Journal of Peace Research

Climate and cohesion: The effects of droughts on intra-ethnic and inter-ethnic trust

Journal of Peace Research
2021, Vol. 58(1) 151–167

DOI: 10.1177/0022343320974096
journals.sagepub.com/home/jpr
SAGE

Alexander De Juan

School of Cultural Studies and Social Sciences, University of Osnabrück

Niklas Hänze

Department of Politics and Public Administration, University of Konstanz

Abstract

While a large body of research has highlighted the conflict-inducing effects of climate change, we still know very little about the mechanisms linking environmental conditions to violent conflict. This article investigates the plausibility of a prominent channel according to which scarcity of natural resources can foster violent conflict through deteriorating intergroup relations. In addition to assessing the direct effects of adverse environmental conditions on intra-ethnic and inter-ethnic trust, we suggest a conditional argument on the role of horizontal inequality of hazard exposure. Environmental hazards are 'unequal' if they systematically affect ethnic groups differently. While inequality may reinforce intra-ethnic ties and out-group suspicion, equal hazard exposure may create a sense of unity among diverse victims in their collective struggle to cope with harsh environmental conditions. We test these arguments in the context of the severe drought periods that affected most East African countries in the years 2004 and 2005. The empirical analysis combines gridded information on drought severity with geo-located survey data across six countries in the region (Afrobarometer survey 2005/2006). Our main analyses find that exposure to drought hazards correlates positively with self-reported trust within and across ethnic groups. The latter association, however, depends on the degree of intergroup equality of hazard exposure and wanes as inequality increases. Taken together, these findings indicate that if droughts increase the risk of violent conflict, they seem to do so through mechanisms other than intergroup polarization and despite their positive association with ethnic trust. This is most likely the case in contexts where there is pronounced horizontal inequality of drought hazards.

Keywords

Africa, Afrobarometer, drought, ethnic trust, violent conflict

Introduction

Recent accounts from northern Mali vividly describe how inter-ethnic relations can deteriorate and lead to massive outbursts of violence in the face of struggles over scarce natural resources:

> Mahamadou Souleymane, a Fulani herder, fled his village last year when militiamen from the Dogon ethnic group attacked. 'They were our friends from our great, great grandfathers,' says Mr Souleymane. But one day last year, they came with automatic rifles and machetes. [...] They told the villagers that if they did not leave, 'no one will survive. We will kill everyone.' (*Economist*, 2019)

This incident reflects a prominent argument in the academic literature on the effects of environmental scarcity: as environmental conditions deteriorate, limited access to essential common goods such as water and food triggers competition among ethnic, religious or regional identity groups.[1] In the

[1] In the following we use 'environmental scarcity', 'scarcity', 'environmental stress', and 'adverse environmental conditions' as synonymous and we define it as a critical depletion or degradation of renewable natural resources.

Corresponding author:
Email: alexander.dejuan@uni-osnabrueck.de

face of existential threats, people rally around salient social identities. These in-group processes often go along with increased out-group polarization. Taken together, both processes increase the likelihood that scarcity will trigger violent conflict across distinct identity groups. However, case studies demonstrate that environmental challenges can also strengthen trust and cooperation (e.g. Aksoy & Palma, 2019). They lend empirical support to research that highlights that environmental hazards can reduce rather than increase the risk of violence. More specifically, hazards may contribute to creating 'communities of fate' that supersede pre-existing differences.

Our article aims to make two contributions to this ongoing debate on the effects of adverse environmental conditions. First, we investigate the underlying mechanisms of the two arguments presented above. We make use of individual-level survey data to assess the effects of environmental scarcity on intragroup and intergroup attitudes. How does scarcity affect people's perceptions of members of their own and of other ethnic groups?

Second, we conduct an explorative analysis of a potential explanation of the heterogeneous effects of environmental scarcity documented by previous studies cited above: the effects may depend on the horizontal inequality of environmental hazards. Environmental scarcity may contribute to improving intergroup attitudes if it affects various ethnic groups to a similar extent. Conversely, high levels of hazard inequality across ethnic, religious or regional lines may trigger antagonizing in-group/out-group processes, intergroup competition, and ultimately violent conflict.

We investigate these hypotheses in the context of the severe droughts[2] that hit many parts of the African continent in the years 2004 and 2005. The countries in the southeastern region were affected particularly severely. Especially low levels of precipitation during the 2004 and 2005 rainy and growing seasons had a massive impact on agricultural production, compromising the livelihoods and food security of approximately 11 to 12 million people across Kenya, Tanzania, Mozambique, Malawi, Zambia, and Uganda. Our analyses investigate the effects of individual-level variation in drought exposure within these severely affected countries. This approach allows us to get a better understanding of the micro-level dynamics taking place within countries that are exposed to harsh environmental conditions.

[2] As long periods of below average water supply, droughts are one example of environmental scarcity.

Our empirical analyses rely on geo-coded survey data provided by the Afrobarometer project. The third survey round conducted in 2005 and early 2006 comprises interviews with around 8,500 respondents across the six countries under investigation. Importantly and contrary to other rounds of the Afrobarometer, this survey wave includes several items that allow us to gauge respondents' trust in members of their own and other ethnic groups. We spatially join these geo-referenced survey data with high-resolution data on drought conditions in the 12 months-period prior to the survey data collection.

We proceed in three steps. First, in order to validate our exogenous drought measure, we investigate correlations between individual-level drought exposure and the extent to which respondents judge food security and famine to constitute the most pressing problem that the government should address. We then proceed to an analysis of associations between individual-level drought exposure and self-reported intra-ethnic and inter-ethnic trust. Finally, we construct a measure of inter-ethnic inequality of drought exposure to assess to what extent the effects of individual-level exposure are conditional on horizontal hazard-inequality.

Our primary results can be summarized as follows. We find consistent and substantive correlations between objective drought exposure and subjective measures of food insecurity/famine, reinforcing our confidence in our data and empirical design. In our main analysis, we find that drought exposure influences intra-ethnic and inter-ethnic trust in a similar way and to a similar extent: individuals who have been heavily exposed to drought conditions have higher levels of self-reported trust in members of their own *and* members of other ethnic groups. The positive correlation with inter-ethnic perceptions, however, appears to depend on horizontal hazard-equality and to wane as intergroup inequality increases.

While this article does not focus on the effects of environmental scarcity on violent conflict, it nonetheless contributes to our understanding of *how* environmental conditions may or may not affect the risk of conflict. Our first contribution consists of a systematic assessment of the micro-foundations of a prominent argument on how environmental scarcity can influence intergroup conflict. We find no evidence that supports the assumption that scarcity fosters intergroup polarization. Our results indicate that if droughts increase the risk of violence, then they seem to do so through other mechanisms and *despite* their effect on ethnic trust.

Second, our findings also suggest that the degree of intergroup equality of hazard exposure shapes the

attitudinal effects of droughts. This lends tentative support to the primary argument underlying the optimistic perspective on the effects of droughts: the perception of joint exposure to existential threats is a key driving force behind improved intergroup relations in the face of scarcity. In addition, this finding also represents a potential explanation for the heterogeneous effects of environmental scarcity on violent conflicts: we should expect the conflict-inducing effects of adverse weather conditions to be the most pronounced in contexts of substantial horizontal hazard-inequality.

Environmental scarcity and ethnic conflict

Empirical research documents the ambivalent nexus between environmental scarcity and violent conflict. Several studies find evidence that adverse weather conditions in terms of particularly high temperatures and low precipitation can increase the risk of intergroup conflict (e.g. Burke et al., 2009; Caruso, Petrarca & Ricciuti, 2016). Studies on environmental peacemaking, on the other hand, argue that a reduction of resource availability provides motives for intergroup cooperation and can thereby reduce the risk of violent conflict (e.g. Adano et al., 2012; Ide, 2019).

Both of these opposing effects could result from a variety of different types of causal channels. Changes in the availability of natural resources could, for example, influence people's opportunity structures, motivate and capacitate certain types of elite framing and mobilization attempts, shape the tactical consideration of armed groups, influence migration patterns and intergroup contact, or affect the quality and strength of state and non-state institutions (Seter, 2016; see presentations and discussions of mechanisms in van Baalen & Mobjörk, 2018; Ide, 2019).

Despite this great variety of mechanisms, most previous studies focus primarily on investigating the nature of the association between environmental scarcity and violent conflict – rather than the causal channels linking one to the other. Only few studies focus on systematically testing mechanisms and their respective micro-level foundations (exceptions inlcude studies by Linke et al., 2015; Detges, 2017; Koubi et al., 2018; Vestby, 2019).

Assessing the validity of causal mechanisms, however, is essential from at least three points of view. First, it helps us interpret the empirical findings outlined above by specifying which of the several potential channels suggested in previous studies are more or less plausible. Second, it could help us identify relevant contextual factors that explain the conditions under which scarcity is more likely to increase or decrease the risk of violent conflict. Third, understanding the mechanisms can inform strategies and concrete activities intended to mitigate the adverse effects of environmental scarcity and foster peacebuilding in contexts that are strongly affected by long-term environmental change.

We aim to investigate the plausibility of a specific causal channel that links environmental conditions to conflict through changes in intergroup relations. Our main outcome of interest is intra-ethnic and inter-ethnic trust. Trust refers to the expectation of benevolence of someone (or a group) and one's own willingness to also act benevolently upon these expectation (Lewicki & Wiethoff, 2000). High levels of intra-ethnic trust and low levels of inter-ethnic trust may increase the risk of conflict. A high level of in-group trust is considered to be one of the most important psychological mechanisms underlying any kind of collective action – including violent mobilization against other groups (Horowitz, 1985; Kramer, Brewer & Hanna, 1996). According to Tilly and Oberschall, intragroup solidarity, trust, and networks allow for effective and efficient 'bloc recruitment' that is at the heart of most large-scale mobilizations (Oberschall, 1973; Tilly, 1978). Low intergroup trust, in turn, inhibits cooperation, prevents credible commitments, and thereby prevents peaceful conflict resolution (Lake & Rothchild, 1996; Lewicki & Wiethoff, 2000). Moreover, low levels of intergroup trust facilitate elites' attempts at radicalizing and mobilizing individuals against members of ethnic out-groups, thereby increasing the risk of violent conflict (Varshney, 2003). Thus, we perceive of intra-ethnic trust and inter-ethnic trust as important antecedents of potential intrastate conflict.

A variety of factors can influence intra-ethnic and inter-ethnic trust, including ethnic diversity, segregation and contact or inequality (e.g. Lei & Vesely, 2010; Kasara, 2013). We seek to investigate how environmental scarcity shapes people's attitudes towards ethnic in-groups and out-groups. The remainder of this section sketches a potential causal channel linking environmental change to violent conflict through changes in ethnic trust.

The first part of this channel is well-established empirically. Many studies demonstrate that global warming may lead to more droughts in the 21st century (e.g. Dai, Zhao & Chen, 2018). Droughts, in turn, are considered to be the drivers of the most substantial crop yield loss in agriculture in many regions of the world (e.g. Daryanto, Wang & Jacinthe, 2016). Shocks to agricultural production are likely to have particularly pronounced livelihood effects on regions that heavily

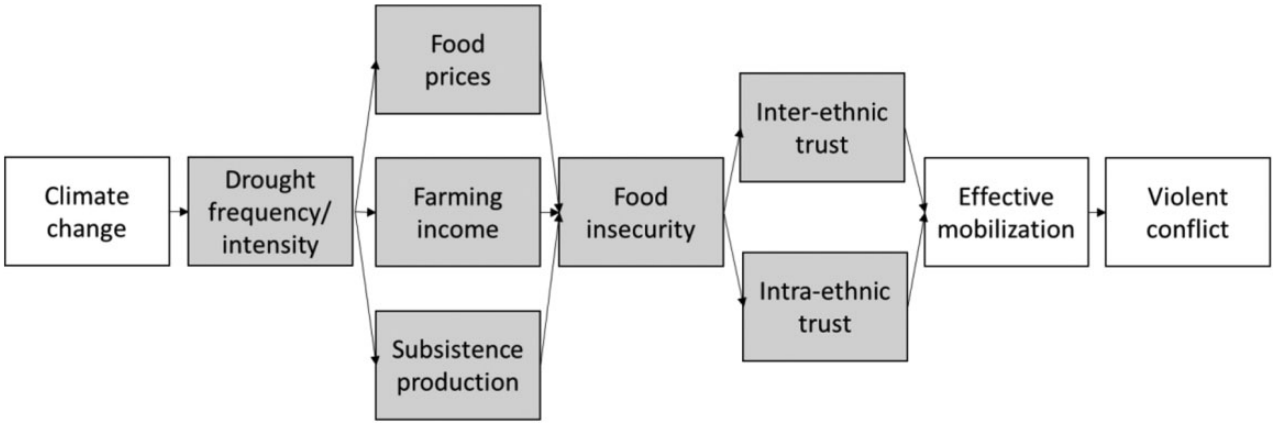

Figure 1. Causal mechanism linking climate change to violent conflict

depend on rainfed agriculture (e.g. Connolly-Boutin & Smit, 2016). A sudden decline in agricultural yields does not only affect subsistence farming. Reduction in the *access* to food is at least equally relevant. Drought-induced yield losses can trigger increases of crop and livestock prices and reduce household incomes for farmers and employees in the agribusiness (Shiferaw et al., 2014).

As argued above, the effects of food insecurity on ethnic relations are less clear. Increased food scarcity could intensify intergroup polarization and intragroup ties and thereby ultimately raise the risk of violent conflict. Conversely, however, it would be equally plausible to assume that scarcity and joint exposure to harsh environmental conditions foster a sense of unity among members of different social groups. This, in turn, could reduce the salience of pre-existing cleavages, undermine mobilization, and decrease the risk of intergroup conflict. Figure 1 illustrates the overall mechanism.

We aim at investigating the middle segment of this mechanism: the effect of droughts and scarcity on social relations within and across ethnic groups. We focus on the effects of individual-level drought exposure within countries that have been heavily affected by droughts: how does individual-level exposure influence perceptions of people's own and other ethnic groups – relative to their less affected co-nationals?

Environmental scarcity and intergroup polarization

Homer-Dixon (1999) has prominently argued that scarcity can aggravate social segmentation because it may affect various social groups differently. Ultimately, increased segmentation of society can then reduce the density of social capital and the trust between different groups. Several quantitative analyses of associations between environmental conditions and violent conflict draw on this line of argumentation – without, however, testing it directly (e.g. Fjelde & von Uexkull, 2012; Raleigh & Kniveton, 2012).

Previous micro-level studies lend some support to the plausibility of the underlying argument that scarcity can erode social institutions and increase antisocial behavior. Prediger, Vollan & Herrmann (2014), for example, analyze the effect of exposure to scarcity of Namibian pastoralists and found a positive relationship between scarcity of natural resources and antisocial behavior. They argue that scarcity fosters competition which, in turn, generates negative attitudes towards others (e.g. Brander & Taylor, 1998; Grossman & Mendoza, 2003; Prediger, Vollan & Herrmann, 2014).

While these studies do not investigate inter-ethnic relations specifically, it seems plausible to assume that scarcity affects antisocial behavior across ethnic groups particularly strongly. Previous studies argue that people prefer to cooperate with coethnics because ethnic identities tend to be co-linear to individual preferences (Alesina & La Ferrara, 2000). Conversely, among diverse populations competition and conflict are more likely due to a higher diversity of interests (Boix & Posner, 1998). Research on 'parochial altruism' highlights that this competition can then strengthen the perception that other social groups constitute an existential threat, hardening one's own group identity and hostility towards outgroups (Choi & Bowles, 2007).

Thus, taken together this research makes it seems plausible that countries affected by harsh environmental conditions such as droughts may exhibit higher risks of conflict because scarcity triggers an increase of social capital within affected groups as well as increased polarization towards other ethnic groups within the same

country. This assumption constitutes the first hypothesis that we will test below:

> *H1:* Exposure to adverse environmental conditions increases intra-ethnic trust and reduces inter-ethnic trust within severely affected countries.

Environmental scarcity and intergroup cooperation

An alternative perspective highlights that scarcity can foster intergroup cohesion. The basic argument is that joint exposure to existential threats creates motives for cooperation: individuals may start to also perceive themselves as members of a 'community of sufferers' rather than as a member of a specific ethnic group alone (Fritz, 1996). Scarcity may thus bring different groups closer together and contribute to building social capital that may form the basis for subsequent peaceful conflict resolution. Several previous qualitative and quantitative analyses on environmental peacemaking and 'disaster diplomacy' draw on this basic argument (Ker-Lindsay, 2000; e.g. Slettebak, 2012). Thus far, however, we have little evidence on the micro-level foundations of this mechanism.

Research in economics lends some support to the underlying assumption that scarcity can in fact strengthen pro-social and cooperative norms and behavior. Studying cooperation under conditions of scarcity in rural China, Nie & Yang (2018) find that people exposed to a higher level of water scarcity also make significantly higher contributions in the public goods game. Aksoy & Palma (2019) study the impact of scarcity on cheating and in-group favoritism based on a lab-in-the-field experiment with coffee farmers in Guatemala. They demonstrate that while individuals display in-group favoritism in times of abundance, in periods of scarcity, subjects are significantly more generous toward the out-group, abolishing in-group favoritism.

Such dynamics may explain why several cross-country studies find no or even negative associations between adverse environmental conditions and violent conflict. The reason may be that scarcity increases cooperation within and among ethnic groups in countries that are severely affected. We summarize this argument in the second (alternative) hypothesis:

> H2: Exposure to adverse environmental conditions increases intra-ethnic and inter-ethnic trust within severely affected countries.

The role of horizontal hazard-inequality

Both of these two (partly) opposing hypotheses are plausible. Both are in line with findings from previous empirical studies. Why then does environmental scarcity seem to lead to a deterioration of inter-ethnic relations while it also seems to contribute to creating inter-ethnic bonds in other instances? The remainder of this section aims to present our argument on the role of horizontal equality/inequality of exposure to environmental hazards.

While environmental conditions may themselves be exogenous to pre-existing socio-economic conditions, their effects are not. The exposure and vulnerability to scarcity may differ significantly across ethnic groups, leading to differential impacts on their members' living conditions. Such a variation may result from ethnic settlement patterns, livelihood strategies or pre-existing horizontal inequalities (e.g. von Uexkull et al., 2016). Taken together, these factors influence the likelihood that harsh environmental conditions will affect different ethnic groups in distinct ways – while some groups may be very heavily affected, others may be spared.

In fact, both perspectives on the effects of environmental scarcity presented above include more or less explicit assumptions on the conditioning role of the intergroup equality of environmental hazards. Research in the first strand has highlighted the relational nature of the concept of scarcity (Selby & Hoffmann, 2014). In this sense, 'scarcity' can refer to a reduction in the availability of natural resources over time but also to low access to resources relative to other individuals, groups, or areas (van Baalen & Mobjörk, 2018). Unequal distribution of hazards across groups may be perceived as unfair and threatening. Thus, Homer-Dixon & Blitt (1998) argue that the extent to which certain groups feel deprived in terms of their *relative* exposure to the hardships resulting from environmental conditions can increase the likelihood of intergroup conflict.

Similarly, research highlighting the potential positive effects of environmental hardship on intergroup relations emphasizes that it is the *joint* exposure that can create social bonds. Thus, the effects suggested by this research perspective are contingent on a certain degree of non-discrimination that is often attributed to climatic phenomena. It is this equality that subjects different population groups to similar suffering and thereby contributes to people's identification with a 'community of fate' that transcends ethnic identities. For example, it has been highlighted that the Sri Lankan tsunami was seen by many as a 'great equalizer': 'The tsunami did not care if people were rich or poor, Sinhalese or Tamil, Muslim, Hindu, or Buddhist' (Choi, 2015: 291).

Thus, whether individual-level exposure to adverse environmental conditions leads to an increase or decrease

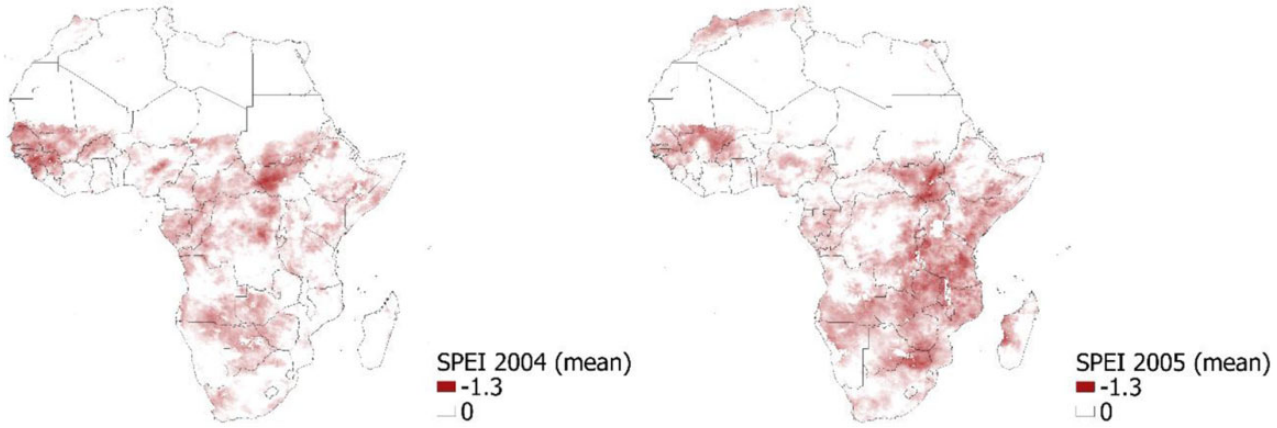

Figure 2. Drought levels (yearly mean SPEI) in Africa in the years 2004 and 2005

in inter-ethnic trust may depend on the degree of group-level equality of exposure within the countries affected by harsh climatic conditions. This basic assumption leads us to our third and final hypothesis:

> *H3:* Group-level equality/inequality of exposure to adverse environmental conditions intensifies the positive/negative effects of individual-level exposure on inter-ethnic trust within severely affected countries.

Droughts on the African continent in the years 2004 and 2005

Droughts are a prevalent phenomenon in many African countries. Moreover, large parts of the population are particularly vulnerable to droughts due to their reliance on rain-fed agriculture (Masih et al., 2014). In the years 2004 and 2005 multiple droughts of different intensity and duration affected various regions of the continent. Figure 2 illustrates the geographical distribution of drought conditions (see data section below on information on the SPEI measure used for the illustration).

Eastern Africa was affected the most. In Kenya, droughts in 2004 led to severe crop failure in five out of seven provinces. In 2005, the rains failed again and the ensuing drought caused a famine in northern parts of the country that affected 2.5 million people (Kandji, 2006). The drought also affected parts of northern Tanzania. The border region between Kenya and Tanzania experienced only between 80% and 20% of normal precipitation (Love, 2004). In 2005, it rained only a little during the long rainy season, while the short rainy season failed completely (Earth Observatory, 2006). This left parts of Tanzania with severely reduced production both from crops and pasture. Uganda also experienced a severe drought in 2005. About 600,000 people were affected, mainly in the north-eastern part of the country (World Bank & Ugandan Office of the Prime Minister, 2012). Within the region of East Africa, Malawi was the most severely affected. A severe drought during the growing season in 2005 caused crops to fail, leading to a severe food crisis. In total 4.2 million people, one-third of the population, suffered from a lack of food (FAO Newsroom, 2005). Parts of Mozambique suffered from a poor harvest following a drought during the 2004–05 agricultural season. The drought threatened the livelihood of half a million people (FAO/WFP, 2005). Similarly, a drought in Zambia in 2005 had severe effects on the agricultural production in the Western and Southern Provinces. An estimated 1.2 million people were in need of assistance to reach their minimum dietary requirements following the drought (Lekprichakul, 2008). This article focuses on the effects of the 2004 and 2005 droughts on these six countries; Figure 3 illustrates the temporal development of the droughts in these countries (see introduction of our drought indicator below).

While all six countries were heavily affected by the drought, they differed substantially in terms of the population's inter-ethnic relations and attitudes prior to the drought. We draw on the second round of the Afrobarometer surveys implemented in 2002 and 2003 (see survey descriptions below) to illustrate these baseline conditions. Unfortunately, these data do not include any direct measures of intra-ethnic and inter-ethnic trust. We rely on three alternative survey questions to illustrate the salience of ethnicity, subjective intergroup relations, and perceptions of ethnic inequality.

The salience of ethnicity varies greatly across countries. In Malawi (61%) and Zambia (49%) large shares of the population felt more attached to their ethnicity than to their nation as a whole – compared to Kenya (27%)

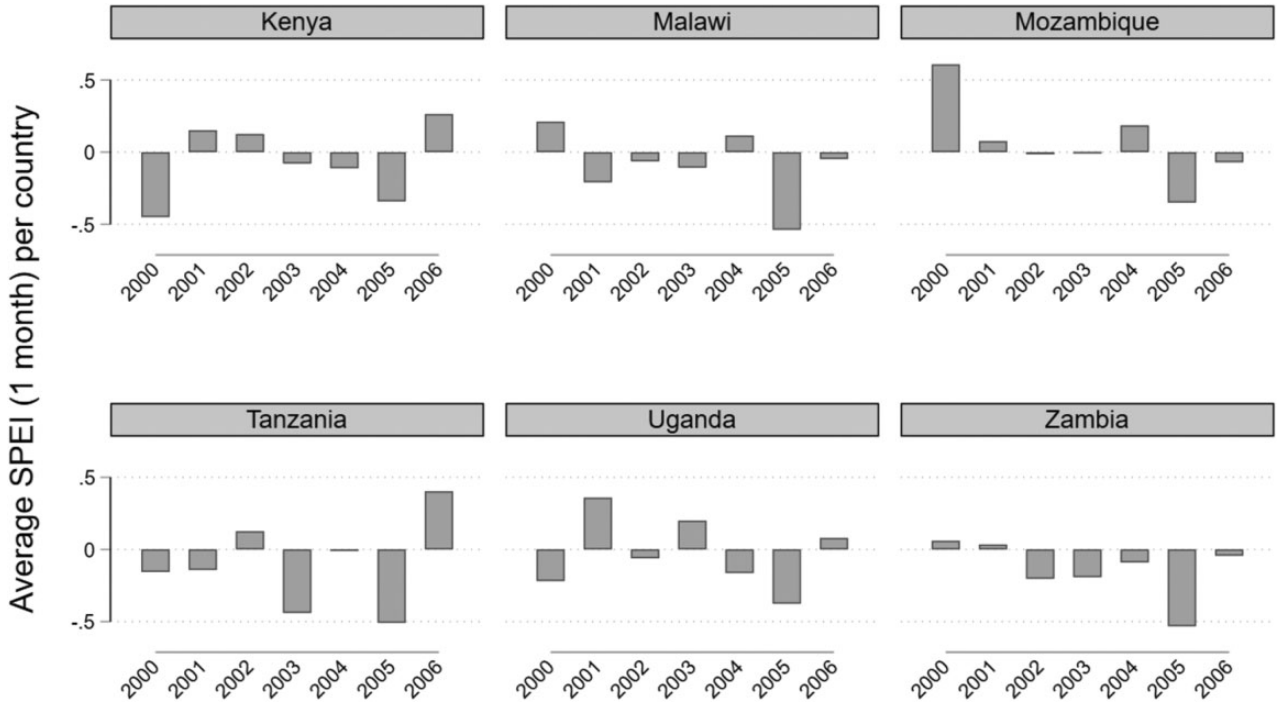

Figure 3. Yearly droughts in the country sample (one-month SPEI)

and Uganda (26%). This self-reported relevance of ethnic identities is in contrast to respondents' assessments of inter-ethnic relations. The Afrobarometer surveys asked interviewees how often conflicts between groups arose in their respective countries. Expectedly, numbers were highest in Uganda (30%) and Kenya (21%) – both countries have experienced repeated waves of ethnic clashes and conflict. Perceptions of ethnic discrimination by the government were by far the strongest in Malawi (54%), followed by Tanzania (34%); they were lowest in Mozambique (19%) and Zambia (25%). The following sections aim at investigating how the droughts in 2004 and 2005 influenced the intra-ethnic and inter-ethnic attitudes of the population in these six countries.

Data and measurement[3]

We draw on survey data from the Afrobarometer project to measure our primary socio-economic and attitudinal outcomes. The Afrobarometer is a non-partisan, pan-African research institution that conducts repeated rounds of public attitude surveys on democracy, governance, the economy, and society across several dozen countries. Interviews are carried out face-to-face by trained interviewers in the language of the respondent's choice. These data offer the great advantage of being a cross-national survey with consistent questions across different countries and languages, allowing us to assess individual-level drought effects in a cross-national sample. In 2017, the AidData project retrospectively geo-coded rounds 1 to 6 of the survey (1999 through 2015). The process aimed to assign longitude and latitude information to the locations of all enumeration areas (EAs) of the Afrobarometer survey.

We rely on geo-coded data from the third survey round, conducted in 2005–06, because the data collection took place during and shortly after the severe droughts described above and because it is the only round that contains direct questions on intra-ethnic *and* inter-ethnic trust.

We restrict our analyses to Eastern Africa for two main reasons: first, we aim at investigating the micro-level foundations of an argument on how drought can increase the risk of violent conflict in drought-affected countries. Thus, rather than comparing across drought-affected and non-affected countries, we focus on effects of droughts on intra-ethnic and inter-ethnic relations *within affected countries*: how does drought influence the attitudes of those that are most affected compared to their co-nationals that suffer less? How does within-country variation in drought exposure influence people's intragroup and intergroup perceptions? In line with this

[3] Summary statistics of our main explanatory, outcome, and control variables are presented in Table A.I. in the Online appendix.

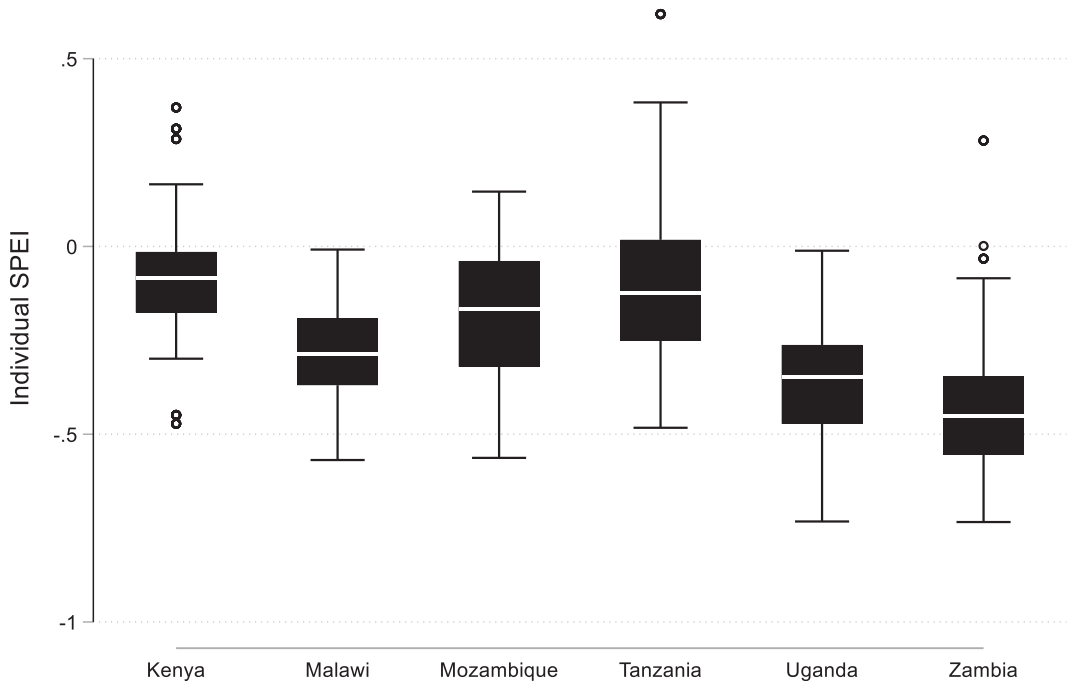

Figure 4. Within-country variation in drought exposure

theoretical focus, we limit our sample to those countries that were severely drought-affected in 2004 and 2005 – according to a mapping study by Masih et al. (2014). Second, drought determinants, temporal patterns, and consequences vary greatly across the continent. We therefore focus on only one region to reduce this heterogeneity and improve the validity of main empirical measures. Thus, while other countries were also affected by drought in 2004 and 2005, we consider only countries located in the most affected geographical region: East Africa. Our final country sample consists of Kenya, Uganda, Tanzania, Mozambique, Malawi, and Zambia.

The average drought exposure is substantially higher in our subsample compared to other parts of the continent (around 50% of a standard deviation). However, drought exposure is far from uniform in the subsample: the standard deviation is comparable to the full sample (0.22 vs. 0.27) – around 12% of the respondents in our subsample did not experience any drought (SPEI>0).[4] Figure 4 displays variation in drought exposure per country in the subsample. We aim to investigate how variation in the extent of exposure influences intragroup and intergroup relations in drought-affected countries.

Across the six country cases, the Afrobarometer dataset contains information on 8,580 respondents. However, our empirical approach forces us to discard a substantive share of this total sample. The Afrobarometer dataset does not contain any information on drought exposure. We therefore retrieve this information by matching respondents' geographical location with spatial data on drought conditions. In order to identify exposure as accurately as possible, we rely on disaggregated drought data that provides information at a horizontal resolution of 5 km (Peng et al., 2019). Thus, the validity of our drought measure partly depends on the precision of the geo-location of Afrobarometer respondents. While the AidData project has mapped survey participants as accurately as possible based on the notes of Afrobarometer enumerators, lack of precise location information has often prevented coders from assigning respondents to specific locations. In these cases, individuals have been attributed the coordinates of adjacent locations mentioned in the enumerator notes or the coordinates of first-order/second-order administrative units.

Assigning levels of drought exposure to respondents based on such coarse location information could introduce additional error into our drought measurement. We therefore restrict our analyses to Afrobarometer respondents whose coordinates correspond to an exact location (geo-precision code 1 according to the AidData precision system). This restriction reduces our sample to 3,365 individuals. As a consequence, the surveys are no longer representative at the country-level. In particular,

[4] See histograms of drought exposure in the full sample and our subsample in Figure A.1. in the Online appendix.

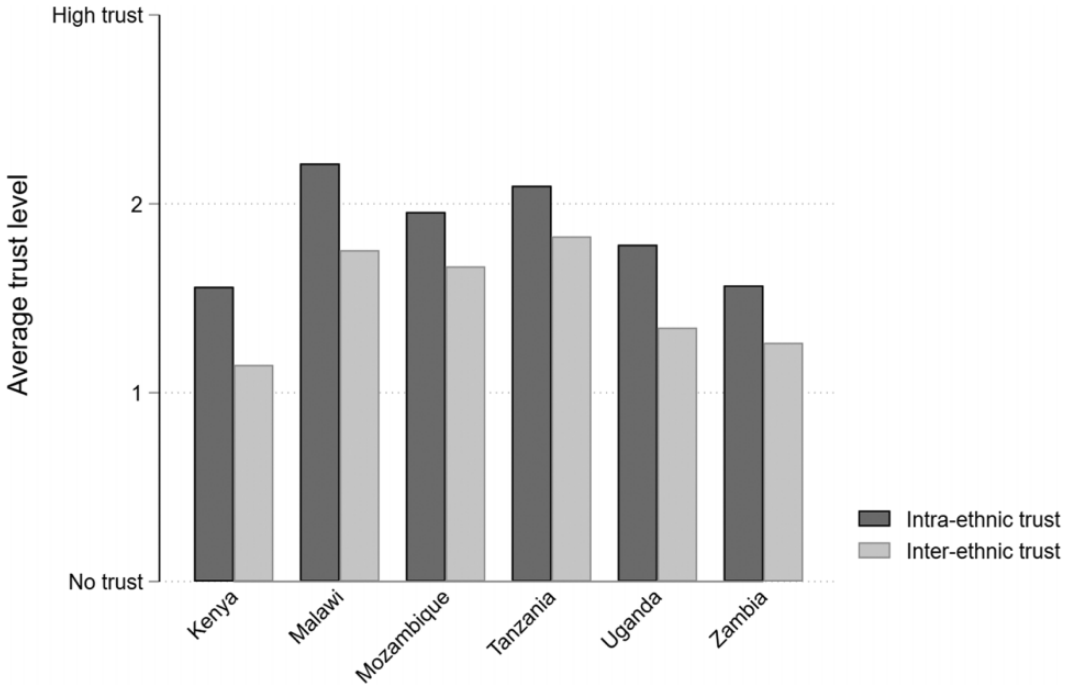

Figure 5. Levels of intra-ethnic and inter-ethnic trust in the sample

this necessary restriction may bias our sample against individuals living in areas that could not be identified with high precision: the rural and more agriculturally dependent population. Because our main research aim is to estimate correlations rather than to describe the characteristics of a population, we have prioritized measurement validity over representativeness.[5]

Our empirical analyses focus on two different types of outcomes in line with the causal argument suggested above. We start by assessing the effects of droughts on food security. In order to assess the extent to which individual respondents have observed or directly experienced food stress as a consequence of the droughts, we rely on three items that ask interviewees to name the three most important problems in their respective countries that the government should address, in order of priority. We generate a continuous variable that ranges from 0 (food shortage or famine not mentioned as priority) to 3 (food shortage or famine mentioned as first priority).

Our main outcomes of interest are intra-ethnic and inter-ethnic attitudes. We make use of two straightforward survey items from the Afrobarometer to measure these variables: 'How much do you trust each of the following types of people: People from your own ethnic group [or tribe] / [respondent's nationality] from other ethnic groups?'. Response options on the four-point Likert-scale range from 'Not at all' to 'I trust them a lot'. We illustrate the distribution of these variables in Figure 5.

Our main explanatory variable is exposure to drought. We rely on the widely used standardized precipitation evapotranspiration index (SPEI). It is based on a climatic water balance model, indicating the difference between the amount of water gained and water lost by the environment. Analyses of the performance of SPEI compared to alternative measures demonstrate that the SPEI is a particularly effective tool for the identification of droughts (Vicente-Serrano, Beguería & López-Moreno, 2010). Higher values of the SPEI indicate *more* availability of water, while negative values indicate drought conditions.

In order to gauge the drought exposure of the Afrobarometer respondents, we rely on a high spatial

[5] Table A.XXXVIII in the Online appendix compares characteristics of our subsample and the full (nationally representative) Afrobarometer sample. The table shows that differences are rather small. We have also implemented additional analyses that aggregate our drought measure at the district level, assign respondents the mean drought-value of their districts, and include all respondents that were at least located in a second-order administrative unit (precision code 3). Table A.XXXVIII shows that this subsample reflects the properties of the full sample. Expectedly, using this coarser measurement of our main explanatory variable introduces additional uncertainty into these analyses. Estimations are substantially less precise but mirror the general trends of the main models (see Online appendix Tables A.II–A.V). Taken together, these findings mitigate concerns that our main results may be driven by biases of our subsample.

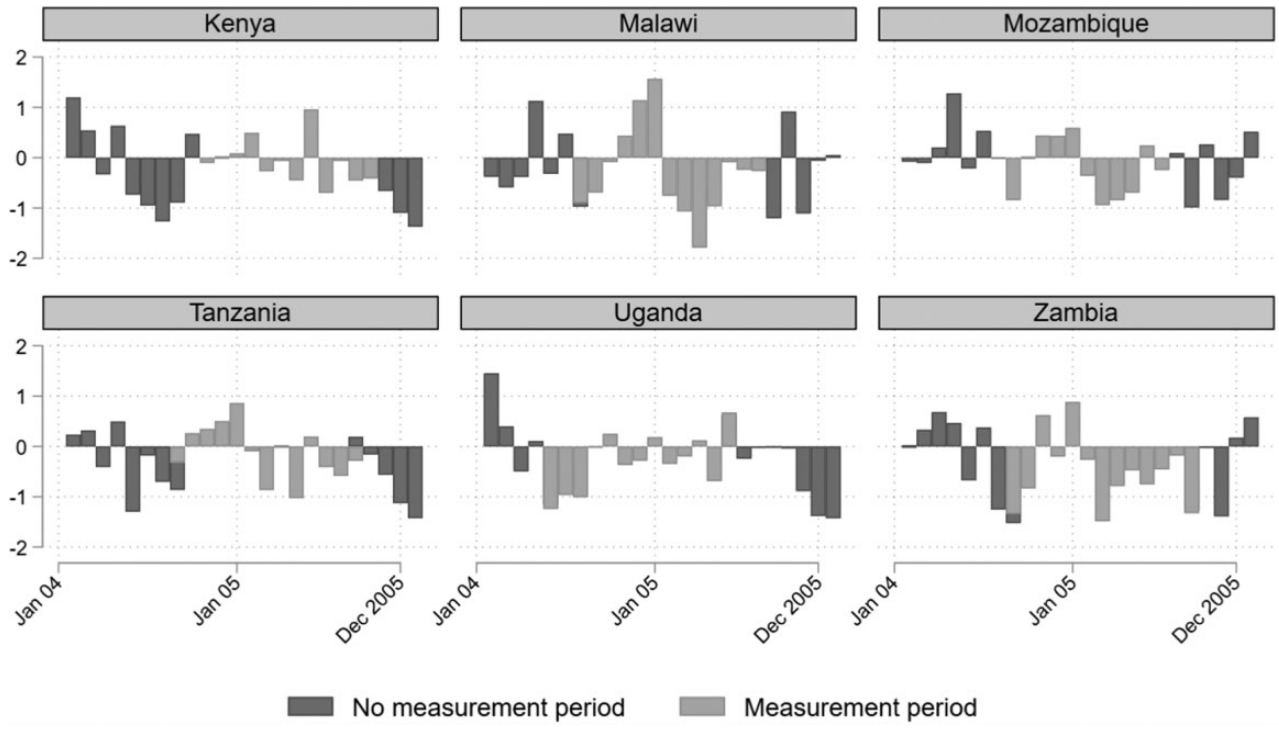

Figure 6. Monthly droughts in the country sample (one-month SPEI) and measurement periods

resolution SPEI created specifically for the assessment of drought vulnerability in Africa (Peng et al., 2019). The dataset spans from 1981 to 2016 and has a 5 km spatial resolution. It relies on precipitation and potential evaporation estimates derived from satellite and station data. These estimates on a highly disaggregated level introduce uncertainty into our drought measure. However, contrary to the geo-located Afrobarometer data discussed above, measurement error in the SPEI data is more likely to be unsystematic or inconsistent and to bias our analysis against finding strong and robust associations between drought exposure and attitudes. Moreover, correlations between the SPEI data and more proximate socio-economic conditions presented below strengthen our confidence in the validity of our drought measure.

To facilitate the diagnosis of droughts of different durations, the dataset provides accumulation periods ranging from one to 48 months. In our main models, we rely on a one-month accumulation period to capture short-term drought events.[6] As mentioned above, we use information on respondents' location to assign each of them a drought value according to the SPEI dataset. For each individual, we calculate the mean one-month SPEI value over a period of 12 months, starting with the month in which the Afrobarometer interview took place. Figure 6 illustrates the measurement periods and mean drought levels per country for the years 2004 and 2005 (please note that lower SPEI values indicate *lower* water availability).[7]

Empirical analysis

This section presents our empirical strategy and the main results of our analyses. The following three subsections present the three consecutive steps of the investigation. The first subsection assesses correlations between our measures

[6] In order to assess the sensitivity of our main results to this measurement decision, we have implemented additional robustness checks using a three-month SPEI over a period of 12 months. The results of these analyses corroborate the findings of our main models (see Tables A.VI–A.IX in the Online appendix). In addition, we have also estimated models using a one-month SPEI measured over three- and six-month periods, respectively. Associations reported below are substantially weaker with these alternative specifications – in terms of coefficient size and in terms of statistical significance (see Tables A.XXVII–A.XXXIV in the Online appendix). This may indicate – in line with previous research – that longer-term weather conditions are more relevant for livelihood conditions and social relations than individual fluctuations.

[7] Our data support the qualitative observation that Malawi has been by far the most heavily affected by the drought. We have therefore re-estimated our main models excluding Malawi from the sample. These additional estimations reproduce the main findings presented below (see Tables A.X–A.XIII in the Online appendix).

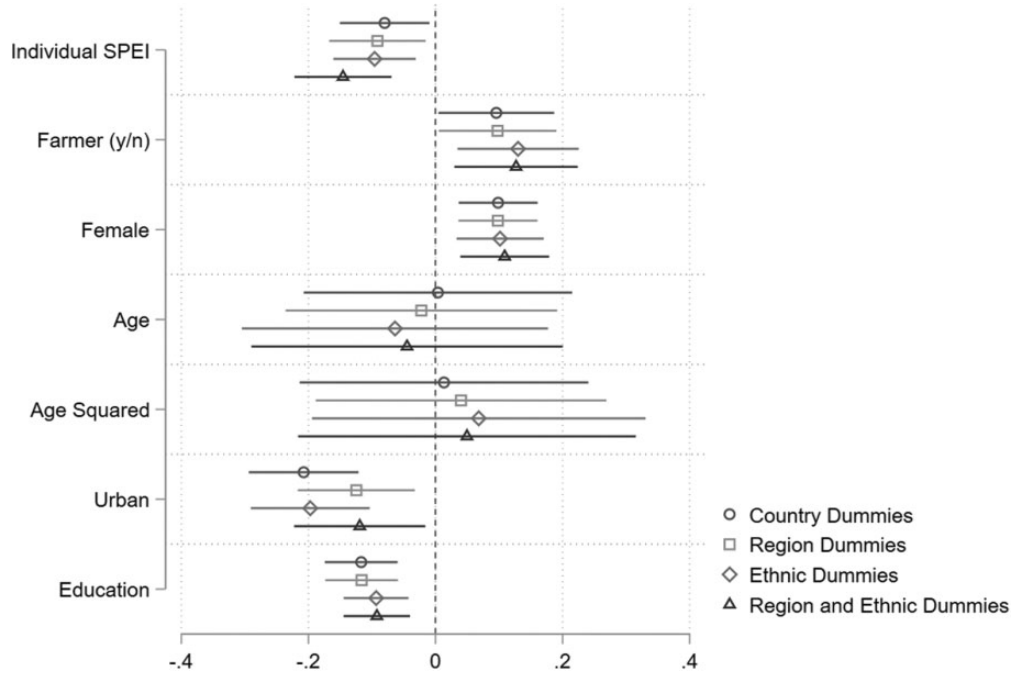

Figure 7. Effects of droughts on subjective food security (food security a priority)

of drought exposure and subjective food insecurity. The primary aim of this analysis is to establish the validity of our measure of drought exposure and to demonstrate that the 2004–05 droughts did in fact create a state of scarcity of existential goods that may have impacted intra-ethnic and inter-ethnic relations in line with the theoretical arguments presented above. The second subsection presents the results of the empirical tests of Hypotheses 1 and 2: estimations of the correlations between objective measures of drought exposure and self-reported intra-ethnic and inter-ethnic trust. In the third subsection we turn to Hypothesis 3. We create a measure of horizontal inequality in drought exposure and assess the extent to which it conditions correlations between individual-level drought exposure and intra-ethnic/inter-ethnic trust.

Correlations between droughts and socio-economic conditions

We estimate four different models to assess the impact of drought exposure on respondents' subjective food insecurity as described above. All models include a limited number of controls that are drawn primarily from the Afrobarometer data. As the survey was implemented after the beginning of the 2004–05 drought period, any control variables from the survey may introduce post-treatment bias into our analysis. We therefore only consider controls that can plausibly be considered to measure pretreatment conditions, in that we expect them to be exogenous to the level of very recent drought exposure: respondents' gender, age (and its squared term), level of education, and occupation (farming yes/no). In addition, we control for the longitude and latitude of the respondents' locations in order to account for potential confounding effects resulting from specific location characteristics and/or settlement patterns.

We use ordinary least squares (OLS) models for our continuous outcome variables. The first model includes country dummies to control for any unobserved variation across countries. The second and third models include region (second-order administrative unit) and ethnic-group dummies instead. The fourth model includes both types of fixed effects. All four models cluster robust standard errors per location (EA).

Across all four models, we find the expected negative correlation between respondents' prioritization of food security and water availability.[8] Correlations are strongest in terms of coefficient size and statistical significance in models that include region and ethnic group fixed effects. Figure 7 plots standardized coefficients for all

[8] Interestingly, we did not find any significant variation of correlations across poverty levels and occupation – either because most people were 'sufficiently' affected by the drought to perceive food security as a pressing problem or because those that were less affected still prioritized food security due to the observation of negative drought effects on people in their vicinities (see detailed results in Tables A.XV–A.XVII in the Online appendix).

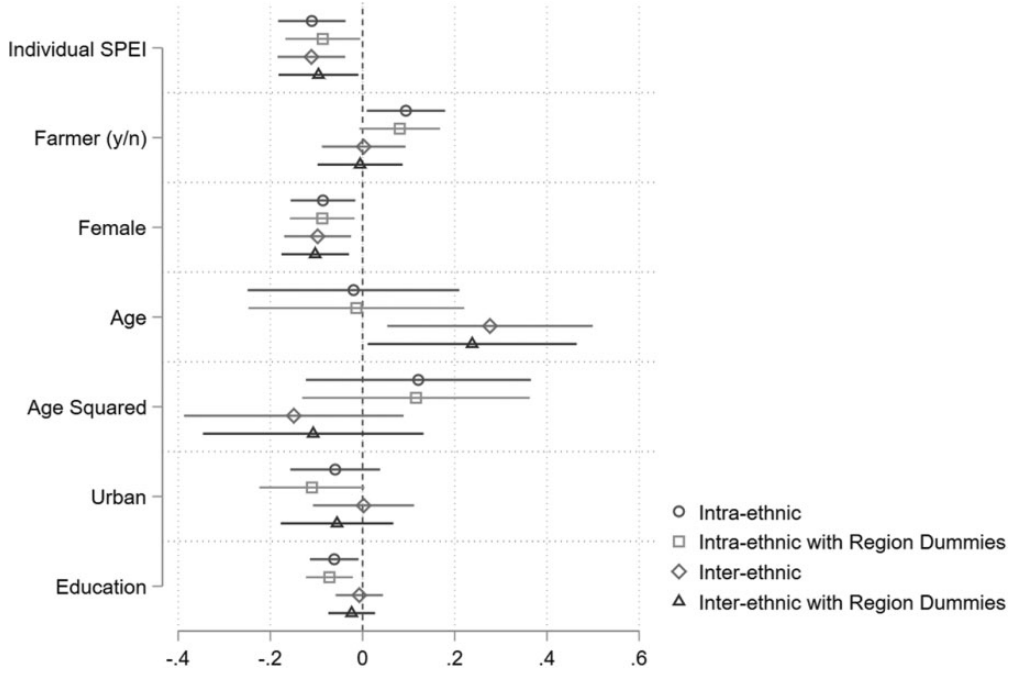

Figure 8. Effects of drought exposure on intra-ethnic and inter-ethnic trust

four models (see detailed results in Table A.XIV. in the Online appendix).[9]

These findings underscore our confidence in our measurement of drought exposure and the basic underlying assumption of our analysis that droughts can negatively impact perceived food security. We now proceed to investigating the attitudinal effects of the drought.

Correlations between droughts and ethnic relations

Our measures of ethnic attitudes are Likert-scaled and we use simple OLS models to estimate the effect of droughts. As we expect baseline levels of intra-ethnic and inter-ethnic trust to vary across ethnic groups, all of the following models include ethnic group dummies to account for this variation. We estimate models without and with additional region dummies. Again, we cluster robust standard errors per location. Figure 8 presents our main results (detailed results are presented in Table A.XXII. in the Online appendix).

We find more severe droughts to be associated with higher average levels of intra-ethnic *and* inter-ethnic trust. The size of the coefficients is very similar. Taken together, these findings indicate that the droughts may have had a more general positive effect on pro-social attitudes. Drought-affected individuals generally appear to have been more willing to trust other people – independently of whether the latter belonged to the respondents' ethnic group or to any other ethnic group. These findings support Hypothesis 2 and partially reject Hypothesis 1 (in terms of the expected negative correlations between droughts and inter-ethnic attitudes). They are in line with previous studies that paint a rather optimistic picture of human behavior in times of crises: rather than reinforcing pre-existing cleavages, the droughts in East Africa appear to have had a generally positive effect on the social fabric.[10] Overall, these findings suggest that the polarization of ethnic attitudes seems to be an unlikely channel through which environmental scarcity can increase the risk of violence.[11]

[9] As alternative measurement, we investigated how far drought exposure increased the number of times that people have gone without food in the past 12 months. We find that the correlations are weaker and that actual food shortage was most pronounced for households that were economically dependent on farming (see detailed results in Tables A.XVIII–A.XXI in the Online appendix).

[10] In the Online appendix, we present the results of two-stage least squares (2SLS) regressions that exploit exogenous variation in food security induced by drought exposure. While uninstrumented food insecurity has no significant effect on ethnic attitudes, it has the expected positive effects on inter-ethnic and intra-ethnic trust in the second stage of the 2SLS model (see Tables A.XXIII–A.XXIV in the Online appendix).

[11] Additional analyses support this interpretation. We have estimated correlations between drought exposure and people's general acceptance of the use of violence (violence never justified vs.

These associations may depend on pre-existing ethnic relations and attitudes. In particular, previous studies indicate that political marginalization can play an important role in terms of determining the vulnerability and coping capabilities of ethnic groups, as well as the quality of inter-ethnic relations (e.g. Fjelde & von Uexkull, 2012): for example, in the face of high political horizontal inequality, drought exposure may increase marginalized groups' distrust in members of the dominant ethnic group. Before we move on to investigate the role of the inter-ethnic distribution of drought impacts, we assess how the positive correlations between drought exposure and ethnic attitudes may be limited to areas with low levels of ethnic discrimination.

We rely on two measures: the first is self-reported political marginalization based on the Afrobarometer data (more or less political influence than other groups in the country). Due to the potential endogeneity of the measure, we also draw on the Geo-coded Ethnic Power Relations Dataset (GeoEPR; Wucherpfennig et al., 2011) to identify politically powerless, discriminated against, and irrelevant ethnic groups. We then estimate interaction effects between drought exposure and these two measures of ethnic inequality. The results indicate consistently that positive correlations between drought exposure and intra-ethnic trust are strongest for members of discriminated-against ethnic groups. We find no evidence of a similar interaction for inter-ethnic trust (see detailed results in Tables A.XXXIX. and A.XXXX in the Online appendix). One potential explanation of this finding is that drought exposure can act as an additional element of discriminated-against groups' more general threat perception – reinforcing in-group-orientation and cohesion among groups with a heightened baseline sense of vulnerability and marginalization.

The role of the inter-ethnic distribution of drought impacts

In the last step of our analysis, we aim to investigate the degree to which the effects of the drought may depend on the distribution of drought exposure across ethnic groups. More specifically, we want to analyze whether the positive effects on the social fabric may be contingent on a relative equity of the negative repercussions of the drought.

We therefore created a measure of drought exposure per ethnic group. As our Afrobarometer data are not representative at the ethnic-group level, we draw on geographic information on the primary settlement areas of ethnic groups provided by GeoEPR (Wucherpfennig et al., 2011).[12] Based on our original SPEI-dataset, we aggregated information on drought exposure per ethnic settlement area and 12-month period prior to the Afrobarometer survey. We then created a relative measure of drought exposure by calculating the difference between each group's aggregate drought index value and the respective country-mean of all ethnic groups. Finally, we matched the Afrobarometer respondents to ethnic settlement areas based on their ethnic self-identification, which is provided in the Afrobarometer data, to assign a group-level drought-equity score to individuals.

We have transformed the variable in such a way that higher values indicate a greater deviation of group exposure from the country mean – no matter whether this difference is positive or negative (i.e. irrespective of whether the ethnic group has been more or less affected by the drought than the average of all other ethnic groups in the country). This approach mirrors the theoretical arguments presented above: any type of intergroup inequality in exposure (no matter the direction) is likely to undermine perceptions of common threats and joint identification as 'communities of fate' – potentially dampening positive correlations between drought exposure and trust. Feelings of unfairness and marginalization may be more pronounced among more affected groups. In line with previous research on the reciprocity of intergroup attitudes (Serva, Fuller & Mayer, 2005; e.g. Ferrin, Bligh & Kohles, 2008), however, we expect that this effect would indirectly also shape trust assessments of less affected groups: if they experience distrust from more affected groups they are likely to reciprocate. Thus, as we expect similar effects of different kinds of inequality (more or less affected than the average) we focus on an absolute measure of the deviation of group-exposure from the country mean.

sometimes necessary). We find weak evidence of a positive correlation: higher drought exposure is associated with stronger agreement with the notion that violence is sometimes necessary. Combined with our main findings, this result indicates that droughts may increase the risk of violence through other channels than in-group/intergroup relations (see Table A.XXXVII in the Online appendix).

[12] As a robustness check, we have estimated our main models with an alternative measure of group-level inequality of drought exposure based directly on the Afrobarometer data. The fact that we are able to reproduce our original results with this alternative measurement strengthens our confidence in our findings (see Table A.XXXV in the Online appendix).

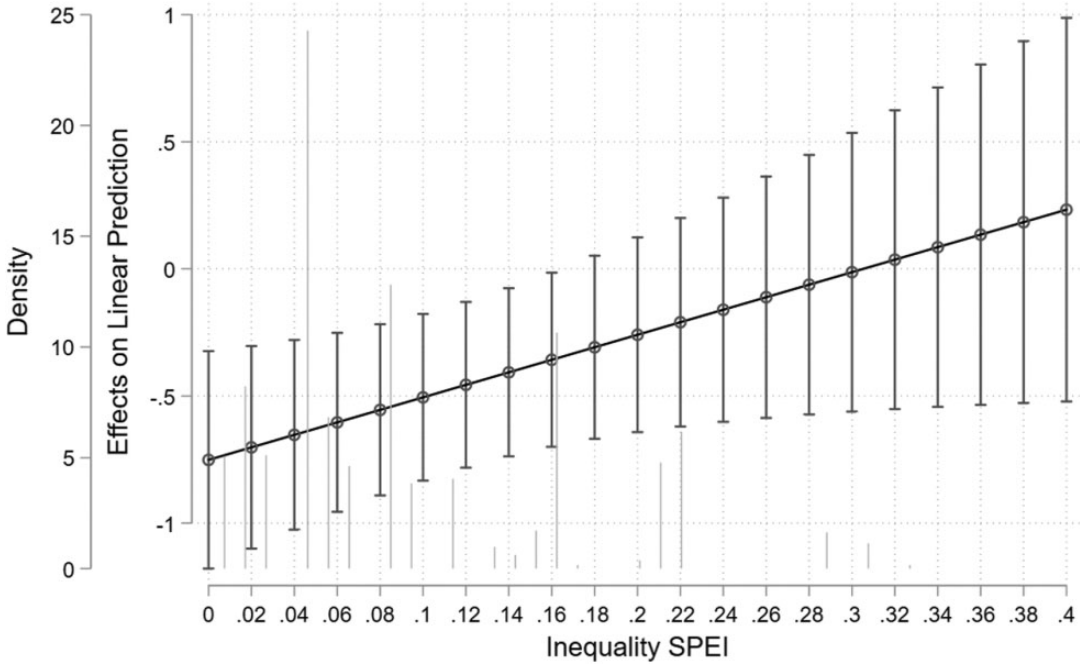

Figure 9. Average marginal effects of individual drought exposure

We now estimate the direct and conditional effects of individual-level drought exposure and group-level equity on our measures of inter-ethnic and intra-ethnic trust. We do not find any evidence of a direct correlation of our measure of inter-ethnic equality with drought exposure in this basic model specification (see detailed results in Table A.XXV in the Online appendix). However, we do find evidence of a significant interaction of individual-level and group-level exposure. We illustrate these associations in Figure 9.[13]

We can see that negative correlations between the SPEI index and our measure of inter-ethnic trust (more drought is associated with more trust) is largely confined to relatively low levels of horizontal inequality. This finding lends additional support to Hypothesis 2. For individuals who suffer from the consequences of the drought, belonging to a group that is affected to a similar degree as other groups in the same country will increase trust in the members of other groups. While high individual-level exposure coupled with high levels of intergroup inequality may reduce trust in other ethnic groups, we find no correlations at conventional levels of statistical significance. This lends tentative support to the primary argument underlying the optimistic perspective on attitudinal drought effects: the perception of joint exposure to existential threats is a key driving force for improved intergroup relations in the face of scarcity.

We aim to scrutinize this result with additional analyses of a specific subgroup of respondents. Not all members of an ethnic group live in the primary settlement areas of their respective groups. Instead, substantial shares of group members may be dispersed across different locations of the country. For individuals residing in more heterogeneous areas far away from the primary settlement areas of their respective groups, group-level drought exposure may be less relevant in shaping their attitudes towards members of their in-group and of other ethnic out-groups. In order to take these potential effects into account, we limit the models presented above to all individuals who live in the primary settlement areas of their respective ethnic groups according to the GeoEPR dataset. These additional analyses reproduce the interactions discussed above – in fact, correlations are substantially stronger in this model (see results in Table A.XVI in the Online appendix). Moreover, we now also find a positive direct correlation between our measure of group inequality and intra-ethnic trust. Thus, within the settlement areas of respondents' own ethnic groups,

[13] Hainmueller, Mummolo & Xu (2018) demonstrate how such linear multiplicative interaction models can suffer from two important problems: they assume linear interaction effects and they can be misleading if there is a lack of common support of the moderator. We use a statistical routine developed by Hainmueller et al. to assess to what extent these problems may affect our main results. The results confirm the general trends described above (see Figure A.2 in the Online appendix).

intergroup dissimilarity can increase intragroup trust independently of whether the respondent herself is affected by the drought – possibly because respondents identify more strongly with the plight of their ethnic group as they can directly observe the (relative) exposure of their coethnics.

Conclusion

This article has sought to empirically investigate a specific mechanism linking environmental scarcity to violent conflict: do adverse environmental conditions influence peoples' attitudes towards members of their ethnic in-group and/or out-group?

Our findings support more optimistic perspectives on the effects of environmental stress. Drought hazards tend to increase social trust – in members of both people's own and other ethnic groups. Intergroup inequality conditions this effect: positive associations between drought exposure and *intra*-ethnic trust (not on inter-ethnic trust) seem to be particularly pronounced among members of politically excluded ethnic groups. More importantly, our results also indicate that it is not only pre-existing political inequality that can dampen the effects of droughts: the more unequal the intergroup distribution of drought exposure itself, the weaker the positive association between exposure and *inter*group trust.

These results help to qualify findings of recent micro-level research. Survey-based studies show that exposure to climate shocks can increase participation in violent activities (Vestby, 2019; see also results reported in footnote 10) and the general endorsement of political violence among people who are politically discriminated against and/or distrust their head of state (Detges, 2017). Our own results indicate that these effects are likely to work through other mechanisms than a polarization of inter-ethnic attitudes – for example through a reduction of the opportunity costs of violence or an intensification of antistate grievances. In this context, drought-effects on ethnic trust can be understood as a potential countervailing force: the improvement of inter-ethnic relations reduces the risk that low opportunity costs and antistate sentiments translate into broad-based ethnic mobilization. Substantial horizontal hazard-inequality can undermine this preventive effect and thereby increase the risk that climate shocks lead to violent conflict.

These findings should be interpreted in light of the three main shortcomings of our analyses. First, we have repeatedly faced trade-offs between the objectives of ensuring the measurement validity of our explanatory variable and the generalizability of our findings. We have prioritized the first over the latter, which has led us to censor the total population of the Afrobarometer data in terms of geographical scope and geo-precision. However, given the remaining cultural, social, and political heterogeneity of our sample, as well as the results of the robustness checks, we are confident that our results can inform future analyses of drought effects in other contexts.

Second, the measurement of our outcome variable has relied on generic survey items asking about people's trust in members of their own and other ethnic groups. Consequently, we have not been able to implement more specific tests of the effects of inequality that look into relations between specific pairs of ethnic groups with different combinations of high and low exposure to drought hazards. Moreover, we have focused on inequality of ethnic groups as defined by the Afrobarometer and the EPR datasets. However, we cannot assess the degree to which the respective categorizations reflect the most salient identities in the eyes of the local population.

Finally, while our analyses seek to inform research on the effects of environmental conditions on violent conflict, we have focused on only one specific element of the causal chains linking scarcity to conflict. While we document the effects of individual-level and group-level exposure to drought hazards on measures of ethnic trust, we do not assess whether and how these attitudes may translate into any specific conflict behavior.

These three caveats provide avenues for future research. In addition to investigating the attitudinal effects of various climatic conditions in other country contexts, research could investigate the effects of inequality in drought exposure based on a survey designed specifically for this purpose – gauging different facets of objective and subjective inequality as well as perceptions towards concrete identity groups. Studies could also investigate the effects of horizontal environmental inequality on violent conflicts. An initial exploratory analysis could combine global SPEI data with information on ethnic settlements to generate country-level measures of intergroup inequality of drought exposure and to estimate the effects on the onset, duration, and intensity of violent conflicts.

Replication data

The dataset, codebook, and do-files for the empirical analysis in this article, along with the Online appendix, can be found at http://www.prio.org/jpr/datasets. All analyses were conducted using Stata 15.1.

ORCID iD

Alexander De Juan https://orcid.org/0000-0002-6649-5064
Niklas Hänze https://orcid.org/0000-0003-4626-7061

References

Adano, Wario R; Ton Dietz, Karen Witsenburg & Fred Zaal (2012) Climate change, violent conflict and local institutions in Kenya's drylands. *Journal of Peace Research* 49(1): 65–80.

Aksoy, Billur & Marco A Palma (2019) The effects of scarcity on cheating and in-group favoritism. *Journal of Economic Behavior & Organization* 165(September): 100–117.

Alesina, Alberto & Eliana La Ferrara (2000) Participation in heterogeneous communities. *Quarterly Journal of Economics* 115(3): 847–904.

Boix, Carles & Daniel N Posner (1998) Social capital: Explaining its origins and effects on government performance. *British Journal of Political Science* 28(4): 686–693.

Brander, James A & M Scott Taylor (1998) The simple economics of Easter Island: A Ricardo-Malthus model of renewable resource use. *American Economic Review* 88(1): 119–138.

Burke, Marshall B; Edward Miguel, Shanker Satyanath, John A Dykema & David B Lobell (2009) Warming increases the risk of civil war in Africa. *Proceedings of the National Academy of Sciences of the United States of America* 106(49): 20670–20674.

Caruso, Raul; Ilaria Petrarca & Roberto Ricciuti (2016) Climate change, rice crops, and violence: Evidence from Indonesia. *Journal of Peace Research* 53(1): 66–83.

Choi, Jung-Kyoo & Samuel Bowles (2007) The coevolution of parochial altruism and war. *Science* 318(5850): 636–640.

Choi, Vivian Y (2015) Anticipatory states: Tsunami, war, and insecurity in Sri Lanka. *Cultural Anthropology* 30(2): 286–309.

Connolly-Boutin, Liette & Barry Smit (2016) Climate change, food security, and livelihoods in sub-Saharan Africa. *Regional Environmental Change* 16(2): 385–399.

Dai, Aiguo; Tianbao Zhao & Jiao Chen (2018) Climate change and drought: A precipitation and evaporation perspective. *Current Climate Change Reports* 4(3): 301–312.

Daryanto, Stefani; Lixin Wang & Pierre-André Jacinthe (2016) Global synthesis of drought effects on maize and wheat production. *PLOS ONE* 11(5): e0156362.

Detges, Adrien (2017) Droughts, state–citizen relations and support for political violence in sub-Saharan Africa: A micro-level analysis. *Political Geography* 61(November): 88–98.

Earth Observatory (2006) Drought in East Africa (https://earthobservatory.nasa.gov/images/6246/drought-in-east-africa).

Economist (2019) How climate change can fuel wars. May (https://www.economist.com/international/2019/05/23/how-climate-change-can-fuel-wars).

FAO Newsroom (2005) Malawi facing serious food crisis (http://www.fao.org/newsroom/en/news/2005/107298/index.html).

FAO/WFP (2005) *Special Report Mozambique: Fao/WFP Crop and Food Supply Assessment Mission to Mozambique*. Food and Agriculture Organization of the UN and UN World Food Programme (http://www.fao.org/3/J5510e/J5510e00.htm).

Ferrin, Donald L; Michelle C Bligh & Jeffrey C Kohles (2008) It takes two to tango: An interdependence analysis of the spiraling of perceived trustworthiness and cooperation in interpersonal and intergroup relationships. *Organizational Behavior and Human Decision Processes* 107(2): 161–178.

Fjelde, Hanne & Nina von Uexkull (2012) Climate triggers: Rainfall anomalies, vulnerability and communal conflict in sub-Saharan Africa. *Political Geography* 31(7): 444–453.

Fritz, Charles (1996) Disasters and mental health: Therapeutic principles drawn from disaster studies. *Historical and Comparative Disaster Series*.

Grossman, Herschel I & Juan Mendoza (2003) Scarcity and appropriative competition. *European Journal of Political Economy* 19(4): 747–758.

Hainmueller, Jens; Jonathan Mummolo & Yiqing Xu (2018) How much should we trust estimates from multiplicative interaction models? Simple tools to improve empirical practice. *Political Analysis* 27(2): 163–192.

Homer-Dixon, Thomas F (1999) *Environment, Scarcity, and Violence*. Princeton, NJ: Princeton University Press.

Homer-Dixon, Thomas F & Jessica Blitt (1998) *Ecoviolence: Links Among Environment, Population and Security*. Lanham, MD: Rowman & Littlefield.

Horowitz, Donald L (1985) *Ethnic Groups in Conflict*. Berkeley, CA: University of California Press.

Ide, Tobias (2019) The impact of environmental cooperation on peacemaking: Definitions, mechanisms, and empirical evidence. *International Studies Review* 21(3): 327–346.

Kandji, Serigne (2006) Drought in Kenya: Climatic, economic and socio-political factors. *New Standpoints* November–December: 17–19.

Kasara, Kimuli (2013) Separate and suspicious: Local social and political context and ethnic tolerance in Kenya. *Journal of Politics* 75(4): 921–936.

Ker-Lindsay, James (2000) Greek–Turkish rapprochement: The impact of disaster diplomacy? *Cambridge Review of International Affairs* 14(1): 215–232.

Koubi, Vally; Tobias Böhmelt, Gabriele Spilker & Lena Schaffer (2018) The determinants of environmental migrants' conflict perception. *International Organization* 72(4): 905–936.

Kramer, Roderick M; Marilynn B Brewer & Benjamin A Hanna (1996) Collective trust and collective action: The decision to trust as a social decision. In: *Trust in*

Organizations: Frontiers of Theory and Research. Thousand Oaks, CA: Sage, 357–389.

Lake, David A & Donald Rothchild (1996) Containing fear: The origins and management of ethnic conflict. *International Security* 21(2): 41–75.

Lei, Vivian & Filip Vesely (2010) In-group versus out-group trust: The impact of income inequality. *Southern Economic Journal* 76(4): 1049–1063.

Lekprichakul, Thamana (2008) Impact of 2004/2005 drought on Zambia's agricultural production: Preliminary results. Working paper. Research Institute for Humanity and Nature Kyoto, Japan 26.

Lewicki, Roy J & Carolyn Wiethoff (2000) Trust, trust development, and trust repair. In: Peter T Coleman, Morten Deutsch & Eric C Marcus (eds) *The Handbook of Conflict Resolution: Theory and Practice*. San Francisco, CA: Jossey-Bass, 86–107.

Linke, Andrew M; John O'Loughlin, J Terrence McCabe, Jaroslav Tir & Frank DW Witmer (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(September): 35–47.

Love, Timothy (2004) *Africa Drought and Floods Hazards Assessment: April 29, 2004 – Somalia*. Famine Early Warning System (https://reliefweb.int/report/somalia/africa-drought-and-floods-hazards-assessment-april-29-2004).

Masih, I; S Maskey, FEF Mussá & P Trambauer (2014) A review of droughts on the African continent: A geospatial and long-term perspective. *Hydrology and Earth System Sciences* 18(9): 3635–3649.

Nie, Zihan & Xiaojun Yang (2018) Resource scarcity and cooperation: Evidence from an irrigation system in western China. *EfD Discussion Paper Series* (http://efdinitiative.org/publications/resource-scarcity-and-cooperation-evidence-irrigation-system-western-china).

Oberschall, Anthony (1973) *Social Conflict and Social Movements*. London: Pearson Education.

Peng, Jian; Simon Dadson, Feyera Hirpa, Ellen Dyer, Thomas Lees, Diego G Miralles, Sergio M Vicente-Serrano & Chris Funk (2019) A pan-African high-resolution drought index dataset. *Earth System Science Data Discussions* (October): 1–26.

Prediger, Sebastian; Björn Vollan & Benedikt Herrmann (2014) Resource scarcity and antisocial behavior. *Journal of Public Economics* 119(November): 1–9.

Raleigh, Clionadh & Dominic Kniveton (2012) Come rain or shine: An analysis of conflict and climate variability in East Africa. *Journal of Peace Research* 49(1): 51–64.

Selby, Jan & Clemens Hoffmann (2014) Rethinking climate change, conflict and security. *Geopolitics* 19(4): 747–756.

Serva, Mark A; Mark A Fuller & Roger C Mayer (2005) The reciprocal nature of trust: A longitudinal study of interacting teams. *Journal of Organizational Behavior* 26(6): 625–648.

Seter, Hanne (2016) Connecting climate variability and conflict: Implications for empirical testing. *Political Geography* 53(July): 1–9.

Shiferaw, Bekele; Kindie Tesfaye, Menale Kassie, Tsedeke Abate, BM Prasanna & Abebe Menkir (2014) Managing vulnerability to drought and enhancing livelihood resilience in sub-Saharan Africa: Technological, institutional and policy options. *Weather and Climate Extremes* 3(June): 67–79.

Slettebak, Rune T (2012) Don't blame the weather! Climate-related natural disasters and civil conflict. *Journal of Peace Research* 49(1): 163–176.

Tilly, Charles (1978) *From Mobilization to Revolution*. New York: McGraw-Hill.

van Baalen, Sebastian & Malin Mobjörk (2018) Climate change and violent conflict in East Africa: Integrating qualitative and quantitative research to probe the mechanisms. *International Studies Review* 20(4): 547–575.

Varshney, Ashutosh (2003) *Ethnic Conflict and Civic Life: Hindus and Muslims in India*, 2nd revised edition. New Haven, CT: Yale University Press.

Vestby, Jonas (2019) Climate variability and individual motivations for participating in political violence. *Global Environmental Change* 56(May): 114–123.

Vicente-Serrano, Sergio M; Santiago Beguería & Juan I López-Moreno (2010) A multiscalar drought index sensitive to global warming: The standardized precipitation evapotranspiration index. *Journal of Climate* 23(7): 1696–1718.

von Uexkull, Nina; Mihai Croicu, Hanne Fjelde & Halvard Buhaug (2016) Civil conflict sensitivity to growing-season drought. *Proceedings of the National Academy of Sciences* 113(44): 12391–12396.

World Bank & Ugandan Office of the Prime Minister (2012) *Uganda: The 2010–2011 Integrated Rainfall Variability Impacts, Needs Assessment and Drought Risk Management Strategy*. Kampala: Department of Disaster Management, Office of the Prime Minister (http://gfdrr.org/sites/gfdrr/files/UGANDA_PDNA_Report_2012.pdf).

Wucherpfennig, Julian; Nils B Weidmann, Luc Girardin, Lars-Erik Cederman & Andreas Wimmer (2011) Politically relevant ethnic groups across space and time: Introducing the GeoEPR dataset. *Conflict Management and Peace Science* 28(5): 423–437.

ALEXANDER DE JUAN, b. 1979, PhD in Political Science (University of Tübingen, 2010); Professor of Comparative Politics, University of Osnabrück, Germany (2018–); his research focuses on the relationship between violent conflict, state-building, and development.

NIKLAS HÄNZE, b. 1995, BA in Political Science (University of Osnabrück, 2020); MA student, University of Konstanz (2020–).