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Quantitative Climate-Conflict Research:
Limitations and Prospects of Alternative Approaches

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Abstract

Decision makers and practitioners have expressed a strong interest in the security implications of climate change since the mid-2000s. In response to this, researchers have produced an impressive literature on climate change and violent conflict. This literature and the resulting discourse are strongly shaped by quantitative research, that is, by statistical studies of a large number of cases. This policy brief identifies eight limitations of quantitative climate-conflict research, outlines the resulting knowledge gaps, and suggests ways to address them.

1 Introduction

Many scholars and policy makers nowadays conceive climate change as a threat multiplier for armed conflict risks (McDonald 2018).[1] The Boe Declaration, signed in 2018 by Australia and several Pacific Island states, explicitly recognises climate change as a security issue (Pacific Islands Forum 2018). In the fourth debate of the UN Security Council on climate change, German Foreign Minister Heiko Maas stated: "Climate change is […] increasingly becoming a threat to international peace and security" (Auswärtiges Amt 2019). In the same

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vein, UN Secretary-General Antonia Guterres remarked that climate change "is already leading to many local conflicts over dwindling resources" (UN 2018).

A broad literature has assessed the potential interlinkages between climate change and various forms of conflict in the past 15 years (for recent overviews, see Buhaug 2018; Koubi 2019). The large majority of studies has analysed violent intergroup conflicts within states (hereafter called "conflict"). Interstate wars have been rare in the past decades and are unlikely to be affected by climate change (Gleditsch 2012; Pettersson et al. 2019). Conflicts not involving physical violence occur in all societies and can even drive positive social change. Researchers have so far also paid limited attention to the impact of conflicts on CO_2 emissions or climate policies (Lloyd 2007).

Climate change is suspected to increase conflict risks in various ways (Scheffran et al. 2012). It can undermine individual livelihoods, for instance, if climate extremes disrupt the economy, reduce harvests, and decrease food availability. Such livelihood insecurity may result in grievances, especially if some social groups feel that their counterparts are better off. Deprived individuals also have less to lose, hence making it easier for armed groups to recruit them (for instance by offering an income). Economic disruptions and higher demand for disaster relief can strain the financial and administrative capability of the state, thereby undermining its capability to mediate tensions and suppress rebellion (Barnett and Adger 2007; Ide and Scheffran 2014). Finally, migration induced by extreme climatic events and sea-level rise can induce conflict about power or resources in the receiving areas (Brzoska and Fröhlich 2015).

For a long time, scholars were divided about whether climate change has an impact on conflict risks (Salehyan 2014). Recently, there seems to be an emerging consensus that climate change makes conflicts more likely. However, such a link is dependent on the presence of context factors like ethnic exclusion or low resilience, and climate change is never the most important conflict driver (Ide et al. 2020; Mach et al. 2019; von Uexkull et al. 2020).

Scholars have long pointed out the dominance of quantitative studies in climate-conflict research (Selby 2014; van Baalen and Mobjörk 2018). Between 2007 and 2015, for instance, 73 percent of all empirical studies on the topic published in leading journals use statistical methods, and many literature reviews focus almost exclusively on knowledge gained through quantitative approaches (Ide 2017). In this working paper, I argue that statistical approaches have greatly advanced our knowledge of climate-conflict links; however, an over-reliance on these approaches also prevents scholars from closing crucial knowledge gaps to the detriment of research and policy.

In the next section (2), I briefly describe how statistical approaches work in climate-conflict research, discuss recent advantages, and illustrate how they have enriched academic debates. Thereafter, I pinpoint eight shortcomings of quantitative research and explain how they affect knowledge production (section 3). The final section (4) of this working paper concludes the discussion and offers suggestions for researchers and decision makers.

2 The Success Story of Quantitative Research on Climate Change and Conflict

Quantitative methods start by defining a temporal and spatial scope (e.g., Africa between 1989 and 2019) as well as a unit of analysis. For example, a study could focus on 54 countries during a period of 30 years, resulting in 54 x 30 = 1,620 country-years (country-year being the unit of analysis). This is a rather large number of cases (or observations)—compared to analyses of, for instance, one storm in a specific country (Walch 2018)—therefore, these studies are called large-N studies. Afterwards, information can be compiled for each country, for instance, on temperature, precipitation and conflict onset. Statistical techniques will then be used to analyse whether higher temperatures and less precipitation increase the risk of conflict onset in the same or the next year, how big this effect is, and whether it remains significant when other predictors of conflict like past violence, democracy or GDP growth (control variables) are introduced into the model.

As indicated before, quantitative studies are the dominant approach in the research field, and have appeared frequently in the high-impact journals most influential in shaping research and policy (Hsiang et al. 2013; Mach et al. 2019; Schleussner et al. 2016). Consequentially, they also shape the recent Intergovernmental Panel on Climate Change report's chapter on climate change and security (Gleditsch and Nordås 2014).

The respective methods have also developed considerably over the past years (Detges 2017a). Moving away from crude data on the yearly and country level, studies have utilised monthly data as well as information on subnational units like districts or artificial grid cells (Almer et al. 2017; van Weezel 2019). Particularly advanced studies have even taken armed groups as the unit of analysis and studied whether drought, specifically during the growing season, affects conflict patterns (von Uexkull et al. 2016), or utilised survey data able to capture sentiments of individuals in affected areas (Detges 2017b; Linke et al. 2018). Quantitative research has also distinguished between various types of conflicts, as climate change might have affected communal violence and civil war in different ways (Detges 2016; O'Loughlin et al. 2014a). Working with subsamples and interaction terms allows researchers to specify the conditions under which climate-conflict links are more or less likely to occur (Ide et al. 2020; von Uexkull et al. 2020).

The wealth and progress of quantitative research has significantly advanced climate-conflict research. If several studies using data on a large number of cases arrive at similar conclusions about the co-occurrence (or correlation) of climatic extremes and conflict, this is a strong indicator for the existence of an underlying causal pattern. Indeed, there seems to be an emerging consensus among quantitative scholars that climate change increases conflict risks, but that (1) other conflict drivers are more important, (2) a climate-conflict link only occurs if certain contextual factors are present, and (3) small-scale conflicts are more likely to be impacted by climate change than full-blown civil wars (Detges 2016; Ide et al. 2020; Schleussner et al. 2016; von Uexkull et al. 2020).

3 Shortcomings and Blind Spots of Quantitative Research

Despite its advances, quantitative research on climate change and conflict still faces several limitations. In the best case, this reduces the ability to address crucial knowledge gaps. In the worst case, these limitations may even affect the results of statistical research. This situation is particularly problematic given the dominance of quantitative methods in the field. Policy makers and scholars working on related topics rely to a large degree on knowledge gained by statistical methods. In the remainder of this section, I discuss eight crucial limitations of quantitative climate-conflict research.

(1) Decisions about which models to use can affect the results. A study of Hsiang and colleagues (2013) published in *Science* and cited almost 1,200 times so far, for instance, finds that temperature and precipitation have a clear impact on the risk of various conflict types. But the results do not hold when plausible adjustments to the statistical models are made, or when control variables are introduced (Buhaug et al. 2014; O'Loughlin et al. 2014b). Selby (2014: 839) therefore claims that "conclusions of quantitative analyses are decisively shaped and biased by modelling assumptions and methods" with no inherently correct model available. Consequentially, the results of quantitative studies should be treated with some caution, at least unless a number of alternative model specifications have been tested (Salehyan and Hendrix 2014).

(2) The datasets underlying quantitative studies are not without problems. Conflict data, for instance, are often underreported in remote, marginal or insecure areas, simply because few media, NGOs and government agencies work there. This is particularly acute for small-scale conflicts and may affect results in a substantive way. In some drought-vulnerable regions in East Africa, for instance, up to 99 percent of all conflict events are not captured by standard datasets (Ide and Scheffran 2014). Yearly or monthly temperature and rainfall averages are sub-optimal proxies for the livelihood impacts of climate variability. An intense drought after fields are harvested, for example, could indicate (in the analysis) severe climate stress in a given year, yet hardly impact local agricultural communities. And even a good average rainfall during the growing season will not improve local livelihoods if two intense storms destroy crops during this period.

(3) There is a regional bias. Adams and colleagues (2018) demonstrate that climate-conflict research is strongly focused on Africa (and, to a lesser degree, Asia), with this tendency being more pronounced for statistical studies. Many quantitative datasets on subnational and small-scale conflicts were initially only available for Africa. This is currently changing with increasing information becoming available on the Middle East, South and Southeast Asia and, most lately, Latin America and Southeastern Europe (Raleigh et al. 2010; Salehyan and Hendrix 2012; Sundberg and Melander 2013). Without sufficient data available, quantitative studies have so far produced few insights on climate-conflict links in vulnerable world regions like Central Asia, Latin America and especially the Pacific (Higgins and Maesua 2019).

(4) Quantitative studies face severe challenges when defining the spatial and temporal scope of their analysis (van Baalen and Mobjörk 2018). There has been a trend towards higher spatial resolution, with grid cells and administrative areas replacing countries as the

unit of analysis. Especially in large countries, this mitigates the risk that statistical analysis links climate extremes to conflict events that occur hundreds of kilometres apart and are completely unrelated. However, changed precipitation patterns can weaken states or trigger migration flows, and hence impact conflict risks beyond the district, region or even country where they occur.

In a similar way, most quantitative studies use a time lag of one year. In other words, they analyse the impact of climate extremes in one year on conflict risk in the next year. This avoids false positives, such as a correlation between an intense storm in October and a conflict onset in March of the same year (which cannot be causally related in any scenario). However, there is evidence that impacts of climate change such as high food prices can have an immediate impact on conflict onset (Heslin 2020). Benjaminsen (2008), by contrast, shows that extreme climate events can affect conflict risks over multi-year, complex causal chains, including failed adaptation efforts, the build-up of grievances and circular migration. The ability of quantitative studies to account for such long causal chains is very limited.

(5) Statistical approaches have shortcomings in accounting for the complexity of local contexts. Using national-level data on democracy or agriculture dependence, for instance, tells us very little about the existence of local vulnerability or conflict management institutions. This is an acute issue given that, even in large civil wars, local cleavages shape conflict dynamics to a considerable extent (Kalyvas 2006). Perceptions of the reasons, extent and impacts of climatic changes are also highly place-specific and shape the behaviour of groups in the face of environmental stress. Attributing bad harvests to global environmental changes or the will of God, for example, is far less conflict-prone than blaming neighbouring groups for the resource degradation (Fröhlich 2012). Survey data capturing the perceptions of locals can partially, yet not fully, account for this issue, which would require in-depth ethnographic or discourse-analytic research.

Relatedly, we know that environment-related conflicts are shaped by various dynamics at the local, national and global scale. The civil war onset in Syria in 2011 has been attributed to a severe (and climate change-induced) drought between 2006 and 2009 (Kelley et al. 2015). Detailed case studies, however, have revealed that the civil war has most likely been a product of local power struggles and unsustainable agricultural practices, political repression and mismanagement by the Syrian state, a lack of rainfall, global neoliberalisation trends, and the Arab Spring in other countries of the region (Ash and Obradovitch 2020; de Châtel 2014; Selby 2018). International (green) commercialisation pressures also interact with local cleavages and climatic changes to shape conflict dynamics (Bergius et al. 2020). Quantitative studies using a few standardised variables are unable to account for such complex multi-scalar patterns.

(6) Quantitative research can reveal correlations between climate change and conflict, but hardly identify and never prove causal relationship. Two-stage models are certainly promising in this regard as they allow, for instance, an assessment of the impact of climate variations on food production, and in turn how food insecurity affects conflict risks (Buhaug et al. 2015). But even then, we do not know whether lower food production weakens the state through reduced tax revenues, or facilitates the recruitment of food insecure people by armed groups, or results in grievances leading to protests and/or armed resistance.

Unless we have a better understanding of the complex, often long and multi-scalar causal chains connecting climate change to conflict, our understanding of the topic remains limited (Brzoska 2018).

(7) The environmental peacebuilding literature highlights that cooperation in the face of shared environmental challenges might also facilitate the establishment of institutions, interdependence, and trust building between parties with tense relations (Ide 2019). Qualitative case studies confirm that this happens in the face of climate extremes as well (Adano et al. 2012; Bukari et al. 2018). However, almost all quantitative studies in the field analyse the impact of climate change on conflict onset, incidence or duration, while paying very little attention to cooperation (see Böhmelt et al. 2014 for an exception). Reasons for this include a lack of solid quantitative data on intrastate (environmental) cooperation, a preference of prestigious (quantitative-leaning) journals in the field for research on conflict, and a general scholarly focus on conflict rather than peace (Bright and Gledhill 2018; Diehl 2016). Due to this strong focus on conflict, quantitative research has so far offered little to debates about cooperative adaptation and climate-resilient peace (Barnett 2019; Hardt and Scheffran 2019).

(8) Several of the seven limitations discussed above impede the ability of quantitative climate-conflict research to provide policy advice. To be sure, this research has been highly visible among politicians, peacebuilders and development workers, among others. But in order to act, practitioners and decision makers need a nuanced understanding of the causal chains connecting climate change to conflict. For example, climate change might increase conflict risks by depriving groups of food, which fuels their grievances and makes them more susceptible to recruitment by violent groups. Food aid and support for agricultural systems would be good policies then. But if the climate-conflict link is driven by armed groups appropriating aid flows linked to more climate extremes, food relief might even worsen the situation. Similar points can be made regarding the multi-scalar context factors offering possibilities for interventions and the potential of conflict-sensitive or even peace-enhancing adaptation measures (Abrahams 2020; Gilmore et al. 2018). Further information on vulnerable regions like Latin America or the Pacific would also be helpful. At the moment, quantitative climate-conflict research is not well equipped to provide these insights.

4 From Here, To Where?

With policy demands for knowledge on climate change mitigation and adaptation increasing, reflections about the achievements and shortcomings of the research field are important. Quantitative climate-conflict research has been well-received in wider debates. Statistical analyses are by far the dominant method in the research field and have significantly advanced our knowledge on the topic. That said, quantitative work on climate-conflict links also suffers from eight limitations (discussed above) that impede its ability to close important knowledge gaps: results that can be affected by (relatively arbitrary) model decisions, shortcomings of underlying datasets, a regional bias, problems in dealing with heterogenous spatial and temporal patterns, insensitivity to complex local and multi-scalar contexts, an inability to study causal relationships, concentration on conflict (rather than peace) outcomes, and limited policy relevance.

To be fair, several of these issues are not exclusive to quantitative work. Qualitative studies on climate-conflict links also frequently suffer from regional biases and a lack of attention to peaceful outcomes (for instance, Adams et al. 2018; Salehyan 2008). Nor is climate-conflict research the only social science field where statistical approaches (initially developed to understand the physical world) face limits (Mirowski 1989).

I would like to suggest three ways to move forward from here.

First, several of the limitations discussed above are not inherent characteristics of quantitative climate-conflict research. Scholars using statistical methods can, for example, find ways to address spatial and temporal heterogeneity (von Uexkull et al. 2016) or cooperation in the face of environmental stress (Böhmelt et al. 2014). Quantitative data on so far understudied regions are also increasingly available. Quantitative climate-conflict research should increase its attention to these issues and develop solutions to address them.

Second, qualitative studies, while not without limitations of their own, can address several limitations and knowledge gaps of quantitative research. They are well-suited, for instance, to trace (long) causal chains, to disentangle local and multi-scalar complexity, and to produce insights on places for which quantitative data are not readily available. In the best case, the strengths of both approaches can be combined in mixed-method research designs (Benjaminsen et al. 2012; Ide et al. 2020). The research community should therefore increase incentives for qualitative research on climate change and conflict. This includes journal editors, funding bodies and reviewers, acknowledging the importance of qualitative work to close the knowledge gaps of quantitative research, rather than treating case studies as "unscientific" or "anecdotal". Bodies like the IPCC or knowledge summaries (e.g., in the form of review articles) should also devote more attention to the qualitative results. Finally, the support of research institutions in hiring and promotion decisions is important because qualitative work is often less likely to be published in leading journals.

Third, decision makers and practitioners would benefit from being aware of the limitations of quantitative climate-conflict research. This can result in, for instance, inviting both quantitative and qualitative experts for consultation or cooperation. Public research funding can also be channelled in a way to support work closing the research gaps left by quantitative research on climate change and conflict. In the end, the topic is too important and too complex to ignore the genuine contributions qualitative scholarship can make.

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