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Climate Change and the Risk of Mass Violence: Africa in the 21st Century

Abstract: Climate change is often related to various adverse effects, among those endangering food security and raising the risk of conflict. But empirical evidence is rather inconclusive so far, particularly about its relationship to (mass) violence. In this letter, we provide a brief review of studies explaining connections between climate change and mass violence and discuss strategies how to properly address the issue in the future, focussing on sub-Sahara Africa (SSA) and climate effects on agricultural production. We conclude that we need better explanations of indirect effects, especially those moderated by the socio-economic systems, and a better understanding of endogeneity issues, especially of shifts in transmission. Hence, a particularly promising direction of research especially for SSA is addressing a combination of agricultural and institutional vulnerabilities.

Keywords: temperature, precipitation, weather extremes, mass violence, sub-Sahara Africa

JEL Classifications: O13, Q54, Q10, N47

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1 Introduction

In November 2013, the *New York Times* reported that while food demand is expected to rise considerably during the 21st century, "global warming could reduce agricultural production by as much as 2% each decade for the rest of this century," and agricultural risks "are greatest for tropical countries, given projected impacts that exceed adaptive capacity and higher poverty rates compared with temperate regions" (Gillis 2013). The article was quoting form a leaking draft report of the International Panel on Climate Change (IPCC) and

points to the danger that the most adverse and sometimes devastating effects and the most existential threats from climate change, including their escalation into small- and large-scale violence, are to be expected for globally and locally marginalized regions and populations. This recalls conclusions from earlier IPCC and other reports, in which climate change was related to endangered food security and increasing risk of conflict (IPCC 2007; Stern 2006; UNDP 2007). However, although scientific interest in the issue is continuously growing (including special issues about climate change and conflict in *Political Geography* in 2007 and the *Journal of Peace Research* in 2012) and empirical treatments have reached a level of considerable sophistication, overall evidence is still rather inconclusive.

Part of the problem are loose relationships between theory and empirics and large quality variations of data (Blattman and Miguel 2010). But part of the problem is also that mass violence[1] is a rather contingent phenomenon. Nevertheless, several factors have been found to be violence-promoting: Among the usual suspects are economic (the "greed versus grievance" debate; Collier, Hoeffler, and Rohner 2009), political (autocracy; Easterly, Gatti, and Kurlat 2006), and ideological reasons (especially fascism, communism and racism; Wayman and Tago 2010), which usually produce the expected econometric results. Cultural (ethnic, linguistic or religious fragmentation), demographic (a large number of young men), and geographic reasons (insurgency promoting terrain) were argued with less convincing results (see for evidence and discussions Blattman and Miguel 2010; Collier, Hoeffler, and Rohner 2009; Fearon and Laitin 2003). Overall, the "most robust empirical finding" is the relevance of low income levels and slow growth rates for the outbreak of violent conflicts, while "the empirical evidence that social divisions, political grievances, and resource abundance are drivers of violence remains weaker and more controversial" (Blattman and Miguel 2010, 45).

In this letter, we provide a brief review of studies explaining connections between climate change and mass violence and discuss strategies how to properly address the issue in the future. Thereby, we focus on sub-Sahara Africa (SSA) and specifically stress the risks associated to agricultural production. Not only is agriculture most crucial for average livelihood in SSA, but it is also likely the macro region facing the most adverse effects of climate change with respect to mass violence. Widespread poverty, institutional weakness, dependence on rain-fed agriculture and considerable histories of violence result in insufficiently

1 By mass violence we understand violent acts with large death tolls (certainly exceeding 1000 people per year or episode), particularly including wars, civil wars, riots, genocides and politicides.

developed resilience and adaptive capacity (notwithstanding successful traditional adaptation procedures at local levels) and also endogeneity issues are particularly viable. In sum, if there is a problem, it is very likely that it turns out most urgent and relevant in SSA, although this of course does not justify viewing it as African "by nature."

2 Climate change and agriculture in SSA

The first part of the latest (fifth) climate change report (IPCC 2013), recently reaffirmed the public that there is still increasing scientific certainty that climate change is an ongoing global phenomenon and that human contribution to it (mainly by still increasing greenhouse gas emissions over the last decades) is considerable. The IPCC identifies several dimensions of climate change, those especially worth mentioning when discussing related socio-economic issues are increased temperature, more imbalanced precipitation patterns, an increase in the number and severity of extreme weather events, sea level rise, and a meltdown of glaciers.

These dimensions have – on average and with considerable regional dispersion – more or less direct effects on the general physical living conditions and especially on the availability and quality of water and arable land and the exposure to potentially catastrophic events. Generally, raising temperatures have negative effects on agricultural production in SSA, where neither higher latitudes nor higher altitudes can sufficiently compensate for losses in lower, tropical lands. Because of the rain-fed and low-tech character of agriculture in SSA and a lack of adaptation and compensation capacities, it is also highly vulnerable to a shortage of rainfall, and even more so to the occurrence of droughts and ENSO[2] events. For the past, it is shown by panel estimations of production functions using historical data that agricultural production in SSA was already considerably affected by too high temperatures and too small precipitation levels (Barrios, Ouattara, and Strobl 2008; Exenberger and Pondorfer 2011). Regarding the future, this connection is also demonstrated by projections of production on the level of single crops: Schlenker and Lobell (2010) report that "the median impacts [...] were –22, –17, –17, –18, and –8% for maize, sorghum, millet, groundnut, and cassava", with

2 ENSO refers to the climate phenomenon El Niño/Southern Oscillation, which is a quasi-periodic variation in sea surface temperatures in the eastern part of the tropical Pacific Ocean, affecting atmospheric circulation patterns and hence (tele-)connected to many regions in the rest of the world.

"severe losses of 27–32% for all crops, except cassava" in the 5th percentile (p. 5). Also Blanc (2012) estimates comparable results: "Relative to a case without climate change, yield changes in 2100 are near zero for cassava and range from –19% to +6% for maize, from –38% to –13% for millet and from –47% to –7% for sorghum under alternative climate change scenarios" (p. 1).

Therefore, for agriculture in SSA, temperature, precipitation and extreme weather events are all very relevant all over the continent, while sea level rise and the loss of glaciers are only locally. Being a tableland continent, there are only a few lands low enough to be directly affected by the expected sea level rise, mainly in Senegal, Nigeria, Mozambique and Kenya, and these are usually not the agriculturally most productive or most densely populated areas. And the few and small glaciers in Africa are confined to some insulated mountain areas in East Africa with local relevance for water availability.

3 Violence and climate change

When addressing the influence of climate change on violence, a central, although far from unique problem becomes even more pronounced: the relevance of interdependence and endogeneity. Mass violence is destructive, especially in the short run and in already poor environments, and has generally a negative effect on GDP, physical and human capital, which results in a larger risk to (re)turn to it in the future.[3] In the case of climate change, the issue may even go further: industrialization, largely responsible for climate change, was certainly also an important driver of economic growth and possibly also of democracy, both enhancing resilience against violent conflict and capacity to fight climate change (Gartzke 2012). The problem is already demonstrated by one of the seminal papers in the field, Miguel, Satyanath, and Sergenti (2004), who introduced an IV approach to conflict economics precisely because of the endogeneity issue. While GDP growth is interdependent with conflict, rainfall variation is exogenous, but regarded as a productivity shock on a sector highly relevant for most SSA economies and hence as being instrumental to GDP growth. As a side-effect, the central result from this empirical study of African states was that more rainfall reduces the risk of conflict considerably.[4]

3 However, there are also solid arguments that in the long run and especially in the European case, war was positively related to innovation (Acemoglu and Robinson 2006, among others).

4 Their numbers tell basically that a "five-percentage-point decline in lagged growth – which is somewhat <1 standard deviation in annual per capita growth – leads to a >12%-point increase in the incidence of civil war, an increase of nearly one-half of the average likelihood of conflict" (Miguel, Satyanath, and Sergenti 2004, 740). While their analysis was recently challenged

In this tradition, several studies find a negative impact of precipitation on conflict.[5] Burke et al. (2009) depart from this kind of studies to reemphasize the impact of temperature. Results (for SSA) show that it is indeed temperature which is more closely related to conflict than rainfall (with more conflict in warmer years) and by projecting their findings until the year 2030, they find an increased conflict risk all over SSA.[6] They also find that the unavoidable uncertainty in these projections originates mainly from an under-specified climate-conflict-nexus and less from climate uncertainty. While this paper is especially valuable for its focus on temperature, in a critique, Buhaug (2010) show that the results obtained are crucially depending on the inclusion of country- and time-effects, which they find systematically explainable by other factors, especially ethno-political exclusion, poverty, and the collapse of the Cold War system. Hence they arrive at contrary conclusions that "climate characteristics and variability are unrelated to short-term variations in civil war risk in Sub-Saharan Africa. The primary causes of civil war are political, not environmental, and although environmental conditions may change with future warming, general correlates of conflicts and wars are likely to prevail" (p. 16481). In a comparable study, Klomp and Bulte (2013) arrive at critical conclusions. They included temperature, precipitation and the ENSO level, controlling for GDP per capita and level of democracy. They summarized that "the great majority of models exploring the association between temperature or rainfall and the onset of conflict do not yield any significant result", that "few robust results emerged, and those that did are not easy aligned with theory" and that these results "tend to be not robust to small specification changes" (p. 14). This reaffirms earlier conclusions that "it is important to stress that climate change will not undermine human security or increase the risk of violent conflict in isolation from other important social factors" (Barnett and Adger 2007, 644).

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methodologically (Ciccone 2011), they countered this attack and reaffirmed their results with the only concession that the first-stage relationship between rainfall and growth became weaker after 2000 (Miguel and Satyanath 2011), pointing to the relevance of structural shifts in this context.

5 But connections are contingent and complex. In the context of cattle-raiding, for example, others find the opposite relationship (Witsenburg and Adano 2009; see also the mentioned special issue of the *Journal of Peace Research*). By applying a broader concept of conflict, Hendrix and Salehyan (2012) show that large deviations in rainfall result in increased social conflict, but whereas violent conflict is especially correlated to wetter years, non-violent is to drier ones.

6 They are brave enough to conclude that "given the 11% of country-years in our panel that experience conflict, this increase corresponds to a 54% rise in the average likelihood of conflict across the continent. If future conflicts are on average as deadly as conflicts during our study period [...] this warming-induced increase in conflict risk would result in a cumulative additional 393,000 battle deaths by 2030" (Burke et al. 2009, 20672).

This is also explicitly shown for the nexus between civil wars and droughts in Africa: "there is no direct, short-term relationship between drought and civil war onset, even within contexts presumed most conducive to violence" (Theisen, Holtermann, and Buhaug 2011–2012, 105). This is reaffirmed by Couttenier and Soubeyran (2013) who only find "weak evidence" for a "positive link between drought and civil war" in SSA (p. 19).

However, this critical position is not shared by all scholars and hence overall evidence is not finally conclusive. A very relevant re-calculation exercise was recently undertaken by Hsiang, Burke, and Miguel (2013), who review and recalibrate 60 methodologically diverse studies world-wide about the connection between various forms of conflict (from interpersonal violence to civilizational collapse) and climate variables (temperature, rain and extremes).[7] While they also emphasize that climate "is only one of many factors that contribute to conflict" (p. 9), the main result is strongly positive: across different settings, deviations from normal precipitation and mild temperatures systematically increase the risk of conflict. Notwithstanding this clear evidence, the study also bears two problems for general conclusions: the minor one is the extreme wide range of definitions of "conflict" embodied in the studies surveyed; the more crucial one is the extreme wide range of measures for what the authors claim to reflect "climate."

This leads us to the general problem that several indicators have been argued to cover the effects of climate change as well as conflict. Climate change measures include the (sometimes lagged) levels or logs of surface temperature and precipitation, continues with their deviations from some kind of mean, the incidence of extreme events (heat waves, droughts, flooding) and ends with more sophisticated measures like evapotranspiration, the Palmer Drought Severity Index (PDSI) or measures covering ENSO events. Not always is the choice of variable guided by theoretical reasoning, and sometimes it is covering weather variations only argued to reflect an underlying climate change dynamic. At the same time, studies about the structural influence of climate change, like for example a long-run causation study by Zhang et al. (2011), are rather rare. Conflict measures, even if confined to a more or less clearly defined form of violence like a civil war, usually have two sources of considerable variation: the first is whether the onset of conflict alone, or its continuation and duration as well are found to be relevant, the second is the measurement threshold (25 and 1000 casualties per year are most common). Hence it is not surprising that results are often sensitive

7 The authors restrict attention "to those studies able to make rigorous causal claims about the relationship between climate and conflict," and are able to "identify, for the first time, commonalities across results that span diverse social systems, climatological stimuli, and research disciplines" (Hsiang, Burke, and Miguel 2013, 9).

to specification changes. Burke et al. (2009), for example, were criticized because of their lack of discrimination between peace years and conflict years with <1000 casualties, and Buhaug (2010) showed that this was indeed relevant for the results obtained.

4 Discussion

Overall, there is no question that the relationship between climate change and violence is complex and hardly ever direct. Consequently, while most of the empirical literature, notwithstanding the often weak results, is in line with the standard intuitive story about the connection between conflict and climate change (which is essentially that climate change results in resource scarcities producing violence), it always points to historical, political and economic reasons beside climate: especially a history of violence, an exclusionary political process, and poor economic performance. Hence, even the rather "simple" framework proposed by Buhaug, Gleditsch, and Theisen (2008) already contains 13 intermediaries and three externalities in five steps: adverse climate change influences migration patterns and economic potentials, which together with bad governance, inequalities and bad neighbours result in increased instability and fragmentation, growing opportunity and motivation to act violent and hence an increased risk of armed conflict. Overall, as Gleditsch (2012) puts it, "the effect [of climate change] plays out in interaction with exogenous conflict-promoting factors" (p. 6).

Consequently, "institutions" are also becoming an issue in the conflict-climate literature. Overall, political inclusiveness is found to be protective against mass violence. Theisen et al. (2011–2012) conclude that "the analysis solidifies claims of recent scholarship on the importance of ethnically inclusive institutions for maintaining peace" (p. 105). Particularly, "armed conflict is more likely to occur in states where existing institutions and mechanisms for conflict resolution cannot provide people with the assurance that climate-induced economic problems will be resolved without recourse to violence" (Koubi et al. 2012, 117). A crucial factor is also the marginal status of a group: "Environmental issues can be catalysts to low-level conflict in marginalized communities, but the critical factor is the extent of political and economic marginalization. Small, politically insignificant ethnic groups experience most conflicts related to environmental pressures" (Raleigh 2010, 69). Butler and Gates (2012) point to the relevance of a "property rights bias," i.e., differences in the access to property rights, which is intensified by large differences in resource endowments. In addition, these dynamics give way to a vicious or a virtuous circle of mutual enforcement.

But there is still more about the connection between climate change and conflict, not so well reflected in the existing literature: it is very likely that there is also a meta-influence of climate change, making its relationship to conflict a moving target. In this direction, Zhang et al. (2011) found for Europe that conflict, via its impact on agro-economic systems, was more likely in periods of cooling between 1500 and 1800, but less likely so in the industrial era. Given the vulnerability of agricultural production to climate change, especially in SSA, this may be an interesting result. However, its relevance is nevertheless questionable, as long as we do not have a clearer picture about transmission, which may structurally differ in time and space. Further, while increasing evidence exist that climate change or at least weather shocks affect income (Dell, Jones, and Olken 2008; Lanzafame 2012), its effects on migration pressure and inequality are often found likely (and constitute the basis of the whole marginalization discussion), but hardly assessed in an empirically robust way allowing for generalizations (not the least because of a lack of data). Finally, also non-linearities play an important role. Especially in poor countries, development and peace-building efforts may completely offset negative effects of climate change, but it is also very likely that the costs of adaptation are high compared to the political and economic costs of violence. Taken together, this allows for a specific corridor (at a low level) of development, in which the risk of violence may even increase, because returns to seeking violent solutions (and thus motivation and potential) increase more pronounced than opportunity costs do.

When coming to recommendations for further research, three points are especially relevant. First, we need better explanations of indirect effects. While the relationship between climate change and mass violence it certainly complex, identification and tracking of specific pathways is possible and a necessary basis for proper operationalization (otherwise, empirical studies largely remain at the level of correlations and are unable to uncover actual channels of causation). In this context, a particular emphasis on scope in time and space is recommended, also to better separate the impact of climate from weather shocks, and to bridge the gap between large-N and case studies. Secondly, it is especially necessary to understand the impact of climate change dynamics and socio-economic systems as well as of socio-economic systems on conflict dynamics. The most promising starting points for this kind of theoretical work are the already established connections between climate effects and agriculture (with special emphasis on different crops and dynamics affecting the respective growing season) and between various forms of poverty and violence (with special emphasize on marginalization patterns and the role of political and economic institutions). Hence, a particularly promising direction of research especially for SSA would be to address a combination of agricultural and institutional vulnerabilities. Thirdly, properly

addressing endogeneity issues, interdependencies and feedback loops is certainly the most crucial methodological challenge. A point deserving special emphasis in this context is the issue of transmission shift, i.e., that climate change dynamics influence not only the likelihood and form of conflicts, but also the kind of connection between climate and conflicts. Projection exercises may be particularly helpful to address this challenge and to link past data with future dangers.

A promising research path should ideally combine these three recommendations and – given the complexity of the issue – is interdisciplinary by definition. If policy recommendations are targeted, which is certainly preferable given the existential relevance of the problem, addressing combined vulnerabilities to climate change and conflict is almost a must. A combination of projections (of climate effects on agricultural production, for example) and path-dependence (of conflict-promoting institutional settings, for example) is especially advisable and may depart from studies like Burke et al. (2009) or Devitt and Tol (2012). In this context, a recent work by Busby et al. (2013) seems to be particularly worth to mention. By using the method of geographically mapping different insecurity risk factors in Africa, they visualize large differences of vulnerabilities in space, but also their clustering. They consider 16 factors in four categories (climate related hazard exposure, household and community resilience, governance and political violence, and population density), many of them available on a sub-national level, identifying regions of pronounced combined risk. Theoretical even more valuable is Scheffran et al. (2012), who also "map" the field of the climate-conflict-nexus and arrive at a matrix of interconnections between climate change, natural resources, human security, and societal stability. Their final call is only consequential: "Research across scientific disciplines will be needed to identify opportunities and coherent strategies to address societal challenges related to climate change" (p. 871).[8] Overall, combinations between these two kinds of exercises would be particularly valuable and welcome, also because this would result in better integrated empirical and theoretical research and more accurate data.[9]

While there is a growing body of literature about the connections between climate change dynamics and (mass) violence, a lot of theoretical as well as empirical and methodological efforts are still to be made to draw a more precise picture of this complex relationship. While connections are less clear cut than

8 Which they did already in 2012, when the large scale compendium *Climate Change, Human Security and Violent Conflict: Challenges for Societal Stability* (Springer, Berlin) was published.

9 This also holds for comparative case study evidence, i.e., case studies with compatible methodologies, which would also be welcome. This would allow achieving thicker descriptions of conflicts and climate change dynamics, which will result not only in better, more localized data (especially on institutions, on marginalized groups, and on actual climate change dynamics "on the ground"), but also in theories better grounded in actual realities.

suggested by various policy statements, they are nevertheless highly likely and existentially relevant for a large number of people and hence a promising and necessary research track to follow. This is further underlined by IPCC (2013). Most climate change effects are already "likely" to realize even in the early 21st century. By the end of the century, general warming is "virtually certain", aggravated heat waves and sea level rise "very likely", heavy precipitation events "very likely over most of the mid-latitude land masses and over wet tropical regions" and more frequent and severe cyclones and droughts are "likely" (at least for certain parts of the world). Hence, it is easily foreseeable that sub-Sahara Africa, already considerably affected by the impact of climate change, will be among the most endangered world regions during the 21st century.

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