Economics Working Paper Series

2017/029

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Rainfall inequality, trust and civil conflict in Nigeria *

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November, 2017

Abstract

Do changes in the distribution of rainfall between ethnic groups increase the risk of armed conflicts within Nigeria? In this paper, we exploit variation in rainfall during the growing season, to study how resource inequality between ethnic groups affects the risks of violent conflicts in Nigeria. Our main results show that a one standard deviation change in between-group rainfall inequality during the growing season increases civil conflicts prevalence in Nigeria by about seven percentage points. This relationship is driven, in part, by declining social capital. Specifically, we demonstrated that an unequal distribution of rainfall between ethnic groups reinforces citizens grievances over government performance and creates mistrust between predominantly farming communities and those engaged in nomadic herding. The analysis highlights the need to develop conflict-sensitive mitigation and adaptation strategies to reduce the adverse effects of climatic shock.

Keywords: Conflict, Inequality, Rainfall, Trust, Nigeria.

JEL Classification: D63, D74, E01

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*We are grateful to Bernard Tanguy, Emanuele Bracco, Jean-François Maystadt, Maria Navarro Paniagua, and Maurizio Zanardi and participants at the NWSSDTP PhD conference in Economics (Manchester), the 16th EUDN PhD Workshop (Wageningen) for their valuable comments and suggestions.

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1 Introduction

In recent years, there has been an increasing awareness that climate change can have destabilizing effect on societies. Through its effect on crop yields, climate variability has been found to affect the risks of armed conflicts between and within various groups in societies (see Fjelde and von Uexkull, 2012; Hsiang et al., 2013; Maystadt et al., 2014). While these claims have sometimes been disputed (Buhaug et al., 2014; Selby, 2014), most of the empirical evidence shows that there exists a strong correlation between climate shocks and violence (for a review, see Burke et al., 2015). Specifically, Schleussner et al. (2016) demonstrates a stronger links for ethnically fractured societies, which are typically more prone to conflicts. An important implication of their analysis is that multi-ethnic countries in regions such as Africa and Asia whose climates are likely to see fundamental shifts in temperature, rainfall, and sea-levels, might be facing fresh threats of violence. Indeed, since the end of the Second World War, nearly two-thirds of intrastate civil war have been fought along ethnic or religious lines (Sambanis, 2001; Denny and Walter, 2014). This already strained relations between ethnic or tribal and religious rivals can be exacerbated by the consequences of climate change. But, what are the mechanisms through which such climatic variations might translate into changing incentives for violence?

In this paper, we focus on the case of Nigeria to investigate the relationship between changes in the distribution in rainfall between ethnic groups and armed conflicts prevalence. As a first step, we investigate whether changes in the distribution of rainfall across ethnic groups living within the same state – i.e. largest administrative unit of Nigeria – increase the incidences of civil conflicts within that state. We take the location of the different ethnic groups within a state from the detailed Nigeria Local Government Handbook. We then spatially merge the location of ethnic groups with a high-frequency and high-resolution rainfall data provided by the European Center for Medium-Term Weather Forecasts (ECMWF). Our key measure of "rainfall inequality" between ethnic groups is then constructed following Guariso and Rogall (2017) and is based on the standard Gini coefficient. Our analysis cover 37 states and 19 years, from 1997 to 2015, which is the period for which all our data sources are available.

Our main result indicates that a one standard deviation increase in rainfall inequality between ethnic groups living within a state increases the risks of civil conflict prevalence by about seven percentage points. In the second part of the paper, we move to investigate the channels through which rainfall inequality may induce higher prevalence of civil conflict. In doing so, we match our ethnicity level information with micro-level data provided by the Afrobarometer. We then construct an ethnic level indicator for general trust; trust in neighbour and government; within-group and between-group trust; government satisfaction; and government corruption. The results suggest that a more unequal distribution of rainfall leads to lower satisfaction with the government and creates mistrust between predominantly farming ethnic groups and those engaged in herding.

Nigeria is an interesting country to consider for at least two reasons. First, it is a highly heterogenous society with more than 300 ethnic groups, a long history of civil conflicts, and currently confronting poor leadership, development challenges, and deep-seated ethnic divisions. The underlying reasons for these divisions have been attributed to the distribution of scarce resources and political power across the various ethnic groups that dot the country's landscape (Papaioannou and Dalrymple-Smith, 2015). Indeed, the perceived dominance of the political and military leaders from the North, and the failure of political leaders to provide an equitable revenue sharing formula has led to the intensity of violent conflicts in recent years.

Secondly, Nigeria is one of the countries identified as a hot spot for climate change, where there is a high possibility of extreme impacts across the different vegetation zones (Müeller et al., 2014). Indeed, it is predicted that "certain parts of the country, specifically the semi-arid North could experience reductions in fresh water availability up to 25-30% due to higher temperature and decreases in rainfall, while in contrast, the Niger Delta region in the South is likely subject to more frequent flooding, also due to increased irregularity in rainfall" (Müeller et al., 2014). These climatic challenges could have extreme negative impacts on health, food security, employment, and economic growth, which could in turn lead to more violence. This sequence seems to be already playing out in a few conflict-prone spots such as the Niger Delta and the arid North-east. Specifically, in recent years there has been increased incidences of violent conflict between predominantly pastoralists and predominantly farming ethnic groups. Data from Armed Conflict Location and Event Data project (ACLED) show that around 1,600 lives were lost to this type of violence in 2015 alone (Baca, 2015). One potential driver of these conflicts is climate-induced competition over water and arable land. To the best of our knowledge, this paper represents the first attempt to empirically investigate this link and its underlying mechanisms.

Our paper contributes to the literature in three ways. First, despite a rapidly growing literature on the potential links between climate variability and conflict, little attention has been paid to examining the cause and effect chain. There are some exceptions to this; for example, recent papers by Schleussner, et al., (2016) and Guariso and Rogall (2017) focus on how climatic conditions can increase the risks of armed conflicts in multi-ethnic socities. Specifically, Guariso and Rogall (2017) use a dataset of 214 ethnicities across 42 African countries to demonstrate how increase in rainfall-based inequality between ethnic groups increases the risks of ethnic conflicts, especially among ethnic groups that have recently lost political power. However, their analysis focuses on a specific channel, related to the balance of political power between ethnic groups. There is a growing consensus among policy makers and academics that more research is needed to better investigate how this broad trend translates in practice within specific contexts. This is because much of the evidence that has been presented have been sensitive to the definition of samples and the variable of interest (see Burke et al., 2009; Ciccone, 2011; Miguel and Satyanath, 2011). For this, a more local level analysis is needed. Our study fills this void by focusing on the cause and effect chain through which variations in climatic conditions can affect an ethnically fractionalized society like Nigeria.

Second, our study complement the literature on the relationship between inequality and conflict (see Stewart, 2005; Østby, 2008; Cederman et al., 2011; Huber and Mayoral, 2014; Kuhn and Weidmann, 2015). While Empirical support for this link remain mixed, most of these studies have had to contend with endogeneity issues and severe data constraints, thus inhibiting an empirically robust causal interpretation. For example, study by Cederman et al. (2011) relied on digitized map of economic activity provided by Nordhaus et al. (2006), which has a limited geographical and temporal scope for Sub-Saharan African countries, to construct their horizontal income inequality measure. Moreover, the digital map does not capture informal activities such as subsistence farming, which remain an important source of livelihood to a large segment of African population, hence inducing potential bias in the inequality measurement. Other studies such as Østby (2008); Huber and Mayoral (2014) rely on household surveys, which are not frequently available and thus tend to be noisy and unreliable (Beegle et al., 2012). To that purpose, we construct a measure of inequality using a high-frequency rainfall dataset, which is available at a resolution of 0.5-degree longitude×0.5-degree latitude. Given the spatial and temporal coverage of gridded weather dataset available, we believe that using rainfall data will help to overcome endogeneity concerns and the lack of disaggregated income data.

Lastly, our paper also relates to the literature on the link between inequality and trust. Most studies that have examined this relationship have typically struggled to make causal inferences due mostly to endogeneity issues. While recent studies (e.g. Barone and Mocetti (2016); Bergh and Bjørnskov (2011)) tend to focus on instrumental variable approach to address endogeneity, the lack of valid instruments has continued to question causality claims. In that regards, we reappraise the relationship between inequality and trust using our unique measures of rainfall inequality, which can be considered as plausibly exogenous to the determinants of trust. In particular, our analysis explores how inequality induces decline in trust, thus heightening the risks of civil conflict prevalence. By doing so, our paper also contributes to the literature on conflict and trust, which has grown fast in recent years but remain deficient in identifying the precise causal links due to concerns about selection bias and omitted variables (see Bauer et al., 2016; De Luca and Verpoorten, 2015; Rohner et al., 2013).

The remainder of this paper is organized as follows. Section 2 provides a contextual background to the study. Section 3 describes the data and empirical strategy, while section 4 presents and discusses the results. Section 5 concludes.

2 Background

Nigeria is a culturally diverse society with a long history of religious, ethnic and civil strives that dates back to the pre-independence era. The amalgamation of Southern and Northern Nigeria in 1914, to create present-day Nigeria has often been cited as the roots to many of the rivalries that dot the political and social landscape of the country (Papaioannou and Dalrymple-Smith, 2015).[1] After

[1]The two regions were previously administered as two autonomous colonies by the British colonial government before 1914.

gaining independence in 1960, Nigeria was plunged into a secession crisis with the Eastern part of the country pulling out to create the state of Biafra in May 1967. Perceived marginalisation in the distribution of scarce resources and political power by the ruling Northern elites underlies the main reasons for the secession, which culminated into a full civil war in July 1967.[2]

The war, which has been described as one of Africa's bloodiest civil war with casualties ranging between 1 and 3 million (Akresh et al., 2012), was followed by several years of military rule that actually suppressed resentments among the different groups. However, with the return to democracy in 1999, the grievances that built up over the decades of military adventurism into governance came to the fore as several restive groups began to emerge across the country. For example, in the oil-rich South-South region, the Movement for the Emancipation of Niger-Delta (MEND) and the Niger Delta People's Volunteers Force (NDPVF) were two militia groups that led violent protests against the Nigeria government, to demand for resource controls and better environmental quality standards (International Crisis Group, 2006). The protests, which later evolved into a full-fledged insurgency in 2006, resulted in several fatalities, kidnappings of oil workers and attacks on oil installations. The insurgency was bolstered by the lack of basic infrastructural facilities (such as electricity, water and hospital) and high rate of unemployment in the region, and continued to spread until June 2009 when the Nigerian government initiated an amnesty program to disarm and reintegrate the militants.

Religious rivalry between Muslims and Christians is another major source of violence in Nigeria. While the 1999 constitution of the Federal Republic of Nigeria classifies it as a secular state, the advancement of religious teachings, especially in most part of Northern Nigeria where Islamic law were introduced, as solutions to political and socio-economic issues, further exacerbated the already tensed relationship between the two major religious groups (Sampson, 2014). Christian communities, particularly those in the affected states, perceived the introduction of Shari'ah (Islamic moral codes) as a threat of "Islamisation" and hence protested against its adoption as state laws. These protests often leads to violent clashes between Muslim and Christians, especially in Northern states such as Kaduna and Plateau where there is a growing Christian population.

In addition, the "Boko Haram" terrorist group, which has unleashed an atrocious campaign against

[2]The failed state of Biafra was championed by the Igbo – a major ethnic group that resides mostly in the South-Eastern part of Nigeria – and other minority ethnic groups (mostly in Nigeria's oil rich south-south region).

both Christians and Muslims in the North-Eastern part of the country, has further stoked the embers of hatred between the two dominant religions.[3] In particular, the group's stated objective of establishing an Islamic caliphate across Northern Nigeria and its assault on churches heightened religious tensions and pitted neighbours against each other (International Crisis Group, 2014). While the root cause of the insurgency is often attributed to the extra-judicial killing of its leader, the International Crisis Group (ICG) in a report published in 2014, noted that sustained economic hardship, rising inequality and social frustrations have continually helped to foster the growth of extremist groups in Nigeria. Indeed, the failure of political leaders to provide an "equitable" way to distribute limited resources across the different groups in the country; a flawed legal system that allows crimes to go unpunished; widespread poverty; and traditional breakdown in conflict resolution mechanisms underlies many of the violent conflicts Nigeria has experienced since the civil war.

Some of the worst violence involved land disputes between ethnic groups and neighbouring communities, especially those in oil-producing states where land ownership attracts some form of compensation payments from multinational companies (Small Arms Survey, 2005). The situation is not much different in Northern Nigeria where clashes involving herdsmen and farming communities in southern and north central zones have surged in recent years. The root causes for this increase might be attributed to rising population pressures and climatic-induced changes. The expansion of human settlements together with the rapid pace of urbanisation has led to the loss of grazing lands, which have long been designated by the central government as reserved areas, thereby increasing pressure on farmlands and the likelihood of conflicts over water pollution and crop damages (Baca, 2015).

Besides, climate changes have intensified droughts and desertification in the semi-arid Northern part of Nigeria. According to a report released in 2016 by the Nigeria Meteorological Agency, the annual rainy season in the country have reduced by an average of 30 days (i.e. from 150 to 120) over the last three decades. Furthermore, it is predicted that future dry spells, especially in Northern regions, may get worse as the world continues to experience hot streak of temperatures.[4] At the same time, reports by the Food and Agriculture Organisation indicates that 50 to 75% of land areas

[3] The insurgency has led to over ten thousand deaths, displaced several others from their homes and worsened the already poor economy in the North East.

[4] Nigeria Meteorological Agency, *Drought and Flood Monitoring Bulletin,* August 2017.

in the North-East and North-West regions are vulnerable to desertification, and the phenomenon is spreading towards the south at the rate of $0.6km$ per year.[5]

These developments have compelled nomadic herders, most of which are ethnic Fulani from Northern Nigeria, to move southwards in search of water and pastures for their herds (International Crisis Group, 2017).[6] As they migrate into lands that are owned by predominantly farming communities, violent conflicts over crop damages or cattle rustling, often erupts. Over the last two decades, this type of violence has increased in both intensity and geographical scope. The Assessment Capacities Projects (ACAPS) reported that there have been at least 360 clashes between farmers and herdsmen in the last five years, resulting in a casualty of approximately 2,400 people in 2016 alone, compared to just 20 battles in the fifteen years before that.[7] With the conflict expanding into southern states, the herder-farmer crisis continues to pose a major threat to Nigeria's national security and may likely aggravate the already fragile relations among the different ethnic and religious groups in the country, if proactive actions are not taken to address the deadly conflict. In our empirical analysis we investigate the link between climatic events and conflicts and shed light on the potential channels.

3 Data and Empirical Strategy

3.1 Data sources

Our sample covers the 37 states of Nigeria (including the Capital city Abuja) over a period of 19 years, from 1997 to 2015. In constructing the dataset, we combine information from several different sources, detailed below.

Conflict variable: Data on conflict was taken from the Armed Conflict Location and Event Data project (ACLED). The ACLED dataset summarizes conflict event by the name of the main actors, location of events, number of fatalities, and event type. Thus, we identify violent events linked to ethnic militia or "unidentified" armed groups, religious groups, farmers, and/or pastoralists occurring in each Local Government Area (LGA) or state in Nigeria. We then define civil conflict events as

[5] *FAO Country Programming Framework (CPF) Federal Republic of Nigeria 2013 - 2017.*

[6] The Fulanis are regarded as the world's largest nomadic group, and occupies a large expanse of land from West to Central Africa countries.

[7] The report can be accessed at: `https://www.acaps.org/country/nigeria/special-reports`.

a binary variable, indicating whether a state has experienced a violent event resulting in at least 20 casualties. ACLED provides the most detailed coverage of conflict events currently available. As a robustness check, we also use the UCDP geo-referenced conflict event dataset, which has the relative advantage of covering more time periods. Thus, in using the UCDP, we extend our analysis to cover the period 1990 to 2015, for which the data is available for Nigeria.

Ethnicity variable: To construct our ethnicity variable, we identify the main, second and third most popular languages in each of Nigeria's 774 Local Government Areas (LGAs) using the 1998 Nigeria Local Government Handbook. The handbook contains information about the historical location of 210 main ethnic groups, spread across the country.[8] We define the borders of each ethnic group using the administrative boundary of the area for which an ethnic group is recorded as the main group in the handbook. Data on administrative boundaries is taken from Global Administrative Areas (GADM). A major concern could be that the construction of our ethnicity variable may not reflect the historical distribution of ethnic groups in Nigeria. To that purpose, we compare our ethnic composition to those recorded in the *Geo-referencing of Ethnic Groups* (GREG) dataset provided by Weidmann, et al., (2010) in an alternative definition.

Rainfall variables: Our rainfall inequality data was constructed based on rainfall data provided by the European Centre for Medium-Term Weather Forecasts (ECMWF) ERA-interim datasets. The ECMWF dataset provides re-analysis of weather data, obtained through a climatic model that combines information from different primary sources, which include weather stations, satellite images and others (Kållberg et al., 2004).[9] The database provides precipitations values at six hourly frequency from 1979 to 2015 at a resolution of 0.5-degree longitude$\times$0.5-degree latitude (corresponding to a pixel size of about 55 square kilometers at the equator). Ethnic groups in our sample covers an average of 12 grid-cells. For the analysis, we focus on rainfall during the growing season, which is when farming and herding activities may become more sensitive to adverse conditions. We follow the same procedures of Kudamatsu et al., (2014), and rely on the Normalized Difference Vegetation

[8]The Local Government Handbook has already been used as a good source of data for the spread of ethnic groups across Nigeria (Larreguy and Marshall, 2016).

[9]Given the sparse distribution of the 44 weather stations across the 774 LGA of Nigeria, re-analysis data appears to be the most reliable source of weather-related information for the country.

Index (NDVI) to define the beginning and end of the plant-growing season at a high resolution of $8 \times 8km$. We then aggregate the information at the level of our rainfall grid cell to obtain the average start and end of the growing season within each cell.[10]

Temperature variables: Data on temperature come from ECMWF ERA-interim datasets at the same frequency and resolution as the rainfall data.

Religious fragmentation and competition variable: We combine data from the Annual Abstract of Statistics published by the Nigeria National Bureau of Statistics and 2009/2010 Nigerian Harmonized Living Standard Survey (HNLSS) to identify the share of the population of the various religious group in the LGA (or state) and thereafter construct an ethnic-level (or state-wide) Herfindahl (religious) fragmentation index, and religious competition. We define religious competition in each LGA (state) by: $1 - |\eta_1 - \eta_2|$. where η_1 and η_1 indicate the LGA (or state) share of the population for the two largest religious groups.

State per capita revenue allocation: Data on states' revenue allocation was obtained from Nigeria's Federal Ministry of Finance, and is available only from 2007 onwards. The per capita allocations were estimated using the aggregate allocations to each state.

Trust-related measures: Data on trust comes from the Afrobarometer surveys, which samples the economic, social and political attitudes of citizens aged 18 and above. The surveys are based on random samples stratified by states and are therefore not representative at the level of Local Government Areas (LGAs). We pool all six available rounds, (eight survey years in total covering 1999 - 2015) to obtain a sample of 19,914 respondents from 582 of Nigeria's 774 LGAs.[11] We then construct seven main indicators, namely: general trust; trust in neighbour and government; within-group and between-group trust; government satisfaction; and government corruption. The *general trust measure* is an index that captures to what extent respondents trust the following: government officials, religious organisations, security agencies such as the Army and Police, own and other ethnic groups, own-family and relatives.[12] *Trust in neighbour and government* is an index capturing to what

[10]Figure A.1 illustrates how the different data sources were combined.

[11]The survey was conducted in 1999, 2001, 2003, 2005, 2007, 2009, 2013 and 2015. The response rate in 2008, for which such information is publicly available, is 72%.

[12]All responses ranges from 0 - 3 but were rescaled from 0 to 1 and then average across respondents of the same ethnicity to obtain an ethnic level index.

extent respondents trust their neighbour and each of the following: the President, the Legislature, the Local councilor, and the electoral commission, respectively. The Cronbach's alpha scale reliability coefficient for the trust in government scale is 0.72.[13]

Within-group and between-group trust measures: To construct these measures, we first average a four-point ordinal scale asking to what extent respondents trust their own and other ethnic groups, respectively. We then compute a within-group trust measure, that captures the respondents' level of trust in own ethnic group, across the different LGAs of the respondent's ethnic group in a state. Between-group trust measures capture trust between the different ethnic groups living within a state.

The *government satisfaction scale* is a summative scale combining six indicators that the government handles the economy, unemployment, health, education, inflation, and water-related issues very well as opposed to very badly. The scale has a Cronbach's alpha scale reliability coefficient of 0.77. Lastly, the *government corruption scale* combines five indicators that the respondents considers the elected officials at the Presidency, National Assembly, and Local Government corrupt or very corrupt. Its Cronbach's alpha scale reliability coefficient is 0.79.

3.2 Rainfall-Based Inequality Measures

In constructing our rainfall inequality measures, we follow closely the approach by Guariso and Rogall (2017). Our key variable of interest is the *Between-Group Inequality (BGR)* measure, defined at level of each one of the states in Nigeria and for each year. The measure captures inequality in the distribution of rainfall during the growing season between the ethnic groups living within a State. The BGR is computed as the weighted average of the differences in rainfall among ethnic groups living within the same state, where the weights are given by the relative size of each ethnic group in the following way:

$$BGR_s = \frac{1}{2\tilde{r_s}} \sum_{i=1}^{N_s} \sum_{j=1}^{N_s} \theta_{i,s}\theta_{j,s}|r_{i,s} - r_{j,s}| \tag{1}$$

where N_s refers to the number of ethnic groups located within state s, $\theta_{i,s}$ is the relative size of the ethnic group i in state s, $r_{i,s}$ is the level of rainfall in ethnic group i's homeland, and $\tilde{r_s}$ is the

[13]The Cronbach's Alpha provides a measure of survey's internal consistency and assess how well a set of variables are related as a group. All responses were then standardized to indicate whether respondents trusts a lot or somewhat in each of the aforementioned group.

yearly average amount of rainfall in the state.

We also define two additional rainfall-based measures of inequality: *Within-Group Inequality (WGR) and Within-State Inequality (WSR)*. To construct WGR, we proceed in two steps: first, we construct a measure of inequality across the different areas that cover an ethnic homeland within a state. The areas are defined by the 0.5×0.5-degree grid-cells in which the rainfall data was provided. More formally, the group specific measure of inequality is computed as:

$$WGR_{i,s}=\frac{1}{2r_{i,s}}\sum_{m=1}^{G_{i,s}}\sum_{n=1}^{G_{i,s}}\pi_{m,i,s}\pi_{n,i,s}|r_{m,i,s}-r_{n,i,s}| \tag{2}$$

where G_i is the amount of rainfall grids covering ethnic group i's boundary, π_m is the relative size of grid-cell m, $r_{i,m}$ refers to the amount of rainfall over the grid-cell m, and r_i is the quantity of rain that fell over ethnic group i's homeland. In the second step, we obtain the state-level measure of within-group inequality by taking the weighted average of $WGR_{i,s}$ across all ethnic groups living within the state, where the weights are defined by the relative size of the ethnic group and relative rainfall in the state. That is:

$$WGR_s=\sum_{i=1}^{N_s}\theta_{i,s}\frac{r_{i,s}}{\sum_{j=1}^{N_s}r_{j,s}}WGR_{i,s} \tag{3}$$

Our last measure, Within-State Inequality (WSR), captures rainfall inequality between grid cells that falls within the same state. The construction of the WSR follows a similar approach to the one used in the first step for WGR, except that here we compare areas across the state, rather than focusing on specific ethnic groups' homelands. Thus, WSR is computed as:

$$WSR_s = \frac{1}{2r_s}\sum_{m=1}^{G_s}\sum_{n=1}^{G_s}\pi_{m,s}\pi_{n,s}|r_{m,s}-r_{n,s}| \tag{4}$$

where G_s refers to the total number of rainfall grids covering state s, while π_m is the relative size of grid-cell m. Table A.1 present the correlation coefficients of the inequality measures, while Table A.2 shows the summary statistics of the main variables of interest.

3.3 Empirical Strategy

We start by empirically investigating the relationship between rainfall-based inequality and the prevalence of civil conflicts across our sample, by running the following analysis:

$$Conflict_{s,y}=\beta_1 inequality_{s,y}+\beta_2 rainfall_{s,y}+\Theta X_{s,y}+\alpha_s+\zeta_y+\alpha_s t+\varepsilon_{s,y} \tag{5}$$

Where s and y denotes the state and year, respectively. The dependent variable is $Conflict$, a binary variable taking on the value of one if state s experiences civil conflict resulting in at least 20 casualties in year t. In a robustness check, we will use the number of fatalities in armed conflicts occurring within states as an alternative dependent variable. $Inequality$ is our variable of interest and indicates one of the rainfall-based inequality measures described above, constructed considering rainfall during the growing season, while $rainfall$ is the yearly average rain that fell within a state's boundaries. X is a vector of geographical and institutional covariates that may affect conflict at the state level. For instance, most analysis of armed conflict in Nigeria emphasize the role of religion as a major factor. Thus, we construct a measure of religious fragmentation and competition in a state. We compute the fragmentation measure as one minus the Herfindahl index of religious group shares and then classify a state as having a high religious fragmentation (equals one) if its index is above median. Similarly, we define religious competition in each state by: $1 - |\eta_1 - \eta_2|$, where η_1 and η_1 indicate the state share of the population for the two largest religious groups. In addition, we include a dummy for oil producing states to proxy for natural resources driven conflict in the Niger-Delta area of the country. Other additional control variables include temperature anomalies the deviation of temperature from its long-term mean value (January 1981 - December 2015), per capital allocations to states, and population. We further include state and year fixed effects α_s, and ζ_y to absorb period and time-invariant effects across states. For instance, the presence of mountainous terrain or the distance from the seat of power may confound the investigated relationships (see, Harari and LaFerrara (2014); Miguel, et al., (2004)). Lastly, we augment the model with state specific time trend $\alpha_s t$ to account for differential linear trends across states.

Given a binary dependent variable, a natural choice of estimation would be to conduct a probit (or logit) estimation, but we use the standard OLS and fit a linear probability model to allow us to adopt spatial-econometrics methods as in Harari and LaFerrara (2014) and Maystadt et al., (2014), which are problematic to implement in limited dependent variable models. Indeed, given the nature of our georeferenced dataset, one concern for our empirical approach may be that observations are not independent across space. To that purpose, we apply Conley's (1999) standard errors, which is robust to spatial dependence of an unknown form in the error term, following the procedure suggested by

Hsiang (2010). Also, in an alternative specification, we re-estimate the above model, controlling for spatial lags of the variables of interests. Here, we follow Harari and LaFerrara (2014) and Maystadt et al., (2014) in constructing a symmetric weighting matrix W of order 2 and thereafter obtain the spatial lags of the independent variables by multiplying the matrix W and the vector of observations.

In the second part of the paper, we try to investigate the channels through which rainfall inequality could lead to higher prevalence of civil conflict. The corresponding empirical model is:

$$polieva_{i,s,y}{=}\beta inequality_{i,s,y} + \Theta X_{s,y} + \alpha_s + \zeta_y + \alpha_s t + \varepsilon_{s,y} \tag{6}$$

Where i, s and y denotes the ethnic, state, and survey year, respectively. The dependent variable *polieva* refers to one of the seven main indicators described above, and inequality refers to the between-group rainfall inequality. X are economic controls such as population and per capita allocations to state, which may confound the observed relationship. In addition, we include a measure of religious fragmentation and competition between the various ethnic groups living within a state. Also, we include state and survey-year fixed effects α_s, and ζ_y to absorb time-invariant effects across states. For instance, the distance from the seat of power may confound the investigated relationships. Lastly, we augment the model with state specific time trend $\alpha_s t$ to account for differential linear trends across states.

4 Main Results

4.1 Civil conflict and BGR inequality

We first present the results of our main specification described in equation (5) in Table 1. In column (1) of the Table, we report the baseline regression without any fixed effects or controls, while in column (2) we introduce year fixed effects and religion controls. These baseline specifications indicate a positive and significant relationship between BGR inequality and the prevalence of civil conflict at the state level. Specifically, the estimated coefficient in column (2) suggests that a one standard deviation increase in BGR inequality would lead to an 8.57 (0.186×0.461) percentage point increase in the prevalence of civil conflict. However, this effect disappears when we add both state fixed effects and climatic controls in column (3) and becomes significant with the inclusion of state-specific time trends in column (4). This latter specification indicates that a one standard deviation increase in rainfall inequality between-groups will heighten the risks of civil conflict prevalence by about five percentage points. In column (5), the effect increase to about seven percentage points when we control for economic characteristics of the states. Compared to the average conflict prevalence in the sample (23%), this result implies an increase of about 30 percent in civil conflict prevalence. While this effect appears smaller than the one estimated by Guariso and Rogall (2017), its magnitude is still in the upper level of the ranking made by Hsiang et al. (2013) in their meta-analysis, and within the range found for studies on Sudan (Maystadt et al., 2014), and Somalia (Maystadt and Ecker, 2014).

In addition, we do not find any evidence to suggest that this effect persists over time as the lagged coefficients of BGR inequality in column (6) and (7) are not statistically different from zero. We also do not find evidence that within-group and within-state rainfall inequality affect the prevalence of civil conflict either when they are introduced separately as in columns (2) and (3) of Table 2 or when they are considered together with between-group inequality as in columns (4) and (5) of the same table, respectively.[14]

4.1.1 Robustness

We check the robustness of our results to a set of alternative specifications of the benchmark model. First, we show that the dynamics is not much different between civil and communal conflicts. Most anecdotal evidence (Baca, 2015; Sayne, 2011) on the potential impact of climate change in Nigeria has often cited competition for arable land between pastoralists and farmers as a possible trigger to violence. Indeed, climate-induced shocks that tend to result in less rainfall and higher temperature can greatly disrupt herders and farmers means of livelihood and hence induces more grievances. Maystadt, et al., (2014) provides suggestive evidence that temperature anomalies heighten intergroup violence between pastoralist and agro-pastoralist's communities in Sudan.

To that purpose, we check the sensitivity of our main results to an alternative definition of conflict communal and non-communal conflicts. We define communal conflicts as battles between pastoralists

[14]Surprisingly, when we include between-group temperature inequality in the same specification with BGR-inequality, we find a negative relationship between temperature inequality and conflict. However, this result does not alter our main variable of interest.

and farmers, resulting in at least 20 fatalities, while non-communal conflicts are other violent events excluding battles between farmers and pastoralists.[15] Results reported in Table 3 shows that the effect of BGR inequality is quantitatively similar to the benchmark results presented in Table 1. Indeed, the result in columns (3) and (6) indicates that a one standard deviation change in BGR inequality would translate into 7.27 and 5.60 percentage points increase in the prevalence of communal non-communal conflicts, respectively.

Second, we show that our results are robust to using number of fatalities and violent events occurring in each state as alternative dependent variables, respectively. Specifically, the results reported in column (5), Panels B and C of Table 4 shows that a one standard deviation change in BGR inequality would lead to 18.9 and 5.5 percentage points increase in the number of fatalities and violent events, respectively. In addition, we show in Panel D of Table 4 that our results are also robust to using the UCDP geo-referenced conflict event dataset, which allows us to extend our analysis to cover the period 1990 to 2015.

Next, we check whether our results hold, when we control for spatial and temporal dependence between observational units. Given the high mobility of pastoralists, one major concern might be that our results are driven by climate induced migration. To test for this, we include spatial lags of the main variable of interest. The results reported in Panel E of Table 4 indicates that the effect of BGR inequality on the prevalence of civil conflict remain positive and significant. As a form of falsification test, we also compute an alternative between-group inequality measure based on rainfall outside of the growing seasons. Given the importance of rainfall in agricultural productions in Nigeria, we would expect the effect of BGR inequality on civil conflict to be less or even null during the non-growing season. Indeed, the results presented in Panel F of Table 4 shows that, while the effect is smaller and marginally significant for the baseline specification without any fixed effects or controls, the impact disappears with the inclusion of these controls.

Furthermore, we assess the robustness of our results to using alternative geo-referenced ethnic dataset for the definition of BGR inequality measure. One might be worried that the construction of our ethnicity variable does not reflect the historical distribution of ethnic groups in Nigeria. In

[15] Communal conflicts involving farmers and pastoralists typically accounts for about 30% of total conflict occurring in each year in Nigeria.

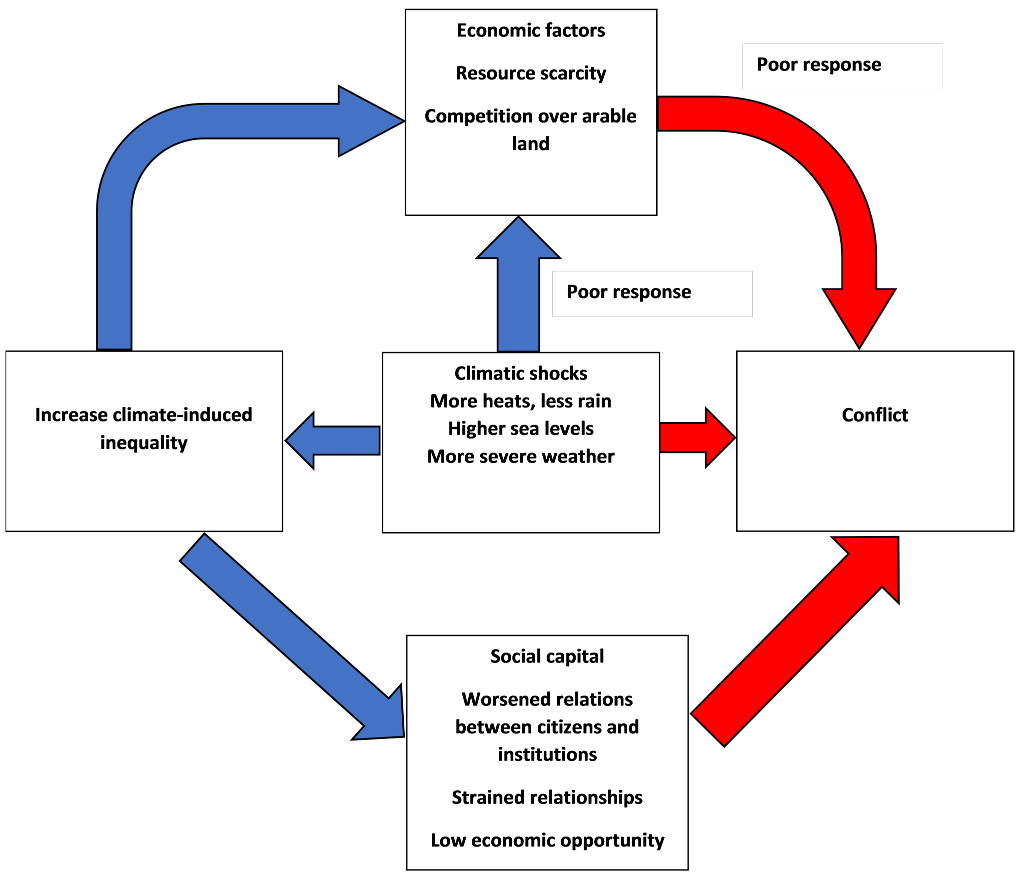
that regards, we use the GREG dataset to identify the historical locations of main ethnic groups across Nigeria, and then redefine the inequality measures using the ethnic homeland as defined in the GREG data. Panel G of Table 4 reports the result for this alternative definition. We find that the impact of BGR inequality on civil conflict prevalence is much stronger compared to when we define the inequality measures using the local government handbook. A possible explanation for this might be related to the replacement of some minority ethnic groups with the "dominant group" they belong to in the GREG dataset thereby inducing higher variations in between-group inequality within states.

We then consider a monthly-level analysis to control for any spurious seasonal correlation that may arise due to variations in weather and conflict. Results reported in Panel H of Table 4 indicates that the coefficients of BGR inequality remain positive and significant, but the effect is much lower compared to the main result. Finally, we show that our results remain robust to the use of a probit model without spatial correction in the standard errors. In Panel I of Table 4, we report the coefficients of the average marginal effects of BGR inequality on civil conflict prevalence. The result in column (5) indicates that a one standard deviation increase in BGR inequality increases the likelihood of civil conflict prevalence by about 9.4 percentage points.

4.2 Transmission Mechanisms

Our previous results showed a significant relationship between rainfall inequality and conflict prevalence. When thinking about the channels, one could think of several reasons why variations in climatic conditions among organized political and/or ethnic groups in Nigeria could lead to violence. First, poor institutional response to a mix of weather-related shock could lead to increased resource scarcity and competition, thus heightening the risks of violence. In particular, the increased incidences of kidnapping for ransom and violent conflict between pastoralists and farmers in recent years had been attributed to lack of economic opportunities and governments' failure to provide designated areas for grazing to the pastoralists' communities (Baca, 2015).

In such circumstances, climate-induced changes that disrupt food and livestock production substantially would increase the risks of conflicts, and create distrust among ethnic groups. An illustrative example is a recent report by Sayne (2011) stating that "in the south, many farmers now plant over grazing routes long agreed upon with Fulani herders" citing climate related factors such as changes in planting techniques due to weather variability as reasons. Such breakdowns in agreement could create mistrust among the two groups and therefore increase structural conflict risks. Besides, poor responses to weather-induced shocks could reinforce citizen's grievances on government's corruption and lack of accountability thereby deepening the cycle of violence (see figure 1 below). Against this background, we turn to the reduced-form relationship between inequality, trust and political preferences.



Adapted from: *Sayne (2011)*

Figure 1: **Channels of Transmission**

4.2.1 Inequality, trust and Political Preferences

While the empirical debate on this relationship continues apace, the weight of the evidence suggests there is a strong negative association between inequality, trust and political participation (see Jordahl

(2009), for a detailed review of empirical studies). However, establishing a causal effect is far from being an easy task due to several reasons. First, the relationship between inequality and trust is likely to be mutually reinforcing. For instance, Bergh and Bjørnskov (2011) demonstrates that countries with higher levels of trust are more likely to have larger welfare states, thus reducing inequality. Similarly, one may argue that higher trust could lead to better performing institutions and markets, which in turn would favour an equitable income distribution process (Uslaner, 2008).

Secondly, most of the empirical studies focusing on the relationship between inequality and the level of social capital are cross-country analysis, which are usually problematic when it comes to drawing causal inferences due mostly to comparability issues between countries, risks of omitting important variables and measurement errors in the inequality measures. At the same time, while robust empirical evidence focusing on within country analysis are quite limited outside of the US, findings for other countries are less conclusive (see, La Ferrara, 2002; Leigh, 2006; Gustavsson and Jordahl, 2008). In this section, we provide a reappraisal of the relationship between inequality, trust and political preferences and, in particular, attempt to address the limitations of previous studies using our unique measures of inequality.

Table 5 presents results of the impact of rainfall inequality on trust, and political evaluations. The results shown in column (1) of Table 5 indicates that an increase in BGR inequality reduces the likelihood that respondents of the same ethnicity would rate high in the general trust scale. More specifically, column (2) and (3) imply that a one standard deviation increase in BGR inequality reduces the likelihood of between and within-group trusts by 10.47 and 8.61 percentage points, respectively. Column (4) identifies a larger effect for trust towards neighbours. The point estimates indicates that higher BGR inequality reduces the likelihood that respondents from the same ethnic group would express that they trust a lot in their neighbour by 11.14 percentage points. Surprisingly, the effect is smaller for trust in government, as the result in column (5) show a 1.75 percentage point reduction.

We also find that an increase in BGR inequality reduces the likelihood that respondents of the same ethnicity would express satisfaction with the way government handles issues related to unemployment, health, education, inflation, and the general economy. Column (6) of Table 5 estimates that a one standard deviation increase in BGR inequality reduces the probability that respondents who share the same ethnicity, would express that they are satisfied with government by three percentage points. Also column (7) shows that a one standard deviation change in BGR inequality increases the likelihood that respondent from the same ethnic group would consider elected government officials as very corrupt by five percentage points.

4.2.2 Average Control Direct Effect

To explore the potential mechanisms through which rainfall inequality may affect the prevalence of conflict, we apply sequential g-estimation as suggested by Acharya et al. (2016) to estimate the average control direct effect (ACDE) of BGR inequality net government satisfaction and trust in government on the likelihood of civil conflict. Specifically, we aim to examine whether any effect of BGR inequality persists after controlling for the intermediate confounder (or our government satisfaction and trust variables in this case). To proceed, we estimate in the first stage, the full benchmark model including the trust-related variables, and measures of government satisfaction and corruption (Table A.12.). Thereafter, we divide the vector of controls into pre-treatment and intermediates. We use rainfall and temperature levels as our pretreatment variables. We then treat all the other controls (i.e. religious, economic and the trust-related controls) as intermediate confounders. While it is possible that we misclassified these confounders, we check that our results are not sensitive to these classifications.

In the second stage of the g-estimation, we use only the pre-treatment variables as controls. One concern with our approach to estimating the ACDE might be that, for linear probability model, the estimates can be biased from model misspecification or if there exist unmeasured confounders between citizen's satisfaction with government, trusts and civil conflict. However, Angrist and Pischke (2009) demonstrate that such bias is likely to be low for marginal effects estimation. Nevertheless, we report bootstrapped confidence intervals for both stages. The results reported in Table (6) suggests that the effects of BGR inequality on civil conflict persists even after accounting for citizen's satisfaction with government handling of the economy, between-group trusts and level of trust in elected government officials. However, the effects dies out when we consider conflict between pastoralists and farmers, thus giving credence to a channel in which climate-induced shocks reinforce citizen's grievances on government handling of the economy, and create mistrust between predominantly farming ethnic groups and pastoralists thereby deepening the cycle of violence.

5 Conclusions

There is much discussion and debate over the role of climate-induced shocks in violent conflicts. The Intergovernmental Panel on Climate Change (IPCC) suggests that the effects of climate change can aggravate stressors such as social tensions, poverty, and environmental degradation, that allows conflict to flourish. However, understanding the exact transmission mechanisms through which variations in climatic conditions can exacerbate these conflict stressors requires a better local-level and country-specific analysis. In this paper, we show how changes in the distribution of rainfall between ethnic groups increase the risks of armed conflicts prevalence in Nigeria, and in particular, investigate the mechanisms underlying the observed relationships. Our main results show that a one standard deviation change in between-group rainfall inequality during the growing season increase communal and civil conflict prevalences by about seven percentage points. The result is robust to a set of alternative specifications. Our analysis suggests a mechanism in which climatic-induced shocks reinforce citizen's grievances over government handling of the economy and creates mistrust between predominantly farming communities and those engaged in nomadic herding.

One important limitation of our study, however, is that we are unable to adequately isolate how economic factors such as climate-induced resource scarcity may contribute to intensify conflict risks. Instead, we focus on the social capital channel potentially linking inequality to conflict. While the dearth of data on socio-economic characteristics of communities and household constrain our ability to evaluate that channel, we acknowledge that there may exist an effect of between-group rainfall inequality that does not operate exclusively through social capital. Nonetheless, our analysis underscores the importance of developing conflict-sensitive mitigation and adaptation strategies to reduce the adverse effects of climatic shocks. In particular, initiatives aimed at reducing Nigeria's frequent farmer-herder violence should focus on strengthening traditional conflict mediation and reconciliation mechanisms, and addressing environmental issues that push nomadic pastoralists to migrate towards the south for water and pastures. Indeed, recent work by Linke et al. (2017) demonstrate the mediating role of formal and informal institutions in moderating the effects of climate-induced conflicts in rural Kenya. Finally, while our results present an empirical evidence of how changes in the distribution of rainfall between ethnic group increase the risk of conflicts, the analysis is limited in predicting future risks relating to how increased frequency and intensity of weather shocks would affect inequality and ability to mitigate competition over resources. Certainly, this will be a path for further research, if there exists an extensive and quality dataset that can allow a robust empirical analysis.

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Table 1. Estimation of Linear Probability Model - Civil conflict and BGR inequality

Dependent Variable	**Civil conflict**						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
BGR inequality	0.383***	0.461***	0.143	0.277**	0.359*	0.280*	0.287*
	(0.096)	(0.111)	(0.237)	(0.138)	(0.191)	(0.149)	(0.161)
BGR inequality (t-1)						0.911	0.842
						(1.127)	(1.115)
BGR inequality (t-2)							0.437
							(1.101)
Rainfall			0.092	0.258*	0.241**	0.251*	0.243*
			(0.063)	(0.138)	(0.103)	(0.142)	(0.137)
Temperature			0.020	0.016	-0.014	-0.014	-0.013
			(0.048)	(0.043)	(0.046)	(0.043)	(0.043)
Religion controls		Included					
Economic controls					Included		
Year FE	No	Yes	Yes	Yes	Yes	Yes	Yes
State FE	No	No	Yes	Yes	Yes	Yes	Yes
State-specific time trends	No	No	No	Yes	Yes	Yes	Yes
R-squared	0.020	0.093	0.151	0.379	0.430	0.406	0.425
Observations	703	703	703	703	333	703	703

Notes: Religion controls include an indicator that a state has high religious fragmentation and a measure of the state religious tension. Economic controls include population and per capital allocations to states.

All inequality measures have been normalized by taking $(X - X_{min})/(X_{max} - X_{min})$

BGR indicates Between-Group Rainfall Inequality

Robust standard errors (in parentheses) are adjusted for spatial dependence of an unknown form (Conley, 1999)

* denotes significant at 10%, ** at 5%, *** at 1%

Table 2. Alternative Estimations - Civil conflict and inequality

Dependent Variable	**Civil conflict**				
	(1)	(2)	(3)	(4)	(5)
BGR inequality	0.359*			0.361*	0.369*
	(0.191)			(0.191)	(0.191)
WGR inequality		0.005		0.058	
		(0.380)		(0.378)	
Within state inequality			0.195		0.273
			(0.512)		(0.509)
BGT inequality					
Rainfall	0.241**	0.222	0.095	0.265	0.099
	(0.103)	(0.231)	(0.393)	(0.230)	(0.390)
Temperature	-0.014	-0.007	-0.008	-0.015	-0.016
	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)
Economic controls	Included	Included	Included	Included	Included
Year FE	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes
State-specific time trends	Yes	Yes	Yes	Yes	Yes
R-squared	0.430	0.427	0.427	0.430	0.431
Observations	333	333	333	333	333

Notes: Economic controls include population and per capital allocations to states.

All inequality measures have been normalized by taking $(X - X_{min})/(X_{max} - X_{min})$

BGR and WGR refers to Between-Group and Within-Group Rainfall Inequality, while BGT is Between-Group Temperature inequality

Robust standard errors (in parentheses) are adjusted for spatial dependence of an unknown form (Conley, 1999)

* denotes significant at 10%, ** at 5%, *** at 1%

Table 3. Civil conflict and inequality - communal conflict vs non-communal

Dependent Variable	Communal conflict			Non-communal conflict		
	(1)	(2)	(3)	(4)	(5)	(6)
BGR inequality	0.309***	0.079	0.391**	0.306***	0.145	0.301*
	(0.107)	(0.231)	(0.189)	(0.219)	(0.252)	(0.172)
Rainfall	0.089	-0.017	0.116	-0.010	-0.009	0.323
	(0.229)	(0.246)	(0.230)	(0.218)	(0.109)	(0.234)
Temperature	-0.055	0.017	-0.021	-0.059	0.027	-0.024
	(0.045)	(0.048)	(0.043)	(0.045)	(0.049)	(0.043)
Religion controls	Included			Included		
Economic controls			Included			Included
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	No	Yes	Yes	No	Yes	Yes
State-specific time trends	No	No	Yes	No	No	Yes
R-squared	0.091	0.166	0.455	0.079	0.162	0.467
Observations	703	703	333	703	703	333

Notes: Religion controls include an indicator that the state has high religious fragmentation and a measure of the state religious tension.
Economic controls include population and per capital allocations to states.
All inequality measures have been normalized by taking $(X - X_{min})/(X_{max} - X_{min})$
BGR indicates Between-Group Rainfall Inequality
Robust standard errors (in parentheses) are adjusted for spatial dependence of an unknown form (Conley, 1999)
* denotes significant at 10%, ** at 5%, *** at 1%

Table 4: Robustness to alternative samples and dependent variables

Dependent Variable	Civil conflict				
	(1)	(2)	(3)	(4)	(5)
Panel A. Main results	0.383***	0.461***	0.143	0.277**	0.359*
	(0.096)	(0.111)	(0.237)	(0.138)	(0.191)
Panel B. Using number of fatalities	1.669***	1.993***	0.699	0.894	1.015*
as dep. var.	(0.351)	(0.405)	(0.847)	(0.632)	(0.544)
Panel C. Using number of violent events	1.138***	1.109***	0.514	0.601*	0.298*
as dep. var.	(0.204)	(0.216)	(0.351)	(0.318)	(0.170)
Panel D. Defining civil conflict based	0.337**	0.121	0.322**	0.327**	0.333**
on UCDP dataset	(0.155)	(0.074)	(0.133)	(0.139)	(0.149)
Panel E. Including spatially lagged	0.381***	0.439***	0.140	0.264*	0.374**
BGR inequality	(0.096)	(0.115)	(0.238)	(0.153)	(0.190)
Panel F. BGR inequality outside	0.283*	0.357	0.139	0.162	0.268
the growing season	(0.166)	(0.220)	(0.236)	(0.240)	(0.217)
Panel G. Defining BGR inequality based on	1.189***	1.431***	0.331	0.647**	0.805*
GREG dataset	(0.315)	(0.365)	(0.280)	(0.321)	(0.418)
Panel H. Considering monthly-level	0.053*	0.055	0.180***	0.153***	0.095***
analysis	(0.029)	(0.037)	(0.034)	(0.032)	(0.048)
Panel I. Probit model (AME) without	0.391***	0.468***	0.292	0.312*	0.504***
spatial correction in SE	(0.101)	(0.114)	(0.233)	(0.163)	(0.114)
Climatic controls		Included	Included	Included	Included
Religion controls		Included			
Economic controls					Included
Year FE	No	Yes	Yes	Yes	Yes
State FE	No	No	Yes	Yes	Yes
State-specific time trends	No	No	No	Yes	Yes

Notes: Religion controls include an indicator that the state has high religious fragmentation and a measure of the state religious tension.
Economic controls include population and per capital allocations to states.
All inequality measures have been normalized by taking $(X - X_{min})/(X_{max} - X_{min})$
BGR indicates Between-Group Rainfall Inequality
Robust standard errors (in parentheses) are adjusted for spatial dependence of an unknown form (Conley, 1999)
* denotes significant at 10%, ** at 5%, *** at 1%
Detailed results are provided in Tables A.4., A.5., A.6., A.7., A.8., A.9., A.10. and A.11. of the Appendix.

Table 5. BGR inequality, trust and political evaluations

Dependent Variables	Trust Variable: General	Between-group	Within-group	Neighbour	Government	Govt satisfaction	Govt corruption
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
BGR inequality	-0.575***	-0.563***	-0.463***	-0.599***	-0.094***	-0.160***	0.288***
	(0.092)	(0.118)	(0.102)	(0.119)	(0.031)	(0.027)	(0.050)
Rainfall	-0.102***	-0.070	-0.102***	-0.079*	-0.010	0.015***	-0.007
	(0.031)	(0.043)	(0.034)	(0.043)	(0.006)	(0.005)	(0.008)
Temperature	0.021	0.012	-0.005	0.019	0.070***	0.077***	-0.034***
	(0.018)	(0.025)	(0.020)	(0.025)	(0.009)	(0.008)	(0.011)
Economic controls	Included	Included	Included	Included	Included	Included	Included
Survey-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-specific time trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.180	0.199	0.173	0.175	0.275	0.221	0.073
Observations	812	812	812	812	812	812	812

Notes: Economic controls include population and per capital allocations to states.
General Trust is a summative scale, indicating that respondents trusts somewhat or a lot in their relatives, neighbours, own ethnic group and others.
Trust in government is a summative scale, indicating that respondents trust somewhat or a lot in the President, state Governor and Local Government Mayor.
Government satisfaction: an indicator that the government handles the economy, health, inequality, and water-related issues very well as opposed to very badly
Robust standard errors (in parentheses) are clustered at the state-level
* denotes significant at 10%, ** at 5%, *** at 1%

Table 6. ACDE of BGR inequality on conflict

	Civil conflict Estimate	95% Bootstrapped CI	Communal conflict Estimate	95% Bootstrapped CI
BGR inequality	0.345	[-0.077 - 0.766]	0.191	[-0.184 - 0.567]
BGR inequality (ACDE)	0.343	[0.030 - 0.755]	0.193	[-0.030 - 0.867]

Notes: For the ACDE, the mediator include government satisfaction scale: an indicator that the government handles the economy, employment, inflation, health, inequality, and water-related issues very well as opposed to very badly; general trust is a summative scale, indicating that respondents trusts somewhat or a lot in their relatives, neighbours, own ethnic group and others; between-group trust is a measure that captures the level of trust between the different ethnic groups living within a state, and trust in government scale: a summative scale, indicating that respondents trust somewhat or a lot in the President, Local Government Mayor, National Assembly, electoral commission, and ruling party Nonparametric bootstrapped 95% CI based on 1,000 replications shown in bracket.

Appendix

August, 2017

Figure A.1: Dataset construction

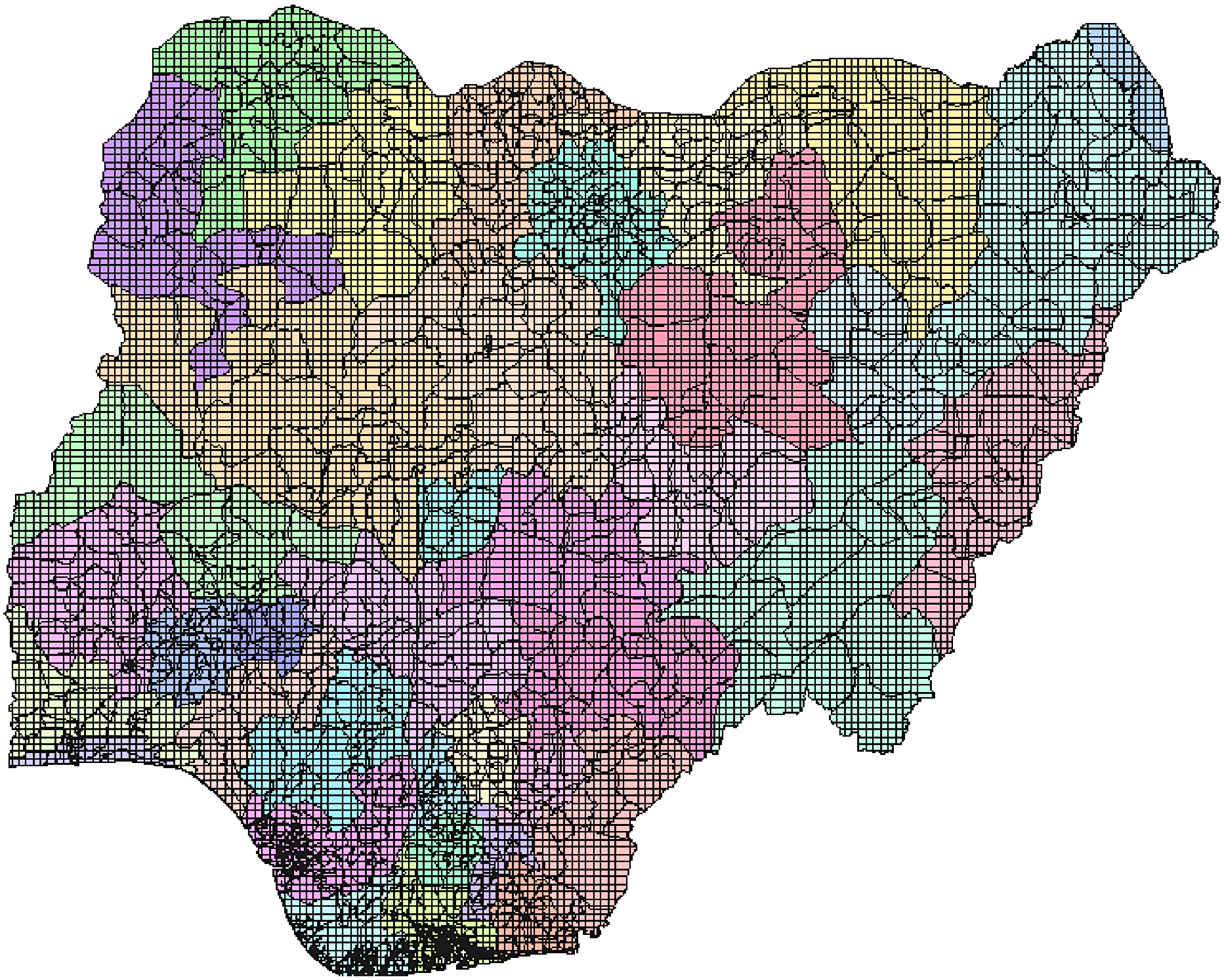

Table A.1. Cross-correlation table

Variables	BGR inequality	WGR inequality	WSR inequality	BGT inequality	WGT inequality	WST inequality
BGR inequality	1.000					
WGR inequality	0.028	1.000				
WSR inequality	0.702	0.711	1.000			
BGT inequality	0.580	0.024	0.453	1.000		
WGT inequality	-0.103	0.857	0.520	0.090	1.000	
WST inequality	0.316	0.624	0.681	0.699	0.763	1.000

Table A.2. Summary Statistics

Variables	**Observations**	**Mean**	**Std. Dev**	**Min**	**Max**
Rainfall	703	59.501	24.471	2.185	180.90
Temperature	703	18.068	5.935	5.188	39.489
Indicator that a state has high religious fragmentation	703	0.485	0.382	0	1
Measure of state religious tension	703	0.258	0.255	0	0.720
Number of violent events	703	9.855	23.53	0	315
Fatalities	703	81.33	428.0	0	7,396
Civil conflict	703	0.232	0.422	0	1
Communal conflict	703	0.284	0.500	0	1
BGR inequality	703	0.174	0.186	0	1
WGR inequality	703	0.102	0.143	0	1
Within-state inequality	703	0.162	0.142	0	1
BGT inequality	703	0.134	0.152	0	1
WGT inequality	703	0.137	0.176	0	1
Within-state Temperature inequality	703	0.184	0.170	0	1
Oil producing state dummy	703	0.351	0.478	0	1
General Trust	1,204	0.499	0.401	0	1
Between-group Trust	1,204	0.525	0.473	0	1
Within-group Trust	1,204	0.573	0.404	0	1
Trust neighbour	1,204	0.511	0.500	0	1
Trust in government scale	1,624	0.341	0.379	0	1
Government corruption scale	1,624	0.530	0.432	0	1
Government satisfaction scale	1,624	0.362	0.329	0	1

Notes: All inequality measures have been normalized by taking $(X - X_{min})/(X_{max} - X_{min})$. BGR indicates Between-Group Rainfall Inequality. WGR indicates Within-Group Rainfall Inequality. BGT indicates Between-Group Temperature Inequality. WGT indicates Within-Group Temperature Inequality.

Table A.3. Civil conflict and inequality - ethnic conflict vs non-ethnic

Dependent Variable		**Ethnic conflict**			**Non-ethnic conflict**	
	(1)	(2)	(3)	(4)	(5)	(6)
BGR inequality	0.174*	0.197	0.346**	0.227**	-0.349	-0.230
	(0.090)	(0.196)	(0.152)	(0.110)	(0.240)	(0.203)
Rainfall	-0.006	-0.006	0.034	-0.005	-0.010	0.062*
	(0.035)	(0.035)	(0.024)	(0.041)	(0.041)	(0.031)
Temperature	-0.049	-0.018	-0.022	0.024	0.058	0.030
	(0.039)	(0.041)	(0.032)	(0.046)	(0.048)	(0.042)
Indicator that the state has high religious fragmentation	0.076			0.256*		
	(0.117)			(0.137)		
Measure of state religious tension	-0.267			-0.474**		
	(0.173)			(0.207)		
Economic controls			Included			Included
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	No	Yes	Yes	No	Yes	Yes
State-specific time trends	No	No	Yes	No	No	Yes
R-squared	0.114	0.197	0.633	0.070	0.148	0.521
Observations	703	703	333	703	703	333

Notes: All inequality measures have been normalized by taking $(X - X_{min})/(X_{max} - X_{min})$.
BGR indicates Between-Group Rainfall Inequality.
Robust standard errors (in parentheses) are adjusted for spatial dependence of an unknown form (Conley, 1999)
* significant at 10%, ** at 5%, *** at 1%

Table A.4.: Robustness to using number of fatalities

Dependent Variable	**Number of fatalities**				
	(1)	(2)	(3)	(4)	(5)
BGR inequality	1.669***	1.993***	0.699	0.894	1.015*
	(0.351)	(0.405)	(0.847)	(0.632)	(0.544)
Rainfall		0.314	0.234	0.129	0.437**
		(0.821)	(0.782)	(0.112)	(0.206)
Temperature		-0.256	-0.101	-0.216*	-0.342**
		(0.188)	(0.190)	(0.131)	(0.155)
Religion controls		Included			
Economic controls					Included
Year FE	No	Yes	Yes	Yes	Yes
State FE	No	No	Yes	Yes	Yes
State-specific time trends	No	No	No	Yes	Yes
R-squared	0.029	0.222	0.372	0.426	0.523
Observations	703	703	703	703	333

Notes: All inequality measures have been normalized by taking $(X - X_{min})/(X_{max} - X_{min})$.

BGR indicates Between-Group Rainfall Inequality.

Robust standard errors (in parentheses) are adjusted for spatial dependence of an unknown form (Conley, 1999)

* significant at 10%, ** at 5%, *** at 1%

Table A.5.: Robustness to using number of violent events

Dependent Variable	**Number of violent events**				
	(1)	(2)	(3)	(4)	(5)
BGR inequality	1.138***	1.109***	0.514	0.601*	0.298*
	(0.204)	(0.216)	(0.351)	(0.318)	(0.170)
Rainfall		0.027	0.189	0.273	0.567
		(0.458)	(0.395)	(0.205)	(0.417)
Temperature		-0.095	-0.004	-0.105	-0.158**
		(0.107)	(0.094)	(0.068)	(0.079)
Religion controls		Included			
Economic controls					Included
Year FE	No	Yes	Yes	Yes	Yes
State FE	No	No	Yes	Yes	Yes
State-specific time trends	No	No	No	Yes	Yes
R-squared	0.045	0.331	0.546	0.612	0.671
Observations	703	703	703	703	333

Notes: All inequality measures have been normalized by taking $(X - X_{min})/(X_{max} - X_{min})$.
BGR indicates Between-Group Rainfall Inequality.
Robust standard errors (in parentheses) are adjusted for spatial dependence of an unknown form (Conley, 1999)
* significant at 10%, ** at 5%, *** at 1%

Table A.6.: Robustness to using alternative conflict dataset (UCDP)

Dependent Variable		**Civil conflict**			
	(1)	(2)	(3)	(4)	(5)
BGR inequality	0.337**	0.121	0.322**	0.327**	0.333**
	(0.155)	(0.074)	(0.133)	(0.139)	(0.149)
Rainfall		0.027	0.169**	0.349*	0.567
		(0.458)	(0.075)	(0.182)	(0.417)
Temperature		-0.195	-0.218	-0.168*	-0.183**
		(0.107)	(0.172)	(0.087)	(0.093)
Religion controls		Included			
Economic controls					Included
Year FE	No	Yes	Yes	Yes	Yes
State FE	No	No	Yes	Yes	Yes
State-specific time trends	No	No	No	Yes	Yes
R-squared	0.045	0.331	0.546	0.584	0.671
Observations	703	703	703	703	333

Notes: All inequality measures have been normalized by taking $(X - X_{min})/(X_{max} - X_{min})$.
BGR indicates Between-Group Rainfall Inequality.
Robust standard errors (in parentheses) are adjusted for spatial dependence of an unknown form (Conley, 1999)
* significant at 10%, ** at 5%, *** at 1%

Table A.7.: Robustness to including spatial lag of BGR inequality

Dependent Variable	**Civil conflict**				
	(1)	(2)	(3)	(4)	(5)
BGR inequality	0.381***	0.439***	0.140	0.264*	0.374**
	(0.096)	(0.115)	(0.238)	(0.153)	(0.190)
Spatially lagged BGR	0.068**	0.095	0.155	0.238*	1.664*
	(0.033)	(0.139)	(0.181)	(0.134)	(0.977)
Rainfall		0.126	0.093	0.130	0.252
		(0.230)	(0.232)	(0.081)	(0.217)
Temperature		-0.010	0.020	0.014	-0.012
		(0.047)	(0.048)	(0.037)	(0.043)
Religion controls		Included			
Economic controls					Included
Year FE	No	Yes	Yes	Yes	Yes
State FE	No	No	Yes	Yes	Yes
State-specific time trends	No	No	No	Yes	Yes
R-squared	0.021	0.094	0.151	0.362	0.433
Observations	703	703	703	703	333

Notes: All inequality measures have been normalized by taking $(X - X_{min})/(X_{max} - X_{min})$.
BGR indicates Between-Group Rainfall Inequality.
Robust standard errors (in parentheses) are adjusted for spatial dependence of an unknown form (Conley, 1999)
* significant at 10%, ** at 5%, *** at 1%

Table A.8.: Robustness to considering BGR inequality outside the growing season

Dependent Variable	**Civil conflict**				
	(1)	(2)	(3)	(4)	(5)
BGR inequality (non-growing)	0.283*	0.357	0.139	0.162	0.268
	(0.166)	(0.220)	(0.236)	(0.240)	(0.217)
Rainfall		0.023	0.016	0.039	0.068*
		(0.045)	(0.045)	(0.0261)	(0.037)
Temperature		-0.017	0.020	0.024	-0.014
		(0.046)	(0.048)	(0.040)	(0.043)
Religion controls		Included			
Economic controls					Included
Year FE	No	Yes	Yes	Yes	Yes
State FE	No	No	Yes	Yes	Yes
State-specific time trends	No	No	No	Yes	Yes
R-squared	0.020	0.093	0.151	0.284	0.430
Observations	703	703	703	703	333

Notes: All inequality measures have been normalized by taking $(X - X_{min})/(X_{max} - X_{min})$.
BGR indicates Between-Group Rainfall Inequality.
Robust standard errors (in parentheses) are adjusted for spatial dependence of an unknown form (Conley, 1999)
* significant at 10%, ** at 5%, *** at 1%

Table A.9.: Robustness to using alternative ethnic dataset (GREG)

Dependent Variable			**Civil conflict**		
	(1)	(2)	(3)	(4)	(5)
BGR inequality	1.189***	1.431***	0.331	0.647**	0.805*
	(0.315)	(0.365)	(0.280)	(0.321)	(0.418)
BGR inequality (t-1)					
BGR inequality (t-2)					
Rainfall		0.023	0.018	0.053*	0.070*
		(0.045)	(0.046)	(0.029)	(0.037)
Temperature		-0.018	0.019	-0.016	-0.011
		(0.046)	(0.048)	(0.042)	(0.044)
Religion controls		Included			
Economic controls					Included
Year FE	No	Yes	Yes	Yes	Yes
State FE	No	No	Yes	Yes	Yes
State-specific time trends	No	No	No	Yes	Yes
R-squared	0.019	0.091	0.151	0.431	0.435
Observations	703	703	703	703	333

Notes: All inequality measures have been normalized by taking $(X - X_{min})/(X_{max} - X_{min})$.
BGR indicates Between-Group Rainfall Inequality.
Robust standard errors (in parentheses) are adjusted for spatial dependence of an unknown form (Conley, 1999)
* significant at 10%, ** at 5%, *** at 1%

Table A.10.: Robustness to considering monthly-level analysis

Dependent Variable			**Civil conflict**		
	(1)	(2)	(3)	(4)	(5)
BGR inequality	0.053*	0.055	0.180***	0.153***	0.095***
	(0.029)	(0.037)	(0.034)	(0.048)	(0.034)
Rainfall		0.007	0.084***	0.089***	0.076***
		(0.019)	(0.022)	(0.024)	(0.021)
Temperature		-0.085***	-0.062***	-0.058***	-0.086***
		(0.014)	(0.013)	(0.016)	(0.014)
Religion controls		Included			
Economic controls				Included	Included
Month FE	No	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	Yes	Yes
State FE	No	No	Yes	Yes	Yes
State-specific time trends	No	No	No	Yes	Yes
R-squared	0.051	0.106	0.303	0.428	0.433
Observations	5,182	5,182	5,182	3,966	3,996

Notes: All inequality measures have been normalized by taking $(X - X_{min})/(X_{max} - X_{min})$.
BGR indicates Between-Group Rainfall Inequality.
Robust standard errors (in parentheses) are adjusted for spatial dependence of an unknown form (Conley, 1999)
* significant at 10%, ** at 5%, *** at 1%

Table A.11.: Robustness to using probit model

Dependent Variable	**Civil conflict**				
	(1)	(2)	(3)	(4)	(5)
BGR inequality	0.391***	0.468***	0.292	0.312*	0.504***
	(0.101)	(0.114)	(0.233)	(0.163)	(0.114)
Rainfall		0.123	-0.053	0.047	0.007
		(0.224)	(0.094)	(0.083)	(0.146)
Temperature		-0.016	-0.018	-0.027	-0.022
		(0.045)	(0.025)	(0.032)	(0.038)
Religion controls		Included			
Economic controls					Included
Year FE	No	Yes	Yes	Yes	Yes
State FE	No	No	Yes	Yes	Yes
State-specific time trends	No	No	No	Yes	Yes
Observations	703	703	703	703	333

Notes: Robust standard errors (in parentheses) are clustered at the state-level

All inequality measures have been normalized by taking $(X - X_{min})/(X_{max} - X_{min})$

BGR indicates Between-Group Rainfall Inequality

* significant at 10%, ** at 5%, *** at 1%

Table A.12.: Civil conflict, trust and inequality

Dependent Variable	**Civil conflict**						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
BGR inequality	0.301	0.298	0.307	0.373*	0.303	0.346*	0.345
	(0.196)	(0.193)	(0.191)	(0.213)	(0.194)	(0.183)	(0.214)
Rainfall	0.011	0.020	0.338	0.323	0.004	0.385	0.384
	(0.039)	(0.052)	(0.214)	(0.239)	(0.214)	(0.054)	(0.239)
Temperature	-0.022	-0.022	-0.011	-0.017	-0.022	-0.018	-0.017
	(0.044)	(0.043)	(0.042)	(0.048)	(0.043)	(0.048)	(0.048)
General Trust	-0.401*						-0.010
	(0.214)						(0.065)
Between-group Trust	-0.341**						-0.103*
	(0.163)						(0.055)
Trust in government scale		-0.403*			-0.023	-0.012	-0.019
		(0.214)			(0.052)	(0.066)	(0.094)
Government satisfaction scale			-0.038***		-0.406*		-0.048***
			(0.012)		(0.239)		(0.015)
Government corruption scale				-0.024		-0.026	
				(0.046)		(0.046)	
Economic controls	Included	Included	Included	Included	Included	Included	Included
Survey-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-specific time trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.448	0.446	0.442	0.470	0.447	0.475	0.475
Observations	296	296	296	296	296	296	296

Notes:All inequality measures have been normalized by taking $(X - X_{min})/(X_{max} - X_{min})$

BGR indicates Between-Group Rainfall Inequality

General Trust is a summative scale, indicating that respondents trusts somewhat or a lot in their relatives, neighbours, own ethnic group and others.

Trust in government is a summative scale, indicating that respondents trust somewhat or a lot in the Government.

Between-group trust is a measure that captures the level of trust between the different ethnic groups living within a state.

Government satisfaction: an indicator that the government handles the economy very well as opposed to very badly.

Robust standard errors (in parentheses) are clustered at the state-level

* denotes significant at 10%, ** at 5%, *** at 1%