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On exposure, vulnerability and violence: Spatial distribution of risk factors for climate change and violent conflict across Kenya and Uganda

Tobias Ide [a, b, *], Janpeter Schilling [a, c], Jasmin S.A. Link [a, d], Jürgen Scheffran [a], Grace Ngaruiya [a, b], Thomas Weinzierl [a]

[a] Research Group Climate Change and Security, Department of Geography, University of Hamburg, Grindelberg 5/7, 20144 Hamburg, Germany
[b] School of Integrated Climate System Sciences (SICSS), University of Hamburg, Grindelberg 5/7, 20144 Hamburg, Germany
[c] International Alert, 346 Clapham Road, London SW9 9AP, United Kingdom
[d] Institute of Sociology, University of Hamburg, Allende Platz 1, 20146 Hamburg, Germany

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ABSTRACT

Recent studies discuss the link between climate change and violent conflict, especially for East Africa. While there is extensive literature on the question *whether* climate change increases the risk of violent conflict onset, not much is known about *where* a climate-conflict link is most likely to be found. We address this question by analyzing the spatial distribution of the factors commonly associated with a high exposure and vulnerability to climate change, and a high risk of violent conflict onset in Kenya and Uganda. Drawing on recent literature and quantitative data for the period 1998–2008, we develop various specifications of a composite risk index (CRI) with a spatial resolution of half a degree for Kenya and Uganda in the year 2008. A quantitative comparison with conflict data for the year 2008 provides support for the composite risk index. Finally, the composite risk index is contrasted with the findings of three qualitative case studies, which provide mixed support for the index and help to identify its strengths and weaknesses as well as conceptual needs for further quantitative studies on climate change and violent conflict.

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Introduction

In recent years, possible connections between climate change and violent conflicts have received increased attention by the scientific and policy community (Meierding, 2013). The causal links are yet unclear and the magnitude of the effect of climate change on violent conflict is heavily discussed (Ide & Scheffran, 2014; Scheffran, Brzoska, Kominek, Link, & Schilling, 2012b; Theisen, Gleditsch, & Buhaug, 2013). This is especially the case for East Africa, which is seen as a region highly vulnerable to climate change (World Bank, 2013b). Several recent studies indicate a link between higher temperatures (Hsiang, Meng, & Cane, 2011; Maystadt & Ecker, 2014; O'Loughlin et al., 2012) or lower precipitation (Ember, Adem, Skoggard, & Jones, 2012; Fjelde & von Uexkull, 2012; Hendrix & Salehyan, 2012; Raleigh & Kniveton, 2012) and violent conflict in this region. They are challenged by other analyses finding no significant impact of temperature increases (Buhaug, 2010) or precipitation decreases (O'Loughlin et al., 2012; Theisen, 2012; Theisen, Holtermann, & Buhaug, 2012) on violent conflict onset in East Africa.

This debate is not settled yet, and we will not assess in this paper *whether* a link between climate change and violent conflict exists in East Africa. Our study rather addresses the question *where* such a link is most likely to occur. Climate change does not affect all parts of the region in the same way. The magnitude of the warming as well as the trend and degree of precipitation changes show considerable local variations (Hulme, Doherty, Ngara, New, & Lister, 2001; IPCC., 2013). Furthermore, some regions, such as coastal areas (facing flood risk) or arid regions (facing drought risk), are more exposed to extreme weather events. And finally, even if areas with similar geographic characteristics are afflicted by similar climatic changes, their adaptive capacities and resilience to violent conflict are likely to differ considerably (Adger, 2006; Barnett & Adger, 2007).

So if climate change is a cause of violent conflicts, then such a link is most likely to occur in regions which simultaneously suffer

* Corresponding author. Research Group Climate Change and Security, Department of Geography, University of Hamburg, Grindelberg 5/7, 20144 Hamburg, Germany. Tel.: +49 (0)40 428389196; fax: +49 (0)40 428389211.
E-mail address: tobias.ide@zmaw.de (T. Ide).

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from adverse climate change, have few capabilities to cope with these changes, and are characterized by pre-existing tensions and conflict (Gemenne, Barnett, Adger, & Dabelko, 2014; Raleigh, Linke, & O'Loughlin, 2014). But until today, few efforts have been made to identify these regions. This paper addresses this gap by using a multi-method approach. It develops a composite risk index (CRI), which consists of exposure, vulnerability, and violent conflict risk variables, has a spatial resolution of 0.5 decimal degrees (°) and focuses on Kenya and Uganda in the year 2008.

We choose to limit our analysis to this reference year and region because the availability, quality and resolution of environmental and socio-economic data up to 2008 is comparatively good for both countries. The other reason for our regional focus is that the debate on environmental or climate change and violent conflict often focuses on Kenya and Uganda (e.g. Adano, Dietz, Witsenburg, & Zaal, 2012; Eaton, 2008; Inselman, 2004; Schilling, Opiyo, & Scheffran, 2012). Therefore, we can also draw on a rich literature to specify our model and contrast it with the findings of other studies as well as with our own case studies.

Our analysis contributes to the existing literature in several ways. It enables qualitative researchers to create most likely-, most unlikely-, most similar systems- or most different systems-research designs, which improves the contribution of case studies to the wider literature on climate change and violent conflict (Ide & Scheffran, 2014). For instance, if a study is unable to detect a relationship between climate change and violence even in highly exposed, vulnerable and conflict prone areas, this would be a strong argument against a supposed climate-conflict-link in East Africa (Gerring & Seawright, 2007). The various maps created on the basis of the risk analysis furthermore facilitate the comparison of commonly used datasets with the results of case studies and field observations (Gleditsch & Weidmann, 2012). Such "ground checking" can help to improve the quality of the respective datasets and is thus likely to benefit future large-N studies. The risk index also provides a valuable tool for policy makers, development workers and security analysts interested in the geographic distribution of the risk factors for climate change and violent conflict. Our study thus contributes to the increasing literature on "climate change hotspot mapping" (de Sherbinin, 2014: 23). Finally, our analysis integrates qualitative and quantitative approaches and thus follows recent calls to integrate various methods in the research on climate change and violent conflict (Meierding, 2013; Scheffran, Brzoska, Kominek, Link, & Schilling, 2012a).

This article proceeds as follows. The theoretical background is introduced in the next section. In section Analyzing the spatial distribution of the risk factors for climate change and violent conflict, we analyze the spatial distribution of the risk factors for climate change and violent conflict in Kenya and Uganda in 2008 and integrate them into a CRI. This analysis is based on a literature review and on quantitative datasets for the years 1998–2008. The results are presented in the form of various risk maps with a spatial resolution of 0.5° (equal to 55.5 km at the equator). In section Evaluation of the composite risk index, we contrast the findings of the risk analysis with conflict data for the year 2008 as well as with three case studies of Loitoktok (Kenya), Southern Turkana-Pokot North (Kenya) and Karamoja (Uganda). While geo-referenced conflict datasets allow a quantitative validation of the CRI, case studies are helpful since they can evaluate the findings of the CRI and its individual components in greater depth. In the final section, we present our conclusions.

Theoretical background

A violent conflict is given when the opposing interests of two or more social groups clash and at least one of the groups uses direct, physical violence in order to enforce or articulate its interests. While most proponents of the climate-conflict thesis agree that environmental violence "tends to be subnational, diffuse, and persistent" (Homer-Dixon & Blitt, 1998: 11), some studies also suggest a link between large-scale intra-state violent conflicts and climate change (e.g. Burke, Miguel, Satyanath, Dykema, & Lobell, 2009). There are several possible ways to define and operationalize climate change. We focus on short- to medium-term temperature and precipitation changes which are common proxies for adverse climate change (e.g. Fjelde & von Uexkull, 2012; O'Loughlin et al., 2012). The main reason for this is that climate change will increase the number of short- to middle-term extreme events, which are more likely to influence conflict patterns than changing long-term averages (e.g. Meierding, 2013). It is acknowledged in the literature that temperature and precipitation changes are at best one among many other causal factors of violent conflict onset, but have the potential to indirectly act as "threat multipliers" (Gemenne et al., 2014: 3).

Various pathways linking climate change and violent conflict have been considered (Gleditsch, 2012; Scheffran & Battaglini, 2011). For instance, several studies in social psychology indicate that higher temperatures cause an increase in human aggression, which can transform into inter-group conflict and violence (Anderson & DeLisi, 2011). Higher temperatures and reduced precipitation can also cause scarcities of water, food and arable land, which might lead to inter-group competition and grievances (Homer-Dixon & Blitt, 1998; Schilling, 2012). These resource scarcities can furthermore undermine the capability of the state (e.g. if it loses legitimacy) and thus its capacity to prevent inter-group conflicts (Kahl, 2006). Finally, opportunity costs for joining a violent group decrease during times of drought, especially in countries with a population heavily dependent on agriculture, such as Kenya and Uganda (Barnett & Adger, 2007).

In order to assess the distribution of risk factors for climate change and violent conflict, we utilize a theoretical model based on three categories. In accordance with the Intergovernmental Panel on Climate Change (IPCC, 2012: 30–36), we first distinguish between exposure and vulnerability to climate change. Exposure means that a particular location is "adversely affected by physical events" (IPCC, 2012: 32), in our case temperature and precipitation extremes. Vulnerability is defined as the "predisposition to be adversely affected" (IPCC, 2012: 32). This understanding of vulnerability has two components, sensitivity and adaptive capacity. Sensitivity "is the degree to which a system is modified or affected by perturbations" (Adger, 2006: 270). Some areas, for instance, are characterized by a high percentage of the population depending on agriculture for income and food generation, thus making them more sensitive to droughts than places with a strong tertiary sector. Adaptive capacity is defined as the ability of a system to change in order to cope with the stress it is facing due to its exposure and sensitivity (Adger, 2006). Examples of adaptation measures include irrigated agriculture or insurance schemes against environmental risks.

However, even a region heavily exposed and very vulnerable to climate change may not experience violent conflict because violent conflict is a complex product of multiple and interacting factors. Even strong proponents of an environment-conflict link claim that "passing the threshold of violence definitely depends on *sociopolitical* factors" (Bächler, 1998: 32). Therefore, the general risk of violent conflict onset is considered as the third component of our risk analysis. The general risk of violent conflict is defined as the likelihood of a violent conflict to break out in a certain area.

Thus, the composite risk index (CRI) will be high for those locations which simultaneously experience a high exposure to adverse temperature and precipitation changes, a high

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