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Abstract

The Role of Droughts and Religious Cleavages in Pastoralist Conflict in Nigeria

by Ruud Koopmans, Daniel Meierrieks and Daniel Tuki

This article studies the role of environmental and religious factors in the occurrence of pastoralist conflict in Nigeria using panel data at the 0.5 x 0.5° grid cell level between 1997 and 2020. The empirical analysis provides robust evidence that the occurrence of droughts does not raise the likelihood of pastoralist conflict in those parts of the country where Muslim herders face a largely Muslim sedentary population. However, when there is a potential for interreligious tensions (i.e., in predominantly Christian parts of Nigeria), droughts significantly fuel pastoralist violence. That is, the adverse interaction between droughts and religious cleavages creates particularly potent conditions for the emergence of pastoralist conflict. This interpretation is supported by original survey data collected in 2021, which shows that Christians and Muslims disagree about the participants and causes of pastoralist conflict in Nigeria, again emphasizing the role of religious divides in this conflict.

Keywords: pastoralist conflict; droughts; religious violence; Nigeria; Fulani; survey evidence

JEL classification: D74, Q54

Zusammenfassung

Die Rolle von Dürren und religiösen Gegensätzen bei Konflikten um Weideland in Nigeria

Ruud Koopmans, Daniel Meierrieks and Daniel Tuki

Anhand von Paneldaten auf einem 0,5° × 0,5°-Raster für die Jahre 1997–2020 untersucht dieser Artikel, welchen Einfluss Umweltfaktoren und Religion auf Konflikte um Weideland in Nigeria haben. Die empirische Analyse liefert robuste Befunde: In Landesteilen, in denen muslimische Viehhirten auf eine überwiegend muslimische sesshafte Bevölkerung treffen, erhöhen Dürren nicht die Wahrscheinlichkeit solcher Konflikte. In Regionen mit potenziellen interreligiösen Spannungen, das heißt in vorwiegend christlichen Teilen Nigerias, begünstigen Dürren hingegen signifikant die Gewalt. Mit anderen Worten schafft die ungünstige Wechselwirkung zwischen Dürren und religiöser Spaltung besonders explosive Bedingungen für das Entstehen von Konflikten um Weideland. Diese Deutung wird durch selbst erhobene Umfragedaten aus dem Jahr 2021 gestützt, die zeigen, dass Christen und Muslime unterschiedliche Auffassungen darüber haben, wer an solchen Konflikten beteiligt ist und welche Ursachen ihnen zugrunde liegen, was die Rolle religiöser Gegensätze in diesem Konflikt erneut betont.

Schlüsselwörter: Konflikte um Weideland; Dürren; religiöse Gewalt; Nigeria; Fulani; Umfrage–ergebnisse"

JEL Klassifikation: D74, Q54

1. Introduction

Data from the *Armed Conflict Location and Events Database* (ACLED) (Raleigh et al., 2010) shows that since the late 1990s, there have been several thousand violent clashes between *pastoralists* (i.e., nomadic herders who breed and take care of livestock) and sedentary communities in sub-Saharan Africa. Approximately 35% of these clashes have occurred in Nigeria, a disproportionally large share even after accounting for Nigeria's population size. Since the late 1990s, pastoralist violence has claimed over 15,000 lives in Nigeria, most of them since 2010. Only the confrontation between the Islamist terrorist group *Boko Haram* and the Nigerian military in the Northeast of the country has been more harrowing. Disputes between sedentary communities and nomadic herders, who in Nigeria belong predominantly to the *Fulani ethnic group*, are not a new phenomenon. They occurred even before the country's independence from British rule (e.g., Ibrahim, 1966). However, such disputes were usually settled peacefully through the judicial system. For instance, as Ibrahim (1966: 174) observes:

> "There is […] a continual struggle between Borori [nomadic herdsman of the Fulani ethnic group] and farmers, and when a dispute goes to the courts – it does in the majority of cases – it invariably ends in the Bororo paying heavy compensation for damage to crops."

Considering recent patterns of pastoralist conflict in sub-Saharan Africa and Nigeria, a puzzle emerges: Why has this type of violence escalated so strongly in Nigeria from the late 1990s onwards? Two solutions for this puzzle have been advanced. The first is unfavorable environmental events, particularly in the form of *droughts.* Conflicts between herders and sedentary communities are rooted in competition over land and water, which intensifies during times of drought. Due to climate change, the Sahel Zone, where most Fulani herders traditionally live, has been increasingly threatened by droughts and desertification. Consequently, in search of suitable pasture for their cattle, Fulani herders have increasingly migrated outside of their traditional rangeland, raising the potential of conflict with sedentary communities that are predominantly engaged in agriculture (e.g., International Crisis Group, 2018; Adaawen et al., 2019; Madu and Nwankwo, 2021).

The second explanation points to the concurrence between pastoralist conflict and the rise in *interreligious tensions* in Nigeria. Since at least the late 1990s, there has been a push to introduce Sharia law in the Northern federal states, which has made violent clashes between Muslims and Christians more likely, especially in the religiously mixed *Middle Belt*, i.e., the transition zone between Northern and Southern Nigeria (e.g., Angerbrandt, 2011;

Kendhammer, 2013). Since 2010, the *Boko Haram* insurgency in Nigeria's Northeast has further stoked interreligious tensions (e.g., Adesoji, 2010; Loimeier, 2012). Crucially, pastoralist conflict in Nigeria also has a religious dimension. The nomadic herders (i.e., the Fulani as well as other smaller pastoralist groups) are overwhelmingly Muslim. While sedentary communities in Nigeria can be either Christian or Muslim, violent conflict may be more likely where sedentary communities are Christian. Under such circumstances, any clash of interests over water and land suitable for both animal husbandry and agricultural use coincides with religious divides. For instance, such divides may make non-violent conflict resolution less likely (e.g., due to the prevalence of distrust between different religious communities), while also introducing additional benefits from conflict (e.g., spiritual benefits from harming "infidels").

In this contribution, we examine whether ecological reasons (the occurrence of droughts) and religious cleavages (differences between Christians and Muslims) can explain the emergence of pastoralist conflict in Nigeria. We also investigate the potential interaction between these two explanations, asking whether it is especially the combination of droughts and religious differences that explains the rise in pastoralist violence and its geographic spread. For our main empirical analysis, we employ a panel dataset that allows us to investigate yearly fluctuations in pastoralist conflict events across approximately 300 grids (measured at the 0.5 x 0.5° grid cell level) in Nigeria, where these grids saw varying religious composition as well as exposure to droughts for our period of observation between 1997 and 2020.

In addition, we use original data from a 2021 survey of approximately 1,600 respondents fielded in Kaduna, a state which has the third highest incidence of pastoralist conflict out of Nigeria's 36 states. This survey evidence complements our macro view on the nexus between religion, ecological disasters and farmer-herder tensions from the panel study with a micro-level (individual) perspective, especially investigating how religious convictions of survey respondents matter to their perceptions about the participants and causes of the pastoralist conflict.

Our empirical analysis shows that violence is especially likely where Muslim herders interact with sedentary communities that are predominantly Christian, a constellation that frequently occurs in the Central and Eastern parts of Nigeria's Middle Belt. Pastoralist violence is less likely to erupt in Northern Nigeria, even though this is the part of the country where the concentration of pastoralists is highest. Yet, in this part of Nigeria pastoralists and sedentary communities share the same religion: Islam. That is, our empirical findings imply that in the

absence of religious cleavages between herders and sedentary communities, the occurrence of droughts does not raise the likelihood of conflict. Where there is a potential for interreligious conflict, however, droughts significantly drive intercommunal violence. Interrogating our survey data for Kaduna State, we find that while Christian respondents are more likely to see pastoralist violence as caused by religion, Muslim respondents are more likely to relate it to ecological problems. What is more, Christians are more distrustful of the Fulani ethnic group (which accounts for most nomadic herders) than Muslim respondents. Thus, the survey evidence bolsters the conclusions that we draw from our grid-level panel analysis especially on the role of religion in this type of conflict.

With our study, we contribute to three strands of the literature. First, we add to the literature on the roots of conflict in Nigeria, especially violence involving pastoralists (e.g., Ajala, 2017, 2020; Ademola, 2020; Chukwuma, 2020; Ejiofor, 2021; George et al., 2021). Here, earlier studies on pastoralist conflict in Nigeria have either disregarded its religious dimension or assessed it with qualitative or descriptive methods. We contribute to this literature by providing a comprehensive quantitative study of the determinants of pastoralist conflict in Nigeria that highlights its potential religious underpinnings. Second, we add to the literature that relates unfavorable climate conditions, extreme weather-related events and climate change to the emergence of various forms of intra-state violence especially in Africa (e.g., Burke et al., 2009; Raleigh and Kniveton, 2012; Fjelde and von Uexkull, 2012; Couttenier and Soubeyran, 2014; von Uexkull, 2014; Eberle et al., 2020; McGuirk and Nunn, 2020; see also overviews by, e.g., Bernauer et al., 2012; Burke et al., 2015; Koubi, 2019). We complement this literature by stressing the role of religious cleavages in moderating the impact of ecological challenges on conflict. Finally, we contribute to the literature on the relationship between religion and violence (e.g., Juergensmeyer, 2006; Basedau et al., 2013; Dawson, 2018) by investigating whether religious cleavages matter to pastoralist conflict, especially studying how the confluence of ecological challenges and religious tensions creates the highest potential for violent conflict.

The remainder of this paper is organized as follows. In Section 2, we discuss linkages between religious cleavages, droughts and pastoralist conflict in Nigeria in more detail, developing three testable hypotheses. We introduce the data to examine these hypotheses in Section 3. Our empirical model and findings are reported in Section 4. Section 5 provides an empirical analysis of our survey data. Section 6 concludes.

2. Literature Review and Hypotheses

2.1 Religion and Pastoralist Conflict

There are several reasons why religious cleavages may increase the risk of socio-economic competition between herders and sedentary communities over land, water and other resources turning violent. As a first reason, an established finding of the literature on social movements and conflicts is that so-called "cross-cutting cleavages" diminish the likelihood of conflict escalation (e.g., Oberschall 1973; Selway 2011; Gubler and Selway 2012; Desmet et al. 2017). A cross-cutting cleavage exists where membership of one salient social group has little predictive power of membership of another salient social group. Under such circumstances, group boundaries and ingroup/outgroup divisions will be less stark.

For the case at hand, this means that we may expect pastoral conflicts to be less likely to escalate when Muslim herders face residents in predominantly Muslim parts of the country. Indeed, the shared religion may then have a pacifying influence. A religion shared by the Fulani herders and the sedentary population makes it easier for disagreements to be resolved amicably, e.g., by appealing to religious authorities respected by both sides. When both nomads and farmers are Muslim, they are also more likely to respect common religious norms concerning property and the use of violence; there is a clear spiritual disbenefit associated with harming people who share the same faith. Finally, a shared religion may expedite kinship (e.g., as it facilitates intergroup marriages). Indeed, there is a substantial body of literature on intergroup conflict that highlights the tendency for people with common cultural characteristics (such as religion) to cohabitate more peacefully (e.g., Allport, 1954; Seul, 1999; Adida et al. 2015).

Another reason religion may matter is ideological. Since the late 1990s, radical Islamist ideologies have spread across the Sahel region and Northern Nigeria in particular. The introduction of Sharia law in most Northern Nigerian states as well as in some states in the religiously mixed Middle Belt has turned religion into a divisive issue in Nigerian politics. Under such circumstances, religious differences may make it more likely that a primarily "secular struggle takes on the aura of sacred conflict" (Juergensmeyer, 2006: 140). Religionized conflict, in turn, gives participants in this conflict access to additional spiritual benefits (e.g., the prospect of heavenly rewards) associated with using violence against non-believers, potentially making it more likely that violence will be used (Juergensmeyer, 2006).

Finally, religious distrust between Muslims and Christians has deep historical roots especially in Nigeria's Middle Belt. In the 19th century, most of the region was conquered in what is known as the "Fulani jihads" and incorporated into the Muslim Caliphate of Sokoto. Under subsequent

British indirect rule, the Northern Hausa-Fulani elite continued to dominate non-Muslim ethnic groups in the Middle Belt, most of which ultimately converted to Christianity (Coleman, 1965; Harnischfeger, 2006). Thus, in the Middle Belt, Christianity developed as an oppositional identity against Muslim domination, a legacy that continues to this day (Vaughan, 2016). Consequently, historic distrust of Muslims among Christians in the Middle Belt may make it more likely that pastoralist conflict escalates where the resident population is predominantly Christian.

In sum, this discussion on the role of religion in conflict points to its capacity to influence ingroup/outgroup dynamics and distrust as well as the benefits of non-violence and violence. Given that herders are predominantly Muslim, we expect violent conflict to be more likely in parts of Nigeria with larger Christian populations, meaning that we expect support for the following hypothesis if religious cleavages play a significant role in pastoralist conflict:

> *Hypothesis 1: Pastoralist conflict is more likely in localities with a larger Christian population.*

2.2 Droughts and Pastoralist Conflict

Pastoralist conflict in Nigeria may also have environmental roots. This argument is related to the broader literature on the role of climate change in political violence, especially also in African context (e.g., Bernauer et al., 2012; Burke et al., 2015; Koubi, 2019). For instance, Fjelde and von Uexkull (2012) examine the occurrence of communal conflict in Sub-Saharan Africa between 1990 and 2008, finding that a lack of rainfall is linked to a higher risk of communal conflict. Similarly, von Uexkull (2014) studies how droughts affect the risk of civil conflict in sub-Saharan Africa between 1989 and 2008, showing that sustained droughts are associated with increased conflict risk. As a final example, Burke et al. (2009) investigate the relationship between temperature increases and civil war in sub-Saharan Africa, finding that warmer years lead to significant increases in the likelihood of civil war in subsequent years.

We relate the arguments concerning the nexus between climate conditions, climate change and violence to pastoralist conflict in Nigeria, given that both the Muslim herders and the sedentary communities with which they are most likely to interact (i.e., rural communities that largely subsist on agriculture) are dependent upon sound ecological conditions to thrive. More specifically, we argue that the occurrence of droughts leads to higher levels of pastoralist conflict. For one, droughts may result in conflict by leading to resource scarcity (e.g., Homer-Dixon, 1999; Bernauer et al., 2012). For instance, a lack of rainfall may lead to water shortages

and reduce the availability of land potentially suitable for crops and livestock. This may directly lead to violent competition over access to water and usable land.

Furthermore, droughts may have additional unfavorable socio-economic effects (e.g., Koubi, 2019). Droughts may reduce economic output associated with both crop planting and animal husbandry, consequently lowering wages and employment in the agricultural sector, while also contributing to higher food prices and food insecurity (e.g., Adams et al., 1998; Carter et al., 2018). By curtailing economic activity, droughts may also reduce tax income, which, in turn, limits public interventions to ameliorate the adverse socio-economic consequences of droughts (Koubi, 2019). Finally, droughts may induce environmental migration that could, in turn, "burden economic and resource bases in […] receiving areas" (Koubi, 2019: 348; for further evidence on the link between climatic conditions and migration, see also Cattaneo and Peri, 2016; Berlemann and Steinhardt, 2017; Helbling and Meierrieks, 2021). In sum, these unfavorable socio-economic effects of droughts may create further—indirect—pathways from droughts to increased conflict risk, creating incentives for violence (e.g., to gain access to resources with force), while lowering the benefits from non-violence (which may arise from, e.g., income earned on the labor market).Thus, we expect support for the following hypothesis if adverse environmental events indeed shape pastoralist conflict:

Hypothesis 2: Pastoralist conflict is more likely during droughts.

2.3 Pastoralist Conflict and the Interaction between Religion and Droughts

Not all empirical studies on the relationship between climatic factors and violence find that the former significantly shapes the latter. For example, Couttenier and Soubeyran (2014) only detect a weak positive link between drought and civil war for a sample of sub-Saharan African countries. Potentially, this is because the relationship between climate conditions and events (such as droughts) and violence (such as pastoralist conflict) is not unconditional but dependent on context. Harking back to our discussion of the role of religion in pastoralist conflict, we expect that adverse environmental events are especially potent in raising the risk of conflict when affected areas are already conflict-prone due to religious differences; or, conversely, religious cleavages are particularly likely to escalate into violent conflict when they are coupled with economic hardship and resource scarcity induced by droughts.

Indeed, this theoretical expectation speaks to Koubi (2019: 354) who, reviewing the literature on the relationship between climate conditions and conflict, notes that "adverse climatic conditions are more likely to lead to conflict in places that already experience[d] conflict". In

her survey, she points to several contextual factors uncovered in earlier empirical studies that may shape the relationship between climate variables and conflict, including, e.g., poor infrastructure, dependence on agriculture and political exclusion (Koubi, 2019). We add to this discussion by examining the role of religious cleavages in affecting the nexus between climate conditions and violent conflict.

We hypothesize that droughts fuel conflict especially in those parts of Nigeria that are already plagued by religious tensions. These tensions (between Christians and Muslims) influence ingroup/outgroup dynamics as well as benefits of non-violence and violence in ways that make conflict more likely. Further socio-economic pressures due to droughts will only increase the likelihood of conflict. This leads to our third testable hypothesis:

> *Hypothesis 3: Pastoralist conflict is especially likely during droughts in localities with a larger Christian population.*

3. Data

For our empirical study of the relationship between droughts, religion and pastoralist conflict in Nigeria, we collect panel data for approximately 300 grids with a resolution of 0.5 x 0.5° (about 55km^2) between 1997 and 2020, using the *PRIO-GRID* (Tollefsen et al., 2012). We consider only grid cells whose centroids are within Nigerian territory. The summary statistics for all variables introduced below are reported in the appendix (Supplementary Table 1).[1]

We discuss the various data sources and variables on which we rely in our subsequent panel analysis below. We supplement this macro-level analysis with micro-data on intergroup trust and conflict perceptions from a large-*N* survey in the state of Kaduna in Northern Nigeria that we conducted in May 2021 in cooperation with *Oxford Policy Management*, a Nigerian private survey company. Here, we selected Kaduna State because it has been greatly affected by violent conflicts between nomadic herders and sedentary farmers, while the state's population is also rather evenly split between Christians and Muslims. The survey was conducted in either English or, if the respondent did not speak English, Hausa (an important local language). Data were collected using computer-assisted personal interviews. We ensured that the enumerators were locals who were familiar with the cultural and geographical environment. For the survey,

[1] Due to missing data, we exclude Osun State in our dataset. As shown in the Appendix (Supplementary Tale 2), this state experienced almost no pastoralist conflict incidents during our period of observation.

respondents were randomly drawn from the local population. In total, 1,608 respondents were interviewed. Of this number, 1,353 were part of the resident population, while the remaining 255 respondents were either nomadic or semi-nomadic herders. Because we do not have a sampling frame for nomadic herders in the state due to their mobile nature, enumerators were asked to inquire whether there was a pastoralist camp nearby whenever they arrived at a community to conduct interviews.

3.1 Measuring Pastoralist Conflict

Data on conflict is from the *Armed Conflict Location and Event Data Project* (*ACLED*) (Raleigh et al., 2010). ACLED provides information on the types, actors, locations, dates and other characteristics (e.g., fatalities) of conflict as well as other violent-adjacent events (Raleigh et al., 2010; ACLED, 2021). Violent events include, e.g., battles, bombings and attacks against civilians, whereas violent-adjacent events are demonstrations that could involve violence as well as politically relevant events such as arrests (ACLED, 2021). Since the ACLED data is georeferenced, we can assign the conflict events to the various grid cells.

The ACLED dataset also contains information on the occupation and ethnicity of the involved actors. A close examination of the data shows that virtually all the actors who are classified as "pastoralists" belong to the Fulani ethnic group, which means that the term "pastoralist" effectively overlaps with the term "Fulani" for Nigeria. The Fulani (or *Fulbe*), who live mostly in Central and West Africa, constitute one of the largest ethnic groups in Africa. According to Sangre (2019: 3), the total Fulani population was approximately 40 million in 2019, with 40% of them residing in Nigeria. Within Nigeria, they account for approximately 9% of the population. Hoppen (1958: 1-3) identifies several groups of Fulani that differ with respect to their degree of pastoralism and integration with local non-Fulani communities. Most important to our study is the difference between the urban Fulani (*Fulbe sire*) who have largely integrated into Hausa culture[2] and the pastoralist Fulani who are semi-nomadic or nomadic (*Fulbe Bororo'en*). It is the latter group of Fulani that ought to be especially relevant to pastoralist conflict in Nigeria.

[2] Indeed, although the Hausa and Fulani are two distinct ethnic groups, they have lived side-by-side for centuries and intermarried, which explains why they are often regarded as a single ethnic group (e.g., Diamond, 1988: 21).

Further supporting the idea that that herders predominantly belong to the Fulani ethnic group, our own survey data for Kaduna State shows that of the 255 nomadic or semi-nomadic respondents, 98% identify as Fulani. All self-identified pastoralists identify as Muslim.

To measure pastoral conflict, we consider ACLED events where one of the actors is associated with the Fulani ethnic group.[3] Our main dependent variable is a binary measure that is equal to unity when a grid-year sees at least one ACLED event that involves a Fulani actor. As an example of such a conflict event, consider the following case ACLED reports for the year 2020: "Three Fulani herders were attacked along the Goragam area in Zango Kataf by farmers who had asked them not to graze in the community" (ACLED-ID 7187156). There are also cases of larger scale intercommunal conflict in the data. For instance, the following 2010 case is reported by ACLED: "Fulani herdsmen and farmers clash in Nassarawa State. Seventy houses burnt down, over 400 families displaced" (ACLED-ID 4964689). What is more, the data accounts for reprisals, which are a common characteristic of pastoralist conflict (Bagu and Smith, 2017). They could take the form of armed pastoralists attacking villages and indiscriminately killing residents in retaliation for the killing or injury of a pastoralist or livestock (see, e.g., Jonathan, 2016). Similarly, resident communities may attack nomadic pastoralists and their livestock in retaliation for the destruction of crops or an earlier attack perpetrated by pastoralists (see, e.g., Arogbonlo 2023).

There are approximately 2,000 events involving Fulani actors during our period of observation, with 80% of them causing at least one fatality. Here, pastoralists could either be the perpetrators or targets. It is inherently difficult to distinguish perpetrators from victims during violent conflicts. However, working with the ACLED rule that civilians are—by definition—unarmed and thus very unlikely to be perpetrators (ACLED, 2021), we can consider the ACLED category "Violence against civilians" to better understand the dynamics of pastoralist conflict in Nigeria. Here, Fulani pastoralists were the perpetrators in 81% of the over 1,300 pastoralist conflict events categorized as "Violence against civilians", which suggests that pastoralists are more

[3] As a robustness check, however, below we use alternative operationalizations of the conflict variable. For instance, we also construct a conflict event variable that considers activities by Fulani actors as well as non-Fulani pastoralist actors (to account for the fact that some pastoralists may belong to smaller ethnic groups). While there are approximately 2,000 Fulani-related incidents, there are less than 100 incidents related to non-Fulani pastoralists. Again, this strongly suggests that pastoralist conflict overwhelmingly involves the Fulani ethnic group.

likely to initiate violence. However, it is also necessary to point out that the ACLED dataset has some limitations. It relies heavily on news reports which are prone to bias. Attacks perpetrated against nomadic herders might make the headlines less often than attacks by herders against resident communities. For instance, this is because nomadic herders often move to remote areas in search of pasture for their livestock, which makes them vulnerable to violence and cattle rustling, while also making a reporting of such events less likely. Indeed, our own survey data collected in Kaduna State in 2021 shows that one in three pastoralists had been a victim of cattle rustling during the last five years.

Figure 1 gives an overview of trends in pastoralist conflict between 1997 and 2020. While conflict was rather subdued throughout the late 1990s and 2000s, we see an uptick in activity especially after 2010.

—Figure 1—

Figure 2 provides an overview of the geographical distribution of pastoralist conflict in Nigeria during our period of observation. Conflict occurred in states located in both Nigeria's Northern and Southern regions. Out of Nigeria's 36 states, Plateau, Benue and Kaduna (which are in the Northern region) accounted for approximately 44% of the ca. 2,000 incidents that occurred in the country during the observation period. Supplementary Table 2 in the appendix provides a full breakdown of the distribution of the number of conflict events across the respective Nigerian states.

—Figure 2—

3.2 Measuring Religious Affiliation

The Nigerian census of 1963 was the last to ask for religious affiliation; no recent statistics on the religious composition of the Nigerian population at the grid level are available. We therefore rely on indirect ways of estimating religious composition. To this end, we use data from the *Georeferenced Infrastructure and Demographic Data for Development* (GRID3).[4] Between 2017 and 2018, this dataset recorded the geo-referenced locations of 33,103 churches and 22,379 mosques in Nigeria. Figure 3 shows their distribution. Consistent with Nigeria's well-known religious North-South divide, mosques are more common in the North, while churches are more common in the South. From the GRID3 data, we create a variable (*share of churches*) that measures the number of churches as a share of the total number of houses of worship (i.e.,

[4] The GRID3 data can be accessed here: https://grid3.org.

churches and mosques) within a specific grid as a measure of religious affiliation. This variable ranges from 0 to 1, with higher values indicating a stronger dominance of Christianity.

—Figure 3—

One may argue that our measure of religious composition at the grid level is imperfect. For instance, churches may be built to cater to different but small denominations (e.g., Protestants, Catholics and Pentecostals), potentially inflating the number of churches in a grid. Similarly, there are concrete spiritual rewards associated with constructing a mosque in Islam (namely a house in paradise). Again, this may mean that there are more mosques in an area than needed for strictly functional purposes, potentially leading to wrong conclusions about religious composition within a grid.

Therefore, as a robustness check, we develop an alternative religious composition measure, using data collected by the *Demographic Health Survey* (*DHS*) in Nigeria between 1990 and 2021.[5] The survey data contains georeferenced information about the respondents' religious affiliation, allowing us to extrapolate the total number of Christians and Muslims residing within each grid cell. Our alternative measure of religious affiliation, then, is the *share of Christians*, defined as the number of Christians as a share of the sum of Christians and Muslims per grid. For our project, we still prefer the share of churches as a measure of religious composition over the share of Christians. For one, this is because we need to extrapolate the DHS data, introducing uncertainty. For another, the DHS tends to oversample women, which may create additional extrapolation problems. However, both measures of grid-level religious composition are in very strong agreement. The pairwise correlation between both measures is r=0.92 (p<0.01), which cross-validates our baseline measure of religious affiliation.

3.3 Measuring Droughts

To generate a drought measure, we rely on the *Standardized Precipitation Evapotranspiration Index* (*SPEI*) developed by Vicente-Serrano et al. (2010) and further described in, e.g., Beguería et al. (2010). The SPEI not only considers precipitation but also evapotranspiration, allowing "for a more complete approach to explore the effects of climate change on drought conditions" compared to other measures of wetness or dryness (Beguería et al., 2010: 1351). In detail, the SPEI is calculated using a water balance methodology, where the SPEI is derived by subtracting potential evapotranspiration from precipitation (Beguería et al., 2010; Vicente-Serrano et al.,

[5] The DHS data can be found here: https://dhsprogram.com/data.

2010).[6] In our analysis, we rely on the SPEI-12, i.e., an index that considers water balance differences over 12 months. We choose this index because it ought to take some time for natural systems (e.g., water reservoirs and soil) to degrade sufficiently to trigger a human response that could also involve violence. Important for our subsequent panel analysis, the SPEI is a standardized measure, allowing for comparison over time and space.

The SPEI ranges from +2.5 to -2.5, where SPEI values >+0.5 would indicate wet spells, whereas SPEI values <-0.5 would indicate dry spells. Our main measure of drought is a dichotomous variable that is equal to unity when the SPEI is equal to or smaller than -0.5 and zero otherwise.

Figure 4 gives an overview of the temporal development of droughts (measured as the annual mean-incidence of droughts over all grid cells) in Nigeria between 1997 and 2020. A simple linear regression of the mean-incidence of droughts on time (as indicated by the black line in Figure 4) indicates that there is a slight increase in the risk of droughts over time. This trend is consistent with the unfavorable effects of climate change (e.g., IPCC 2014, 2021).

—Figure 4—

Furthermore, Figure 5 illustrates the geographical distribution of droughts in Nigeria during our period of observation, measured by the total number of years that a grid cell experienced drought between 1997 to 2020. Droughts tended to be less common in the Southwestern and Northern parts of Nigeria, while they tended to occur more frequently in the Middle Belt and Eastern parts of the country.[7] At the same time, Figure 5 also relates the geographical distribution of the incidence of pastoralist conflict to the distribution of droughts. There does not seem to be a clear correlation between both variables. Indeed, calculating the pairwise correlations between all variables of interest as grid-specific averages over time, we find that that there is no statistically significant association between droughts and conflict (Supplementary Table 3). By contrast, as also reported in Supplementary Table 3, a higher share of churches or Christians positively correlates with the mean incidence of conflict. This finding speaks to our theoretical expectations that religious differences between Muslim herders and non-Muslim resident communities could incite violence. Finally, the interaction between the

[6] For further information on the construction and calculation of the SPEI, see https://spei.csic.es/home.html.

[7] The four empty in the southwestern part of the map, for which no data on droughts were available, overlap with Osun state and were excluded from our analysis.

drought and religion variables also positively correlates with the mean incidence of pastoralist conflict in statistically significant ways (Supplementary Table 3). This is a first indication that the combination of droughts and Christian dominance appears to be related to more conflict. At the same time, calculating cross-sectional correlations averaged over the whole observation period means to disregard the temporal dimension of the nexus between conflict, droughts and religion. However, for droughts—which are defined as short-run negative deviations from long-run expected levels of wetness—accounting for this temporal dimension is crucial. Consequently, below we study the relationship between pastoralist conflict events, droughts and religious differences in a panel setting that can accommodate both the data's cross-sectional and time-series dimensions.

—Figure 5—

4. Panel Estimates

4.1 Empirical Model

We examine the relationship between pastoralist conflict and the prevalence of droughts as well as local religious composition by estimating the following linear probability model:

$$conflict_{it} = \beta_1 * religion_{it} + \beta_2 * drought_{it} + \beta_3 * (religion_{it} \times drought_{it}) + \beta_{'} * X'_{it} + \alpha_s + \lambda_t + \varepsilon_{it} \qquad (1)$$

Here, *conflict* is a binary variable that is equal to unity if grid *i* sees at least one conflict event in year *t*. The occurrence of conflict is explained by the incidence of *drought* (i.e., a dummy variable that is equal to unity if SPEI-12 ≤ -0.5), a grid's religious composition (*religion*; churches as a share of the number of churches and mosques) and the interaction between both variables. As a robustness check, we use the share of Christians as an alternative indicator for religion.

The model also includes state-fixed effects and year-fixed effects, α and λ, respectively. The former allows us to control for the role of time-invariant factors that may confound the relationship between pastoralist conflict and droughts. For instance, geographical conditions specific to certain Nigerian states (e.g., proximity to major water reservoirs) may be conducive to conflict over water and land, while also potentially impacting the risk of droughts. Similarly, year-fixed effects control for the influence of Nigeria-wide trends and events that may have affected conflict and droughts. For example, they may capture changes in federal policy concerning land use, e.g., with respect to the creation of grazing areas as well as pastoralists'

access to basic infrastructure and veterinary services for their herds (e.g., Balarabe, 2021; Ejiofor, 2021).

Finally, we include a vector of baseline controls, X'. First, we control for a grid's *population size* (*WorldPop Dataset*).[8] The likelihood of conflict may increase with population size simply due to scale effects. Second, we control for *nightlights*, using data from the *Earth Observation Group of the Colorado School of Mines*.[9] Nightlights are a common measure of economic development, especially when sub-national economic accounting data is missing (Gibson et al., 2020). For example, local economic development may correlate with the local vulnerability to droughts and the attractiveness of religion. Finally, we consider a grid's *temperature* (operationalized as the annual mean temperature), using data from the *Climatic Research Unit of the University of East Anglia*.[10] According to Auffhammer et al. (2013: 188), there is a strong correlation between temperature and rainfall, meaning that it may be advisable to account for both variables at the same time.

4.2 Main Empirical Results

Our main regression results are reported in Table 1. In a parsimonious model that considers separately the relationship between drought and pastoralist conflict as well as religion and conflict, respectively, we find that pastoralist conflict is more likely in grids that see droughts and that are more Christian. Once we add the interaction term between droughts and religious differences (Model 2), we find that there is a statistically significant association between the interaction term and conflict risk and between the share of churches and conflict risk, respectively. The association between the drought variable and conflict is no longer statistically significant. This main finding is robust to the inclusion of controls for population size, economic development (nightlights) and temperature (Model 3).

—Table 1—

These findings are also robust to the occurrence of other types of conflict in the grid of interest (Model 4). Using data from ACLED, this latter variable is a binary variable indicating the presence of conflict events that do not involve pastoralists, e.g., incidents involving Islamist

[8] The data is available at: www.worldpop.org.

[9] The nightlight data can be found here: https://eogdata.mines.edu/products/vnl/.

[10] The gridded climate data is available here: https://crudata.uea.ac.uk/cru/data/hrg.

groups such as *Boko Haram*.[11] The occurrence of other types of conflict in the same grid may be relevant to pastoralist conflict for two reasons. For one, the occurrence of non-pastoralist conflict allows pastoralist to access more easily weapons and knowledge about warfare (by learning from other militant groups), facilitating the use of violence. For another, especially violence by Islamist groups—inspired by ideas about religious political violence developed largely outside of Nigeria and sub-Saharan Africa—may further ideologize pastoralist conflict and consequently make violence more acceptable. For instance, the growing influence of *al-Qaeda* (especially *al-Qaeda in the Islamic Maghreb*) and the *Islamic State* may have fueled pastoralist conflict especially after 2007 (see also Figure 1). Furthermore, jihadist ideology offers an anti-state, anti-elite and pro-pastoral perspective that is attractive to nomadic actors, as argued for the Malian case by Benjaminsen and Ba (2019). In line with these arguments, we find a strong effect on the prior occurrence of other types of conflict on the likelihood of pastoralist conflicts. In Model 5 of Table 1, finally, we use our survey-based approximation of the share of Christians rather than the share of churches as our measure of religious composition. Results are very similar, with the exception of the direct effect of droughts, which remains statistically significant here.

For the results of the interactions reported in Table 1, the regression coefficient associated with the drought variable is only meaningful in grids with no churches, while the coefficient associated with the share of churches only tells us how the degree of prevalence of Christianity matters to conflict when there are no droughts. Here, we find that higher levels of Christianity are related to higher conflict risk also when there are no droughts. This speaks to our first hypothesis (*H1)* which postulates that pastoral conflicts are more likely to occur in areas with a predominantly Christian population. By contrast, at least for completely Muslim parts of Nigeria (approximately 15% of all observations) droughts are usually not linked to conflict risk in statistically meaningful ways. For this sub-group of grids there is little support for our second hypothesis (*H2)*.

Our third hypothesis *(H3)* posits that droughts increase a grid's likelihood of experiencing pastoralist conflict especially as the share of Christians living in the grid increases. We can examine this hypothesis by inspecting the likelihood of conflict given various degrees of prevalence of Christianity during and in the absence of droughts. We do so in Figure 6, using

[11] Using the number of non-pastoralist conflict events rather than a binary indicator as a robustness check yields results that are like those reported in Table 1.

our baseline specification (Model 3 in Table 1). Indeed, we find that a larger share of churches in combination with droughts is associated with a substantial risk of pastoral conflict. The difference between years with and without droughts is not statistically significant for grids with none to few churches, which again supports our earlier finding that droughts do not fuel pastoral conflict in the absence of religious differences. Put differently, the likelihood of pastoral conflicts occurring is low when the resident population within the grid is predominantly Muslim. As we suggested above, this may be because the common religion (Islam) of nomadic pastoralists and the resident population facilitates trust between nomadic and sedentary population groups and the settlement of disputes over land and water without recourse to violence even during times of resource scarcity.

—Figure 6—

4.3 Robustness Checks

We conduct a series of robustness checks to assess whether modelling choices affect our main empirical conclusions. First, we consider whether alternative operationalizations of the dependent variable matter. We operationalize pastoral conflict as (1) the absolute number of events, (2) the per capita number of events per grid-year, (3) violence against civilian targets (meaning that we exclude battles with other armed actors) as well as by considering (4) only lethal pastoralist conflict events or (5) activities by Fulani- and non-Fulani actors to account for the fact that some smaller ethnicities also practice nomadic animal husbandry. Finally, we replicate our main results using conflict data obtained from two alternative sources: the *Uppsala Conflict Data Program Georeferenced Event Dataset (UCDP-GED)* (Sundberg and Melander, 2013) and the *Global Terrorism Database (GTD)* (START, 2022).[12]

Second, we use different measures of drought, e.g., considering alternative negative SPEI-12 cutoffs to define a drought and by using data on grid-specific levels of precipitation. This is to rule out that our findings are due to idiosyncratic choices with respect to defining drought events.

Third, we employ categorical instead of continuous measures of the prevalence of Christianity to study differences between groups of grid cells characterized by different ranges of religious

[12] The variable derived from the UCDP-GED data focuses on incidents where at least one of the actors is defined as "Fulani." The variable derived from the GTD dataset focuses on incidents involving actors defined as "Fulani extremist."

compositions (operationalized by the share of churches as well as Christians). For instance, we consider quartiles of religious affiliation by grid. For one, this allows us to consider non-linear relationships. For another, it also makes our results less vulnerable to endogeneity concerns. Pastoralist conflict may affect the distribution of churches and mosques (e.g., as places of worship are destroyed). Using broad categorical instead of continuous measures of the prevalence of Christianity makes it less likely that pastoralist conflict induces a "switch" from one category to another, mitigating endogeneity concerns.

Fourth, we include additional control variables. For instance, we account for the influence of population growth, economic growth and the availability of grazeland on the nexus between religion, droughts and the risk of pastoral conflict. Furthermore, we run a model in which we control for past conflict by means of a lagged dependent variable to help us capture potential conflict dynamics (e.g., Beck and Katz, 2011).

Finally, we run some models where we drop potentially influential outliers with respect to, e.g., local population size, rainfall or land use. Moreover, in addition to a contemporaneous relationship between religion, drought and conflict as tested in our main panel model, we also consider deeper lags of the time-variant variables.

As shown in the Appendix, regardless of how we measure conflict (Supplementary Table 4), drought (Supplementary Table 5) or religious composition (Supplementary Table 6), we still find that the predominance of Christians is associated with a greater likelihood of pastoral conflict, especially when a grid also experiences a drought. This main empirical conclusion is also robust to the inclusion of additional controls, including a lagged dependent variable (Supplementary Table 7), the consideration of sub-samples that remove potentially influential outliers (Supplementary Table 8) and deeper lags of the time-variant variables (Supplementary Table 9). In sum, our various robustness checks produce findings that mirror the main results reported in Table 1.

4.4 Religion, Droughts and Proximate Pastoralist Conflict

As an empirical extension, we study how grid-specific religious cleavages, environmental problems and their interaction matter to conflict in *proximate* grids. Indeed, it is plausible that unfavorable local conditions also matter to neighboring areas. For one, pastoralist actors are—by definition—mobile. They may evade areas affected by droughts or religious tensions. For another, drought and religious cleavages may also motivate parts of the commonly sedentary population to flee to proximate areas. Movements by pastoralist and formerly sedentary actors

may, in turn, contribute to increased resource scarcity in proximate areas that are the destination of these movements. What is more, there ought to exist ethno-religious ties (due to settlement patterns) as well as economic linkages (e.g., in the form of trade) between proximate areas, making it more likely that unfavorable local conditions also increase the risk of conflict in adjacent areas.

To test the possibility that local environmental and religious conditions also matter to proximate pastoralist conflict, we create an alternative dependent variable. This variable is equal to unity when there is a pastoralist conflict in at least one of the eight contiguous grid cells surrounding a grid cell of interest.[13] That is, we test whether grid-specific environmental and religious conditions affect the risk of pastoralist conflict in contiguous grids.

We report our findings in Table 2. In short, we find that especially the combination of religious cleavages (characterized by a dominance of Christians, as indicated by the share of churches or Christians) and droughts leads to more pastoralist conflict also in neighboring grids. On the one hand, these findings are in line with our main empirical results in that the occurrence of droughts significantly fuels violence when there is potential for interreligious conflict. On the other hand, they also speak to the idea that population mobility and ethno-religious as well as economic ties facilitate the spread of local conflict over space.

—Table 2—

5. Survey Evidence

Our panel analysis provides macro-level support for the hypothesis that religious cleavages are is a potent catalyst of pastoralist conflict, especially during times of drought. In this section, we provide additional micro-level evidence that supports the results of the previous analyses. Drawing on data from our survey described above, we examine how religious differences among Nigerian survey respondents shape their perceptions about the Fulani people as well as

[13] For grid cells that are at within Nigeria but at its national borders, we also consider conflict events in surrounding grids located in neighboring countries. We do because some pastoralists move across international boundaries with their livestock. There is also only weak border enforcement in Nigeria, while the ECOWAS protocol also allows free movement within West Africa.

of the causes of the farmer-herder conflict. The summary statistics for all variables used in this section are reported in the appendix (Supplementary Table 10).

5.1 Variables of Interest

We consider the respondents' answers to the following survey questions:

1) "How much do you trust the Fulani people?" Respondents could respond that they trust this group completely, somewhat, not very much or not at all. Our survey shows that ca. 25% of respondents do not trust the Fulani very much or not at all.

2) "Some people say the conflict between farmers and herdsmen is motivated by religion. To what extent do you agree with this?" Respondents could strongly agree, somewhat agree or disagree with this statement or say that they neither agree nor disagree. Approximately 75% of all respondents know about the farmer-herder conflict (1,152 out of 1,553 respondents), suggesting that this conflict is a salient issue. Out of the respondents with knowledge about the conflict, ca. 32% to some extent or strongly agree with the statement that religion causes his type of conflict.

3) "Some people say the conflict between farmers and herders is caused by inadequate rainfall, which makes it hard for herders to find grazing land for their cows. To what extent do you agree with this?" About 26% of respondents somewhat or strongly agree with the statement that pastoralist conflict is due to a lack of rainfall.

5.2 Empirical Model and Results

We analyze how religious differences matter to distrust of the Fulani people with the following model:

$$distrust_i = \alpha + \beta_1 * muslim_i + \beta, * X_i' + \theta_p + \varepsilon_{it} \qquad (2)$$

Whether respondents consider pastoralist conflict in Nigeria to be an ecological-climatic or religious issue is investigated with the following empirical model:

$$agree_{ij} = \alpha + \beta_1 * muslim_i + \beta, * X_i' + \theta_p + \varepsilon_{it} \qquad (3)$$

That is, we ask to what extent a respondent *i* distrust the Fulani people (Equation 2) or agrees with a statement on the causes of the farmer-herder conflict (Equation 3), given their religion (*Muslim*). In our sample, 37% of respondents are Christian, while the rest are Muslim.[14]

We also account for several controls (education, age, income satisfaction, household ownership of land, gender, relationship status, and membership of the Fulani tribe). The operationalization of these variables is described in Supplementary Table 10. As pastoralist conflict may more strongly involve individuals working in agriculture, we furthermore include a variable that measures whether a respondent has an agricultural job as, e.g., a planter or farmhand (*farmer*). About 380 respondents (ca. 35% of all respondents who are in employment) work in agriculture.[15] Finally, in some specifications we include a set of survey precinct dummies (θ) to control for conditions that are fixed at the precinct level (i.e., shared by all respondents surveyed at precinct *p*) and which may matter to respondents' perception of the Fulani people or the causes of conflict. For instance, there may be differences in such perceptions depending on whether respondents live in rural or urban parts of Kaduna State.

Estimates of Equation (2) are reported in Table 3. We find that Muslims (compared to Christians) are considerably less likely to report low levels of trust in members of the Fulani tribe. This finding also holds when we do not include members of the Fulani tribe themselves, who naturally report high levels of trust, in the analysis (Model 3 of Table 3). In sum, the findings of Table 3 speak to our argument that religious divides may contribute to pastoralist conflict by systematically affecting trust in pastoralists.

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[14] In Kaduna State Christians and Muslims account for approximately half of the population. That is, in our survey we oversample Muslims to some extent (because we specifically survey the state's mobile population that is predominantly Muslim). In our regression analyses reported below, we consequently use sampling weights to achieve representativeness, weighing observations of Christians more strongly than those of Muslims. However, weighted and unweighted regressions produce results that are very similar.

[15] About one-half of the agricultural workers are Christian, while the other half is Muslim. An additional 54 respondents say they work as herders or pastoralists (these latter respondents are not counted as agricultural workers). All self-identified herders or pastoralists are Muslim. What is more, all 255 nomadic or semi-nomadic respondents are also Muslim, where 97% of them identify as Fulani. This supports our argument that herders are predominantly Muslim and Fulani.

—Table 3—

In Table 4 we report how religious differences affect how individuals think about the causes of pastoralist conflict in Kaduna State.[16] We find that Muslims (compared to Christians) are less likely to agree with the statement that pastoralist conflict is due to religion, whereas they are more likely to agree with the statement that this conflict is due to a lack of rainfall. This suggests that religious differences also matter to individual perceptions about the roots of pastoralist conflict in Kaduna State. As an interesting finding for the control variables, agricultural workers (who may be Muslim or Christian) are less likely to agree with the notion that farmer-herder conflict originates from a lack of rainfall.

—Table 4—

In sum, while the survey evidence provides only a snapshot of individual perceptions about the pastoralist conflict in a specific year and part of Nigeria, the findings still complement our earlier panel evidence in two major ways. First, there is considerable agreement among respondents with the potential ecological and religious causes of this conflict that we proposed in this paper. In other words, respondents also relate pastoralist conflict in Nigeria to these causes, suggesting that the hypotheses we developed and tested earlier are sound. Second, religious cleavages clearly shape how individual respondents think about the Fulani ethnic groups as well as about the roots of pastoralist conflict.

6. Conclusion

Considering increases in both the frequency and ferocity of clashes between sedentary communities and nomadic (Fulani) herders in Nigeria since the late 1990s, we study the role of droughts and religious cleavages in this type of conflict. Using panel data at the 0.5 x 0.5° grid cell level between 1997 and 2020, we find that droughts do not tend to raise the likelihood of pastoralist conflict in those parts of the country where Muslim herders face a largely Muslim sedentary population. By contrast, religious differences (where Muslim herders face a more

[16] We only ask those survey respondents about their individual assessments of the causes of pastoralist conflict that know about this conflict in the first place. This may raise concerns about sample selection. Thus, we also estimate a series of Heckman two-step selection models (Heckman, 1979). Here, we do not find that religious affiliation matters to selection. The selection model findings are like those reported in Table 4, suggesting that the data is consistent with no selection.

Christian population) correlate with a higher risk of pastoralist conflict also in the absence of droughts. What is more, the interaction between droughts and religious cleavages creates particularly potent conditions for the emergence of pastoralist conflict. For instance, by exacerbating resource scarcity and socio-economic hardship, environmental problems in the form of drought may further aggravate interreligious cleavages characterized by, e.g., unfavorable ingroup/outgroup dynamics. In an empirical extension, we show that local droughts and religious divides also correlate unfavorably with the likelihood of pastoralist conflict in proximate areas. For instance, this may be due to the mobility of nomadic herders and patterns of ethno-religious kinship between neighboring areas.

Given that the Fulani herders are almost exclusively Muslim and Nigerian society is very pious, we argue that religious differences between Christians and Muslims may matter to pastoralist conflict by removing means to resolve disputes over land and water peacefully (e.g., as there are no common religious institutions and authorities to appeal to). Rather, engaging in violence against "infidels" may produce additional spiritual benefits (e.g., the prospect of heavenly rewards). Indeed, findings from our original survey of individuals in Kaduna State (a state strongly affected by pastoralist conflict) speak to the notion that there are elevated levels of distrust between Christians and the Fulani (who are almost exclusively Muslim). Moreover, our survey data shows that Christians are more likely to see pastoralist violence as caused by religion, whereas Muslim respondents are more likely to relate it to ecological problems (i.e., droughts). Again, this demonstrates that religious convictions are a key factor in pastoralist conflict in Nigeria.

Climate change is expected to further worsen water shortages and droughts (IPCC, 2014, 2021). Our study suggests that pastoralist conflict may consequently be anticipated to intensify, especially in those parts of Nigeria where Muslim herders face Christian (sedentary) populations. Policy-makers are well advised to take this prediction into account to reduce both local (economic) vulnerability to droughts and interreligious tensions.

Since in many parts of the Sahel Zone, and to some extent also in East Africa, the ecological zone where pastoralism and sedentary agriculture compete for resources overlaps with the spatial boundary between Muslim-majority and Christian-majority regions, we suspect that our finding that violent conflict is driven by the intersection of droughts and religious cleavages is also relevant elsewhere. Consequently, future research should focus on studying to what extent our results replicate for and can be generalized to other parts of Africa. Furthermore, beyond Africa and its Muslim-Christian divide, research on the effects of climate change on violent

conflict in other parts of the world should also consider their potential conditionality on the salience of religious cleavages.

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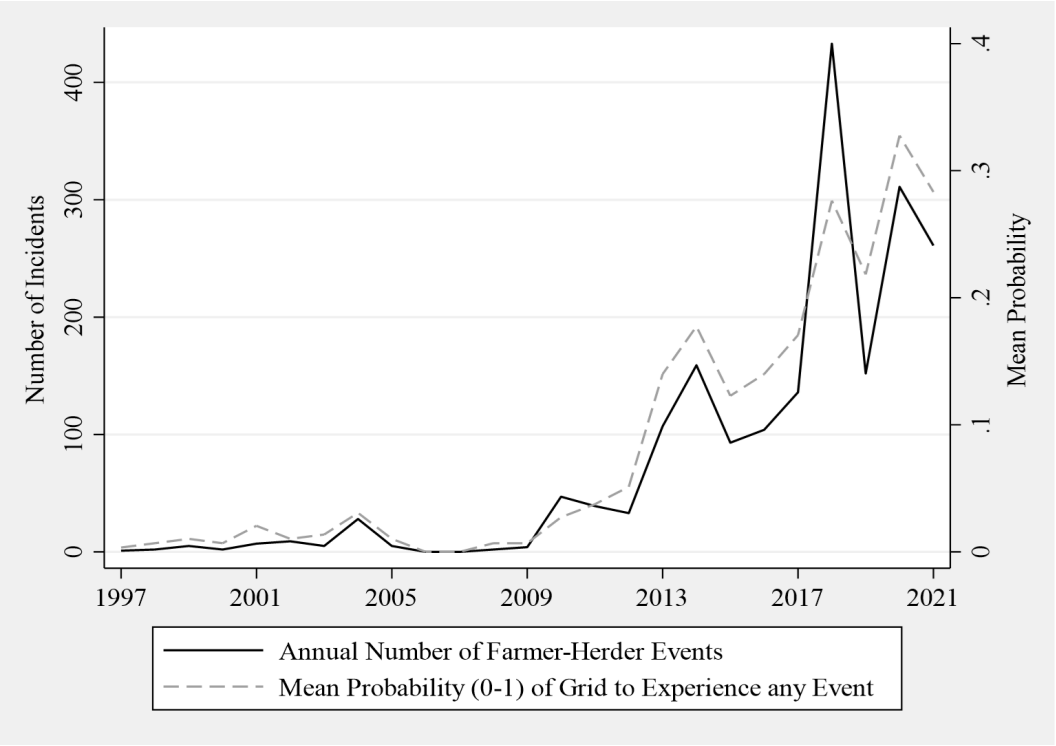

Figure 1: Trends in Pastoralist Conflict

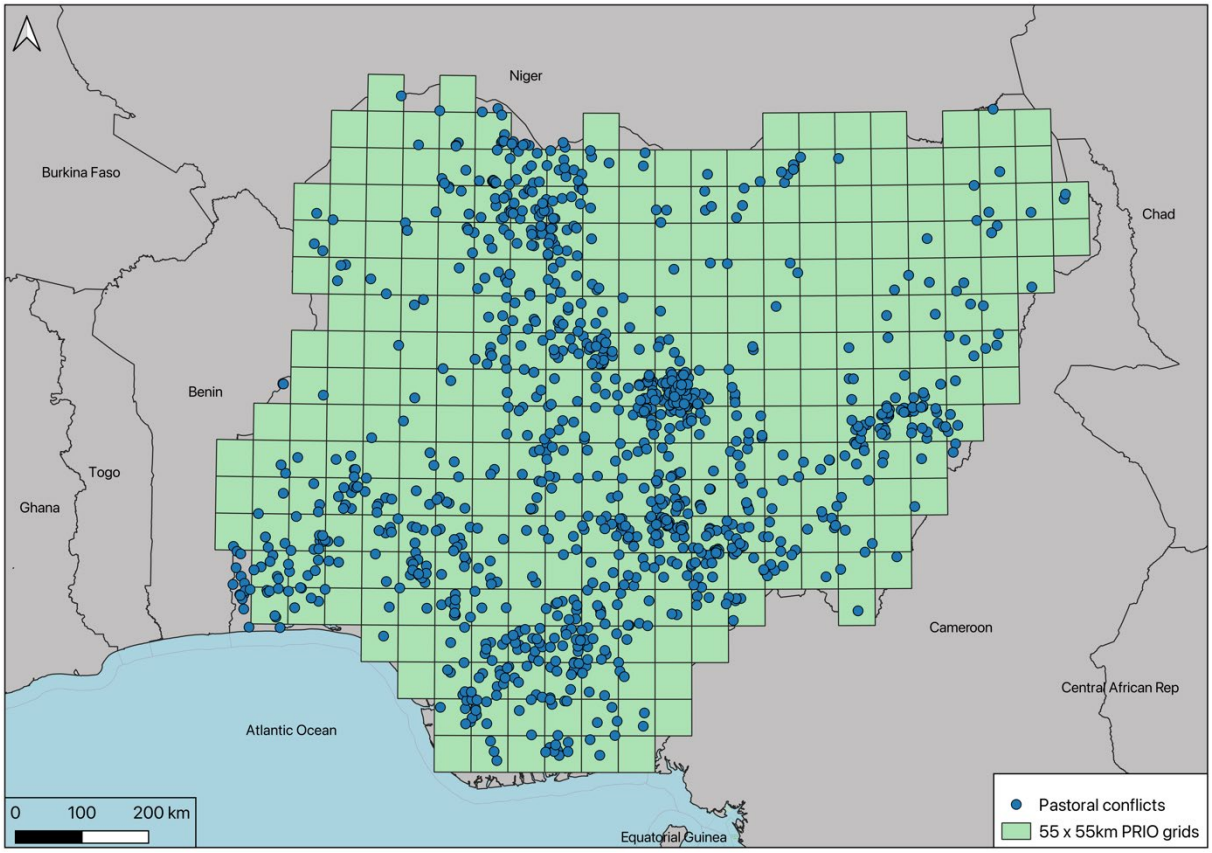

Figure 2: Geographical Distribution of Pastoralist Conflict

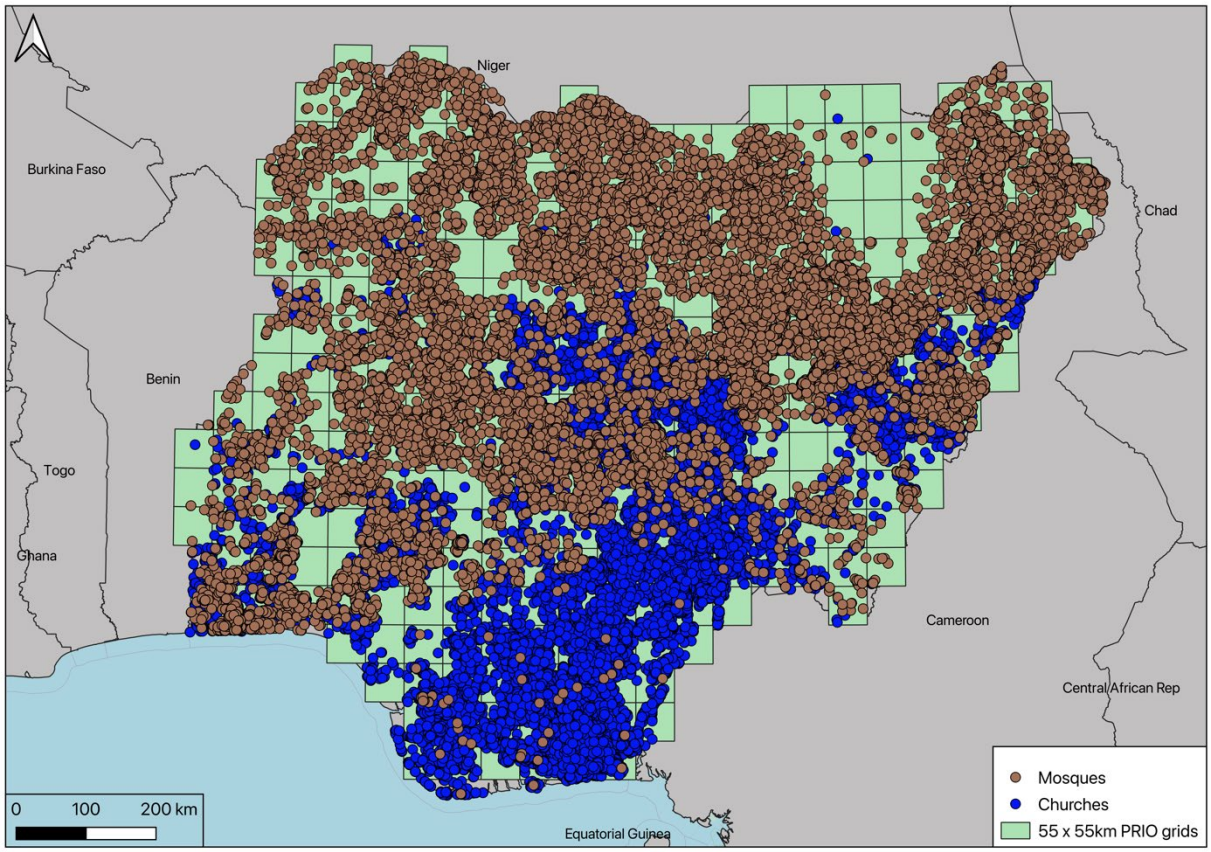

Figure 3: Religious Composition across Nigeria

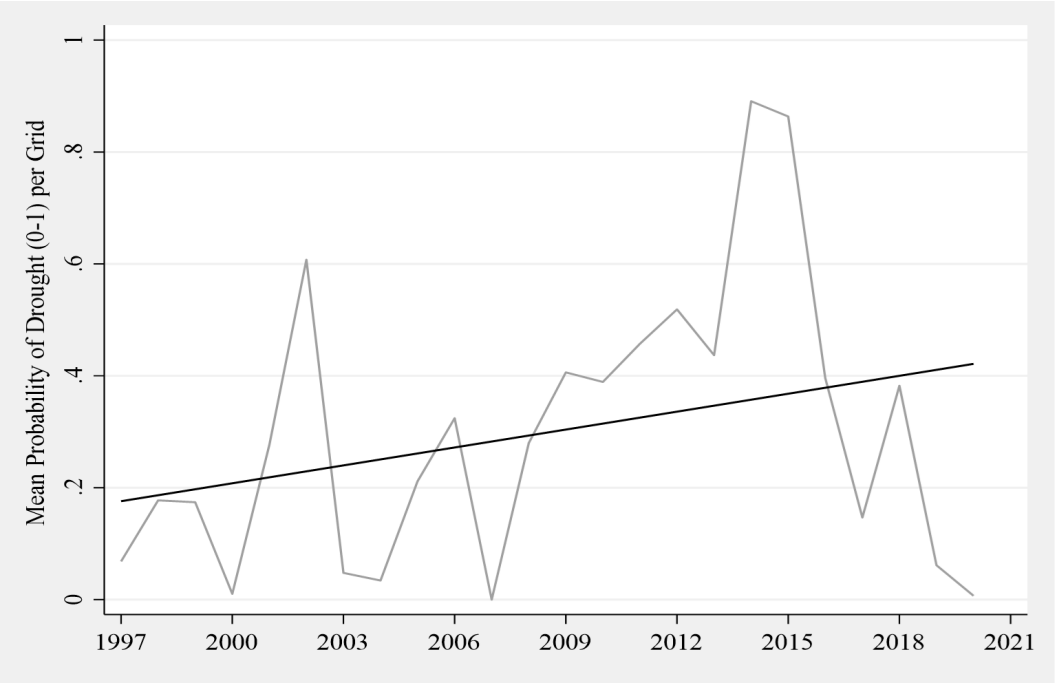

Figure 4: Prevalence of Droughts

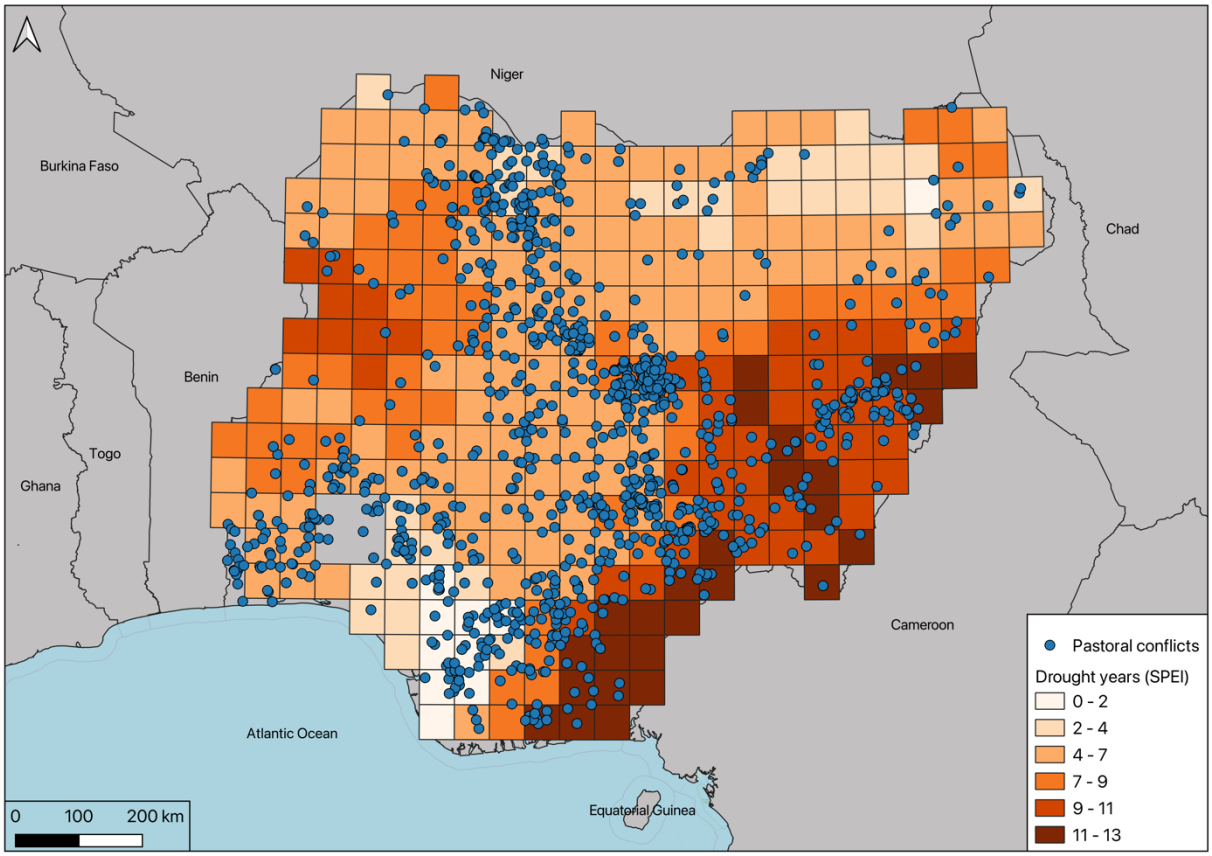

Figure 5: Geographical Distribution of Droughts

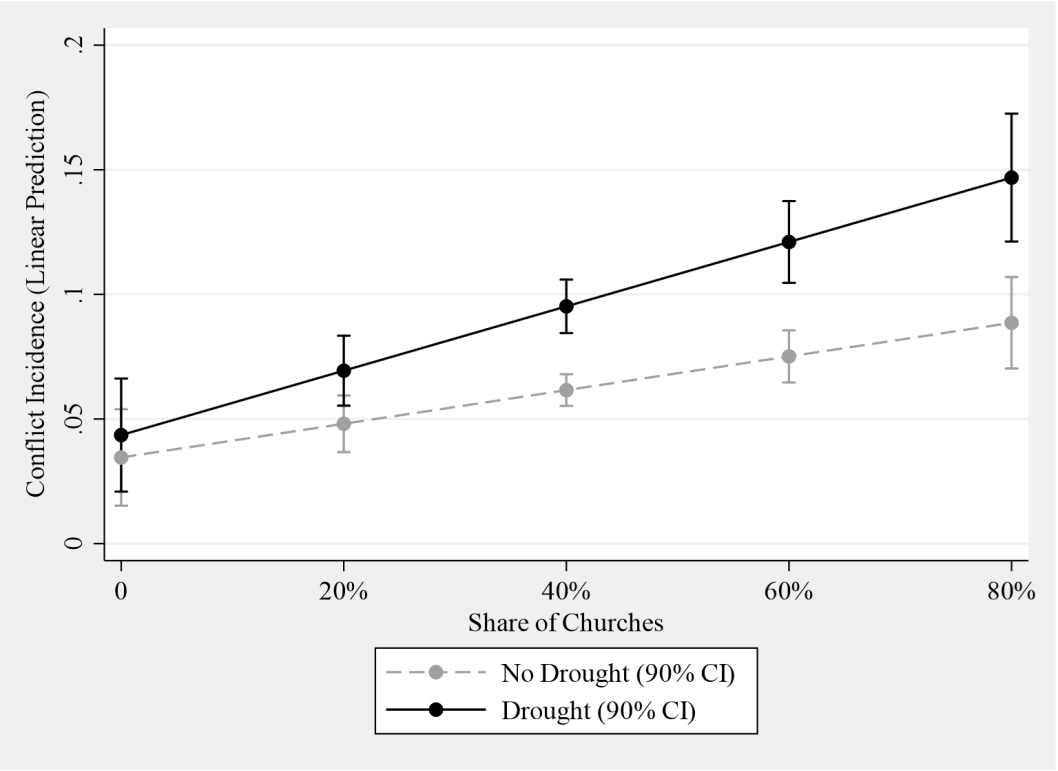

Figure 6: Interaction between Droughts and Religion

	(1)	(2)	(3)	(4)	(5)
Drought	0.037***	0.008	0.009	0.012	0.020**
	(0.007)	(0.009)	(0.009)	(0.009)	(0.009)
Share Churches	0.096***	0.076***	0.068**	0.062**	
	(0.029)	(0.028)	(0.027)	(0.025)	
Drought * Share Churches		0.064***	0.062***	0.056**	
		(0.022)	(0.022)	(0.022)	
Share Christians					0.078***
					(0.028)
Drought * Share Christians					0.054**
					(0.023)
Population Size			0.033***	0.022**	0.022**
			(0.012)	(0.009)	(0.009)
Nightlight			-0.002	-0.003	-0.003
			(0.002)	(0.002)	(0.002)
Temperature			-0.006	-0.005	-0.008
			(0.007)	(0.007)	(0.007)
Other Conflict $_{t-1}$				0.072***	0.069***
				(0.011)	(0.011)
Observations	7,032	7,032	7,032	7,032	6,936
Adjusted R^2	0.192	0.193	0.197	0.207	0.210

Notes: OLS estimates reported. Dependent variable is the incidence of pastoralist conflict (ACLED data). State- and year-fixed effects always included. Standard errors clustered at the grid level in parentheses. *p<0.1, **p<0.5, ***p<0.01.

Table 1: Panel Estimates

	(1)	(2)	(3)	(4)	(5)
Local Drought	0.076***	0.020	0.018	0.019	0.027*
	(0.011)	(0.016)	(0.016)	(0.016)	(0.014)
Local Share Churches	0.194***	0.155***	0.137***	0.135***	
	(0.035)	(0.035)	(0.033)	(0.032)	
Local Drought * Local Share Churches		0.124***	0.109***	0.106***	
		(0.029)	(0.028)	(0.028)	
Share Christians					0.162***
					(0.029)
Drought * Share Christians					0.124***
					(0.028)
Local Pastoralist Conflict			0.231***	0.228***	0.224***
			(0.019)	(0.019)	(0.019)
Population Size				0.022***	0.022***
				(0.007)	(0.008)
Nightlight				-0.005**	-0.005**
				(0.002)	(0.002)
Temperature				-0.004	-0.001
				(0.008)	(0.009)
Observations	7,032	7,032	7,032	7,032	6,936
Adjusted R^2	0.435	0.438	0.453	0.454	0.458

Notes: OLS estimates reported. Dependent variable is the incidence of pastoralist conflict in proximate grids (ACLED data). State- and year-fixed effects always included. Standard errors clustered at the grid level in parentheses. *p<0.1, **p<0.5, ***p<0.01.

Table 2: Pastoralist Conflict in Proximate Grids

	(1)	(2)	(3)
Muslim	-1.656***	-1.371***	-1.277***
	(0.103)	(0.188)	(0.206)
Farmer		-0.012	-0.030
		(0.167)	(0.189)
Secondary Education		0.124	0.134
		(0.136)	(0.146)
Age		-0.010**	-0.012**
		(0.005)	(0.005)
Income Satisfaction		0.012	0.025
		(0.122)	(0.134)
Land Ownership		0.001	-0.086
		(0.119)	(0.133)
Female		0.240**	0.336**
		(0.121)	(0.135)
In Relationship		-0.168	-0.161
		(0.143)	(0.156)
Fulani Ethnicity		-1.256***	
		(0.175)	
Precinct Dummies	No	Yes	Yes
Observations	1,533	1,532	1,232
Pseudo R^2	0.066	0.134	0.104

Notes: Ordered logit estimates reported. Dependent variables measure agreement with statement concerning distrust of the Fulani people (see also main text). Model 3 excludes respondents who identify as Fulani. Robust standard errors in parentheses. *p<0.1, **p<0.5, ***p<0.01.

Table 3: Individual Correlates of Distrust of Fulani

	(1)	(2)	(3)	(4)
Cause of Conflict →	Religion	Religion	Rainfall	Rainfall
Muslim	-1.495***	-1.622***	0.580***	0.512**
	(0.118)	(0.264)	(0.122)	(0.229)
Farmer		-0.008		-0.431**
		(0.187)		(0.200)
Secondary Education		-0.232		-0.533***
		(0.187)		(0.178)
Age		-0.011**		-0.018***
		(0.006)		(0.006)
Income Satisfaction		0.237		0.285*
		(0.166)		(0.160)
Land Ownership		0.056		0.014
		(0.151)		(0.149)
Female		0.366**		-0.205
		(0.160)		(0.161)
In Relationship		-0.028		0.052
		(0.180)		(0.181)
Fulani Ethnicity		-0.104		0.307
		(0.238)		(0.230)
Precinct Dummies	No	Yes	No	Yes
Observations	1,153	1,152	1,153	1,152
Pseudo R^2	0.056	0.122	0.009	0.094

Notes: Ordered logit estimates reported. Dependent variables measure agreement with statement concerning the role of religion or lack of rainfall in the farmer-herder conflict, respectively (see also main text). Robust standard errors in parentheses. *p<0.1, **p<0.5, ***p<0.01.

Table 4: Individual Assessment of Causes of Farmer-Herder Conflict

Supplementary Tables

	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
ACLED Pastoralist Incidents (0/1)	7,032	0.076	0.264	0	1
Drought (SPEI-12 ≤ -0.5)	7,032	0.299	0.458	0	1
Share of Churches (0-1)	7,032	0.441	0.382	0	1
Share of Christians (0-1)	6,936	0.361	0.386	0	1
Population Size	7,032	0.497	0.707	0.011	11.223
Nightlights	7,032	0.957	3.086	0	36.948
Temperature	7,032	27.402	1.197	20.692	30.35

Note: See also the main text for the operationalization of variables in empirical models.

Supplementary Table 1: Summary Statistics

State	Frequency	Percent	Cumulative	State	Frequency	Percent	Cumulative
Abia	5	0.25	0.25	Katsina	41	2.08	51.12
Adamawa	89	4.52	4.78	Kebbi	8	0.41	51.52
Akwa Ibom	5	0.25	5.03	Kogi	48	2.44	53.96
Anambra	18	0.91	5.95	Kwara	22	1.12	55.08
Bauchi	8	0.41	6.35	Lagos	6	0.30	55.39
Bayelsa	3	0.15	6.50	Nassarawa	127	6.45	61.84
Benue	351	17.84	24.34	Niger	43	2.18	64.02
Borno	12	0.61	24.95	Ogun	39	1.98	66.01
Cross River	4	0.20	25.15	Ondo	38	1.93	67.94
Delta	83	4.22	29.37	Osun	12	0.61	68.55
Ebonyi	12	0.61	29.98	Oyo	47	2.39	70.93
Edo	24	1.22	31.20	Plateau	360	18.29	89.23
Ekiti	12	0.61	31.81	Rivers	7	0.36	89.58
Enugu	35	1.78	33.59	Sokoto	8	0.41	89.99
Federal Capital Territory	21	1.07	34.65	Taraba	144	7.32	97.31
Gombe	4	0.20	34.86	Zamfara	53	2.69	100.00
Imo	10	0.51	35.37	Total	1,968	100.00	
Jigawa	25	1.27	36.64				
Kaduna	242	12.30	48.93				
Kano	2	0.10	49.03				

Supplementary Table 2: Distribution of Pastoralist Conflict Events across Nigeria's States

	Conflict	Drought	Churches	Interaction (Drought* Churches)	Christians
Drought	-0.01				
	(0.98)				
Churches	0.49	0.20			
	(0.00)***	(0.00)***			
Interaction	0.36	0.62	0.85		
(Drought*Churches)	(0.00)***	(0.00)***	(0.00)***		
Christians	0.49	0.13	0.92	0.75	
	(0.00)***	(0.02)**	(0.00)***	(0.00)***	
Interaction	0.37	0.54	0.80	0.93	0.85
(Drought*Christians)	(0.00)***	(0.00)***	(0.00)***	(0.00)***	(0.00)***

Notes: Conflict=Mean incidence of pastoralist conflict per grid over observation period. Drought=Mean incidence of drought per grid over observation period. Churches=Mean share of churches (over sum of churches and mosques) per grid. Christians=Mean share of Christians (over sum of Christians and Muslims) per grid. Interaction=Product of drought and churches or Christians, respectively. p-values in parentheses. **p<0.05, ***p<0.01.

Supplementary Table 3: Pairwise Correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Measurement of Conflict →	Event count	Events per capita	Binary; at least one fatality	Binary; against civilians	Binary; all pastoralists	GTD data	UCDP data
Drought	0.013	0.005	-0.005	-0.003	-0.000	0.000	-0.002
	(0.016)	(0.024)	(0.009)	(0.010)	(0.010)	(0.007)	(0.005)
Share Churches	0.136***	0.177**	0.055**	0.056**	0.062**	0.050***	0.045***
	(0.050)	(0.069)	(0.026)	(0.027)	(0.028)	(0.018)	(0.017)
Drought * Share Churches	0.123***	0.175***	0.077***	0.078***	0.070***	0.058***	0.053***
	(0.045)	(0.058)	(0.021)	(0.022)	(0.022)	(0.018)	(0.017)
Baseline Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	7,032	7,032	7,032	7,032	7,032	7,032	7,032
Adjusted R^2	0.195	0.174	0.175	0.204	0.211	0.185	0.131

Dependent Variables: (1) (inverse hyperbolic sine-transformed) number of Fulani incidents per grid-year; (2) (inverse hyperbolic sine-transformed) number of Fulani incidents per capita and per grid-year; (3) binary measure with 1=at least one Fulani incident with at least one fatality per grid-year; (4) binary measure with 1=at least one Fulani incident directed against civilian target per grid-year; (5) binary measure with 1=at least one incident per grid-year characterized by ACLED as involving Fulani or pastoralist actors; (6) binary measure with 1=at least one pastoralist incident per grid-year, with data from the Global Terrorism Database (GTD); (7) binary measure with 1=at least one pastoralist incident per grid-year, with data from the Uppsala Conflict Data Program (UCDP). Data for models (1) to (5) from ACLED.

Notes: OLS estimates reported. State- and year-fixed effects always included. Baseline Controls=population size, nightlights and temperature. Standard errors clustered at the grid level in parentheses. *p<0.1, **p<0.5, ***p<0.01.

Supplementary Table 4: Alternative Operationalizations of Conflict

	(1)	(2)	(3)	(4)
Drought Measure →	SPEI-12 < -0.8	SPEI-12 < -1	SPEI-6	Precipitation
Drought	-0.015	-0.039*	0.017*	-0.001*
	(0.014)	(0.020)	(0.010)	(0.000)
Share Churches	0.061**	0.072***	0.067**	0.094*
	(0.027)	(0.026)	(0.027)	(0.049)
Drought * Share Churches	0.129***	0.127***	0.069***	0.000
	(0.036)	(0.038)	(0.024)	(0.000)
Baseline Controls	Yes	Yes	Yes	Yes
Number of Observations	7,032	7,032	7,032	7,032
Adjusted R^2	0.200	0.196	0.199	0.195

Drought measures: (1) SPEI-12 smaller than -0.8 (instead -0.5); (2) SPEI-12 smaller than -1 (instead -0.5); (3) SPEI-6 smaller than -0.5 (instead of SPEI-12); (4) Precipitation in mm (instead of binary drought measure).

Notes: OLS estimates reported. Dependent variable is the incidence of Fulani activity. State- and year-fixed effects always included. Baseline Controls=population size, nightlights and temperature. Standard errors clustered at the grid level in parentheses. *p<0.1, **p<0.5, ***p<0.01.

Supplementary Table 5: Alternative Measurements of Drought

	(1)	(2)	(3)	(4)	(5)	(6)
Drought	0.016*	0.017*	0.013	0.023***	0.020**	0.012
	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)
Share Churches	0.037**			0.015	0.038**	0.026
(1=50% and more)	(0.015)			(0.016)	(0.017)	(0.016)
Drought * Share Churches	0.047***			0.038**		
	(0.017)			(0.018)		
Share Churches		0.012			0.038**	
(1=33%-66%)		(0.013)			(0.017)	
Share Churches		0.043**			0.028	
(2=+66%)		(0.019)			(0.017)	
Drought * Share Churches		0.002			0.044	
(33%-66%)		(0.018)			(0.028)	
Drought * Share Churches		0.057***			0.038*	
(+66%)		(0.020)			(0.019)	
Share Christians			0.001			0.026
(1=25%-50%)			(0.012)			(0.016)
Share Christians			0.030*			0.032*
(2=50%-75%)			(0.017)			(0.019)
Share Christians			0.048**			0.023
(3=+75%)			(0.021)			(0.020)
Drought * Share Christians			0.012			0.063**
(25%-50%)			(0.022)			(0.028)
Drought * Share Christians			0.042*			0.078**
(50%-75%)			(0.024)			(0.031)
Drought * Share Christians			0.054***			0.040**
(+75%)			(0.020)			(0.020)
Baseline Controls	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	7,032	7,032	7,032	7,152	7,152	7,152
Adjusted R^2	0.197	0.198	0.198	0.194	0.196	0.197

Notes: OLS estimates reported. Dependent variable is the incidence of Fulani activity. State- and year-fixed effects always included. Baseline Controls=population size, nightlights and temperature. Standard errors clustered at the grid level in parentheses. *p<0.1, **p<0.5, ***p<0.01.

Supplementary Table 6: Categorical Variables for Religion

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Additional Control →	Population Growth	Growth Nightlights	Grazeland	Land Cover	Forests	(Grid-Fixed Effects)	Lagged DV
Drought	0.011	0.010	-0.022**	0.009	0.009	0.004	0.005
	(0.010)	(0.010)	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)
Share Churches	0.073**	0.073**	0.012	0.073***	0.068**		0.053**
	(0.028)	(0.028)	(0.025)	(0.027)	(0.027)		(0.021)
Drought * Share Churches	0.056**	0.057**	0.090***	0.061***	0.061***	0.070***	0.056***
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.023)	(0.019)
Additional Control	-0.001	0.011***	0.000***	-0.000	-0.039		0.278***
	(0.001)	(0.003)	(0.000)	(0.000)	(0.066)		(0.031)
Baseline Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	6,739	6,739	5,274	7,032	7,032	7,032	6,739
Adjusted R^2	0.198	0.198	0.155	0.198	0.197	0.264	0.251

Additional Controls: (1) population growth (first-difference of logged population size); (2) nightlight growth (first-difference of logged nightlights); (3) grazeland; (4) land cover; (5) forest cover; (6) grid-fixed effects instead of state-fixed effects (former effects collinear with share of churches). (7) Lagged dependent variable (DV). Additional land use data is from the *Hyde-3.2 Dataset* (Klein Goldewijk et al. 2017).

Notes: OLS estimates reported. Dependent variable is the incidence of Fulani activity. State- and year-fixed effects always included. Baseline Controls=population size, nightlights and temperature. Standard errors clustered at the grid level in parentheses. *p<0.1, **p<0.5, ***p<0.01.

Supplementary Table 7: Additional Control Variables

	(1)	(2)	(3)	(4)	(5)
Source of Outlier →	Precipitation	Forest	Grazeland	Population	Conflict
Drought	0.006	0.001	0.007	0.001	-0.001
	(0.012)	(0.010)	(0.010)	(0.009)	(0.018)
Share Churches	0.076***	0.063**	0.062**	0.049*	0.057*
	(0.028)	(0.028)	(0.028)	(0.026)	(0.031)
Drought * Share Churches	0.057**	0.096***	0.078***	0.087***	0.071**
	(0.024)	(0.026)	(0.024)	(0.024)	(0.030)
Baseline Controls	Yes	Yes	Yes	Yes	Yes
Number of Observations	6,328	6,336	6,504	6,329	4,488
Adjusted R^2	0.203	0.197	0.201	0.191	0.249

Outliers/Sample: (1) drops top 10% grids with lowest levels of precipitation; (2) drops top 10% grids with highest levels of forest cover; (3) drops top 10% grids with lowest levels of grazeland; (4) drops top 10% grids with lowest levels of population; (5) drops all grids that never experience any pastoralist conflict.

Notes: OLS estimates reported. Dependent variable is the incidence of Fulani activity. State- and year-fixed effects always included. Baseline Controls=population size, nightlights and temperature. Standard errors clustered at the grid level in parentheses. *p<0.1, **p<0.5, ***p<0.01.

Supplementary Table 8: Role of Outliers and Sample Choice

	(1)	(2)	(3)
Drought $_{t-1}$	-0.004		
	(0.009)		
Drought $_{t-2}$		-0.030***	
		(0.011)	
Drought $_{t-3}$			-0.032**
			(0.012)
Share Churches	0.067**	0.050*	0.042
	(0.028)	(0.028)	(0.030)
Drought $_{t-1}$ * Share Churches	0.075***		
	(0.022)		
Drought $_{t-2}$ * Share Churches		0.126***	
		(0.023)	
Drought $_{t-3}$ * Share Churches			0.158***
			(0.025)
Baseline Controls	Yes	Yes	Yes
Number of Observations	6,739	6,446	6,153
Adjusted R^2	0.198	0.203	0.209

Notes: OLS estimates reported. Dependent variable is the incidence of Fulani activity. State- and year-fixed effects always included. Baseline Controls=population size, nightlights and temperature. Standard errors clustered at the grid level in parentheses. *p<0.1, **p<0.5, ***p<0.01.

Supplementary Table 9: Lag Structure

	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
Distrust of Fulani	1,533	1.697	1.597	0	4
Cause of Conflict: Religion	1,153	1.321	1.672	0	4
Cause of Conflict: Rainfall	1,153	1.083	1.578	0	4
Muslim	1,553	0.633	0.482	0	1
Farmer	1,553	0.243	0.429	0	1
Secondary Education	1,552	0.360	0.480	0	1
Age	1,553	34.607	13.808	15	85
Income Satisfaction	1,553	0.486	0.499	0	1
Land Ownership	1,553	0.431	0.495	0	1
Female	1,553	0.540	0.499	0	1
In Relationship	1,553	0.710	0.454	0	1
Fulani Ethnicity	1,553	0.193	0.395	0	1

Variable operationalization: Secondary Education=Equal to unity if respondent has at least completed high school/secondary education; zero otherwise. Age=Respondent's age in years. Income Satisfaction=Equal to unity if respondents say they are, relative to others, satisfied or very satisfied with their current income; zero otherwise. Land Ownership=Equal to unity if respondents answer that their family owns a plot of land; zero otherwise. Female=Equal to unity if respondents say they are female; zero means respondents are male. In Relationship=Equal to unity if respondents say they are in a relationship or married; zero otherwise (e.g., respondent being single, widowed or divorced). Fulani Ethnicity=Equal to unity of respondents say that they identify as a member of the Fulani ethnic community, cultural group or tribe; zero otherwise. Other variables are described in the main text. All variables constructed from own survey data described in the main text.

Supplementary Table 10: Survey Data Summary Statistics and Variable Operationalization