journal of peace RESEARCH

Climate clashes? Weather variability, land pressure, and organized violence in Kenya, 1989–2004

Journal of Peace Research
49(1) 81–96

DOI: 10.1177/0022343311425842
jpr.sagepub.com
SAGE

Ole Magnus Theisen

Norwegian University of Science and Technology & Centre for the Study of Civil War, PRIO

Abstract

The evidence of coming climate change has generated catastrophe-like statements of a future where a warmer, wetter, and wilder climate leads to a surge in migrant streams and gives rise to new wars. Although highly popular in policy circles, few of these claims are based on systematic evidence. Using a most-likely case design on Kenya 1989–2004, with new geographically disaggregated data on armed conflicts below the common civil conflict level, this study finds that climatic factors do influence the risk of conflicts and violent events. The effect is opposite to what should be expected from much of the international relations literature; rather, it supports the observations made by recent anthropological studies. Years with below average rainfall tend to have a peaceful effect on the following year and less robustly so for the current year as well. Little support is found for the notion that scarcity of farmland fuels violence in itself or in election years. More densely populated areas – not areas with a low land per capita ratio – run a higher risk of conflict. Election years systematically see more violence, however. The findings therefore support the notion that large-scale intergroup violence is driven by calculation and political gain rather than desperate scrambles for scarce land, pasture, and water resources.

Keywords

climate change, elections, Kenya, land, resource scarcity, violence

Introduction

> There is one issue I want to raise, general to all. Water. Water for livestock, water for people. They go into conflict because water is not available. If we had water we could start sorting out the conflict. A lot of fighting is over water availability. (Elder from the Jie group in Uganda, cited in Mkutu, 2008: 14)
>
> The threat from climate change is serious ... more frequent drought and crop failures breed hunger and conflict. (Obama, 2009)

The two statements above, one from a person of a marginalized group, the other from arguably the most powerful person in the world, both posit a clear link between resource scarcity and conflict. They also fit nicely into the popular narrative on sub-Saharan Africa as a desperately poor continent without sufficient food, water, or livelihoods for its growing population. In a nightmarish account of Africa, Kaplan (1994) pointed to high rates of population growth and allegedly unsustainable resource utilization as two main factors behind the development failure of several African states. This so-called 'crisis-narrative' (Roe, 1995) has also been used to explain why civil or intergroup violence breaks out and why civil violence is more prevalent in less developed countries. Add to this the recent debate on the future consequences of climate change, and this neo-Malthusian explanation should be as relevant as ever. For instance, a recent report by Safeworld (2009: i) argues that in the 2009 drought in East Africa:

Corresponding author:
ole.magnus.theisen@svt.ntnu.no

> There seemed a clear correlation between the scarcity of natural resources resulting from the drought, and violent conflict. In the context of growing awareness and concern about global warming, this inevitably prompts the question as to whether Kenya's prolonged drought was a consequence of climate change – and to what extent therefore climate change will lead to an increase in violent resource-based conflicts.

Several scholars also attribute intergroup violence in Kenya to scarce renewable resources. Dietz (1987) and Mkutu (2008) claim a strong link between drought and pastoral violence, whereas Kahl (2006) suggests that violence in the central parts of Kenya in election periods is heavily influenced by competition over scarce farmland. However, the link between scarce resources and conflict is contested in general (Peluso & Watts, 2001; de Soysa, 2002), as well as in the particular case of Kenya (Witsenburg & Adano, 2009).

In the following I will first demonstrate why Kenya is a critical case in analyzing the potential links between scarce renewable resources and violent conflict. Thereafter, I review the existing research on resource scarcity and armed conflict in general and on Kenya in particular. Subsequently, I outline my research design before I present and discuss my findings. My findings indicate that relatively dry years tend to have a peaceful effect on the following year. Little support is found for the notion that scarcity of farmland fuels violence in itself or in election years, but an election by itself increases risk. More densely populated areas run a higher risk of conflict, but this is not due to pressure on cropland; rather, it is likely to be driven by other mechanisms that put densely populated areas at risk.

Why study Kenya?

In a region where four out of five neighboring countries have experienced some of the longest and bloodiest civil conflicts in Africa, Kenya's civil peace offers at first glance a peaceful contrast. Except for the brief violence associated with the failed 1982 coup attempt and the irredentist Shifta war in the North-Eastern Province immediately following independence, Kenya's post-independence period has been free of insurgent movements. However, the country has seen several quite bloody episodes of interethnic conflicts and state repression, the latter mostly taking the form of groups supporting the incumbent attacking civilians suspected of supporting the opposition. The lack of a large-scale civil war in Kenya eliminates the possibility that interethnic violence is simply a spillover from a civil war, for instance as a power-struggle along ethnic lines within a rebel movement. Other factors not directly related to civil war dynamics are likely to be at center stage. Of course, this does not mean that civil conflict dynamics are absent, since conflicts in its neighboring countries are frequently seen as influencing violence in Kenya (Mkutu, 2008). This lack of an insurgent movement is the first reason for using Kenya as a suitable case when studying the links between scarce resources and conflict.

Kenya's sluggish economic growth has been partly blamed on its population growth rate and the lack of available farmland to occupy the growing population (Markakis, 1998: 95). Whereas the economically most productive regions were peaceful until 1991, the northern and eastern districts have seen persistent intergroup conflicts since the pre-colonial era (Kimenyi & Ndung'u, 2005). Most of the time this has taken the form of one group fighting another with the occasional involvement of state forces.[1] With the announcement of multi-party elections upcoming in 1992, this pattern changed as interethnic violence flared up in Bungoma and Trans-Nzoia districts in late 1991. Unrest spread across Rift Valley Province as prominent politicians within the regime incited, trained, and paid KANU supporters to attack opposition supporters and claim the land as theirs (Roessler, 2005). The violence subsided slowly from 1993 to 1995, only to resurface on a smaller scale on the coast before the 1997 elections. While the 2002 elections were calm, the period leading up to and immediately following the 2007 elections saw renewed bloodshed in central parts of Kenya. Politicized land conflicts, allegedly over disputed land-resettlement schemes in Mt Elgon district, led to the formation of the Sabaot Land Defense Force, which committed several atrocities in the 2006–08 period (Simiyu, 2008). Thus, it has been argued that much interethnic violence is driven partly by land scarcity, as Kenya's economy and growing population is highly dependent on agricultural produce.

The violence in Kenya's drylands is also frequently explained as stemming from conflicts over other scarce resources, such as pasture and water sources, an explanation refueled by the debate on climate changes. Several anthropologists and economists claim a strong link between drought and conflict (e.g. Burke et al., 2009;

[1] In the notable cases of the 1980 Bulla Kartasi Estate massacre (Garissa) and the 1984 Wagalla massacre in which several hundred Degodia Somalis are said to have been slain on Moi's order, and the violence associated with the de-facto annexation of the Ilemi triangle (now Kibish division in Turkana) in 1988, the state was the main agent of the violence and killed a large number of civilians.

Dietz, 1987; Miguel, Satyanath & Sergenti, 2004; Mkutu, 2008). The arguments relating land scarcity to the election violence (Kahl, 2006) and about pastoralist conflict during and after drought and in the dry season make the country a very well-suited case for a study of the relationship between resource scarcity and conflict. Some have argued that resource scarcity is a more plausible driver of smaller conflicts than of full-blown civil wars (Barnett, 2001; Suliman, 1999). Since Kenya has experienced several intergroup conflicts, it is an excellent test case. Moreover, many of the hypotheses in the environmental security literature are based on cases from Kenya (e.g. Kahl, 2006; Mkutu, 2008). Studying one country also implies that country-specific factors do not affect the observations differently. Among the large number of suggested factors linking resource scarcities conditionally to conflict in the environmental security literature (Homer-Dixon, 1999; Kahl, 2006), Kenya exhibits several, such as a low degree of economic development, high ethnic barriers, societal inequalities, an unstable neighborhood, and contested elections. Even though it is impossible to generalize from a single case, testing a case where the theory should apply best could tell us more about the applicability of the theory in general. This is what Lijphardt (1971) refers to as a 'fitting' case study.

Theory and hypotheses

Scarce renewable resources and armed conflict

As already noted, politicians and NGOs have repeatedly claimed a strong link between climate change and violent conflict, but rarely with reference to existing scholarly work. Environmental security scholars such as Homer-Dixon (1999) and Kahl (2006) arguably form the scholarly tradition that most generally links scarcity of renewable resources to armed violent conflict. They argue that social consequences of environmentally-induced migration, soil degradation, droughts, floods, and other natural disasters, as well as more slow-moving processes such as decreased land productivity due to population pressure, can cause social processes that again can lead to violent conflict.

Homer-Dixon's (1999) tripartite concept of *environmental scarcity* relates to the supply, demand, and distribution of a resource. When *environmental scarcity* is sufficiently acute it can lead to chronic poverty which, in turn, can lead to violence. Homer-Dixon emphasizes that environmental degradation and absolute scarcity are, to a large extent, exogenous to social processes, and that economic, cultural, and political institutions are partly endogenous to scarcity. It is therefore appropriate to treat demographic and environmental factors as independent variables, and social variables such as migration and conflict as dependent variables. Although Homer-Dixon's model refers to renewable resource scarcity in general, he claims that the importance of climate induced scarcities will become more pronounced in the future.

During the last five to ten years, a number of large-N analyses have tested relationships between inter-year climatological variability and violence. Miguel, Satyanath & Sergenti (2004) as well as Hendrix & Glaser (2007) find that negative rainfall shocks either directly – or via economic shocks – increase the risk of civil armed conflict. Jensen & Gleditsch (2009) criticize Miguel et al.'s (2004) operationalizations. However, they find a significant although weaker and less robust effect of rainfall. Furthermore, Ciccone (2011) shows that earlier findings on rainfall and conflict, using percentage change from one year to the next as the measure of drought, are sensitive to changes from a relatively wet year to a normal year. What might appear to be a drought could simply be a regression towards the mean. Thus, to date there is little robust statistical evidence linking lower rainfall to civil armed conflict. In a recent study, Burke et al. (2009) find that sub-Saharan countries run a significantly and substantially higher risk of experiencing civil conflict onsets in warmer years. However, Buhaug (2010) shows that their findings are quite fragile. Accounting for the importance of local geographic, climatic, and socio-political factors, Theisen, Holtermann & Buhaug (2011-12) use data on subnational units for Africa and find no relationship between drought and civil conflict onset. The lack of robust findings on the relationship between climatic factors and conflict can be due to the fact that almost all studies to date have looked at civil conflict, that is, insurgencies against the state. As argued above, several scholars argue that scarce resources should be more relevant in generating smaller more local conflicts than civil or intrastate wars (Barnett, 2001; Suliman, 1999).

A few studies have systematically analyzed whether drought influences the risk of pastoral conflict. Meier et al. (2007), studying the border areas between Uganda, Kenya, Sudan, and Ethiopia over two years, find that periods with more abundant vegetation experience a higher incidence of raids and no link between rainfall deficiency and violence. Taking a longer-term perspective, Witsenburg & Adano (2009) analyze the Marsabit district in Kenya and find that wetter years see on average more than twice as many killed than do drier years.

Thus, empirical studies on local violence so far have lent little support to the notion that droughts fuel violence.

Like the cross-national analyses on the climate–conflict nexus, cross-national analyses on land pressure and conflict have generally failed to find support for such a linkage (Salehyan, 2008; Theisen, 2008). In single-country analyses there is more support. Testing the effect of land pressure on routine and episodic violence in Indonesian provinces, Østby et al. (2011) find no effect, but they do find some interactive effects between intergroup inequalities and population growth on violence. Similarly, Urdal (2008) finds some evidence for a link between rural population density and conflict in India. Looking at land scarcity, distribution, and violence in a Rwandan community for the period 1988 to 1995, André & Platteau (1998) find that a decreasing land per person ratio combined with rising inequalities and low off-farm employment opportunities increases tensions considerably. What empirical support there is for the resource scarcity viewpoint can be found in statistical studies of single countries rather than in global or regional studies. Before I proceed to conduct such a test, I will have a closer look at the proposed causal linkages between scarce resources and conflict for Kenya.

Droughts and violence

The arid and semi-arid lands (ASALs) of Northern and Eastern Kenya are predominantly inhabited by pastoralists. Districts such as Marsabit, Turkana, and West Pokot see persistent cattle rustling followed by cycles of revenge – indeed it is very rare that a year goes by without reports of members of different groups killing each other. Groups in much of Northern Kenya and the border areas of Uganda, Sudan, Ethiopia, and Somalia are involved in similar interaction patterns that oscillate between cooperation and cycles of violence. In these areas the population depends on the bimodal rainy season for their livelihood. A drought can have devastating effects on herds, frequently leading to migration to wells and rivers that members from different ethnic communities have to share. As pointed out by Witsenburg & Adano (2009: 515) and Meier, Bond & Bond (2007: 721), the direct reliance on rainfall and the persistence of violence in drylands dominated by pastoralists give the linkage between climate factors such as droughts and violence some face validity. The suggested mechanisms are not always well understood and some are partly contradictory.

Reuveny (2007) has argued that climate change-induced migration can cause violence under certain circumstances. McCabe (2002: 130ff) describes being attacked by Pokot raiders while trekking with a Turkana family southward to dry season pastures in the borderlands between West Pokot and Turkana districts during an extreme drought. The Turkana took the risk of being raided due to the relatively good dry season pastures. The family lost two herders and over 100 small stock. It was not competition over scarce pasture or water that caused the raid, but the fact that the drought brought Pokot and Turkana into proximity of each other, thus facilitating raiding by the better armed Pokot. Echoing this, Mkutu (2008) argues that tension is frequently fuelled by the migration to pasture in dry periods, which involves crossing into another group's area.

However, dry periods could also potentially reduce the risk of conflict as they are found to have a clear impact on the relative prices of vital commodities in pastoralist areas of the Horn of Africa. Hence, they also reduce the economic value of the raiding output. During one drought the price of a goat fell from approximately USD 20 to 5 (GOK, 2000). Due to difficulties of finding water and pasture for the herds, the price of cattle drops in drier years, whereas the prices of grain necessary for survival rise. The same tendency can be found in other pastoralist areas in the Sahel belt (see, for instance, Legge, 1995 on Niger). Droughts also thin the vegetation that provides camouflage for rustlers (Meier, Bond & Bond, 2007; Witsenburg & Adano, 2009), increase labor time in herding cattle for pasture and water, reduce the ability of cattle to sustain longer treks, and prolong the visibility of cattle trails (Witsenburg & Adano, 2009). Thus, our expectations as to whether droughts should increase or decrease the risk of conflict depend on whether cattle raiding should be seen as an activity where the aim is to gain assets, whether it should be seen as straightforward conflicts over scarce resources, or whether droughts simply and indirectly increase the risk as implied by the Turkana study by McCabe (2002) by increasing interaction between groups. In short, the issue is whether violence should be seen as opportunistic calculation or as a sign of desperation. Although the argument based on rainfall deficiency is arguably most relevant for the ASALs of Northern Kenya and cattle-raiding related conflicts, violence in southern Kenya has also been argued to be over scarce river water during drought (Homer-Dixon, 2007). In light of the contrasting expectations and findings in the literature on droughts and violence, two competing hypotheses can be derived:

H1a: Drier years see more conflicts and events.

H1b: Drier years see fewer conflicts and events.

Violence does not necessarily take place where the droughts occur, but could occur in less drought-prone areas close to the droughts if migration or similar processes are at play. Hence, an alternative hypothesis can be put forward:

H2: A shorter distance to drought increases the risk of conflict.

Since Burke et al. (2009) have argued that warming fuels conflict, I also test:

H3: Warmer years see more conflicts and events.

Land, elections, and violence

Kahl (2006) stresses that political factors alone cannot explain electoral violence in Kenya – they must be complemented by an explanation that takes into consideration demographics as well as natural resources. Feeling threatened by political liberalization, segments of the Moi regime capitalized on environmental, demographic, and historical grievances by fuelling violence in densely populated and agriculturally rich areas in order to stay in power after the 1992 elections:

> The overcrowding of the violence-affected areas is obvious . . . The end result of rapid population growth, environmental degradation, and unequal land distribution was thus an increasingly fierce competition between individuals and social groups for arable land. (Kahl, 2006: 138)

Mueller (2008) echoes this, claiming that resentment towards non-KANU groups in the Rift Valley among Moi's supporters was growing due to landlessness and a feeling of marginalization. Given the prominence of the land-pressure question in arguments on violence in LDCs in general and Kenya the following hypothesis should be tested:

H4: Areas with a low land per capita ratio run a higher risk of experiencing violence.

Oucho (2002) argues that this violence in central Kenya has taken the form of ethnic cleansing as smaller ethnic groups have called for ethnically homogenous constituencies and regionalism – so-called 'majimboism' – in fear of being dominated by larger ethnic groups. This becomes evident when political competition heats up around elections.

Land and elections are therefore frequently linked in generating violence, as in the case of the 2007 elections (Tostensen, 2009). Bates (2008) concurs, arguing that violence between the Kikuyu and KANU-affiliated groups in the time up to and after the 1992 elections was a result of militias being built around politicians as they 'sought to build reputations for being able to defend rights to land'. As Mueller (2008: 190) puts it: 'mobilizing resentment against outsiders [non-KANU] over land dovetailed with the self-interest of local elites and with efforts to ensure Moi's political survival after 1991'. If land-based grievance has been used as a political instrument up to and following periods of heightened political competition, it could be expected that:

H5: Areas with a low land per capita ratio run a higher risk of experiencing interethnic violence in election years than other areas.

The stories of election-related violence in Kenya point to ethnicity and political competition as central factors (see Kasara, 2010). Although this is obviously a highly relevant topic, the scope of this article will not permit an analysis that would do justice to these factors. Ethnicity is therefore only treated as a control variable in this study.

Research design and analysis

Data on intergroup violence in Kenya

To date there exists no dataset with time-series information on intergroup violence in Kenya. The logical starting point for gathering information on ethnic violence would at first glance be police records or other official statistics. However, as Bocquier & Maupeu (2005) point out, in Kenya there is no extensive database that records all deaths. Police archives for the last 30 or so years are almost completely inaccessible. Their solution is to use the relatively free and independent press in Kenya to generate a dataset on violent deaths. Similar approaches have been employed by, among others, Varshney, Tadjoeddin & Panggabean (2008) to collect information in Indonesia on violence from the level of civil conflict right down to the level of routine violence.

Since the focus is on large-scale violence, I chose to follow Varshney, Tadjoeddin & Panggabean (2008) by not including violence between two individuals unless it triggered a larger group clash. What is covered is violence conducted by a group on another group, as well as violence by the state or state actors on a group or on civilians.[2] As news reports, particularly from the Northern districts bordering Sudan, Ethiopia, and Somalia, can be sparse and the most violent cases are much more likely to be reported, I set a lower limit on violence that generated 25 deaths in a calendar year.[3] If one incident resulted in 25 or more killed but there were uncertainties with one of the parties, I included the conflict as long as it did not overlap in time or space with another incident or conflict. The dataset includes other forms of violence than exclusively group on group violence. In addition to so-called communal conflicts, it also includes state violence against civilians/militias[4] and state-sponsored violence via non-state actors towards civilians. The dividing line between what is state-instigated violence, what is exclusively communal warfare, and what is repression by police or other state forces is hard to draw. For instance, conflicts involve fighters from other countries' insurgent or government armies – UPDF fighters together with Karamojong (these UPDF soldiers might very well be ethnic Karamojong) and Oromo Liberation Front and Ethiopian forces along the Ethiopian border. Here the lines between acting as a soldier for the state, acting on behalf of a group interest (more or less altruistic), and one's own self-interest can be blurred. It is hard to justify an objective criterion that distinguishes between different forms of violence. I have therefore chosen a quite inclusive criterion. The only event that generated 25 or more deaths in the study period that is left out is the Al Qaeda attack on Nairobi in 1997. I used the Factiva database as a starting point and supplemented it with material from scholarly work and NGO reports to generate the dataset. My dependent variable *conflict* is simply the first event of a conflict that generated at least 25 deaths in the same year. The other dependent variable is each recorded event for the conflict. This means that

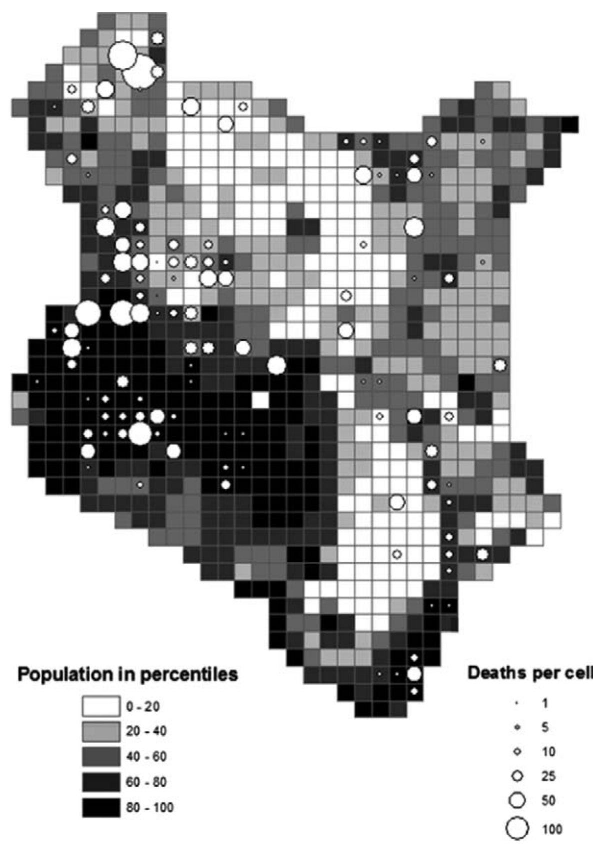

Figure 1. Population and conflict events, 1989–2004

events with less than 25 killed are included as long as they are part of a conflict that killed 25 persons that year. Events that are not part of a conflict pattern that in total do not generate 25 deaths in a year are not included. Both *conflict* and *event* are dichotomous variables, although I performed extra robustness checks using the count of events in a cell per year. I recorded the most accurate location of each event and assigned geographic coordinates. In cases where no exact location could be assessed, I assigned it to the administrative unit of the lowest order that could be identified. For an illustration of where the events occur in relation to population density, see Figure 1.

Research design

My analyses are for the years 1989–2004, as my measure of rainfall is limited up to 2004. There were in total 47 separate conflicts (counted by year) in this period, and 172 separate cell-years that include events. I use a grid fishnet of 0.25° by 0.25° resolution. I use artificially imposed cells rather than political-administrative units or ethnic group areas for three reasons mainly. Firstly, there is a huge variation in size between districts, and the same is the case for areas defined by ethnic

[2] Police killings of criminals or civilians are not included unless there is a clear ethnic or organizational overtone (such incidents rarely lead to more than 25 killed anyway). The General Service Units (GSU) frequently intervene to curb cattle rustling between communities. Such incidents are included.

[3] As Bocquier & Maupeu (2005: 334) put it, 'The press not only underreports violent deaths, its reports are also biased towards the most extreme events.'

[4] The two instances in the dataset of state repression that was not provoked by some violent prelude with an interethnic element are the repression of the Saba Saba demonstrations in 1990 and the KANU-regime's use of police and KANU-supporters against the opposition in Central Kenya in 1997.

characteristics. Secondly, in Kenya administrative as well as ethnic borders are in themselves analytically interesting in explaining violent conflict, and therefore not suitable as units of analysis studying violence. For instance, Kasara (2010) has shown that the growth of districts in Kenya is influenced by electoral competition. In contrast, artificial grid cells are not affected by political processes on the ground. Finally, modeling dependence between observations is more straightforward in a set-up with uniformly shaped units.

Independent variables

Rainfall deficiency. Geo-referenced precipitation data were derived from the Global Precipitation Climatology Centre of the World Meteorological Organization (Rudolf & Schneider, 2005) and contain annual estimates of total precipitation (mm) for the global land surface at 0.5° resolution for all years, 1989–2004. I test three operationalizations of rainfall shortage. I follow Hendrix & Salehyan (2012) in operationalizing rainfall deviation as the percentage deviation from mean rainfall in the cell in year *t* divided by the panel standard deviation.[5] Large parts of Kenya are susceptible not only to annual aberrations in rainfall patterns but also intra-annual deviations from the norm causing droughts in 'normal' years, with profound consequences for livelihoods (McCabe, 2002). In order to capture both inter- and intra-annual deviations from normal precipitation, I employed the Standardized Precipitation Index, SPI6. The index is based on an aggregation of monthly aberrations from normal rainfall during the six preceding months and then given an index value. These running monthly values are then aggregated to a yearly format (McKee, Doeskin & Kleist, 1993), coded as a dummy for at least a moderate drought in the year of observation. In order to tap whether violence occurs near droughts but not necessarily exactly where droughts occurred due to migration and related processes, I also used a measure that gives the distance in kilometers to the nearest drought.[6] All precipitation measures were tested for the current and previous year. Since the data are only available in a 0.5° by 0.5° resolution, this resulted in less than desired spatial variation for my 0.25° by 0.25° cells.

Temperature. My measure of temperature is the CRU TS 3.0 data from the University of East Anglia (CRU, 2008). These data contain annual estimates of temperature (Celsius) for the global land surface at 0.5° resolution for all years, 1989–2004 (Mitchell & Jones, 2005). The assumption is that the higher the temperature the drier the cell, all other things being equal. The operationalization and resolution is the same as for the deviation in precipitation measure.

Population density and land pressure. My measure of population density is the Gridded Population of the World dataset, Version 3 (CIESIN, 2005) aggregated up to the 0.25° cell size which gives the cell-specific estimates of population size for 1990 and every five years on. I interpolated the trend between each data point and extrapolated the values for 1989. Since population density is not a precise measure of land pressure, I generated the share of a cell with intensive agriculture in order to test Hypotheses 4 and 5. The data are derived from 1980 Landsat data by JICA, National Water Master Plan, Kenya (1987), accessed at ILRI (http://192.156.137.110/gis/search.asp? id=288). The dataset contains information on land use classified in 14 classes. Dense agriculture (11) and plantation (13) represent intensive agriculture. The cell values are the share of the cell's landmass that falls into either of these two categories. As an alternative measure I derived the land of a cell that is defined as cropland by WRI (2007). To obtain a measure of population pressure, both the intensive agriculture and cropland measures were normalized by the population count in the cell. The measures for population per cell and cropland per capita have been divided by 1,000 to ease interpretation.[7] Since large parts of Kenya are too dry for crops and therefore would get zero or very low values on these land-scarcity measures, I include a dummy for cells with an average annual precipitation of less than 700 mm, the conventional threshold for semi-arid land. Since largely urban regions with non-agricultural economies may get 'false' low land to person ratios, I employed a dummy capturing the cells containing Kenya's towns with over 100,000 inhabitants.

Control variables. The most fine-grained and suitable dataset on ethnic groups in Kenya is the Ethnologue v.16 dataset (Lewis, 2009). From this dataset I generated two dummies, one capturing whether a cell harbors two groups, the other three or more groups to allow for an elevated risk of greater ethnic heterogeneity. Both

[5] This goes for all my deviation measures.

[6] Divided by 1,000 to get readable regression results.

[7] Agricultural land per capita was multiplied by 1,000 and the interaction between cropland per capita and election by 1,000,000, to ease interpretation.

boundaries between ethnic groups and overlapping ethnic areas are taken into account. The election variable is a dummy for the years 1992, 1997, and 2002 in which Kenya had parliamentary elections.

Poverty is one of the most central factors explaining civil violence, but less is known for other forms of organized violence. To capture the effect of poverty, I used the 1999 estimates of the so-called poverty density, which is the proportion of the population living below the poverty line[8] per square kilometer (CBS, 2003). The data were aggregated from the mean poverty density for polygons within each cell. As the poverty density closely follows population density, the values were normalized by the population in the cell in 2000 to get an approximation of the proportion of persons in a cell who live below the poverty line. The original data for most of Kenya are at the location level (CBS, 2003), whereas for North-Eastern Province the data are at the Constituency level (CBS, 2005).

In order to control for temporal dependence I created a variable capturing the time since last violent event for each cell (Raknerud & Hegre, 1997), operationalized as a decay function with the risk of conflict halving approximately every half-year. Since unmeasured geographic variables could affect the conflict risk, I generated a measure capturing the share of neighboring cells up to the third order that experienced an event the previous year. This is similar in approach although not identical to the measure used in Hegre, Østby & Raleigh (2009).

Results[9]

Table I shows the results from the effect of climate factors on the risk on conflict. Model 1 shows that a positive deviation in precipitation from the period mean in the current year is negatively related to conflict, that is, drier years are marginally more at risk of conflict, but this is far from significant. To test whether an abnormally wet or dry year runs a higher risk of conflict, I included a squared term for precipitation, both in the current year and the previous year. Model 1 shows that there is no such curvilinear tendency for conflicts for the current year. The results for the lagged rainfall deviation variables indicate that the linear term is negatively related to conflict, whereas the squared term is positively related to conflict, but neither of them is significant. The two terms are highly correlated, and dropping the squared term reveals that the linear term is positively and highly significantly increasing conflict risk, as shown in Figure 2 (see also web appendix Table IE). Years following wetter rather than drier years are systematically more at risk of conflict, in contrast to what one should expect from much of the environmental security literature. On the other hand, the finding is quite in line with the results from Witsenburg & Adano (2009) for Marsabit and Moyale districts, which indicate that droughts can have a temporary cooling effect on tensions. To check if this was in line with the literature on violence in pastoralist areas where drier periods have been found to be less violent, I ran Model 2 on cells with an average annual precipitation of less than 700 mm. The results remained the same (see Table IE in the web appendix). Thus, the peaceful effect of dry years applies both to arid and semi-arid areas.

As already discussed, a year with above average precipitation measured at the annual level can mask an actual drought if the precipitation is plentiful but falls too late, too suddenly or in excessive concentration. The SPI6 dummy captures such deviations, as well as years of substantial below average precipitation. In contrast to the simpler measures in Models 1 and 2, both the current year measure and the one-year lag are negative but far from significant. Model 4 captures the effects of droughts in the neighborhood via processes such as migration. Distance to drought in the current year is negatively but insignificantly related to conflict, whereas for the previous year it is positive and significant, signaling that proximity to drought last year decreases conflict risk. This is in line with the findings in Model 2. However, the average distance to drought as measured by SPI6 is actually significantly lower in the wetter parts of Kenya than in the drier areas, although in substantive terms the difference is quite small (70 vs. 75 km is average distance for ASAL vs. non-ASAL cells). The SPI6 measure thus reveals that high-rainfall areas are just as prone to erratic rainy seasons as drier areas are. Regarding Hypothesis 2, the conclusion is that the closer a cell was to a drought last year, the lower the risk of conflict.

[8] There is a substantial difference between rural and urban poverty, as subsistence agriculture and access to natural resources make it easier to survive for less in the countryside. The data on the poverty line reflect the easier access to subsistence resources in rural areas. The poverty line is defined as spending less than Ksh 1,239 per month in the countryside versus Ksh 2,648 per month in urban areas (WRI, 2007: 13).

[9] All climate models were also run with relogit (see web appendix posted with the replication data). This resulted in more variables being significant. But this was the same if these models were run with OLS. Thus, using a fixed-effects model is necessary to catch some time-invariant factors that affect conflict risk. Dropping outliers did not substantially affect my results.

Table I. Conflict and climate factors

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*
Precipitation %	0.003					
	(0.003)					
Precipitation % squared	–0.001					
	(0.000)					
Precipitation % $_{t-1}$		0.004				
		(0.003)				
Precipitation % squared $_{t-1}$		–0.000				
		(0.000)				
SPI6 drought			–0.001			
			(0.002)			
SPI6 $_{t-1}$ drought			–0.002			
			(0.001)			
Distance to SPI6				–0.005		
				(0.004)		
Distance to SPI6 $_{t-1}$				0.014**		
				(0.006)		
Temperature %					0.002	
					(0.005)	
Temperature % squared					0.000	
					(0.001)	
Temperature % $_{t-1}$						–0.005
						(0.003)
Temperature % squared $_{t-1}$						0.001*
						(0.001)
Neighborhood $_{t-1}$	0.033	0.030	0.031	0.031	0.031	0.031
	(0.026)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)
Time since event	–0.009	–0.009	–0.009	–0.009	–0.009	–0.009
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Constant	0.010	0.009	0.007	0.007	0.012	0.002
	(0.008)	(0.008)	(0.006)	(0.006)	(0.014)	(0.007)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Trend	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,520	13,520	13,520	13,520	13,520	13,520
R^2	0.002	0.003	0.002	0.003	0.003	0.002
Number of cells	845	845	845	845	845	845

Robust standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.
1991 dummy dropped due to perfect prediction of peace.

Models 5 and 6 show results for the warming hypothesis. Neither is significant at the 5% level, however. The warming hypothesis is therefore not supported.

Table II reports the climate models for events. Both the linear and squared term for precipitation in the current year significantly affect event risk. The risk of an event increases quite steadily up to around the 80th percentile, where the effect shows a slight downward trend (see Figure A1 in the web appendix). Thus, the impact of the non-linear effect captured in the polynomial is small. The effect is not very robust; dropping the neighborhood variable renders both the linear and squared rainfall variables insignificant. For precipitation in the previous year, the effect of the linear term is significantly increasing event risk just as it did in the parallel model for conflicts (Model 2). The results for the SPI6 measure of drought confirm the findings for deviations in precipitation. Whereas there is a negative but non-significant effect for the current year, the effect is significant for SPI6 drought last year. Looking at the results from Tables I and II jointly, we find some support for Hypothesis 1b rather than for 1a – conflicts measured as the first event or as all events in a year tend to be less likely in years following drier years.

The results for proximity to an SPI6 drought for events are similar to those found for conflicts. A higher

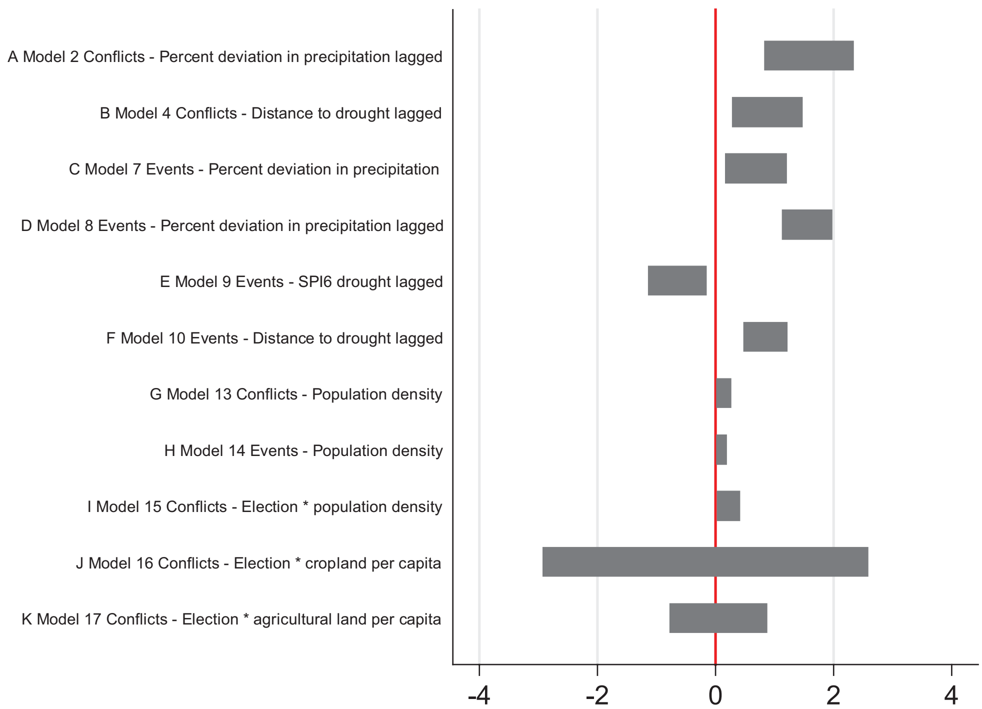

Figure 2. Relative risk of conflict or event, 1989–2004
The graph illustrates 95% confidence bands of difference in estimated risk between the 10th and 90th percentiles of the variable of interest, holding all control variables at their median. If the gray box crosses the line at zero the effect is non-significant. For Model 16, the 99th percentile was used, and for Model 17 the 95th percentile had to be used in order to get variation. The calculations were conducted using the relogit software (King & Zeng, 2001).

distance to last year's closest drought elevates the risk of a cell experiencing an event (higher values on the proximity to drought measure indicate longer distances). This implies that there is quite strong support for the notion that drought has a peaceful effect on the following year, operationalized as deviation from period mean, SPI6 drought, or distance to SPI6 drought.

Regarding the deviations in temperature, only last year's value affects event risk significantly. For the previous year the linear term is negatively associated with event risk, whereas the squared term is increasing risk and both are significant. A plot of the risk (Figure A3 in the web appendix) reveals a U-shaped curve where both very cold and very warm years increase the risk of an event the following year. Hypothesis 3 therefore receives mixed support. To test the robustness of the results for events, I ran the analyses in Table II with the current year's neighborhood effect instead of last year's. This made all climate results insignificant (see Table IIC in the web appendix). However, to control for all other events in the neighborhood the same year automatically introduces reverse causation for events that occurred prior to their neighboring events. This control is not run on the conflict variable, as this is almost invariably the first in a neighborhood in any given year, and controlling for neighboring events would be controlling for subsequent events in the same conflict. For this reason, my conclusion is based on last year's neighborhood variable.

Table III shows the analyses of land pressure and elections on the risk of violence. The results are nearly identical for the variables of interest between the models for conflicts and events respectively. I therefore show only the baseline model for events (Model 14 – see web appendix Tables IIIA and IIB for all models). All models show that population density increases conflict risk, even after controlling for major towns. This is a conventional finding in disaggregated conflict studies. However, no one has been able to point a finger to the mechanisms behind this finding. Candidate explanations are land scarcity, strategic objectives, and perhaps most convincingly simply violence occurring where there is more interaction (more densely populated areas) and hence a higher baseline risk of being killed.

Regarding Hypothesis 4, the baseline risk for a conflict is not elevated in areas with a low cropland per capita ratio (Model 16) or intensive agriculture (Model 17). To stop at an unmitigated relationship between land pressure and conflict would not do justice to the claims made

Table II. Events and climate factors

	Model 7	*Model 8*	*Model 9*	*Model 10*	*Model 11*	*Model 12*
Precipitation %	0.013**					
	(0.006)					
Precipitation % squared	–0.002**					
	(0.001)					
Precipitation % $_{t-1}$		0.016***				
		(0.005)				
Precipitation % squared $_{t-1}$		–0.001				
		(0.001)				
SPI6 drought			–0.002			
			(0.003)			
SPI6 $_{t-1}$ drought			–0.008***			
			(0.003)			
Distance to SPI6				–0.008		
				(0.008)		
Distance to SPI6 $_{t-1}$				0.047***		
				(0.013)		
Temperature %					0.005	
					(0.007)	
Temperature % squared					0.000	
					(0.002)	
Temperature % $_{t-1}$						–0.027***
						(0.006)
Temperature % squared $_{t-1}$						0.004***
						(0.001)
Neighborhood $_{t-1}$	0.201***	0.185***	0.190***	0.194***	0.192***	0.200***
	(0.053)	(0.052)	(0.052)	(0.053)	(0.052)	(0.053)
Time since event	–0.034	–0.034	–0.034	–0.034	–0.034	–0.034
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Constant	0.034**	0.032**	0.023**	0.020*	0.033	0.005
	(0.014)	(0.013)	(0.011)	(0.011)	(0.021)	(0.014)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Trend	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,520	13,520	13,520	13,520	13,520	13,520
R^2	0.012	0.015	0.012	0.013	0.012	0.013
Number of cells	845	845	845	845	845	845

Robust standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
1991 dummy dropped due to perfect prediction of peace.

by scholars such as Kahl (2006) and Oucho (2002), who argue that electoral competition is crucial in explaining why latent land-related grievances are turned into violence. Although the interaction term between elections and cropland in Model 16 has a positive effect on conflict risk, Figure 2 reveals that only interaction with population density leads to a significant (but marginal) increase in risk. In sum, land pressure on its own or in interaction with elections does not increase conflict risk. Hypotheses 4 and 5 are not supported.

Table III shows that factors other than land scarcity explain conflicts and events in Kenya. Arid and semi-arid areas run a higher risk of conflict, but this is not significant at the 5% level. In the discussion on what factors increase the risk of violence, it was quite clear that elections should affect the risk as they can be employed as an instrument to either displace groups from a district or to prevent them from voting in order to influence the outcome of the election. In line with the qualitative literature on violence in Kenya, elections increase the risk significantly for both conflicts and events. This finding corroborates Fjelde's (2009) study of communal violence in Nigeria. Ethnic diversity also affects conflict and event risk. Whereas the dummy for two groups in a cell is far from significant, the dummy for three or more groups in a cell is quite consistently related to a higher risk. Poverty

Table III. Land pressure and elections

Variables	Model 13 Conflict	Model 14 Event		Model 15 Conflict	Model 16 Conflict	Model 17 Conflict
Election	2.311**	3.541***	2.241**	2.244**	2.380**	2.311**
	(0.944)	(0.880)	(0.953)	(0.949)	(0.956)	(0.944)
Population	0.001**	0.001**	0.001	0.001**	0.001**	0.001**
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Population*election			0.001			
			(0.001)			
Cropland adjusted for population				–0.012		
				(0.023)		
Cropland*election				113.897***		
				(31.444)		
Agric. land adjusted for population					14.744	
					(16.332)	
Agric. land*election					–0.003	
					(0.036)	
Semiarid	0.623*	–0.054	0.635*	0.596*	0.628*	0.623*
	(0.336)	(0.196)	(0.336)	(0.346)	(0.350)	(0.336)
Poverty (ln)	–0.279**	–0.223**	–0.278**	–0.269*	–0.276*	–0.279**
	(0.141)	(0.090)	(0.141)	(0.138)	(0.141)	(0.141)
Large town	–0.287	0.358	–0.315	–0.284	–0.275	–0.287
	(0.823)	(0.365)	(0.833)	(0.803)	(0.817)	(0.823)
Two groups	–0.182	0.210	–0.186	–0.189	–0.192	–0.182
	(0.396)	(0.218)	(0.396)	(0.393)	(0.394)	(0.396)
Three or more groups	0.920**	0.557**	0.909**	0.880**	0.878**	0.920**
	(0.413)	(0.248)	(0.412)	(0.415)	(0.419)	(0.413)
Neighborhood $_{t-1}$	6.141**	8.015***	6.193**	6.198**	6.152**	6.141**
	(3.047)	(1.522)	(3.018)	(3.048)	(3.046)	(3.047)
Time since event	1.846***	1.683***	1.877***	1.862***	1.841***	1.846***
	(0.452)	(0.270)	(0.447)	(0.451)	(0.454)	(0.452)
Constant	–9.920***	–9.371***	–9.899***	–9.726***	–9.906***	–9.920***
	(1.593)	(1.333)	(1.593)	(1.596)	(1.596)	(1.593)
Year dummies	Yes	Yes		Yes	Yes	Yes
Trend	Yes	Yes		Yes	Yes	Yes
Observations	13,232	13,232		13,232	13,232	13,232

Robust standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
1992 and 1994 dummies dropped due to multicollinearity. Dummy for 1991 dropped due to perfect prediction of peace.

Table IV. Summary of results

Hypothesis	*Conflict*	*Event*
Hypothesis 1a: Drier years	Not supported	Not supported
Hypothesis 1b: Wet years	Supported for t–1	Supported
Hypothesis 2: Distance to drought	Opposite for t–1	Opposite for t–1
Hypothesis 3: Warmer years	Not supported	Mixed
Hypothesis 4: Land pressure	Not supported	Not supported
Hypothesis 5: Low land per capita ratio × Elections	Not supported	Not supported

measured as poverty density divided by population density turns out to be significantly and negatively related to events and less robustly so for conflicts. This finding might seem counter-intuitive. While the pastoralist areas that see an overwhelming share of the conflicts are quite uniformly poor, due to the sheer size of the country, quite a few of the cells covering these areas are also peaceful. It is very likely that these poor and sparsely populated areas have markedly higher per capita risk of violence than agricultural areas. However the focus on large-scale violence is posing a different question. For a study that uses a per capita measure of persons killed, see Witsenburg & Adano (2007). Disaggregated single-country studies have found poverty both to decrease the risk of violence (Hegre, Østby & Raleigh, 2009) and increase it (Østby et al., 2011), and risk rising to a point where it starts to drop (Tadjoeddin & Murshed, 2007). From Table III we see that both a shorter time since the previous event in the cell and a higher share of neighboring cells with events last year increases conflict and event risk.

Discussion

Tests of the hypotheses on resource scarcity lend most support to those that argue that resource scarcity does not fuel violence and seems even to favor those that see droughts as temporarily cooling tensions. Whereas land scarcity in the traditional Malthusian sense is not fuelling violence, climate factors play a role. Firstly, precipitation last year has an effect opposite to that suggested in the Environmental Security literature. Secondly, the effect of temperature goes in both directions and is significant in one model only. Since the majority (40 out of 47) of the conflicts involve pastoralists, the dynamics described by Witsenburg & Adano (2009) could be at play in explaining why a drier year leads to more peace in the next. Their argument is based on one area, however, and should be compared with anthropological explanations from other areas. Eaton (2008), analyzing raiding behavior in North-Western Kenya and the adjoining part of Uganda, came to similar conclusions. Raiding is much less likely during droughts. As he puts it, 'The people of the North Rift are well aware that intensive fighting during a drought is suicidal', and therefore cooperation and reconciliation are sought in years of hardship (Eaton, 2008: 101). Whether climate change will exacerbate conflict incidence and intensity is uncertain and cannot necessarily be extrapolated from my results here, since they are based on short-term fluctuations rather than trends. That being said, climate change is likely to increase the frequency of extreme weather events such as droughts.

As a critical test case for environmental security theory, this analysis lends little support to the resource scarcity perspective. Future studies should test the external validity of the findings for Kenya to see if the effects of climate factors found here conform to a broader pattern as suggested by Suliman (1999), among others. Furthermore, other indicators of land scarcity, such as the share of people being landless in agricultural economies and effects of soil erosion, should be investigated. To date, there is a paucity of good data on this. Border politics of weak states, particularly in sparsely populated drylands, should be studied more closely, as these are factors that arguably affect mobility, interaction, and conflict risks in many African countries. Lastly, and perhaps most importantly, in order to gain a fuller understanding of interethnic violence below the level of civil conflict, the agency and constraints of central actors such as local and national level politicians should be assessed. The environmental security paradigm is largely a bottom-up perspective of violence and is therefore not very well suited for this purpose.

Conclusion

This article has shown the merit of using subnational data to test general theories on one form of violence which has been given little attention in systematic studies. I find that climatic factors do influence the risk of conflict and conflict events. I find quite strong evidence for years following wetter years being less safe than drier years. This is probably due to the infeasibility of large-scale violence in times of extreme scarcity as reconciliation, cooperation, and peace are normally sought in pastoralist societies if a drought occurs. Such an end to hostilities is frequently not long-lasting and fighting is more likely when groups have recovered from hardship. The thesis that land scarcity breeds violence in itself and in election years receives little support, although population density per se is found to increase conflict risk. Future research should try to identify which characteristics of sparsely populated borderlands make them more susceptible to violence. Is it political marginalization, spillover of civil conflicts, or hideouts for criminal elements?

Replication data

The dataset, codebook, and do-files for the empirical analysis in this article can be found at http://www.prio.no/jpr/datasets, along with a web appendix with additional tables. All analyses were done using Stata 11.2.

Acknowledgements

I would like to thank two anonymous referees, Halvard Buhaug, Andreas Tollefsen, Toni André Mikkola, Kathleen Cunningham, Karen Witsenburg, Nils Petter Gleditsch, and the participants at various workshops and conferences for helpful comments.

Funding

This research has been funded by the Research Council of Norway (Grant 193754/S30) as part of the research project 'Security Implications of Climate Change'.

References

André, Catherine & Jean-Philippe Platteau (1998) Land relations under unbearable stress: Rwanda caught in the Malthusian trap. *Journal of Economic Behavior & Organization* 34(1): 1–47.

Barnett, Jon (2001) *The Meaning of Environmental Security: Ecological Politics and Policy in the New Security Era*. London: Zed.

Bates, Robert H (2008) *When Things Fell Apart: State Failure in Late-Century Africa*. New York: Cambridge University Press.

Bocquier, Philippe & Hervé Maupeu (2005) Analysing low intensity conflict in Africa using press reports. *European Journal of Population* 21(2–3): 321–345.

Buhaug, Halvard (2010) Climate not to blame for African civil wars. *PNAS* 107(38): 16477–16482.

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

Center for International Earth Science Information Network (CIESIN) (2005) Gridded Population of the World Version 3 (GPWv3): Population density grids. Palisades, NY: Socioeconomic Data and Applications Center (SEDAC), Columbia University (http://sedac.ciesin.columbia.edu/gpw, accessed 20 January 2010).

Central Bureau of Statistics (CBS), Ministry of Planning and National Development (2003) *Geographic Dimensions of Well-Being in Kenya: Where are the Poor? From Districts to Locations*. Vol. I. Nairobi: Central Bureau of Statistics.

Central Bureau of Statistics (CBS), Ministry of Planning and National Development (2005) *Economic Survey 2005*. Nairobi: Central Bureau of Statistics.

Ciccone, Antonio (2011) Economic shocks and civil conflict: A comment. *American Economic Journal: Applied Economics*, 3(4): 215–227.

Climate Research Unit (CRU) (2008) CRU Datasets, [Internet]. University of East Anglia, British Atmospheric Data Centre (http://badc.nerc.ac.uk/data/cru, accessed 31 January 2010).

de Soysa, Indra (2002) Paradise is a bazaar? Greed, creed, and governance in civil war, 1989–99. *Journal of Peace Research* 39(4): 395–591.

Dietz, Tom (1987) *Pastoralists in Dire Straits: Survival Strategies and External Interventions in a Semi-Arid Region at the Kenya/Uganda Border: Western Pokot, 1900–1986*. Amsterdam: Netherlands Geographical Studies.

Eaton, Dave (2008) The business of peace: Raiding and peace work along the Kenya Uganda border (Part I). *African Affairs* 107(427): 89–110.

Fjelde, Hanne (2009) Sub-national determinants of non-state conflicts in Nigeria, 1991–2006. Presented at the 50th Annual Convention of the International Studies Association, New York, 15–18 February.

Government of Kenya (GOK) (2000) *Emergency Take Off of Livestock under Drought Intervention Measures*. Nairobi: Government of Kenya.

Hegre, Håvard; Gudrun Østby & Clionadh Raleigh (2009) Poverty and civil war events: A disaggregated study of Liberia. *Journal of Conflict Resolution* 53(4): 598–623.

Hendrix, Cullen S & Sarah M Glaser (2007) Trends and triggers: Climate change and civil conflict in sub–Saharan Africa. *Political Geography* 26(6): 695–715.

Hendrix, Cullen & Idean Salehyan (2012) Climate change, rainfall, and social conflict in Africa. *Journal of Peace Research* 49(1): 35–50.

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

Homer-Dixon, Thomas (2007) *The Upside of Down: Catastrophe, Creativity and the Renewal of Civilization*. London: Souvenir.

Jensen, Peter Sandholt & Kristian Skrede Gleditsch (2009) Rain, growth, and civil war: The importance of location. *Defence and Peace Economics* 20(5): 359–372.

JICA (1987) *National Water Master Plan, Kenya*. Nairobi: Japan International Co-operation Agency (http://192.156.137.110/gis/search.asp? id=288, accessed 1 August 2011).

Kahl, Colin (2006) *States, Scarcity, and Civil Strife in the Developing World*. Princeton, NJ: Princeton University Press.

Kaplan, Robert D (1994) The coming anarchy. *Atlantic Monthly* 2(2): 44–76.

Kasara, Kimuli (2010) Ethnic beachheads and vote buying: The creation of new administrative districts in Kenya, 1963–2001. Unpublished ms.

Kimenyi, Mwangi S & Njuguna S Ndung'u (2005) Sporadic ethnic violence: Why has Kenya not experienced a full-blown civil war? In: Paul Collier & Nicholas Sambanis (eds) *Understanding Civil War: Volume 1: Africa*. Washington, DC: World Bank, 123–156.

King, Gary & Langche Zeng (2001) Explaining rare events in international relations. *International Organization* 55(3): 693–715.

Legge, Karen (1995) Changing responses to drought among the Wodabee of Niger. In: Paul Halstead & John O'Shea (eds) *Bad Year Economics: Cultural Responses to Risk and Uncertainty*. Cambridge: Cambridge University Press, 81–86.

Lewis, M Paul (2009) *Ethnologue: Languages of the World*. 16th edn. Dallas, TX: SIL International.

Lijphardt, Arendt (1971) Comparative politics and the comparative method. *American Political Science Review* 65(3): 682–693.

Markakis, John (1998) *Resource Conflicts in the Horn of Africa*. London: Sage.

McCabe, Terrence (2002) *Cattle Bring Us to Our Enemies: Turkana Ecology, Politics, and Raiding in a Disequilibrium System*. Ann Arbor, MI: University of Michigan Press.

McKee, Thomas B; Nolan J Doeskin & John Kleist (1993) The relationship of drought frequency and duration to time scales. Preprints, 8th Conference on Applied Climatology, Anaheim, CA, 17–22 January, 179–184 (http://ccc.atmos.colostate.edu/relationshipofdroughtfrequency.pdf, accessed 8 January 2011).

Meier, Patrick; Doug Bond & Joe Bond (2007) Environmental influences on pastoral conflict in the Horn of Africa. *Political Geography* 26(6): 716–735.

Miguel, Edward; Shanker Satyanath & Ernest Sergenti (2004) Economic shocks and civil conflict: An instrumental variable approach. *Journal of Political Economy* 112(4): 725–753.

Mitchell, Timothy D & Philip D Jones (2005) An improved method of constructing a database of monthly climate observations and associated high-resolution grids. *International Journal of Climatology* 25(6): 693–712.

Mkutu, Kennedy A (2008) *Guns and Governance in the Rift Valley: Pastoralist Conflict and Small Arms*. Oxford: James Currey.

Mueller, Susanne D (2008) The political economy of Kenya's crisis. *Journal of Eastern African Studies* 2(2): 185–210.

Obama, Barack H (2009) Remarks by the President at United Nations Secretary General Ban Ki-moon's Climate Change Summit 22 September. United Nations Headquarters, New York (http://www.whitehouse.gov/the_press_office/Remarks-by-the-President-at-UN-Secretary-General-Ban-Ki-moons-Climate-Change-Summit/, accessed 8 February 2010).

Østby, Gudrun; Henrik Urdal, Mohammad Zulfan Tadjoeddin, S Mansoob Murshed & Håvard Strand (2011) Population pressure, horizontal inequality and political violence: A disaggregated study of Indonesian provinces, 1990–2003. *Journal of Development Studies* 47(3): 377–398.

Oucho, John O (2002) *Undercurrents of Ethnic Conflict in Kenya*. Boston, MA: Brill.

Peluso, Nancy Lee & Michael Watts, eds (2001) *Violent Environments*. Ithaca, NY & London: Cornell University Press.

Raknerud, Arvid & Håvard Hegre (1997) The hazard of war: Reassessing the evidence of the democratic peace. *Journal of Peace Research* 34(4): 385–404.

Reuveny, Rafael (2007) Climate change-induced migration and violent conflict. *Political Geography* 26(6): 656–673.

Roe, Emery M (1995) Except-Africa: Postscript to a special section on development narratives. *World Politics* 23(6): 1065–1069.

Roessler, Phillip G (2005) Donor-induced democratization and the privatization of state violence in Kenya and Rwanda. *Comparative Politics* 37(2): 207–227.

Rudolf, Bruno & Udo Schneider (2005) Calculation of gridded precipitation data for the global land-surface using in-situ gauge observations. Proceedings of the 2nd Workshop of the International Precipitation Working Group IPWG, 231–247 (http://www.isac.cnr.it/~ipwg/meetings/monterey-2004/pdf/Rudolf.pdf, accessed 20 March 2010).

Safeworld (2009) *Climate Change and Conflict: Lessons from Community Conservancies in Northern Kenya*. London: Conservation Development Centre, International Institute for Sustainable Development and Safeworld (http://www.iisd.org/pdf/2009/climate_change_conflict_kenya.pdf, accessed 20 January 2010).

Salehyan, Idean (2008) From climate change to conflict? No consensus yet. *Journal of Peace Research* 45(3): 315–326.

Simiyu, Robert Romborah (2008) *Militianisation of Resource Conflicts: The Case of Land-Based Conflict in the Mount Elgon Region of Western Kenya*. Pretoria: Institute for Security Studies.

Suliman, Mohamed (1999) The rationality and irrationality of violence in sub-Saharan Africa. In: Mohamed Suliman (ed.) *Ecology, Politics and Violent Conflict*. London: Zed, 27–43.

Tadjoeddin, Mohammad Zulfan & Syed Mansoob Murshed (2007) Socio-economic determinants of everyday violence in Indonesia: An empirical investigation of Javanese districts, 1994–2003. *Journal of Peace Research* 44(6): 689–709.

Theisen, Ole Magnus (2008) Blood and soil? Resource scarcity and internal armed conflict revisited. *Journal of Peace Research* 45(6): 801–818.

Theisen, Ole Magnus; Helge Holtermann & Halvard Buhaug (2011-12) Drought, political exclusion, and civil war. *International Security*. 36(3): 79–106.

Tostensen, Arne (2009) Electoral mismanagement and post-election violence in Kenya: The Kriegler and Waki Commissions through a human rights lens. *Nordic Journal of Human Rights* 27(4): 427–451.

Urdal, Henrik (2008) Population, resources and violent conflict: A sub-national study of India 1956–2002. *Journal of Conflict Resolution* 52(4): 590–617.

Varshney, Ashutosh; Mohammad Zulfan Tadjoeddin & Rizal Panggabean (2008) Creating datasets in information poor environments: Patterns of collective violence in Indonesia, 1990–2003. *Journal of East Asian Studies* 8(3): 361–394.

Witsenburg, Karen & Wario Roba Adano (2007) The use and management of water sources in Kenya's drylands: Is there a link between scarcity and violent conflicts? In: Bill Derman, Rie Odgaard & Espen Sjaastad (eds) *Conflicts over Land and Water in Africa*. Oxford: James Currey, 215–238.

Witsenburg, Karen & Wario Roba Adano (2009) On rain and raids: Violent livestock raiding in Northern Kenya. *Civil Wars* 11(4): 514–538.

WRI (2007) *Nature's Benefits in Kenya: An Atlas of Ecosystems and Human Well-Being*. Nairobi: World Resources Institute (http://pdf.wri.org/kenya_atlas_fulltext_300.pdf, accessed 21 August 2010).

OLE MAGNUS THEISEN, b. 1981, MA in Political Science (Norwegian University of Science and Technology, NTNU, 2006); PhD candidate in political science, NTNU (2009–); associate researcher, Centre for the Study of Civil War, Peace Research Institute Oslo, PRIO (2009–).