



Climate–conflict research: some reflections on the way forward

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A decade of systematic research on climate change and armed conflict has revealed a number of interesting patterns but few results that are robust across studies. This essay takes stock of the quantitative empirical literature, identifies central limitations, and presents five priorities for future research in the field. While these priorities refer to technical and operational aspects of statistical analysis, their underlying motivation, and objective, is to develop a better and more refined theoretical understanding of possible indirect and conditional connections between climatic changes and violent conflict. © 2015 The Authors. *WIREs Climate Change* published by John Wiley & Sons, Ltd.

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INTRODUCTION

Ten years of generalizable quantitative research on climate change and armed conflict appears to have produced more confusion than knowledge. This is not to say that the research is either empirically sloppy or poorly executed analytically. On the contrary, there has been remarkable progress with respect to data availability and quality as well as statistical sophistication over the years. Yet, the ‘cacophony of different findings’¹ in the field signals a failure to converge on a single robust association between climate and conflict, and several opposing and seemingly incompatible patterns have been reported. This scientific controversy has attracted considerable media attention, to the extent that a call for peace among researchers on climate and conflict has been expressed.² Accordingly, I find it timely to reflect on the achievements—and challenges—of this scholarship. In doing so, I seek not to provide an exhaustive review of the scientific literature but rather to discuss briefly what insights this research has produced, identify central limitations,

and sketch a plan for the way forward. Readers interested in a more detailed synthesis of the literature should consult the comprehensive list of reviews published in the last few years.^{3–13}

STATE OF THE ART AND ITS LIMITATIONS

The most immediate insight gained from quantitative research on climate and conflict is that the two phenomena are not connected in the simple and direct manner as sometimes portrayed. Despite tabloid claims such as ‘climate change will push world into war’¹⁴ and ‘climate change impacts [...] are serving as catalysts for conflict’,¹⁵ the most comprehensive assessment of the scientific literature to date, the Human Security chapter in the UN Intergovernmental Panel on Climate Change’s (IPCC) Fifth Assessment Report, states that ‘collectively the research does not conclude that there is a strong positive relationship between warming and armed conflict’ (Ref 3, p. 16). This should not be taken as evidence that climate is causally unrelated to violent conflict but it does imply that caution should be exercised whenever security dimensions of climate variability and change are discussed—until a larger body of nuanced and context-sensitive analyses is available.

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This leads to a second lesson learned: There is a disturbing disconnect between underlying theoretical arguments and the manner in which empirical analyses normally are carried out. In general, the quantitative comparative literature is weak on theory, and explanations for observed patterns (or lack thereof) are often made *post hoc*. Accordingly, similarly specified models are used to explain different outcomes and similar outcomes are analyzed using different model specifications. One reason for the shallow treatment of theory in quantitative research is that the causal frameworks proposed in the abstract theoretical literature often are so complex that they do not lend themselves to systematic empirical evaluation.¹⁶ The urgency and alarmist tone of the climate security debate may have contributed to this trend as journals and journalists alike appear especially attracted to sensational findings and tabloid conclusions, with the result that researchers are pushed to oversell their findings. Far from subscribing to Selby's¹⁷ sweeping dismissal of quantitative analysis as a suitable scientific method in climate–conflict research, I still find it obvious that scholars have an important job to do in terms of developing more precise theoretical models and designing more refined, theory-informed empirical models.

Another limitation with extant research concerns the tension between climate variability and climate change. Although much of the public discourse concerns possible long-term impacts of climate change, virtually all empirical work to date relates to short-term changes in weather patterns and extreme weather events. While that research is interesting in its own right, it does not follow that a long-term shift in normal conditions (e.g., a 2°C warmer world) will have the same impact on social systems as a short-term anomaly of a similar magnitude (2°C above monthly mean). Unfortunately, researchers are often not clear on the distinction between climate variability and climate change, and findings of behavior related to the former are often used as foundation for projecting impacts of the latter.

At a more fundamental level, an obvious and arguably more significant limitation of quantitative research is its inability to capture and quantify very complex causal linkages that span long time periods, or vary greatly in the temporal dimension between cases and involve many intermediate steps. To the extent that climatic conditions affect conflict dynamics only in interaction with very rare constellations of case-specific conditions, it can probably never be detected with statistical significance in a comparative, generalizable analytical design. The conflict and massacre in Darfur in the early 2000s may represent one such case. Absent the scientific

controversy around the true causal influence of the Sahelian drought two decades earlier,¹⁸ the many comparable ‘counterfactuals’—i.e., neighboring societies that remained peaceful despite experiencing the same drought and similar challenges to land use practices—make Darfur an anomaly, rather than an illustrative case representative of a widespread pattern. Such anomalous cases are not the kind of social behavior quantitative analysis is designed to uncover.

Quantitative climate–conflict research is not all about unreasonable assumptions and simplistic research designs, however. Recent years have seen a gradual shift toward more disaggregated empirical studies and increasing attention to political violence beyond civil war. Aided by advances in geo-referenced data and methods, researchers are now able to investigate climate–conflict dynamics at a local level.^{19,20} Likewise, finer temporal resolution of climate and conflict data permits exploring seasonal dynamics and near immediate social impacts of climatic shocks.^{21,22} Moreover, researchers are beginning to explore how conflict-inducing effects of climatic anomalies may be conditioned by key intermediate impacts, notably economic shocks and food production.^{23,24} While these studies are still limited in number, they represent important steps in the right direction.

THE WAY FORWARD

The emerging wealth of detailed data opens up new opportunities for quantitative research, but making meaningful use of these data requires more sophisticated theoretical models. Indeed, further scientific progress in this field depends critically on our ability to specify plausible causal mechanisms, the conditions under which these are likely to play out, the actors at play, and the range of possible outcomes in terms of conflictive (or cooperative) behavior. This is certainly not a trivial challenge but it must be addressed. In the next sections, I briefly discuss five recommendations that I consider central in furthering this research. These five components are intrinsically related and there is no unidirectional relationship between them. Rather they should be seen as complementary and mutually reinforcing building blocks in the construction of a comprehensive, yet testable, theoretical framework of the climate–conflict nexus.

Specify Relevant Climatic Conditions

In moving the climate–conflict field forward, we must be clearer on which environmental conditions we consider a security threat. There may be legitimate reasons to fear an escalation of violence in reaction to certain climatic anomalies, but inconsistent results

from extant empirical research imply that a sweeping and homogenous effect is unrealistic. And why should there be one? There is no reason that a rapid-onset climatic shock (e.g., flood) should have the same consequence for social behavior as the early arrival of the rainy season or a wet year. Yet, coarse data and vaguely formulated theoretical expectations imply that these distinct conditions often look similar—and are treated as such. By moving beyond generic climatic patterns to specific conditions and events, we necessarily also need to consider why these constitute a security threat—and how.

Increasingly specific theoretical expectations should be accompanied by more sophisticated indicators of environmental and ecological stresses. Rapid development of the climate sciences and growing availability of high-resolution data in time-series format open up new avenues in that regard. Hence, if we seek to study impacts of drought on communal relations, remote sensing-based vegetation indices or advanced measures of soil moisture and land degradation at a subnational level are better able to represent actual environmental conditions than basic time- and space-aggregated indicators of temperature and rainfall levels.

Specify Causal Mechanisms and Context

The absence of a robust direct association between climate and civil conflict need not imply that certain climatic conditions cannot be related to conflict in more subtle ways. Rather than assuming a simple, direct association, future research must consider the mechanism(s) through which a climatic phenomenon might translate into a social outcome. If we believe such a causal relationship works via adverse macro-economic shocks and resultant intra-regime instability, then this should be stated clearly, observable implications should be identified, and the empirical analysis specified accordingly.

A related limitation of extant research is the habitual but often tacit *ceteris paribus* assumption, implying that a given treatment affects a given outcome (e.g., probability of riots) in a universal manner. However, there is no mechanistic link between the environment and society that dictates the same social response to a climatic phenomenon across contexts. Societies differ with respect to environmental vulnerability, coping capacity and ability to adapt, and also with respect to exogenously defined drivers of latent conflict risk. A one-standard deviation loss of rainfall during the growing season is more detrimental to Niger's agriculture than to Norway's, and the conflict potential of rising food prices or dwindling agricultural income also differs widely between locations.

Many studies seek to reduce such unit heterogeneity by limiting focus to Sub-Saharan Africa, as African countries are commonly considered to share many of the factors that shape climate change vulnerability. Yet, even this subcontinent exhibits enormous variation in most relevant conditions, such as population size (Nigeria vs Cape Verde), ethnic composition (Democratic Republic of Congo vs Lesotho), ecological diversity (Madagascar vs Djibouti), economic performance (Equatorial Guinea vs Burundi), and extent of democratic institutions (Mauritius vs Swaziland). These differences are likely to condition any conceivable societal impact of climate change but they remain unaccounted for in most contemporary research.²⁵

The development of a more nuanced theoretical approach also needs to account for plausible intervening factors. Increased warming during the growing season may reduce yields and agricultural income in tropical and dry climates but can have a positive impact on productivity in higher latitudes. Moreover, famines are political catastrophes, not natural disasters; loss of food production need not implicate insufficient food availability, dramatically higher consumer prices or significant loss of farmer income if responsible governments are at hand and proper coping mechanisms exist. More generally, there is a tendency in this literature to underestimate or outright ignore the importance of institutions and quality of governance and instead place full emphasis on the reductionist and near-deterministic narrative of scarcity-induced competition and conflict among burgeoning (African) populations.^{26,27} Notable exceptions to this general pattern include Busby et al.'s innovative vulnerability mapping project,²⁸ Ide et al.'s construction of a composite risk index,²⁹ and Wischnath and Buhaug's sampling of especially vulnerable sub regions.³⁰ Ironically, as noted by Gartzke,³¹ the major driver of anthropogenic climate change—economic development—is also one of the most powerful correlates of reduced conflict risk. Likewise, many rapidly industrializing countries marred by industry-induced environmental degradation and poor resource management are at the same time making good progress in improving resilience to climate-related hazards through poverty alleviation, education, and improved health care provision.

Specify Actors and Agency

The formulation of plausible mechanisms and intervening factors conditioning a climate effect necessarily also involves identifying central actors at play. In furthering theory building along this line, it may be instructive to draw on the complementary dimensions of opportunity and motive.³² Regardless of the

aspect of climate change under consideration, we should identify which segments of society are affected (farmers, pastoralists, urban poor, political elite, etc.) and assess their ability to act as a collective organization to redress their grievances. Insights and inspiration on these dimensions may be gained by synthesizing the rich qualitative literature. Of course, increasing marginalization need not (and usually does not) result in overt conflict. Some social cohorts may lack a unifying identity or suffer from internal rivalry; others may lack the resources and organizational skills necessary for mobilization and collective action. Moreover, any resulting conflict need not be instigated by those most frustrated: Diffusion of social grievances can give rise to self-serving entrepreneurs, including the incumbent regime, who may seek to exploit the situation in order to raise popular support for their cause.³³ Political ecology has long emphasized the role of human agency,³⁴ and it is not inconceivable that an observed covariation between anomalous weather and violent clashes is due to tactical considerations and has little to do with local scarcity or environmental degradation *per se*.³⁵ Making progress on identifying and quantitatively modeling actor profiles and societal conditions amenable to such causal pathways stands out as a major challenge for future research.

Specify Social Outcome

A natural next step when the relevant actors have been identified is to consider their likely repertoire of contention.³⁶ Urban consumers are unlikely to employ guerrilla warfare in response to rising cost of bread but may well turn to the streets in large numbers to voice their discontent. Discriminated minorities in the periphery, in contrast, may consider attacks at local government facilities to be a more viable strategy if they believe the government is to blame for their deteriorated living conditions and less costly modes of expression are unavailable. Regardless of the actors involved and the type of collective action employed, however, the state plays a critical role in curbing, or fuelling, such animosities, which again speaks to the importance of context.

The quantitative climate–conflict literature consists predominantly of studies of civil conflict, in large part due to data availability. However, the organization of a rebel movement requires planning, resources, know-how, and a critical mass of motivated recruits, and a civil conflict further requires a state government that is willing to respond with military force against its population. Only a minority of today's societies contain all of these ingredients, which is part of the reason why even the recent, dramatic global financial crisis of 2007–2008 failed to trigger a new wave of civil

wars, despite the undisputable association between poor economic performance and increased conflict risk.³⁷ But climatic changes might conceivably have a wider impact on other forms of political instability. There is a wealth of qualitative research on land-use disputes in resource-scarce environments, and while the causal link to exogenous climatic changes often is tenuous, communal conflict is generally seen as a more plausible outcome of environmental degradation than large-scale violence.³⁸ Likewise, the recent 'Arab Spring' uprisings have accentuated claims that food price shocks can be an important trigger of urban political violence,³⁹ although these events also fall outside standard definitions of civil conflict.

Recent advances in data collection now make it possible to investigate violent unrest beyond the scope of civil conflict.^{40–42} However, it is not given that any impact of climate change necessarily will be negative for society. Increased awareness of environmental challenges and adverse ecological changes can also be powerful drivers of positive change, such as innovation and redistribution. Besides, we should not forget that historically cooperation—not conflict—is the modal outcome of growing resource scarcities,^{43–45} although the climate change–cooperation connection has received little attention.

Justify Spatiotemporal Domain

What is a reasonable time lag from a given climatic phenomenon occurs to a social response is observed? Clearly, that will depend on the type of event, the actors involved, and the transmission mechanisms and interacting factors that connect the end points in the causal chain. While human and material losses to an extreme weather event can trigger resentment and protests against an ignorant government within a matter of days, communal tensions over access to common pool resources as a consequence of drought-induced changes in migratory patterns may have a decadal time span. Likewise, loss of harvest to extreme weather may have a local impact on producers but its effect on consumers can have a national or global spatial reach.

Traditionally, researchers have been forced to use annualized and country-averaged data even if the underlying theoretical motivation might prescribe a near instant and/or highly localized effect. Over-aggregation in time and space implies blending important data signals with noise and obstructs the detection of systematic co-variation patterns in the data—if such exist at a finer spatiotemporal scale. Increasing availability of remotely sensed environmental indicators and geo-referenced conflict event data means that scaling now is becoming less of a technical problem, but the theoretical challenge

remains. Indeed, reaching the optimal spatiotemporal resolution is among the most demanding aspects of designing a good quantitative model of climate and conflict. At a minimum, researchers must be more explicit about why the chosen level of analysis is appropriate, although a more satisfactory approach would be to develop a flexible analytical framework that allows climate effects to vary in space–time dimensions between observations.

CONCLUDING REMARKS

The IPCC's Fifth Assessment Report notes that several factors that increase general conflict risk are sensitive to climate change (Ref 3, p. 16), but there is no direct and simple causal association between nature and society. Besides, it is unclear how observed social responses to climate variability and shocks can be translated into meaningful projections about societal impacts of future climate change. This essay has identified five research priorities to achieve a more robust, general understanding of indirect and conditional connections between climatic changes and security.

Let's be honest; research on social processes always comes with a considerable margin of uncertainty, and even if the five challenges discussed above are addressed there will be limits to what we can say about climate and conflict. For example, we will never be able to conclude with certainty that a given conflict would never have occurred in the absence of observed environmental change, or that a conflict would certainly have occurred in the absence of observed adaptation. Likewise, despite advances in conflict forecasting methodologies,⁴⁶ we will never be able to predict the onset of a new violent conflict with certainty based on quantifiable information alone.

Moreover, while the recent past is often a good indication of forthcoming events, the possibility for tipping points in nature–society relations implies that there are limits to what we can infer about the future from historical data.

Climate change and conflict may be related in other, less controversial and quite possibly much more important ways than those considered here. I therefore end on noting two areas that deserve more scientific attention than presently acknowledged. First, while the impact of climatic changes on conflict risk in stable societies may be negligible (Ref 3, p. 16), armed conflicts, by virtue of their destructive nature, are destined to increase societies' vulnerability to climate change. Civil war is development in reverse,^{47,48} and many of the negative impacts of conflict on economic activity, education, health, and food security are major drivers of environmental vulnerability.^{27,49} In unstable corners of the world, ending violent conflict may be the most efficient and cost-effective way to improve social resilience to climate change. Second, future research should also consider the conflict potential of climate change adaptation and mitigation. While poverty alleviation is generally considered a no-regret adaptation strategy, policies that imply land-use changes or have far-reaching externalities may constitute significant challenges for affected communities. Ill-advised climate adaptation plans have the potential to trigger resentment and conflict.⁵⁰ Adverse impacts of dam construction and hydropower production on biodiversity and livelihood security are well documented.⁵¹ Less well researched but potentially more dramatic, rapid increases in carbon tax and other draconian measures to reduce emissions from aviation can have much more instant and much more severe impacts on tourism-dependent economies than may climate change by itself.⁵²

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