regions, weather patterns crucially determine income and food provision. Rainfall provides freshwater and makes land suitable for grazing and agriculture (Biazin et al., 2012). When rainfall patterns shift, so does water crucial for agricultural production. For example, in dryland regions it has been estimated that in individual drought years, renewable water resources may decrease to half of the long-term average (Shiklomanov, 1998). Especially in the absence of irrigation, which is very rare in Africa for example, negative rainfall anomalies, or droughts, therefore negatively affect food provision and income in rural areas (Gray & Mueller, 2012; Olsson et al., 2014; Schmidhuber & Tubiello, 2007). These impacts affect both live-stock keeping and crop-farming and associated livelihoods (Morton, 2007).

In this dissertation, I suggest that contractions in agricultural livelihoods give rise to a greater propensity to engage in organized violence, but only under specific circumstances. The linkage between climate variability, decline in agricultural livelihoods and conflict is not deterministic and there are a number of conditioning variables, both in the link between climate variability and the adverse implications for income and food provision, and from there to organized violence.

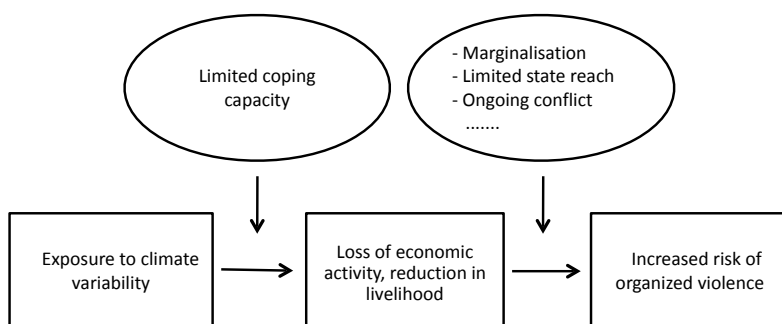


Figure 1. Hypothesized conditional linkages between climate variability and organized violence

Climate variability does not always lead to economic hardship. From the disaster risk reduction literature, we know that the impact of a natural hazard depends first of all on the severity and duration of exposure to a natural hazard. While communities may be able to handle minor natural hazards, the coping capacity of individuals and communities is increasingly strained with longer or repeated exposure (Sabates-Wheeler et al., 2008; Essay I). This is for example due to vital assets for productivity being sold. Second, the vulnerability to climate variability is important (Barnett & Adger, 2007). Vulnerability is determined by the sensitivity of the livelihood to climate impacts, for example due to reliance on farming or pastoralism (Martin, Müller, Linstädter, & Frank, 2014; Olsson et al., 2014). Vulnerability is also increased where alternative sources of income in times of crises are lacking (Kijima, Matsumoto, & Yamano, 2006). Third, the economic impact of climate variability depends on cushioning mechanisms in times of economic crises, such as aid and insurances by governmental and non-governmental actors. Political marginalization is important for the willingness of governments to invest in the development of a region (Boone, 2003) and to provide disaster relief (Plümper & Neumayer, 2009; Raleigh, 2010). Even democratic governments may remain inactive and reluctant to redistribute domestic resources to avert economic hardships, if the affected population is marginalized and not decisive for general elections (Plümper & Neumayer, 2009). A fourth factor that is very important for the overall impact of climate variability is the degree of predictability. Predictability influences whether it is possible to adapt efficiently. Where climate variability increases the unpredictability and volatility of supply with water and arable land local adaptation is challenging (Low 1990; Essay III).

So, under the outlined conditions climate variability may lead to a considerable worsening of the economic situation of affected populations, including in the lack of food provision and income. Yet, why and when should

violence result? The motivations for violent mobilization in a situation of economic hardship may be multiple and varying across contexts as indicated in previous research on the micro-foundations of civil wars. Such research indicates that several mechanisms may be present in the same conflict (Humphreys & Weinstein, 2008; Pugel, 2007) or even manifest themselves in the same individual (Essay IV). An important channel is that a decline in economic status lowers the opportunity costs of violence (Collier & Hoeffler, 2004). At the individual level the use of violence then may serve economic interests, for example if participation in violence promises economic rewards as selective incentives (Lichbach, 1998) such as a salary or food access available to armed actors. The link between climate variability and violence can be expected to be particularly salient in a situation of scarcity where water and arable land that have diminished due to climate variability and violence is used by the armed actors to gain access to these resources (Essay III). Of particular value is strategically important territory that promises long-term access to resources, such as wells in drylands (Detges, 2014). Feelings of relative deprivation (Gurr, 1970) may be added to economic plight. For example, where the government allegedly favors another group, anger and feelings of injustice may add to economic needs (Essay II and IV).

Naturally, there are many alternative responses in the face of a shrinking resource base and economic hardship. Economic hardship, induced by climate variability or other causes, is widespread, while armed conflict is rare (Collier & Hoeffler, 2004). For example, individuals could ration food hoping for better times or migrate searching for relief elsewhere (Kniveton, Smith, & Black, 2012). These mechanisms leading to mobilization for violence are more likely to exist where the economic and political context makes other options to improve the economic status less viable. The absence of legal and political channels to redress grievances because of the characteristics of the legal system (Eck, 2014), political marginalization (Raleigh, 2010) and exploitative politicians that mobilize grievances for gaining political support (Boone, 2014; Kahl, 2006) are likely important conditions that dissuade affected individuals from seeking peaceful means to improve their economic status (Essays II-IV). In addition, agriculture-dependent impoverished individuals also lack alternative options in the wake of instability. Tied to their land, and less likely to migrate, they are more likely to become involved in violent conflict, including recruitment by armed actors (Essay IV).

Yet, not only the availability of alternative non-violent options, but also the ability of populations to organize for violence, matters. The feasibility of organizing for violence not only depends on the availability of weapons and logistical abilities, but also on overcoming the collective action problem (Lichbach, 1998; Olson, 1965). An individual faces immediate and large costs when participating in violent movements, while the benefits of political violence are usually collective goods or distant promises. Especially economic plight can often be relieved in a less risky way than through the use of

violence. The collective action problem is an extreme hurdle that partly explains why millions suffer from poverty and hunger following droughts, while armed conflict is still extremely rare.

Mobilization for violence is easier under certain circumstances. First, where adverse climate effects and vulnerability coincide with social cleavages, such as salient ethnic cleavages, mobilization is facilitated by pre-existing networks (Eck, 2009; Horowitz, 1985). Communal groups often share not only ethnicity, but also a common agricultural livelihood such as farming or pastoralism, leading in these cases vulnerability and mobilization potential to reinforce each other (Essays II and III). Second, where armed organizations are already active the logistic start-up costs have already been paid and joining is comparably easier (Essays I and IV). As illustrated by the Mt. Elgon conflict, the ongoing violence also limits the options to continue farming and exposes individuals to coercion or peer pressure to participate in fighting (Essay IV). Thus, economic pressures and exposure to conflict may be mutually reinforcing in increasing the likelihood of mobilization for violence.

Lastly, the opportunity structure for violent mobilization is important. The state is likely to suppress violence close to its strongholds such as important urban centers. Yet, it may ignore intentionally, or be incapable of addressing, disputes and discontent in remote areas (Essays III and IV). These areas tend to be less accessible and therefore more likely to see conflict (Fearon & Laitin, 2003; Tollefsen & Buhaug, 2015). They also tend to be less important to the state government (Boone, 2003; Raleigh, 2010). In these marginal areas participants in violence may expect that using violence would allow them to grab the resources they need without fearing government intervention (Essay III and IV). Alternatively, they may also perceive violence against other groups or government officials as a means to attract the attention of the government to their grievances (Essay IV).

Moreover, the vulnerability to adverse impacts of climate variability is related to the type of organized violence. The societal actors hit by the adverse impacts of climate variability have different capacities to deal with it. Yet, conditions that increase vulnerability to adverse impacts of climate variability are often detrimental to the capacity to organize for large-scale violence. Thus, the most vulnerable societal groups are not necessarily the ones most likely to engage in large-scale violence.¹ For example, small rural societal groups reliant on small-scale farming and livestock keeping are very vulnerable to climate variability (Morton, 2007). Yet these kind of smaller, often

¹ Similarly, at the individual level women and children are often seen as more vulnerable to climate change than men (Adger et al., 2014). Women often have less access to crucial assets such as land, credit and social protection in times of crises and often therefore have less capacity to cope (FAO 2015). Still, their economic misery, caused by environmental degradation or disasters, is not likely to lead to mass participation in violence. Instead perpetrators of violence are often men (Collier & Hoeffler, 2004).

politically marginalized, groups are typically incapable of challenging the state (Raleigh, 2014).² As vulnerability is detrimental to the strong fighting capacity needed to start larger scale violence, particularly vulnerable groups may be more likely to start fighting with other communal groups (Essay II and Essay III). While conflict dynamics may be affected, the onset of large-scale civil conflict due to adverse impacts of climate variability is thus unlikely.³

In addition to these indirect linkages, climate variability also has direct impacts on the likelihood and durability of peaceful cooperation over resources such as water and arable land. In general, negotiations and compromise are clearly less costly ways of resolving disputes over resources, as the cost of conflict tends to outweigh the potential benefit of gaining access through violent means (Goldstone, 2002). Therefore, disputes over these resources are generally solved peacefully (Böhmelt et al., 2014). Yet, climate variability may directly affect the likelihood and durability of cooperation over resource access. In particular, where climate variability makes land and water resources shift widely this hampers cooperation, as the payoffs from agreements over these volatile resources are unstable as further developed in Essay III.

Methodological approach

This theoretical framework has several implications for the methodological approach adopted in this dissertation. First, one implication is that we should expect important differences between different forms of conflicts, both with regards to actors involved and issues fought over. The form of violence seems to vary with the vulnerability and capacities of societal groups behind armed organizations (cf. also (Raleigh, 2014)). Moreover, the *issue* of the conflict is important. Climate variability directly affects the supply of resources such as water and arable land and can be expected to more likely lead to disputes over these issues than over others. These differences between types of conflicts thus have implications for the theoretical expectations and how to test them. Naturally, different forms of violence do not

² In addition, in very remote areas with little government presence the government may not actually be mediating resource access, but other groups manage this distribution and access instead (see Essay 2).

³ This is corroborated by previous research. There are no consistent findings of climate variability leading to the onset of new civil conflicts (Hsiang et al., 2011; Theisen et al., 2011; Wischnath & Buhaug, 2014a). Yet, climate variability seems to be associated with sustaining and fuelling existing civil conflicts (Caruso et al., 2016; Wischnath & Buhaug, 2014b; Von Uexkull, Buhaug, Croicu & Fjelde 2016).

necessarily occur separately from each other. For example, around 55 percent of communal conflicts occur simultaneously with civil conflict violence (Brosché & Elfverson, 2012). The Mt. Elgon conflict forming the empirical context of Essay IV is an example of the complexity of violence involving both violence against another group, against the state and civilians. Yet, given these considerations, each essay develops and tests theoretical arguments on particular forms of violence matching the theoretical expectations.

In addition, the recruitment bases of armed actors involved in communal and civil conflicts seem to differ. Tightly knit groups delineated along livelihood and communal identity lines make decisions over both negotiations with other groups as well as over livelihood decisions. Communal groups interact peacefully and fight conflicts over critical resources, such as boundaries between homelands, dryland pastures and water (Bogale & Korf, 2007; Turner, 2004; Von Uexkull & Pettersson, 2013). For example, among the Turkana of Northern Kenya community-endorsed livestock raiding has a long tradition, clashes at crucial dry-season water holes occur and a system of internal sanctions punishes defectors (Mathew & Boyd, 2011; McCabe, 2004). In line with these arguments, this dissertation theorizes about the behavior of communal groups as cohesive actors in Essays II and III, and also takes into account conflict issues in Essay III.

In civil conflict, armed groups are formally organized for combat and the question of why some individuals participate in these, while others stay out, is still poorly understood. The pool of potential recruits to a civil conflict seems generally larger and not necessarily confined to one cohesive ethnic group. For example, among conflicts over government power since 1946, 55 percent were not fought along ethnic identity lines (Denny & Walter 2014). There are also armed actors recruiting from several ethnic groups (Wucherpfennig, Metternich, Cederman, & Gleditsch, 2012). For example, in the civil war in Darfur starting in 2003, the SLM/A rebel group had their recruitment base among the Fur, Zaghawa and Masalit ethnic groups (Brosché & Elfverson, 2012). It is therefore not necessarily suitable to theorize about the behavior of cohesive societal groups unless one is looking at specific subsets. Accordingly, in Essays I and IV, which focus on conflict involving organized militias and rebel groups, the theoretical and analytical focus is on individual-level causal mechanisms.

Another important implication of the theoretical framework is that subnational spatial disaggregation is necessary both in order to capture vulnerability and effects on livelihoods as well as the spatial variation in weather events that do not follow national borders. Capturing the effect of climate variability on organized violence therefore needs to be based on subnational data. Yet, it is a challenge to determine a suitable unit of analysis that captures both relevant subnational variations, but also the expected violent outcome. The Modifiable Areal Unit Problem (MAUP) (Openshaw, 1984) postulates that the choice of spatial units of analysis can greatly affect the results

obtained. This is in many ways a persistent challenge and to date there is no standard approach to solving the MAUP (Donnay & Bhavnani, 2016). In this dissertation I mitigate the problem by using different units of analysis: politically relevant administrative units in Essay II and grid cells of different sizes in Essays I and III.⁴

Also the temporal resolution bears theoretical relevance. As argued in the theoretical framework, violence needs to be feasible. Some expressions of climate variability have impacts that are detrimental to mobilization for violence and the capacities of armed actors to conduct violence. For example, heavy rainfall may make routes impassable (Landis, 2014). It seems therefore likely that there often is a lag between natural hazards and violence. The essays take into account potential lags between shocks and mobilization by introducing different lag structures in the statistical models (Essay II) and/or formulating hypotheses based on cumulative exposure to several drought events (Essay I) or general patterns of volatility (Essay III) that thus capture potential effects in a wider time span.

A related issue is that many active conflicts do not see battles in every week or month. This is especially true for areas with significant seasonal variation, where environmental conditions hamper military activities during some months due to, for example, impassable roads (Landis, 2014). This is also true for low-intensity conflicts that see long pauses in fighting. By using yearly data rather than a shorter temporal resolution, the dissertation minimizes the problem of conflating observations that are truly peaceful with non-conflict observations that reflect a temporary lull in fighting.

Lastly, the theoretical framework points to a number of interlinked steps and a variety of conditioning variables, both at the individual, sub-national and national level. This is a great challenge to extensive quantitative studies (Buhaug, 2015). It is one reason why some dismiss quantitative studies in this research field altogether (Selby, 2014). While acknowledging the challenges of complexity of the theoretical framework, this dissertation builds on the assumption that they can be overcome. Understanding the bigger picture and the whole causal chain can be achieved through a larger number of systematic studies zooming in on specific links within the wider theoretical framework. Thus, although single studies are limited in scope, over time the research field will cumulate knowledge on the whole causal chain and the most relevant conditioning factors.

Extensive systematic studies across a larger number of observations are particularly important in this field as they can isolate the effects of specific variables and allow for generalization. Yet, the attempt to isolate specific

⁴ Arguably the best way of addressing this issue is an actor-based approach focusing on the exposure of societal groups to climate variability and their conflict involvement (Von Uexkull, Buhaug, Croicu, & Fjelde, 2016). Yet, for communal violence and other forms of violence there is no comprehensive data on settlement patterns and conflict involvement to my knowledge.

effects requires simplifying parts that are not in focus and reducing theoretical complexity. With these considerations in mind, Essay I, for example, focuses specifically on taking into account coping capacities for drought while not modeling conditional effects on the second part of the causal chain, i.e. the question of why violence is chosen and not any other means to redress grievances. All quantitative studies of the dissertation include fixed effects models that make it plausible that, although not captured explicitly in the model, other time invariant risk factors such as the location and general traits of the state regime are accounted for. Thereby, it is plausible to argue that all else equal, the climate indicators are associated with the dependent variable.

Naturally, quantitative studies are fully dependent on the availability of data that is relevant to test theoretical expectations. Yet, data are limited, especially at the subnational level. This makes it important to complement quantitative studies with more qualitative approaches. Qualitative studies are also better able to trace mechanisms and capture complexity that provide nuance to the proxies available for quantitative tests. With Essay IV, the dissertation includes a micro-level study based on qualitative interviews that captures nuanced patterns and causal mechanisms at the individual level.

Guided by these methodological considerations, this dissertation combines quantitative and qualitative approaches. Cognizant of the larger theoretical framework including the important questions of agency and resolve that explain the final step in using violence, each essay attempts to isolate a specific effect. Yet, collectively, all essays contribute to understanding the whole causal chain laid out in the theoretical framework.

Presentation of the essays

This dissertation consists of four independent but related essays. All studies contribute to understanding the relationship between climate variability and organized violence, and all include novel empirical analyses of different dependent variables.

Essay I: Sustained drought, vulnerability and civil conflict in Sub-Saharan Africa.

The first essay “Sustained drought, vulnerability and civil conflict in Sub-Saharan Africa” was published in 2014 in *Political Geography*. It focuses squarely on the first step in the causal chain outlined in figure 1. It takes explicitly into account the circumstances under which climate variability

translates into adverse impacts for livelihoods, and thereby into a higher risk of involvement in civil violence.

In particular, building on the literature on disaster risk reduction, it theorizes under what circumstances climate variability translates into economic hardship. Based on this literature, it suggests that exposure to sustained drought undermines the coping capacity of individuals. It also proposes that reliance on rainfed agriculture for income and food provision renders individuals particularly vulnerable to drought. The empirical implications of these theoretical arguments are that areas experiencing sustained drought or depending on rainfed agriculture are more likely to see civil conflict violence following drought, *ceteris paribus*.

The paper evaluates the relationship between sustained drought, rainfed agriculture and civil conflict violence statistically at the subnational level, contributing one of the first comprehensive subnational studies on civil conflict violence and climate variability. It uses novel high-resolution data on civil conflict events in Sub-Saharan Africa from 1989 to 2008 (Sundberg & Melander, 2013), combined with data on cropland cover and drought events. As cropland cover varies considerably in space, the analysis is conducted based on yearly observations of grid-cells of 0.5 x 0.5 degrees. In order to evaluate the argument that sustained exposure erodes coping mechanisms, the essay introduces independent variables mapping the continuous or cumulative exposure to drought for several years.

In line with the argument, the essay finds that a drought has no universal direct short-term effect on civil conflict violence. Yet, rainfed croplands see an increased risk of civil conflict violence following drought. There is also some support for the proposition that areas experiencing sustained drought have a higher risk of conflict.

Essay II: Climate triggers: Rainfall anomalies, vulnerability and communal conflict in Sub-Saharan Africa

The second essay "Climate triggers: Rainfall anomalies, vulnerability and communal conflict in Sub-Saharan Africa" is co-authored with Hanne Fjelde and was published in 2012 in *Political Geography*. It focuses on a different form of organized violence than Essay I, namely communal violence fought between non-state groups that are identified based on a shared identity. It advances specific arguments about how this form of violence is affected by climate variability. Like Essay I, it focuses mainly on the first stage of the causal chain, i.e. the question of when climate variability translates into a shock to income and food production for rural livelihoods. It investigates multiple dimensions of vulnerability, in particular poverty and political exclusion. It takes into account potential cushioning mechanisms by the state

that is suggested to be less likely to provide relief to marginalized groups in the wake of a natural hazard, compared to non-marginalized groups. An implication is that the effect of rainfall anomalies on communal conflict will be stronger in the presence of economic and political marginalization.

The article evaluates these arguments statistically, utilizing a disaggregated dataset of first-order administrative units combining rainfall data with geo-referenced event data on the occurrence of communal conflict in Sub-Saharan Africa between 1990 and 2008 (Sundberg & Melander, 2013). Results suggest that large negative deviations in rainfall from the historical norm are associated with a higher risk of communal conflict. There is some evidence that the effect of rainfall shortages on the risk of communal conflict is amplified in regions inhabited by politically excluded ethno-political groups. Contrary to expectations, economic marginalization does not significantly alter the effect of rainfall shortages.

Beyond contributions to the literature on climate variability and conflict, the essay also presents the first comprehensive systematic study of communal violence across Sub-Saharan Africa in general.

Essay III: Volatile Environments: Climate, State Reach and Communal Conflict in Sub-Saharan Africa

The third essay “Volatile environments: Climate, state reach and communal conflict in Sub-Saharan Africa” focuses on the second part of the causal chain outlined in figure 1, theorizing how climate-induced volatility in resource availability affects the likelihood and stability of cooperative agreements between communal groups.

As a novel theoretical argument the study proposes that resource volatility increases conflict risks over land and water resources even in the absence of acute scarcity. This proposition is based on three causal mechanisms. First, even if there is no current shortage, the experience of a widely varying supply of crucial resources produces an anticipation of future scarcity, which increases the incentives for the capture of strategic resources. Second, volatility makes it more difficult to conclude and uphold inter-communal agreements about resource access and distribution. Third, volatility encourages migration and nomadic livelihoods that in turn could make disputes more likely as they foreclose opportunities for iterated bargains between groups, which would otherwise facilitate finding self-enforcing modes of cooperation.

I suggest that the relationship between volatility and conflict is conditioned by the willingness and ability of the state government to prevent and manage disputes. Remote regions with limited infrastructure and markets tend to be economically less important to the government so it can tolerate

local disputes and ignore local grievances at lower costs (Boone, 2003; Raleigh, 2010). These areas are also less accessible for security forces (Tollefsen & Buhaug, 2015). It is therefore in these areas far from urban centres where the adverse consequences of erratic and volatile rainfall, including conflicts over land and water resources, are suggested to play out.

These arguments are tested statistically using data at the subnational level on 0.5 x 0.5 decimal degree grid cells. The paper utilizes novel data on conflict issues in non-state conflicts and squarely focuses on communal conflicts fought over land and water issues (Von Uexkull & Pettersson, 2013). This data is combined with information on the location of battle events between non-state groups covering Sub-Saharan Africa in the 1989-2008 period (Sundberg & Melander, 2013). Expecting that remote areas see lower government capability and willingness to effectively respond to local grievances and disputes, conditional effects are modeled based on an indicator for travel time to urban centers that captures both distance and infrastructure (Nelson, 2008).

In line with theoretical expectations, the findings suggest that the higher the volatility of rainfall, the higher the risk of communal conflicts over land and water. This pattern is most pronounced in remote regions, which are further and more difficult to access from urban areas. Findings are robust to the inclusion of a number of controls associated with remoteness and vulnerability and re-analysis using alternative units of analysis of 1 x 1 decimal degrees grid cells.

Essay IV: Flight, Fight or Farm? Agricultural Dependence and Participation in Land-related Conflict

The fourth essay “Flight, Fight or Farm? Agricultural Dependence and Participation in Land-related Conflict” seeks to increase the understanding of drivers of participation in land-related violence.

The essay proposes that one key to understanding why individuals participate in land-related conflict is found in their dependence on land as a source of livelihood. Where land is the main source of income and individuals lack alternative income opportunities losing land access has grave economic consequences. As instability increases individuals tied to land are therefore less likely to leave. This makes them more vulnerable to becoming involved in the conflict, e.g. through forced recruitment by militias or peer-pressure. Staying in a conflict zone, individuals dependent on agricultural are also particularly vulnerable to a conflict’s adverse economic effects, such as displacement, looting and destruction of farm goods. Where individuals experience conflict-related economic shocks, opportunity costs for engaging in violence are lowered and economic grievances may rise and with these the

propensity to participate. While these mechanisms apply to armed conflict in general, there is another reason why agricultural dependence increases participation in land-related conflicts specifically. Land-related conflicts typically arise in a context of growing land competition under uncertainty over ownership (Boone 2014). Individuals dependent on agriculture have higher expected benefits of joining a fight that promises continued or more permanent access to land given the significance of land for their livelihoods. These interlinked causal mechanisms are mutually reinforcing and together make agricultural dependence an important explanation of participation in land-related violence. These theoretical conjectures are developed based on comprehensive interview material on 75 ex-participants in land-related violence of the Sabaot Land Defence Force (SLDF) in Mt. Elgon, Kenya. The Mt. Elgon conflict shares important characteristics with other land-related armed conflicts, and thus provides a useful context for developing explanations that are relevant for other settings.

Essay IV contributes to the literature on participation in violence. While this literature has proposed a number of mechanisms that increase participation, it has not addressed explicitly the puzzle of why individuals stay and get exposed to recruitment, and do not leave while they can. This is surprising as many of the most commonly cited mechanisms proposed for participation, such as peer-pressure and coercion are driven by conflict exposure. They are based on individuals staying in a region of instability, rather than leaving it. By focusing on participation in land-related conflict specifically, the fourth essay also zooms in on an empirical domain that has received little attention in previous research on participation in organized violence.

While not dealing with climate variability specifically, the study is informative for all parts of the causal chain outlined in the theoretical framework. While Essay I departs from the understanding that rainfed agricultural areas are particularly vulnerable, one contribution of the fourth paper is that it adds nuance to the concept of vulnerability by focusing on the coping mechanisms available at the individual level. The understanding of agricultural dependence developed builds on the disaster vulnerability literature, including factors such as educational attainment, economic status and social capital that may help buffer losses. Yet, in addition, the paper also takes into account the possibility of migration as an adaptation mechanism and theorizes how agricultural dependence limits mobility. This is important for several reasons. The literature on climate variability and conflict often sees migration as a potential link from climate variability to conflict. The influx of migrants may lead to conflicts in host regions (Reuveny 2007). Yet, this paper emphasizes how the *lack* of mobility may also increase the potential for violent mobilization. It shows that individuals who are dependent on agriculture are less likely to be capable of leaving a region that sees increased instability and therefore are more likely to be recruited into armed groups.

In addition, the findings of the large N literature, including Essay I in this dissertation, indicate that climate variability may feed ongoing violence. This paper adds another dimension of how agriculture-dependent individuals are populations at risk. Agricultural dependence does not only mean that individuals are vulnerable to climate variability. It also means that they are less likely to get out of the conflict zone. This makes them vulnerable along two dimensions to combined effects of climate shocks and conflict exposure, and likely puts them at high risk of getting recruited into armed groups if exposed to both.

Conclusions

According to a Chinese proverb, a falling tree makes more noise than a growing forest. Similarly, alleged climate conflicts like Syria (Kelley, Mohtadi, Cane, Seager, & Kushnir, 2015) have received great attention by the media and policy, while many examples of cooperation even under dire ecological circumstances do not make headlines. Cases of armed conflicts over resources like land or water are the exception rather than the rule (Böhmelt et al., 2014). Armed conflict and violent mobilization is clearly not the default response to environmental stress.

That said, this dissertation suggests that climate variability does increase the risk of organized violence under specific circumstances. The essays in this dissertation suggest that the impacts of climate variability on organized violence are conditional on specific climate patterns, the sensitivity of livelihoods, and state governance. Essay I suggests that the exposure of vulnerable agricultural livelihoods to sustained drought increases the risk of civil conflict violence. Essay II indicates that rainfall anomalies increase the risk of communal violence, an effect which is amplified by political marginalization. Essay III finds support for the proposition that even in the absence of acute scarcity, volatility in resource supply increases the risk of communal conflict over land and water in remote regions, which tend to have limited state presence. Essay IV proposes that individuals depending on agriculture are prone to participate in land-related conflict as they face impediments to leaving a conflict zone, and additionally have high incentives to partake in fighting for land. The dissertation thus helps identify the specific context and the process through which climate variability – via adverse impacts on livelihoods – has the potential to fuel civil and communal conflicts.

Policy implications

These findings have implications for policy. First of all, it is important to emphasize that “nature” is not to blame. The dissertation argues that the economic and political context largely conditions the effect of climate varia-

bility. This is crucial, as political leaders sometimes have used the climate as a scapegoat for governance failures. For example, facing widespread protests on the streets, the Venezuelan president Maduro blamed a severe drought for power shortages as a major water reservoir saw unprecedented low levels of water in early 2016 (CBC news, 2016). Critics blame instead failed economic policies and lack of investment in maintenance (CBC news, 2016). Similarly, while a particularly severe drought hit Syria before the war starting 2011, the extent of the humanitarian crises during the drought has been attributed to a culmination of decades of sustained mismanagement over water and land resources (De Châtel, 2014). These examples illustrate the danger of depicting climate change as an external force, which allows political leaders to blame a factor beyond their influence for governance failures. There is little “natural” about these disasters. Instead, the structures that make countries and subnational regions sensitive to climate impacts and increase conflict risks deserve attention. Collectively, the essays in this dissertation emphasize the importance of addressing a number of economic and political factors.

First, the dissertation points to the importance of marginalization conditioning the impact of climate variability on organized violence. Societal groups that are excluded from power are less likely to receive disaster aid and are more sensitive to the climate. They are also more likely to be disfavored compared to other population groups and are less likely to see their grievances addressed, making them more susceptible to communal violence as Essay II suggests. Similarly, areas with limited state reach, and associated limited infrastructure are more likely to see communal violence over land and water as demonstrated in Essay III. The responses of the participants in violence interviewed in Essay IV show that the perception of an absent government made the SLDF militia’s promise of land redistribution credible to individual participants. Accordingly, more inclusive governance reducing political marginalization may lower both the vulnerability to climate change and conflict risks. Developing infrastructure moves remote regions economically closer to urban centers and facilitates efficient security provision.

Second, the results of the dissertation underline that ongoing conflict itself increases the vulnerability of agricultural livelihoods. Essay IV illustrates how the conflict hindered farming activities in Mt. Elgon and that most participants in violence had been victims of evictions before joining. Essay I indicates that drought fuelled civil conflict violence mostly in ongoing conflicts. These findings are not surprising. Where conflict is ongoing, the collective action problem and logistical challenges have been overcome. Under these circumstances, where the start-up costs of organizing for violence have already been paid, shocks to income and food production that are compounded by the adverse economic effects of ongoing warfare may create a feedback loop that sustains conflict. Hence, conflict prevention is extremely important for reducing vulnerability to climate variability and preventing

these vicious circles. Given the strong correlation between past and future conflict it is also probably one of the most effective measures for averting a conflictive future (Hegre et al., 2013).

Lastly, the dissertation emphasizes the sensitivity of agriculture and agricultural livelihoods. Agricultural livelihoods are not only particularly vulnerable to climate change (Olsson et al., 2014). It is also among these individuals and societal groups that climate variability increases the risk of involvement in conflict. Essay I shows that for rainfed cropland a significant linkage between drought and civil conflict violence exists. Essay IV points to the individual-level mechanisms. Perceptions of land dependence, low education and limited outside opportunities provide incentives for joining in violence that promises economic benefits, such as land access. This finding points to the importance of making agriculture more resilient to climate variability and lessening dependence on agriculture. Reducing the importance of land as the primary source of livelihood, for example via education and encouraging livelihood diversification, would decrease the likelihood that land or water are seen as resources worth fighting for. Previous research on agriculture provides guidance for a number of concrete measures: for example, improving food storage improves coping capacities of smallholder farmers and pastoralists (Morton, 2007). Micro-insurance schemes against weather-based risks may be another way of reducing vulnerability (Olsson et al., 2014).

Addressing marginalization, reducing violence and strengthening coping capacities of rural livelihoods are important measures for reducing the adverse impact of climate variability. Where this is not done and socio-economic developments stagnate, conflicts and exclusionary policies continue to be a reality, severe climate change with more frequent droughts and less precipitation will add a burden and likely contribute to instability. With the Paris Agreement of 2015 the international community has agreed to keep the increase in average surface temperature by the end of the century well below 2 degrees (Schellnhuber, Rahmstorf, & Winkelmann, 2016). Working towards this ambitious target, while improving economic development, agricultural production and reducing conflict risks is the overarching political challenge.

Implications for future research

Empirically, this dissertation focuses on Sub-Saharan Africa, a part of the world that is particularly vulnerable to climate change (Niang et al., 2014). Factors increasing the vulnerability of Sub-Saharan Africa as a region may have influenced the specific findings of this dissertation. The weakness of institutions, the high prevalence of armed conflict and the important role of agriculture for African economies may be scope conditions for the relationships discovered. In addition, the relative importance of ethnicity that facilitates group mobilization could be special in this part of the world (Horowitz,

1985). Civil conflicts and violence between communal groups are not confined to Africa (Sundberg et al., 2012; Tubi & Feitelson, 2016). Neither are challenges relating to climate variability, as the examples of Syria (Kelley et al., 2015) Venezuela (CBC news, 2016), or Indonesia (Barron et al., 2009; Caruso et al., 2016) highlight. Yet, whether the results of this dissertation are generalizable to other regions is an open question that warrants further investigations. Future research needs to go beyond the African continent and systematically identify the conditions at different levels of analysis that make areas and countries vulnerable to the linkages outlined in this dissertation.

The dissertation also draws attention to the ambiguous role of migration and mobility. Essay IV argues that immobility due to agricultural dependence in Mt. Elgon made individuals more prone to exposure to the adverse effects of conflict and participate in fighting. This illustrates that mobility is an important coping mechanism to instability. Similarly, Essay III argues that mobility is a strategy to cope with volatile resource supply. Yet, as Essay III emphasizes, migration processes could themselves give rise to tensions. It argues that mobility may instead be a driver of conflict as it forecloses iterated bargains between groups that do not interact regularly. The conditions under which migration leads to conflict in host regions, including son of the soil conflicts, warrant further research (Côté & Mitchell, 2015).

Yet, perhaps most important for understanding the security implications of climate change is the study of the indirect effects on a variety of conflict drivers. This dissertation focuses primarily on a particular causal pathway, subnational linkages between climate variability and conflict via impacts on rural livelihoods. Yet, there are a number of other pathways that are little explored. As the latest report of the Intergovernmental Panel on Climate Change (IPCC) states: “*Some of the factors that increase the risk of violent conflict within states are sensitive to climate change.[...] Although there is little agreement about direct causality, low per capita incomes, economic contraction, and inconsistent state institutions are associated with the incidence of violence.*” (Adger et al., 2014, p. 758). For example, there is growing evidence for the effect of temperature anomalies on a country’s economic performance (Burke et al., 2016; Burke, Hsiang, & Miguel, 2015). Further studies on indirect effects will allow us to make more realistic assessments of the total effect of climate variability and change on conflict risks.

References

- Adano, W. R., Dietz, T., Witsenburg, K., & Zaal, F. (2012). Climate change, violent conflict and local institutions in Kenya's drylands. *Journal of Peace Research*, 49(1), 65–80. <http://doi.org/10.1177/0022343311427344>
- Adger, W. N., Pulhin, J. M., Barnett, J., Dabelko, G. D., Hovelsrud, G. K., Levy, M., ... Vogel, C. H. (2014). Human security. In C. B. Field, V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandrea, T. E. Bilir, ... L. L. White (Eds.), *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel of Climate Change* (pp. 755–791). Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.
- Arjona, A., & Kalyvas, S. N. (2011). Recruitment into Armed Groups in Colombia: A Survey of Demobilized Fighters. In Y. Guichaoua (Ed.), *Understanding Collective Political Violence* (pp. 143–172). Houndmills, UK: Macmillan Palgrave.
- Barnett, J., & Adger, W. N. (2007). Climate change, human security and violent conflict. *Political Geography*, 26(6), 639–655. <http://doi.org/doi:10.1016/j.polgeo.2007.03.003>
- Barron, P., Kaiser, K., & Pradhan, M. (2009). Understanding Variations in Local Conflict: Evidence and Implications from Indonesia. *World Development*, 37(3), 698–713. <http://doi.org/10.1016/j.worlddev.2008.08.007>
- Benjaminsen, T. A., Alinon, K., Buhaug, H., & Buseth, J. T. (2012). Does climate change drive land-use conflicts in the Sahel? *Journal of Peace Research*, 49(1), 97–111. <http://doi.org/10.1177/0022343311427343>
- Bergholt, D., & Lujala, P. (2012). Climate-related natural disasters, economic growth, and armed civil conflict. *Journal of Peace Research*, 49(1), 147–162. <http://doi.org/10.1177/0022343311426167>
- Bernauer, T., Böhmelt, T., & Koubi, V. (2012). Environmental changes and violent conflict. *Environmental Research Letters*, 7(1), 015601.
- Biazin, B., Sterk, G., Temesgen, M., Abdulkedir, A., & Stroosnijder, L. (2012). Rainwater harvesting and management in rainfed agricultural systems in sub-Saharan Africa – A review. *Recent Advances in Water Resources Management*, 47–48(0), 139–151. <http://doi.org/10.1016/j.pce.2011.08.015>
- Bogale, A., & 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. <http://doi.org/10.1080/00220380701260093>
- Bohlken, A. T., & Sergenti, E. J. (2010). Economic growth and ethnic violence: An empirical investigation of Hindu—Muslim riots in India. *Journal of Peace Research*, 47(5), 589–600. <http://doi.org/10.1177/0022343310373032>
- Böhmelt, T., Bernauer, T., Buhaug, H., Gleditsch, N. P., Tribaldos, T., & Wischnath, G. (2014). Demand, supply, and restraint: Determinants of domestic water conflict and cooperation. *Global Environmental Change*, 29, 337–348. <http://doi.org/10.1016/j.gloenvcha.2013.11.018>

- Boone, C. (2003). *Political Topographies of the African State*. New York: Cambridge University Press.
- Boone, C. (2014). *Property and political order: land rights and the structure of conflict in Africa*. Cambridge, United Kingdom: Cambridge University Press.
- Brosché, J., & Rothbart, D. (2013). *Violent Conflict and Peacebuilding. The continuing crisis in Darfur*. New York, NY, USA: Routledge.
- Brosché, J., & Elfversson, E. (2012). Communal conflict, civil war, and the state: Complexities, connections, and the case of Sudan. *African Journal on Conflict Resolution*, 14(1), 33–66.
- Buhaug, H. (2006). Relative Capability and Rebel Objective in Civil War. *Journal of Peace Research*, 43(6), 691–708. <http://doi.org/10.1177/0022343306069255>
- Buhaug, H. (2010). Climate not to blame for African civil wars. *Proceedings of the National Academy of Sciences*, 107(38), 16477–16482. <http://doi.org/10.1073/pnas.1005739107>
- Buhaug, H. (2014). Concealing agreements over climate–conflict results. *Proceedings of the National Academy of Sciences*, 111(6), E636–E636. <http://doi.org/10.1073/pnas.1323773111>
- Buhaug, H. (2015). Climate–conflict research: some reflections on the way forward. *Wiley Interdisciplinary Reviews: Climate Change*. <http://doi.org/10.1002/wcc.336>
- Buhaug, H., Benjaminen, T. A., Sjaastad, E., & Theisen, O. M. (2015). Climate variability, food production shocks, and violent conflict in Sub-Saharan Africa. *Environmental Research Letters*, 10(12), 125015.
- Buhaug, H., Nordkvelle, J., Bernauer, T., Böhmelt, T., Brzoska, M., Busby, J. W., ... von Uexkull, N. (2014). One effect to rule them all? A comment on climate and conflict. *Climatic Change*, 127(3-4), 391–397. <http://doi.org/10.1007/s10584-014-1266-1>
- Burke, M., Craxton, M., Kolstad, C. D., Onda, C., Allcott, H., Baker, E., ... Tol, R. S. J. (2016). Opportunities for advances in climate change economics. *Science*, 352(6283), 292–293. <http://doi.org/10.1126/science.aad9634>
- Burke, M., Hsiang, S. M., & Miguel, E. (2015). Global non-linear effect of temperature on economic production. *Nature*, 527(7577), 235–239.
- Burke, M., Miguel, E., Satyanath, S., Dykema, J. A., & Lobell, D. B. (2009). Warming increases the risk of civil war in Africa. *Proceedings of the National Academy of Sciences*, 106(49), 20670–20674. <http://doi.org/10.1073/pnas.0907998106>
- Butler, C. K., & Gates, S. (2012). African range wars: Climate, conflict, and property rights. *Journal of Peace Research*, 49(1), 23–34. <http://doi.org/10.1177/0022343311426166>
- Caruso, R., Petrarca, I., & Ricciuti, R. (2016). Climate change, rice crops, and violence: Evidence from Indonesia. *Journal of Peace Research*, 53(1), 66–83. <http://doi.org/10.1177/0022343315616061>
- CBC news. (2016). We're living worse than in a war': Venezuela's deepening economic crisis. Retrieved July 4, 2016 from <http://www.cbc.ca/news/world/venezuela-crsis-food-electricity-oil-shortage-inflation-1.3643216>
- Collier, P., & Hoeffler, A. (2004). Greed and grievance in civil war. *Oxford Economic Papers*, 56(4), 563–595. <http://doi.org/10.1093/oep/gpf064>
- Côté, I., & Mitchell, M. I. (2015). Deciphering “Sons of the Soil” Conflicts: A Critical Survey of the Literature. *Ethnopolitics*, 1–19. <http://doi.org/10.1080/17449057.2015.1089050>

- Cunningham, D. E., & Lemke, D. (2011). *Beyond Civil War: A Quantitative Analysis of Sub-State Violence*. Paper presented at the 52th Annual Meeting of the International Studies Association, Montreal, Canada, 17-21 March.
- Cunningham, D. E., & Lemke, D. (2013). Combining Civil and Interstate Wars. *International Organization*, 67(03), 609–627.
<http://doi.org/10.1017/S0020818313000167>
- De Châtel, F. (2014). The Role of Drought and Climate Change in the Syrian Uprising: Untangling the Triggers of the Revolution. *Middle Eastern Studies*, 50(4), 521–535. <http://doi.org/10.1080/00263206.2013.850076>
- De Juan, A. (2015). Long-term environmental change and geographical patterns of violence in Darfur, 2003–2005. *Political Geography*, 45, 22–33.
<http://doi.org/10.1016/j.polgeo.2014.09.001>
- Denton, F., Wilbanks, T. J., Abeysinghe, A. C., Burton, I., Gao, Q., Lemos, M. C., ... Warner, K. (2014). Climate-resilient pathways: adaptation, mitigation, and sustainable development. In C. B. Field, V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandrea, T. E. Bilir, ... L. L. White (Eds.), *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel of Climate Change* (pp. 1101–1131). Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.
- De Soysa, I. (2002). Paradise is a Bazaar? Greed, Creed, and Governance in Civil War, 1989–99. *Journal of Peace Research*, 39(4), 395–416.
<http://doi.org/10.1177/0022343302039004002>
- Detges, A. (2014). Close-up on renewable resources and armed conflict: The spatial logic of pastoralist violence in northern Kenya. *Political Geography*, 42, 57–65.
<http://doi.org/10.1016/j.polgeo.2014.06.003>
- Diehl, P. F. (1992). What Are They Fighting for? The Importance of Issues in International Conflict Research. *Journal of Peace Research*, 29(3), 333–344.
<http://doi.org/10.2307/424285>
- Diehl, P. F., & Gleditsch, N. P. (2000). *Environmental Conflict*. Boulder, Colorado: Westview Press Inc.
- Donnay, K., & Bhavnani, R. (2016). The Cutting Edge of Research on Peace and Conflict. In D. Backer, R. Bhavnani, & P. Huth (Eds.), *Peace and Conflict 2016* (pp. 4–18). New York: Routledge.
- Dore, M. H. I. (2005). Climate change and changes in global precipitation patterns: What do we know? *Environment International*, 31(8), 1167–1181.
<http://doi.org/10.1016/j.envint.2005.03.004>
- Eck, K. (2009). From Armed Conflict to War: Ethnic Mobilization and Conflict Intensification. *International Studies Quarterly*, 53(2), 369–388.
<http://doi.org/10.1111/j.1468-2478.2009.00538.x>
- Eck, K. (2014). The law of the land: Communal conflict and legal authority. *Journal of Peace Research*, 51(4), 441–454. <http://doi.org/10.1177/0022343314522257>
- Fearon, J. D., & Laitin, D. D. (2003). Ethnicity, Insurgency, and Civil War. *The American Political Science Review*, 97(1), 75–90.
<http://doi.org/10.2307/3118222>
- Fjelde, H., & von Uexkull, N. (2012). Climate triggers: Rainfall anomalies, vulnerability and communal conflict in Sub-Saharan Africa. *Political Geography*, 31(7), 444–453. <http://doi.org/10.1016/j.polgeo.2012.08.004>
- Gleditsch, N. P. (1998). Armed Conflict and The Environment: A Critique of the Literature. *Journal of Peace Research*, 35(3), 381–400.
<http://doi.org/10.1177/0022343398035003007>

- Gleditsch, N. P., Wallensteen, P., Eriksson, M., Sollenberg, M., & Strand, H. (2002). Armed Conflict 1946-2001: A New Dataset. *Journal of Peace Research*, 39(5), 615–637. <http://doi.org/10.1177/0022343302039005007>
- Goldstone, J. A. (2002). Population and Security: How Demographic Change Can Lead to Violent Conflict. *Journal of International Affairs*, 56(1), 3–21.
- Gray, C., & Mueller, V. (2012). Drought and Population Mobility in Rural Ethiopia. *World Development*, 40(1), 134–145. <http://doi.org/10.1016/j.worlddev.2011.05.023>
- Guichaoua, Y. (2010). How Do Ethnic Militias Perpetuate in Nigeria? A Micro-level Perspective on the Oodua People's Congress. *World Development*, 38(11), 1657–1666. <http://doi.org/10.1016/j.worlddev.2010.03.004>
- Guichaoua, Y. (2014). Group Formation, Identities, and Violent Mobilisation: Evidence from Nigeria and Niger. In P. Justino, T. Brück, & P. Verwimp (Eds.), *A Micro-Level Perspective on the Dynamics of Conflict, Violence, and Development*. Oxford University Press.
- Gurr, T. R. (1970). *Why men rebel*. Princeton: Princeton University Press.
- Hauge, W., & Ellingsen, T. (1998). Beyond Environmental Scarcity: Causal Pathways to Conflict. *Journal of Peace Research*, 35(3), 299–317. <http://doi.org/10.1177/0022343398035003003>
- Hegre, H., Karlsen, J., Nygård, H. M., Strand, H., & Urdal, H. (2013). Predicting Armed Conflict, 2010–20501. *International Studies Quarterly*, 57(2), 250–270. <http://doi.org/10.1111/isqu.12007>
- Hendrix, C., & Glaser, S. M. (2007). Trends and triggers: Climate, climate change and civil conflict in Sub-Saharan Africa. *Political Geography*, 26(6), 695–715. <http://doi.org/doi:10.1016/j.polgeo.2007.06.006>
- Hendrix, C., & Salehyan, I. (2012). Climate change, rainfall, and social conflict in Africa. *Journal of Peace Research*, 49(1), 35–50. <http://doi.org/10.1177/0022343311426165>
- Homer-Dixon, T. F. (1999). *Environment, Scarcity, and Violence*. Ewing, NJ, USA: Princeton University Press.
- Horowitz, D. L. (1985). *Ethnic Groups in Conflict*. Berkeley and Los Angeles: University of California Press.
- Hsiang, S. M., Burke, M., & Miguel, E. (2013). Quantifying the Influence of Climate on Human Conflict. *Science*, 341(6151). <http://doi.org/10.1126/science.1235367>
- Hsiang, S. M., & Meng, K. C. (2014). Reconciling disagreement over climate–conflict results in Africa. *Proceedings of the National Academy of Sciences*, 111(6), 2100–2103. <http://doi.org/10.1073/pnas.1316006111>
- Hsiang, S. M., Meng, K. C., & Cane, M. A. (2011). Civil conflicts are associated with the global climate. *Nature*, 476(7361), 438–441. <http://doi.org/10.1038/nature10311>
- Humphreys, M., & Weinstein, J. M. (2008). Who Fights? The Determinants of Participation in Civil War. *American Journal of Political Science*, 52(2), 436–455. <http://doi.org/10.1111/j.1540-5907.2008.00322.x>
- IPCC. (2013). Summary for Policymakers. In T. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, ... Midgley (Eds.), *Climate Change 2013 - The Physical Science Basis. Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 3–30). Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.

- IPCC. (2014). Summary for Policymakers. In C. B. Field, V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandrea, T. E. Bilir, ... L. L. White (Eds.), *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 1–32). Cambridge, United Kingdom, and New York, NY, USA: Cambridge University Press.
- Kahl, C. H. (1998). Population Growth, Environmental Degradation, and State-Sponsored Violence: The Case of Kenya, 1991-93. *International Security*, 23(2), 80–119.
- Kahl, C. H. (2006). *States, Scarcity, and Civil Strife in the Developing World*. Princeton and Oxford: Princeton University Press.
- Kelley, C. P., Mohtadi, S., Cane, M. A., Seager, R., & Kushnir, Y. (2015). Climate change in the Fertile Crescent and implications of the recent Syrian drought. *Proceedings of the National Academy of Sciences*, 112(11), 3241–3246. <http://doi.org/10.1073/pnas.1421533112>
- Kijima, Y., Matsumoto, T., & Yamano, T. (2006). Nonfarm employment, agricultural shocks, and poverty dynamics: evidence from rural Uganda. *Agricultural Economics*, 35, 459–467. <http://doi.org/10.1111/j.1574-0862.2006.00191.x>
- Klomp, J., & Bulte, E. (2013). Climate change, weather shocks, and violent conflict: a critical look at the evidence. *Agricultural Economics*, 44(1), 63–78. <http://doi.org/10.1111/agec.12051>
- Kniveton, D. R., Smith, C. D., & Black, R. (2012). Emerging migration flows in a changing climate in dryland Africa. *Nature Climate Change*, 2(6), 444–447.
- Koubi, V., Bernauer, T., Kalbhenn, A., & Spilker, G. (2012). Climate variability, economic growth, and civil conflict. *Journal of Peace Research*, 49(1), 113–127. <http://doi.org/10.1177/0022343311427173>
- Landis, S. T. (2014). Temperature seasonality and violent conflict: The inconsistencies of a warming planet. *Journal of Peace Research*, 51(5), 603–618. <http://doi.org/10.1177/0022343314538275>
- Lichbach, M. I. (1998). *The rebel's dilemma*. University of Michigan Press.
- Linke, A. M., O'Loughlin, J., McCabe, J. T., Tir, J., & Witmer, F. D. W. (2015). Rainfall variability and violence in rural Kenya: Investigating the effects of drought and the role of local institutions with survey data. *Global Environmental Change*, 34, 35–47. <http://doi.org/10.1016/j.gloenvcha.2015.04.007>
- Low, B. S. (1990). Human Responses to Environmental Extremeness and Uncertainty: A Cross-Cultural Perspective. In E. Cashdan (Ed.), *Risk and Uncertainty in Tribal and Peasant Economies* (pp. 229–255). Boulder, Colorado: Westview Press Inc.
- Martin, R., Müller, B., Linstädter, A., & Frank, K. (2014). How much climate change can pastoral livelihoods tolerate? Modelling rangeland use and evaluating risk. *Global Environmental Change*, 24, 183–192. <http://doi.org/10.1016/j.gloenvcha.2013.09.009>
- Mathew, S., & Boyd, R. (2011). Punishment sustains large-scale cooperation in prestate warfare. *Proceedings of the National Academy of Sciences*, 108(28), 11375–11380. <http://doi.org/10.1073/pnas.1105604108>
- Maystadt, J.-F., Calderone, M., & You, L. (2015). Local warming and violent conflict in North and South Sudan. *Journal of Economic Geography*, 15(3), 649–671. <http://doi.org/10.1093/jeg/lbu033>
- Maystadt, J.-F., & Ecker, O. (2014). Extreme Weather and Civil War: Does Drought Fuel Conflict in Somalia through Livestock Price Shocks? *American Journal of Agricultural Economics*, 96(4), 1157–1182. <http://doi.org/10.1093/ajae/aau010>

- McCabe, T. (2004). *Cattle Bring Us to Our Enemies: Turkana Ecology, Politics, and Raiding in a Disequilibrium System*. Ann Arbor, Michigan, USA: University of Michigan Press.
- McDoom, O. S. (2013). Who killed in Rwanda's genocide? Micro-space, social influence and individual participation in intergroup violence. *Journal of Peace Research*, 50(4), 453–467. <http://doi.org/10.1177/0022343313478958>
- Meier, P., Bond, D., & Bond, J. (2007). Environmental influences on pastoral conflict in the Horn of Africa. *Political Geography*, 26(6), 716–735. <http://doi.org/doi:10.1016/j.polgeo.2007.06.001>
- Melander, E. (2016). Organized Violence in the World 2015: An assessment by the Uppsala Conflict Data Program. *UCDP Paper*, (9).
- Miguel, E., Satyanath, S., & Sergenti, E. (2004). Economic Shocks and Civil Conflict: An Instrumental Variables Approach. *Journal of Political Economy*, 112(4), 725–753. <http://doi.org/10.1086/421174>
- Morton, J. F. (2007). The impact of climate change on smallholder and subsistence agriculture. *Proceedings of the National Academy of Sciences*, 104(50), 19680–19685. <http://doi.org/10.1073/pnas.0701855104>
- Mueller, L. (2013). Democratic revolutionaries or pocketbook protesters? The roots of the 2009–2010 uprisings in Niger. *African Affairs*, 112(448), 398–420. <http://doi.org/10.1093/afraf/adt042>
- NATO Parliamentary Assembly. (2015). *Resolution 427 on climate change and international security*. Retrieved March 5, 2016 from <http://www.nato-pa.int/default.asp?CAT2=3924&CAT1=16&CAT0=576&SHORTCUT=3742&SEARCHWORDS=Resolution,427>
- Nel, P., & Righarts, M. (2008). Natural Disasters and the Risk of Violent Civil Conflict. *International Studies Quarterly*, 52(1), 159–185. <http://doi.org/10.1111/j.1468-2478.2007.00495.x>
- Nelson, A. (2008). *Estimated travel time to the nearest city of 50,000 or more people in year 2000*. Global Environment Monitoring Unit. Joint Research Centre of the European Commission. Retrieved August 1, 2014 from <http://forobs.jrc.ec.europa.eu/products/gam/>
- Niang, I., Ruppel, O. C., Abdrabo, M., Essel, A., Lennard, C., Padgham, J., & Urquhart, P. (2014). Africa. In C. B. Field, V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandrea, T. E. Bilir, ... L. L. White (Eds.), *"Climate Change 2014: Impacts, Adaptation, and Vulnerability Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. (pp. 1199–1265). Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.
- O'Loughlin, J., Linke, A. M., & Witmer, F. D. W. (2014a). Effects of temperature and precipitation variability on the risk of violence in sub-Saharan Africa, 1980–2012. *Proceedings of the National Academy of Sciences*, 111(47), 16712–16717. <http://doi.org/10.1073/pnas.1411899111>
- O'Loughlin, J., Linke, A. M., & Witmer, F. D. W. (2014b). Modeling and data choices sway conclusions about climate-conflict links. *Proceedings of the National Academy of Sciences*. 111(6), 2054–2055. <http://doi.org/10.1073/pnas.1323417111>
- O'Loughlin, J., Witmer, F. D. W., Linke, A. M., Laing, A., Gettelman, A., & Duthia, J. (2012). Climate variability and conflict risk in East Africa, 1990–2009. *Proceedings of the National Academy of Sciences*, 109(45), 18344–18349. <http://doi.org/10.1073/pnas.1205130109>
- Olson, M. (1965). *The Logic of Collective Action. Public Goods and the Theory of Groups*. Cambridge, MA & London: Cambridge University Press.

- Olsson, L., Opondo, M., Tschakert, P., Agrawal, A., Eriksen, S. H., Ma, S., ... Zaki-Deen, S. A. (2014). Livelihoods and poverty. In C. B. Field, V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandrea, T. E. Bilir, ... L. L. White (Eds.), *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel of Climate Change* (pp. 793–832). Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.
- Openshaw, S. (1984). *The Modifiable Areal Unit Problem*. Norwich, UK: Geo Books.
- Papaioannou, K. J. (2016). Climate shocks and conflict: Evidence from colonial Nigeria. *Political Geography*, 50, 33–47. <http://doi.org/10.1016/j.polgeo.2015.07.001>
- Pettersson, T., & Wallensteen, P. (2015). Armed conflicts, 1946–2014. *Journal of Peace Research*, 52(4), 536–550. <http://doi.org/10.1177/0022343315595927>
- Plümper, T., & Neumayer, E. (2009). Famine Mortality, Rational Political Inactivity, and International Food Aid. *World Development*, 37(1), 50–61. <http://doi.org/10.1016/j.worlddev.2008.05.005>
- Pugel, J. (2007). *What the fighters say: A survey of ex-combatants in Liberia*. Monrovia, Liberia: UNDP.
- Raleigh, C. (2010). Political Marginalization, Climate Change, and Conflict in African Sahel States. *International Studies Review*, 12(1), 69–86. <http://doi.org/10.1111/j.1468-2486.2009.00913.x>
- Raleigh, C. (2014). Political hierarchies and landscapes of conflict across Africa. *Political Geography*, 42, 92–103. <http://doi.org/10.1016/j.polgeo.2014.07.002>
- Raleigh, C., Choi, H. J., & Kniveton, D. (2015). The devil is in the details: An investigation of the relationships between conflict, food price and climate across Africa. *Global Environmental Change*, 32, 187–199. <http://doi.org/10.1016/j.gloenvcha.2015.03.005>
- Raleigh, C., & 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. <http://doi.org/10.1177/0022343311427754>
- Raleigh, C., Linke, A., Hegre, H., & Karlsen, J. (2010). Introducing ACLED: An Armed Conflict Location and Event Dataset. *Journal of Peace Research*, 47(5), 651–660. <http://doi.org/10.1177/0022343310378914>
- Raleigh, C., & Urdal, H. (2007). Climate change, environmental degradation and armed conflict. *Political Geography*, 26(6), 674–694. <http://doi.org/doi:10.1016/j.polgeo.2007.06.005>
- Reuveny, R. (2007). Climate change-induced migration and violent conflict. *Political Geography*, 26(6), 656–673. <http://doi.org/doi:10.1016/j.polgeo.2007.05.001>
- Rosenfeld, B. (2016). Reevaluating the Middle Class Protest Paradigm: A Case-Control Study of Democratic Protest Coalitions in Russia. Unpublished manuscript.
- Salehyan, I. (2008). From Climate Change to Conflict? No Consensus Yet. *Journal of Peace Research*, 45(3), 315–326. <http://doi.org/10.1177/0022343308088812>
- Salehyan, I., Hendrix, C., Hamner, J., Case, C., Linebarger C., Stull, E., & Williams J., (2012). Social conflict in Africa: A new database. *International Interactions* 38(4): 503-511.
- Salehyan, I. (2014). Climate change and conflict: Making sense of disparate findings. *Political Geography*, 43, 1–5. <http://doi.org/10.1016/j.polgeo.2014.10.004>

- Salehyan, I., & Hendrix, C. (2014). Climate shocks and political violence. *Global Environmental Change*, 28, 239–250.
<http://doi.org/10.1016/j.gloenvcha.2014.07.007>
- Scacco, A. (2012). Who Riots? Explaining Individual Participation in Ethnic Violence. Unpublished manuscript.
- Scheffran, J., Brzoska, M., Kominek, J., Link, P. M., & Schilling, J. (2012). Climate Change and Violent Conflict. *Science*, 336(6083), 869–871.
<http://doi.org/10.1126/science.1221339>
- Schellnhuber, H. J., Rahmstorf, S., & Winkelmann, R. (2016). Why the right climate target was agreed in Paris. *Nature Climate Change*, 6(7), 649–653.
- Schmidhuber, J., & Tubiello, F. N. (2007). Global food security under climate change. *Proceedings of the National Academy of Sciences*, 104(50), 19703–19708. <http://doi.org/10.1073/pnas.0701976104>
- Selby, J. (2014). Positivist Climate Conflict Research: A Critique. *Geopolitics*, 19(4), 829–856. <http://doi.org/10.1080/14650045.2014.964865>
- Seneviratne, S., Nicholls, N., Easterling, C. M., Goodess, S., Kanae, J., Luo, Y., ... Zhang, X. (2012). Changes in Climate Extremes and their Impacts on the Natural Physical Environment. In C. B. Field, V. Barros, T. Stocker, D. Qin, D. J. Dokken, K. L. Ebi, ... P. M. Midgley (Eds.), *Managing the risks of extreme events and disasters to advance climate change adaptation* (pp. 109–231). Cambridge, UK, and New York, NY, USA: Cambridge University Press.
- Shiklomanov, A. I. (1998). *World Water Resources: A New Appraisal and Assessment for the 21st Century*. Paris: UNESCO. Retrieved March 5, 2016 from <http://unesdoc.unesco.org/images/0011/001126/112671Eo.pdf>
- Slettebak, R. T. (2012). Don't blame the weather! Climate-related natural disasters and civil conflict. *Journal of Peace Research*, 49(1), 163–176.
<http://doi.org/10.1177/0022343311425693>
- Smith, D., & Vivekananda, J. (2007). *A Climate of Conflict*. London: International Alert.
- Smith, T. G. (2014). Feeding unrest: Disentangling the causal relationship between food price shocks and sociopolitical conflict in urban Africa. *Journal of Peace Research*, 51(6), 679–695. <http://doi.org/10.1177/0022343314543722>
- Sundberg, R., Eck, K., & Kreutz, J. (2012). Introducing the UCDP Non-State Conflict Dataset. *Journal of Peace Research*, 49(2), 351–362.
<http://doi.org/10.1177/0022343311431598>
- Sundberg, R., & Melander, E. (2013). Introducing the UCDP Georeferenced Event Dataset. *Journal of Peace Research*, 50(4), 523–532.
<http://doi.org/10.1177/0022343313484347>
- Theisen, O. M. (2008). Blood and Soil? Resource Scarcity and Internal Armed Conflict Revisited. *Journal of Peace Research*, 45(6), 801–818.
<http://doi.org/10.1177/0022343308096157>
- 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. <http://doi.org/10.1177/0022343311425842>
- Theisen, O. M., Gleditsch, N. P., & Buhaug, H. (2013). Is climate change a driver of armed conflict? *Climatic Change*, 117(3), 613–625.
<http://doi.org/10.1007/s10584-012-0649-4>
- Theisen, O. M., Holtermann, H., & Buhaug, H. (2011). Climate Wars? Assessing the Claim That Drought Breeds Conflict. *International Security*, 36(3), 79–106.
http://doi.org/10.1162/ISEC_a_00065
- Tollefsen, A. F., & Buhaug, H. (2015). Insurgency and Inaccessibility. *International Studies Review*, 17(1), 6–25. <http://doi.org/10.1111/misr.12202>

- Tubi, A., & Feitelson, E. (2016). Drought and cooperation in a conflict prone area: Bedouin herders and Jewish farmers in Israel's northern Negev, 1957–1963. *Political Geography*, *51*, 30–42. <http://doi.org/10.1016/j.polgeo.2015.11.009>
- 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. <http://doi.org/doi:10.1016/j.polgeo.2004.05.009>
- Ugarriza, J. E., & Craig, M. J. (2013). The Relevance of Ideology to Contemporary Armed Conflicts: A Quantitative Analysis of Former Combatants in Colombia. *Journal of Conflict Resolution*, *57*(3), 445–477. <http://doi.org/10.1177/0022002712446131>
- Urdal, H. (2005). People vs. Malthus: Population Pressure, Environmental Degradation, and Armed Conflict Revisited. *Journal of Peace Research*, *42*(4), 417–434. <http://doi.org/10.1177/0022343305054089>
- US National Security Strategy. (2015). Retrieved March 5, 2016, from https://www.whitehouse.gov/sites/default/files/docs/2015_national_security_strategy.pdf
- Verwimp, P. (2005). An economic profile of peasant perpetrators of genocide: Micro-level evidence from Rwanda. *Journal of Development Economics*, *77*(2), 297–323. <http://doi.org/10.1016/j.jdeveco.2004.04.005>
- Von Uexkull, N., Buhaug, H., Croicu, M., & Fjelde, H. (2016). Civil conflict sensitivity to growing season drought. Forthcoming in *Proceedings of the National Academy of Sciences*.
- Von Uexkull, N., & Pettersson, T. (2013). *What they are fighting for: Conflict issues in African non-state armed conflicts 1989-2011*. Paper presented at the Meeting of the European Network of Conflict Research (ENCoRe), Amsterdam, 24-26 April.
- Wischnath, G., & Buhaug, H. (2014a). On climate variability and civil war in Asia. *Climatic Change*, *122*(4), 709–721. <http://doi.org/10.1007/s10584-013-1004-0>
- Wischnath, G., & Buhaug, H. (2014b). Rice or riots: On food production and conflict severity across India. *Political Geography*, *43*, 6–15. <http://doi.org/10.1016/j.polgeo.2014.07.004>
- Witsenburg, K. M., & Adano, W. R. (2009). Of Rain and Raids: Violent Livestock Raiding in Northern Kenya. *Civil Wars*, *11*(4), 514–538. <http://doi.org/10.1080/13698240903403915>
- Wucherpfennig, J., Metternich, N. W., Cederman, L.-E., & Gleditsch, K. S. (2012). Ethnicity, the State, and the Duration of Civil War. *World Politics*, *64*(1), 79–115. <http://doi.org/10.1017/S004388711100030X>