NBER WORKING PAPER SERIES

TRANSHUMANT PASTORALISM, CLIMATE CHANGE, AND CONFLICT IN AFRICA

Eoin F. McGuirk
Nathan Nunn

Working Paper 28243
http://www.nber.org/papers/w28243

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
December 2020, Revised May 2021

We are grateful to Alex Orenstein and Elias Papaioannou for helpful feedback and comments. We also thank seminar participants at Tufts University, Harvard University, the CEPR Macroeconomics and Growth Programme Meeting, CSAE (Oxford), PacDev (UC San Diego), Oz Virtual Econ Seminar, and the Research Institute for Development, Growth and Economics, Towards Sustainable Growth Workshop. We also thank Mohammad Ahmad, Laura Kincaide, Leo Saenger, and Satish Wasti for excellent RA work. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

Transhumant Pastoralism, Climate Change, and Conflict in Africa
Eoin F. McGuirk and Nathan Nunn
NBER Working Paper No. 28243
December 2020, Revised May 2021
JEL No. N10,Q54,Z1

ABSTRACT

We consider the effects of climate change on seasonally migrant populations that herd livestock – i.e., transhumant pastoralists – in Africa. Traditionally, transhumant pastoralists benefit from a cooperative relationship with sedentary agriculturalists whereby arable land is used for crop farming in the wet season and animal grazing in the dry season. Droughts can disrupt this arrangement by inducing pastoral groups to migrate to agricultural lands before the harvest, causing conflict to emerge. We examine this hypothesis by combining ethnographic information on the traditional locations of transhumant pastoralists and sedentary agriculturalists with high-resolution data on the location and timing of rainfall and violent conflict events in Africa from 1989–2018. We show that droughts in the territory of transhumant pastoralists lead to conflict in neighboring areas. Consistent with the hypothesis, these conflict events are concentrated in agricultural areas; they occur during the wet season and not the dry season; and they are due to rainfall's impact on plant biomass growth. This mechanism explains a sizable proportion of conflict events in Africa, particularly civil conflicts and religious-extremist attacks. We find that the effects are muted in the presence of irrigation aid projects, but not in the presence of other forms of foreign aid. The effects approach zero as pastoral groups share more political power.

Eoin F. McGuirk
Department of Economics
Tufts University
Braker Hall
Medford, MA 02155
eoin.mcguirk@tufts.edu

Nathan Nunn
Department of Economics
Harvard University
1805 Cambridge St
Cambridge, MA 02138
and NBER
nnunn@fas.harvard.edu

1. Introduction

Civil conflict deters private investment, undermines state capacity, and destroys physical and human capital. As of 2020, there were an estimated 79.5 million forcibly displaced people worldwide. In Africa alone, 1.23 million people were killed in civil conflict events during the thirty years from 1989–2018.[1] These events have become more frequent and more severe over time. During the same period, as a consequence of climate change, annual rainfall has been well below average and droughts have become more common. These trends are consistent with a growing literature that links hot and dry weather to violence at both the interpersonal and intergroup levels (Miguel, Satyanath and Sergenti, 2004, Burke, Miguel, Satyanath, Dykema and Lobell, 2009, Hsiang, Burke and Miguel, 2013, Harari and La Ferrara, 2018, Fetzer, 2020, Eberle, Rohner and Thoenig, 2020).

Due to a relative dearth of evidence on specific causal mechanisms, questions remain about the future impact of climate change on conflict (Burke, Hsiang and Miguel, 2015, Solow, 2013, Mach, Kraan, Adger, Buhaug, Burke, Fearon, Field, Hendrix, Maystadt, O'Loughlin, Roessler, Scheffran, Schultz and von Uexkull, 2019). In this paper, we test a mechanism linking weather shocks to violent conflict between sedentary agricultural and transhumant pastoral ethnic groups in Africa. Sedentary agriculturalists are groups who cultivate crops and reside in fixed settlements. Transhumant pastoralists are groups who practice animal husbandry and engage in *transhumance*, which is the seasonal movement of grazing animals.

In typical years, neighboring agricultural and transhumant pastoral groups coexist in a symbiotic relationship that is characterized by this seasonal migration. In the wet season, agriculturalists farm on productive lands while transhumant pastoralists exploit more marginal lands that produce sufficient plant biomass (or *phytomass*) for their livestock. After the final harvest, the pastoralists migrate along well-established corridors to arrive at the agricultural farmlands for the dry season, where they benefit from the year-round availability of phytomass while providing organic fertilizer in exchange. These journeys can range from hundreds of meters to hundreds of kilometers. In low precipitation years, there may not be enough phytomass produced on the marginal grazing lands to sustain pastoralists' livestock. When this happens, they are forced to migrate to agricultural farmlands before the dry season. If the animals arrive before the final harvest, conflict can emerge due to damaged crops and competition for resources such as water and pasture.[2]

This mechanism generates a clear hypothesis: droughts that occur in the territories of transhumant pastoralists lead to conflict in nearby agricultural lands. We test the hypothesis by examining the incidence of conflict using two sets of geocoded conflict measures, one collected by the Uppsala Conflict Data Program (UCDP) (Sundberg and Melander, 2013) and another by the Armed Conflict Location & Event Data Project (ACLED) (Raleigh, Linke, Hegre and Karlsen, 2010). To determine the identity of transhumant pastoral groups, we use data from the *Ethnographic Atlas* (Murdock, 1967), which contains information on the economic and cultural

[1]Data on displaced people are from the UNHCR's Refugee Population Statistics Database. The figure on conflict fatalities comes from the Uppsala Conflict Data Program version 19.1 (Sundberg and Melander, 2013).

[2]For recent descriptions of this process, see Moritz (2010), Kitchell, Turner and McPeak (2014), and Brottem (2016).

practices of pre-colonial ethnic societies worldwide. We construct two ethnicity-level measures of transhumant pastoralism. Both combine ethnographic information on the historical importance of animal herding in the society, as used by Becker (2019), with information on the historical mobility of an ethnicity. One variable defines transhumant groups as being those that are traditionally fully- or semi-nomadic. The other broadens the definition to also include groups that are traditionally semi-sedentary or live in impermanent settlements. We assign these characteristics to territories on a map using information on the traditional boundaries between ethnic groups in Africa from Murdock (1959).

We begin the analysis by examining whether or not violence is more prevalent in land just outside of transhumant pastoral groups. We first study variation at the ethnicity level and find that the incidence of conflict within a group's territory is higher if they are adjacent to ethnic groups that are transhumant pastoral. We then move to a more micro approach and study the relationship at the level of a 0.5-degree grid cell level. For each cell, we first identify its 'nearest neighboring ethnic group,' which is the ethnic group, among all ethnic groups that are contiguous to the cell's own ethnic group, that is geographically closest to the cell. We find the same relationship at the cell level: grid-cells that have a nearest neighboring ethnic group that is transhumant pastoral experience more conflict. The relationships are present whether we use the UCDP or ACLED data. When we distinguish between types of conflict, we find that the effect appears to be driven by conflicts that involve state actors, such as the police or military. This is consistent with accounts of state forces representing agricultural landowners and non-state forces being transhumant pastoral ethnic groups.

We then turn to the central question of the paper, which is whether adverse rainfall shocks that occur in the territories of transhumant pastoralists lead to conflict in nearby agricultural lands. We undertake our analysis using a panel that varies by 0.5-degree grid-cell and year (1989–2018 when using the UCDP data and 1997–2020 when using the ACLED data). All specifications include grid-cell fixed effects, which account for time-invariant factors, and country-year fixed effects, which account for common macro-level shocks that vary by country and year.

We test whether the incidence of conflict in a cell is differentially influenced by precipitation in the nearest neighboring ethnic group if they are transhumant pastoral. Thus, the coefficient of interest is for an interaction between the measure of transhumant pastoralism of a grid-cell's nearest neighboring ethnic group and the average amount of rain in that group's territory in a year. We find clear evidence that higher precipitation in the nearest neighboring ethnic group reduces conflict in a given cell, but only if the neighbor is transhumant pastoral.

The estimated effects are sizable and significant. We find that a one standard deviation adverse precipitation shock in a transhumant pastoral society raises the risk of conflict in a nearby grid-cell by around 35%, or 1.21 percentage points (from a mean of 3.5% to 4.71%). For the same shock, a non-transhumant pastoral group is predicted to have a much smaller effect that is not statistically different from zero (around 2%, or 0.07 percentage points). The specifications also allow for a direct effect of rainfall that occurs in the grid-cell itself or in the territory of the ethnic group in which the grid-cell lies. We find that the estimated direct effects of precipitation are small and statistically insignificant. Thus, while we estimate sizable spillover effects due to the nearby presence of transhumant pastoralism, we find no evidence that rainfall in a cell directly affects conflict in the same cell.

Consistent with our hypothesis, we find that the estimated spillover effects are primarily driven by conflict in agricultural territories. This is consistent with periods of low precipitation inducing transhumant pastoralists to migrate early (during the wet season) to agricultural farmlands, which results in damaged crops, competition for resources, and conflict.

We also conduct a series of additional exercises to test for this particular mechanism. First, we estimate strikingly similar results when we replace data on precipitation with data on phytomass growth, as recorded by the European Union's *Copernicus* satellite program. Since phytomass growth is potentially endogenous to conflict, we also estimate the relationship using precipitation as an instrument, again finding similar results.[3]

Second, we use month-level conflict data to further test the implications of our hypothesis. If adverse shocks induce pastoral groups to migrate before the harvest, and if this movement leads to conflict due to damaged crops and competition for resources, then we should observe these conflict events during the wet (i.e., growing) season, and not during the dry season. We find that this is the case: adverse rainfall shocks in transhumant pastoral societies lead to conflict in nearby cells during the wet season, but not during the dry season. Again, the results are explained entirely by conflict in agricultural cells. We see precisely the same pattern when we study the impact of phytomass growth rather than precipitation. These results are not due to the existence of 'fighting seasons' during which all conflict takes place—indeed the unconditional probability of conflict is slightly higher during the dry season than the wet season. Instead, they bolster the hypothesis that adverse environmental shocks upend the traditional relationship between neighboring farmers and herders by inducing competition for resources before the growing season has ended.

Finally, we show that there is no spillover effect when we replace our data on precipitation with data on temperature. This is informative for two reasons. First, many studies have shown that temperature is linked to conflict through a variety of mechanisms that are orthogonal to our hypothesis (Burke et al., 2015). The absence of any effect indicates that these mechanisms do not explain our results. Second, the finding is consistent with the fact that temperature is a second-order determinant of phytomass growth, explaining about a sixth of the variation explained by precipitation, which is the first-order determinant.

We then turn to a discussion of the lessons and implications of our findings. We first ask whether this mechanism is able to explain the rise in extremist-religious conflict involving self-styled jihadist groups in Africa since 2000. Since transhumant pastoral groups are more likely to be Muslim and sedentary agricultural groups more likely to be Christian, conflicts between the two groups may be viewed as (or spiral into) religious warfare. We show that the effect of climate change through our documented mechanism affects both jihadist conflicts and non-jihadist conflicts similarly. (This holds when we control for the religion of people inhabiting these areas today.) Since jihadist conflicts were very rare prior to 2000, the similar marginal effect has

[3]We do not use phytomass data for the main analysis because the series only begins in 1999, which is ten years later than our conflict and precipitation data.

resulted in a much larger rate of growth of jihadist conflicts in the past two decades. These findings suggest that an important factor in religious conflicts is climate change and scarcity and that they are not only due to atavistic grievances.

Next, we consider what factors can help mitigate the effects of adverse climate events on conflict between transhumant pastoralists and farmers. We begin by examining whether the representation of transhumant pastoral groups in national government affects our estimates. We use the Ethnic Power Relations dataset to calculate, for each year and country, the extent to which transhumant pastoral groups hold power in national politics and allow our estimated effects to vary depending on this measure. We find that our spillover effect is reduced, and approaches zero, as transhumant pastoral groups gain a higher (and closer to representative) share of national power. The result is consistent with accounts of state forces responding with violence to incursions by pastoral groups when the latter are politically excluded. This pattern suggests that climate-induced conflict between farmers and herders can be mitigated with more equitable political representation.

We next examine the role of international aid projects, focusing particularly on projects aimed at curbing the effects of climate change, namely agricultural irrigation projects and environmental conservation or forestry projects. On the one hand, such projects may mitigate the effect of droughts on conflict by helping to alleviate the adverse effects of climate change and adverse weather shocks. On the other hand, some have claimed that such projects can further exacerbate tensions and marginal pastoral groups by disrupt transhumance routes. Agricultural irrigation projects promote the use of marginal land for farming rather than grazing and conservation areas can disrupt the traditional routes of transhumance pastoral groups.

To test for the effects of such aid projects, we allow our main estimated effect to vary by the cumulative presence of World Bank aid projects in a country and year between 1995 and 2014. We find that the presence of irrigation projects in a country appears to reduce the adverse effects of droughts on conflict on agricultural land. By contrast, the presence of conservation projects appears to exacerbate the effects slightly, although the estimates are underpowered and sensitive to the measure of transhumance we use. As a final exercise, we test for effects of foreign aid in general, distinguishing between agriculture and non-agricultural aid. We find that at this level of aggregation, aid projects do not change our main estimated effects.

The third implication of our findings that we consider relates to what our findings teach us about our ability to obtain unbiased estimates of the effects of adverse climate events when, as our findings show, weather events in one location, can cause conflict in another. To identify this relationship, we specified a mechanism of interest and were able to measure the relevant variables. However, in other settings researchers may not have access to the appropriate contextual knowledge or data. In such settings, failing to correctly model the spillover effects could lead researchers to underestimate the true impact of adverse rainfall shocks on conflict. The extent of such a bias will depend on the level of analysis chosen by the researcher. For example, when using low-resolution (e.g., country-level) data, it is plausible that both the weather event and the conflict event occur within the same unit of analysis. In this case, the spillover effects will be captured. However, when analyzing high-resolution (e.g., cell-level) data, empirical designs that do not explicitly model the spillover effects will fail to capture the potential impact of weather events that are experienced outside of the cell. This logic indicates that the estimated direct effect of adverse rainfall shocks on conflict will depend on the size of the unit of analysis.

We show that this is indeed the case by estimating the effect of rainfall in a cell-year on conflict in the same cell-year for grid-cells ranging in size from 0.5 degree to 8 degrees (which is just larger than the mean country size in Africa). Consistent with the presence of spillover effects, we find that the negative impact of rainfall on conflict gradually increases in magnitude as we enlarge the area of the unit of analysis. This pattern is only present when we focus on the subsample of Africa that is suitable for agriculture and pastoralism, which is around 56% of its landmass. This exercise highlights the pitfalls of ignoring spillover effects in granular data. It also indicates that in the presence of spatial spillovers, simply adjusting the size of the cells being studied is not sufficient. In settings where the spillovers are not universal across space, one needs also to have a minimal understanding of the source of the spillovers. This implies that details of the local cultural context are important for identifying the effects of climate change.

Our findings add to the existing ethnographic literature on the relationship between sedentary farmers and nomadic herders in Africa in the pre- and post-colonial periods (Lewis, 1961, Jacobs, 1965, Konczacki, 1978, Dyson-Hudson and Dyson-Hudson, 1980). We also build upon more recent studies that document how adverse climate shocks affect African pastoral groups (Little, Smith, Cellarius, Coppock and Barrett, 2001, McPeak and Barrett, 2001, Maystadt and Ecker, 2004, Bollig, 2006) and how they affect relations between pastoral and agricultural groups (Benjaminsen, Alinon, Buhaug and Buseth, 2012, Eberle et al., 2020).

Our findings also shed light on the nature of cross-ethnicity conflicts more generally. In particular, they pinpoint one mechanism consistent with the recent finding in Depetris-Chauvin and Özak (2020) that conflict tends to occur near ethnic boundaries, and also with the recent finding in Eberle et al. (2020) that conflict tends to be higher at the boundaries of nomadic and non-nomadic groups. Our analysis supports these findings and provides evidence that an important mechanism underlying the relationship is the disruption of the traditional symbiotic relationship between pastoralists and sedentary farmers. Eberle et al. (2020) also show that the heightened conflict between nomadic and non-nomadic groups is greater when temperatures are higher, consistent with existing studies showing that heat can increase violence (Hsiang et al., 2013, Baysan, Burke, González, Hsiang and Miguel, 2019). Our analysis of temperature, rainfall, and phytomass suggests that the thermal stress 'heat and hate' effect documented in Eberle et al. (2020) is distinct from the rainfall effects found here.

We also contribute directly to the literature on climate and conflict (see Burke et al., 2015) and to a broad literature on the determinants of conflict within Africa, including studies that explore the importance of historical factors (e.g., Besley and Reynal-Querol, 2014, Depetris-Chauvin, 2015, Michalopoulos and Papaioannou, 2016, Moscona, Nunn and Robinson, 2020); ethnic or social factors (Montalvo and Reynal-Querol, 2005, Esteban, Mayoral and Ray, 2012, Rohner, Thoenig and Zilibotti, 2013); and economic factors, especially shocks to the opportunity cost of conflict (McGuirk and Burke, 2020), which can be challenging to distinguish empirically from shocks that affect other drivers of conflict (Blattman and Miguel, 2010, Dube and Vargas, 2013, Dal Bó and Dal

Bó, 2011). We overcome this issue with our spillover design, which traces the effect of an adverse economic shock that occurs in one ethnic territory on conflict that occurs in a neighboring ethnic territory.

An important aspect of our mechanism is that the link between rainfall and conflict occurs through spatial spillovers. Our findings thus contribute to other analyses that aim to estimate climate-conflict relationships at a disaggregated level while allowing for the possibility of spatial spillovers (e.g., Harari and La Ferrara, 2018). This prior research takes a more empirical approach towards characterizing the nature of spillovers on average within Africa. By contrast, our analysis starts with a particular theoretical mechanism in mind that is motivated by the ethnographic literature. We then build our estimator to capture this precise mechanism while accounting for other, more general forms of spillover. Thus, our strategy is similar to other studies that also specify a particular spillover mechanism ex-ante that is then brought to the data. For example, König, Rohner, Thoenig and Zilibotti (2017) estimate the effects of weather shocks experienced by a military or rebel group's network of allies and enemies during the Second Congo War.

Lastly, our findings contribute to our understanding of the relationships between climate change, migration, and conflict (Black, Bennett, Thomas and Beddington, 2011, Bosetti, Cattaneo and Peri, 2018). While the literature has tended to focus on climate change and permanent migration (e.g., Barrios, Bartinelli and Strobl, 2006, Marchiori, Maystadt and Schumacher, 2012, Cattaneo and Peri, 2016), our findings speak to the role of seasonal migration in mediating the relationship between climate change and conflict. Thus, our findings provide an interesting contrast to Bosetti et al.'s (2018) finding that permanent migrations reduce the adverse effects of climate change on conflict in origin countries and have no effect on receiving countries.

The paper is organized as follows. In Section 2, we provide a description of the traditional symbiotic relationship between nomadic pastoralists and sedentary farmers in Africa. We also discuss recent changes in climate on the continent and how this has affected the nature of the farmer-herder relationship. In Section 3, we describe the data used in the main analysis. In Section 4, we present quantitative cross-sectional evidence on the prevalence of conflict in these areas. In Section 5, we propose and test an econometric model that explicitly addresses the spillover effect of weather shocks at the cell-level. In Section 6, we present a series of analyses that test for causal mechanisms. In Section 7, we turn to the implications of our findings, including an examination of factors that may mitigate the effects that we estimate, as well as a study of the implications of our findings for estimating the effect of rainfall on conflict more generally.

We now turn to a description of the background of our setting and an overview of the relationship between sedentary farmers and transhumant pastoralists that is core to our mechanism of interest.

2. Background and Context

A. Traditional Farmer-Herder Relations

Animal husbandry is the primary mode of subsistence for a large number of individuals in rural parts of the African continent. Recent estimates suggest that 268 million people—approximately 22% of the population of Africa—obtain the majority of their income from animals. Approximately 43% of Africa's landmass supports pastoral activities (FAO, 2018, p. 1).

Most pastoral groups in Africa are *transhumant*, which means that they engage in seasonal movements of their animals. This is an important attribute that is central to our analysis. These activities are also commonly referred to as 'nomadic pastoralism,' which the OECD describes as "the livelihood of a group of human beings based on the movement of large herds of herbivores maximizing use of plant and water resources, which are limited, variable and dispersed." (OECD, 2014, p. 142)

A defining feature of transhumant pastoralism is that it results in regular seasonal interactions with sedentary agriculturalists. Farmers and herders have developed a symbiotic relationship that allows for both groups to use land and other resources in an efficient and mutually beneficial manner.

On the continent, naturally-occurring seasons generate a period (or periods) of the year that are wet or dry. Exactly when during the year the wet and dry seasons occur depends on where one is on the continent, and particularly whether one is north or south of the equator. The seasonal variation is shown in Figure 1, which reports rainfall across the continent in two months, August and January. August, which is shown on the left, is a wet season month for most of the continent that lies north of the equator. For the continent south of the equator, the month is part of the dry season. By contrast, in January, which is shown on the right, the north experiences a dry season and the south a wet season.

The transhumant migrations that occur are illustrated in the maps of Figure 2, which provide stylized depictions of hypothetical sedentary agricultural groups (in blue) and transhumant pastoral group (in red) in West Africa. During the wet season, when crops are cultivated, pastoralists keep their livestock on marginal grazing land that is not suitable for agriculture but does support the growth of wild grasses that provide sustenance to animals. During the dry season, this growth no longer occurs. As a result, herds are moved to the more fertile farmlands that are used for agriculture during the wet season but are left fallow during the dry season. This movement is shown by the arrows in the right map. Animal herds are allowed to graze on the land during this period. This arrangement benefits both the pastoralists, who enjoy the dry-season production of animal feed, and the farmers, whose land is improved by the animals' manure, a form of nitrogen-rich organic fertilizer. At the end of the dry season, herds are moved from the agricultural lands and return to the more marginal grazing lands. This is shown by the arrows in the left map.

Thus, due to the seasonal movements of herds, both sedentary farmers and transhumant pastoralists are able to exploit the land efficiently and cooperatively.

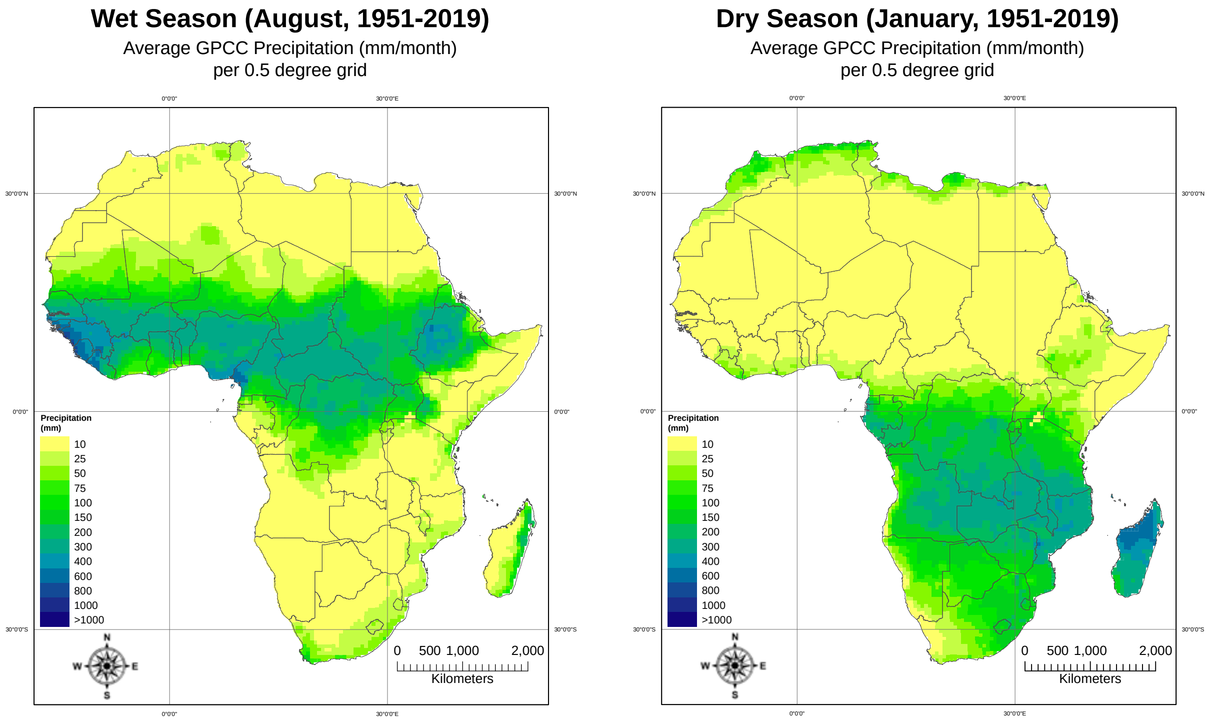


Figure 1: Seasonal rainfall in Africa showing (from the perspective of the northern hemisphere) rainfall during a month of the wet season (left) and during a month of the dry season (right).

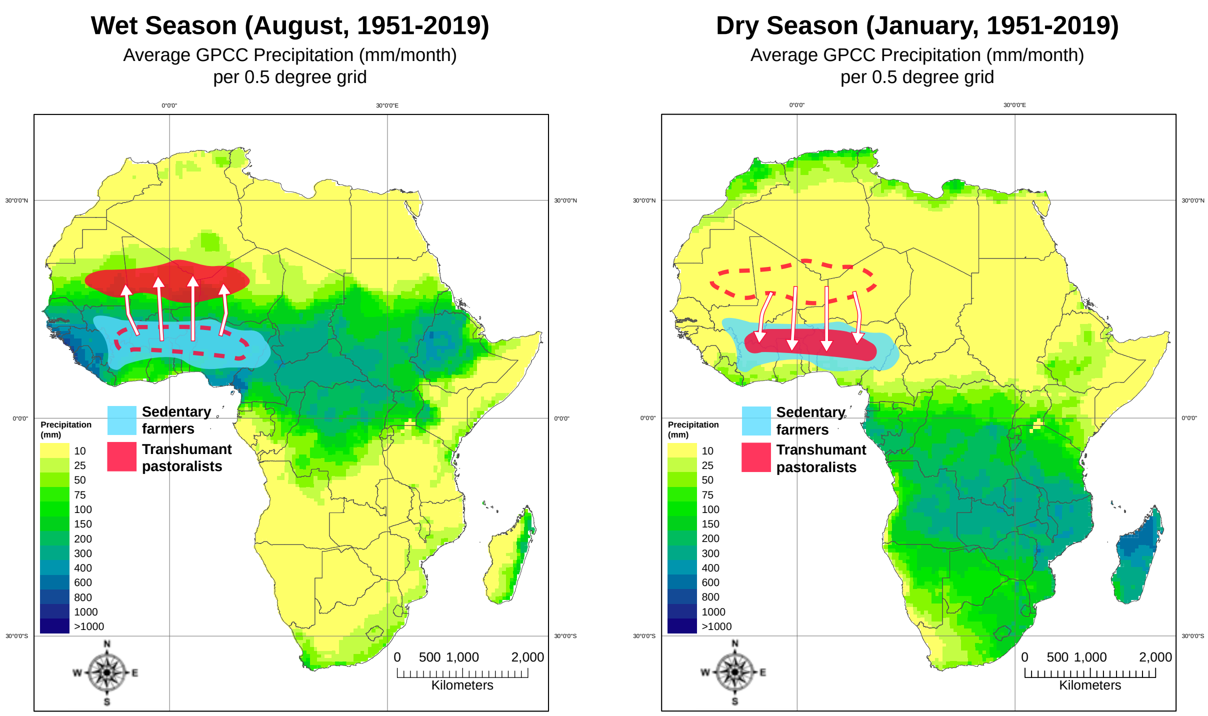


Figure 2: Rainfall and seasonal migration in Africa.

Stenning (1959), in his study of the pastoral Fulani, describes their transhumant relationship with the neighboring agriculturalists of the Uda'en as follows:

> In the dry season herds are dispersed southward in response to shortages of pasture and water and congregate again in the north to avoid tsetse fly in the wet season. A wide variation in the distance and impetus of these movements is found, depending on location variations in savannah habitat, but seasonal movement is a consistent feature of Fulani pastoralism throughout this zone... pastoral life is pursued not in isolation, but in some degree of symbiosis with sedentary agricultural communities. Alongside the continuous exchange of dairy products for grain and other goods, there have existed, possibly for many centuries, arrangements for pasturing cattle on land returning to fallow, and for guaranteeing cattle tracks and the use of water supplies. Pastoral Fulani did not, and do not, merely graze at will, but obtained rights to the facilities they required from the acknowledged owners of the land. (pp. 4, 6)

The details of transhumant pastoralism and of the timing and nature of the symbiotic relationship with farmers varies from region to region. For example, while most of the continent experiences one wet season and one dry season, some locations experience a "dual wet season," meaning a wet season, then a dry season, and then another wet season. Other locations are "bimodal," having one wet season, but within this, two clear peaks during the wet season. However, across the continent, the most common pattern is for one wet season that has a unimodal distribution of rainfall. The second most common, which is present in parts of Kenya, Ethiopia, and Somalia, is for two distinct wet seasons, each of which has a unimodal distribution of rainfall (Herrmann and Mohr, 2012). However, in all cases, the logic of seasonal movements of grazing animals to fallow agricultural lands still holds.

The consequence of these traditional relationships is that there exist extensive transhumance routes in the parts of Africa with ecological zones that have these features, the largest region being the Sahel. These transhumance routes, examples of which is illustrated in Figure 3 for Mali, have a number of characteristics that are important for our empirical strategy. The routes vary in length, ranging from hundreds of meters to hundreds of kilometers. Although they tend to be in a predominantly north-south direction, they do vary in direction. They typically cross ethnic and national boundaries.

B. Effects of Climate Change

While the symbiotic relationship between sedentary agriculturalists and transhumant pastoralists has never free conflict free, recent decades appear to have witnessed a rise in conflict between the two groups, at least if measured by the prevalence of media coverage.[4] At this same time, the

[4]Examples of recent accounts include The Economist ("Fighting in the Sahel has forced 1.7m people from their homes," accessed July 2020 at `https://www.economist.com/graphic-detail/2020/06/20/fighting-in-the-sahel-has-forced-17m-people-from-their-homes`); Foreign Affairs ("The Deadliest Conflict You've Never Heard of," accessed July 2020 at `https://www.foreignaffairs.com/articles/nigeria/2019-01-23/deadliest-conflict-youve-never-heard`); and Reuters ("Sahel herders facing harshest dry season in years, aid agency warns," accessed July 2020 at `https://www.reuters.com/article/us-africa-herders/sahel-herders-facing-harshest-dry-season-in-years-aid-agency-warns-idUSKBN1CW1ZF`).

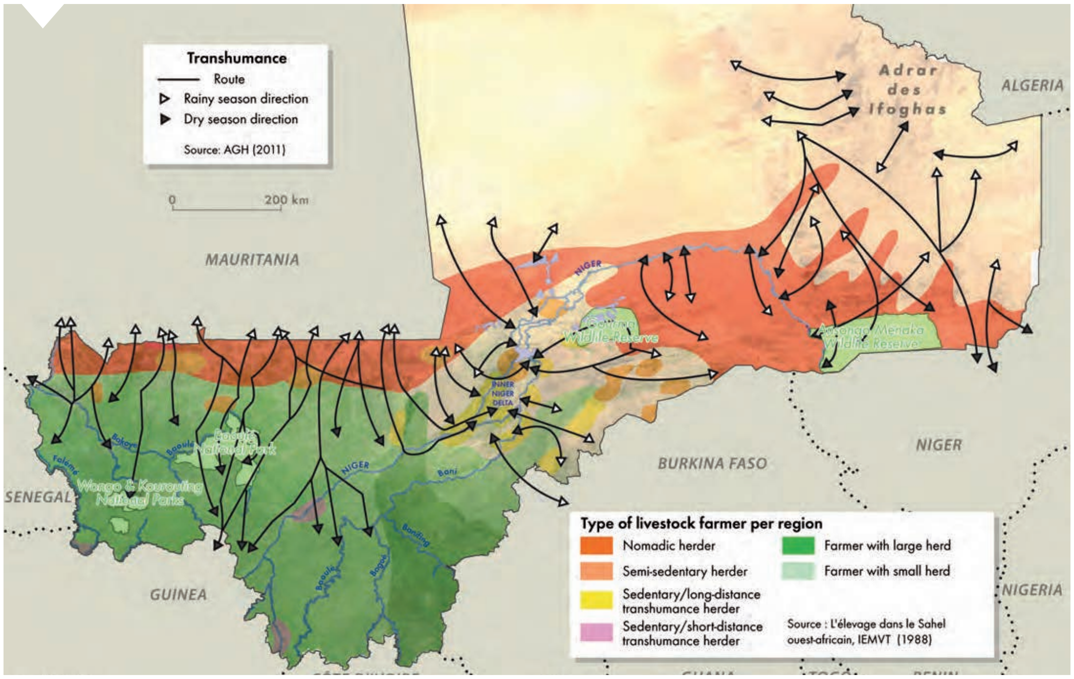


Figure 3: Seasonal transhumance routes of nomadic pastoralists in Mali

African continent as a whole, but particularly the Sahel region, has experienced rainfall that is persistently below average. Existing climatological research indicates that there was a noticeable change towards a weaker monsoon and drier conditions beginning in the late 1960s (Nicholson, Fink and Funk, 2018). Recent rainfall data show that within the Sahel region, between 1970 and 2017, average rainfall was below the long-run (1900–2017) average in 36 of the 47 years (Schneider, Becker, Finger, Meyer-Christoffer, Rudolf and Ziese, 2015). In recent years, there is some evidence that the rainfall shortage during the past decades is attenuating. However, the evidence also indicates that important characteristics of the rainy season have also permanently changed (Biasutti, 2018, Herrmann and Mohr, 2012).

These trends are plausibly explained by the climatology literature, which has established a strong correlation between rainfall and the amount of living organic plant matter—referred to as *phytomass*—produced in the Sahel. This relationship has been shown to be present regardless of the intensity with which animal grazing takes place (Hein, 2006). While temperature is also a factor, its role is primarily due to the effect that it has on rainfall (Biasutti, 2018). Thus, given the central importance of rainfall—particularly monsoon rainfall—for phytomass growth, our analysis focuses on this characteristic of climate.

Moreover, because we aim to estimate precise spatial spillovers at a local level, our analysis requires variability in the determinants of plant growth at a fine geographic resolution. As illustrated by the maps in Appendix Figure A1, this is true for precipitation, but much less so for temperature. The effect that temperature has on rainfall does not vary at a local level: temperature in one macro-level region affects the rainfall patterns in another. For example, Shanahan, Overpeck, Anchukaitis, Beck, Cole, Dettman, Peck, Scholz and King (2009) examine paleohydrological data from the past three millennia and show that persistent drought in West

Africa is caused by increased Atlantic sea surface temperatures. Cook and Vizy (2013) document the effects that warming in the Middle East, South Asia, and particularly the Indian Ocean have on precipitation in Eastern Africa.

In short, although temperature changes are important at a macro-level due to their effect on spatial and temporal rainfall patterns, the existing research indicates that, at a local level, temperature is not the primary determinant of phytomass. As we explain in further detail in the next section, our own calculations are consistent with this conclusion. We find that for a given location, the annual variation in rainfall explains about six times more of the variation in phytomass than temperature does.

3. Data

A. Description, Sources, and Validation

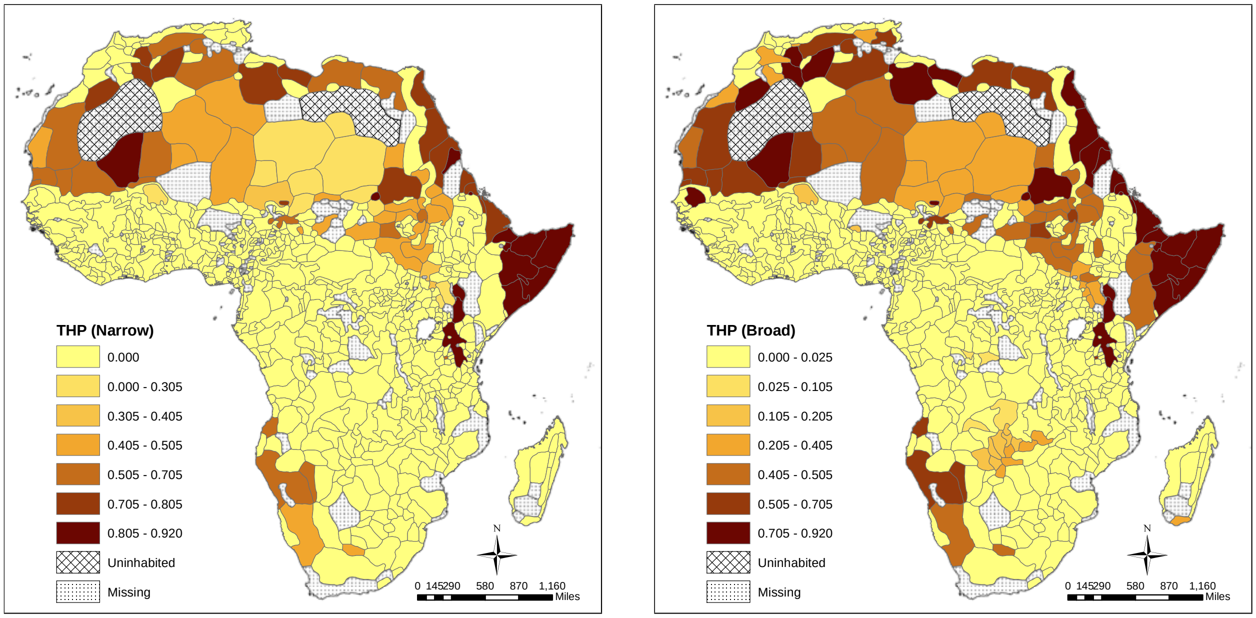
Conflict Our baseline set of geocoded conflict variables is from the Uppsala Conflict Data Program (UCDP). Conflict events are two-sided battles or one-sided attacks that produce at least one fatality. In order to be included, all conflict dyads must have engaged in a large-scale conflict battle in which at least 25 people were killed. We include two mutually exclusive categories of conflict: *State* implies that the state was involved in the event; *Non-State* implies that only non-state actors, such as rebel groups or militias, were involved. UCDP conflict data run from 1989–2018.

We also use an alternative set of geocoded conflict variables taken from the Armed Conflict Location & Event Data project (ACLED), which run from 1997–2020. Because the ACLED data are available for a shorter time period, we use the UCDP data for our baseline estimates and check the robustness of our findings to the use of the ACLED data. We consider only violent conflict events, namely two-sided battles and one-sided attacks. There is no equivalent criteria for inclusion to the ACLED dataset, which is perhaps why the unconditional probability of ACLED conflict incidence is 8% while the figure for UCDP is 3% (see Table 1).

Transhumant Pastoralism To identify transhumant pastoral societies, we use information from the *Ethnographic Atlas*, a database of 1,265 ethnic groups assembled and published by Murdock from 1962–1980. We construct a composite index that captures the two key aspects of transhumant pastoralism.

The first key aspect is that the group moves seasonally; namely, that they are transhumant. There is extensive information in the *Ethnographic Atlas* on the mobility of ethnic groups traditionally. Variable v30 of the database codes groups as falling within one of the following categories that describe the nature of settlement: (1) Nomadic or fully migratory; (2) Seminomadic; (3) Semisedentary; (4) Compact but impermanent settlements; (5) Neighborhoods of dispersed family homes; (6) Separated hamlets; (7) Compact and relatively permanent; and (8) Complex settlements.

Although transhumance is not measured explicitly, nearly all forms of movement are today seasonal—non transhumant nomadism is now rare. Thus, we take being traditionally nomadic



(a) Narrow definition of transhumant pastoralism

(b) Broad definition of transhumant pastoralism

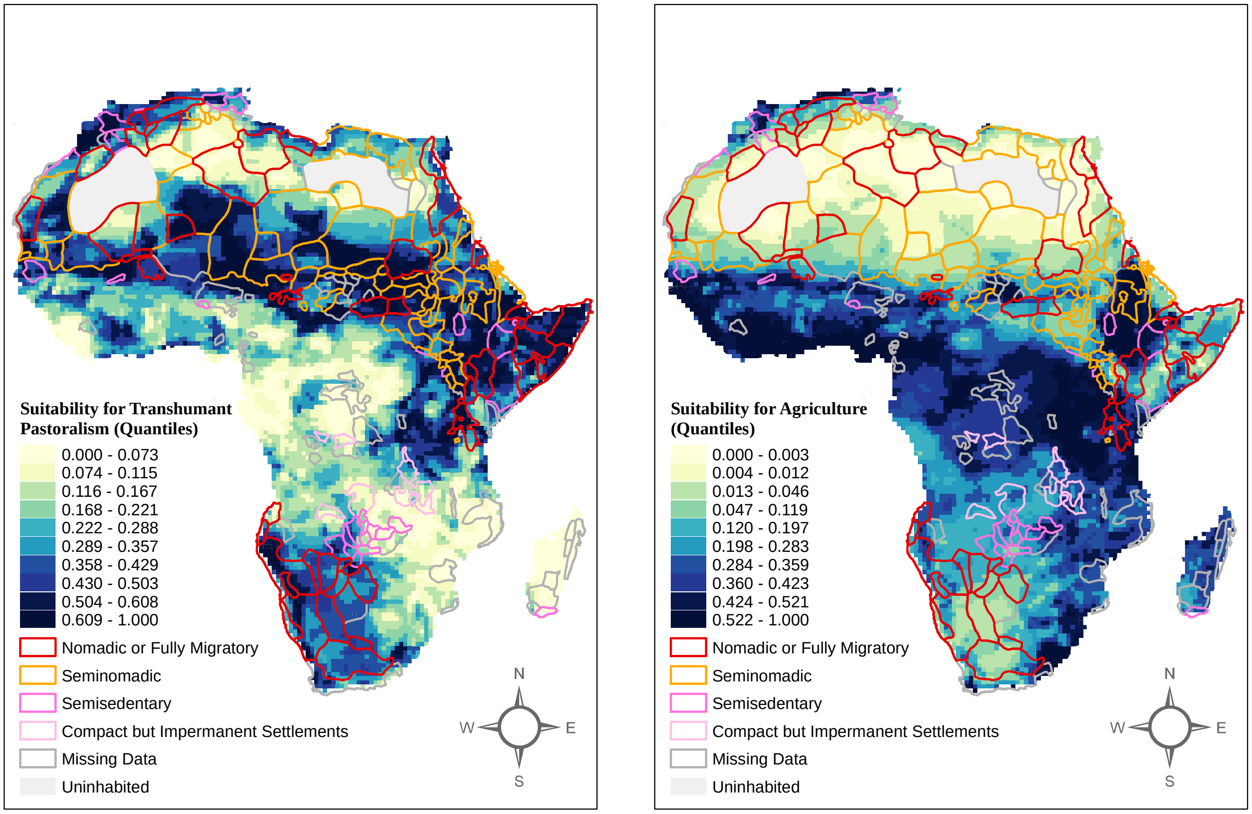
Figure 4: Cross-ethnicity measures of transhumant pastoralism.

as a proxy for being transhumant. We create two indicator variables that allow for two definitions: our 'narrow' definition of transhumance includes only groups that are 'nomadic or fully migratory' or 'seminomadic'; while our 'broad' definition of transhumance additionally includes groups that are 'semisedentary' or that have 'compact but impermanent settlements.' The variants differ in whether groups that are semi-mobile are coded as being transhumant (second measure) or not (first measure). We denote this variable $Transhumant_e$.

The second key aspect of transhumant pastoralism is the herding of animals. To capture this dimension, we build on a measure developed by Becker (2019). Her variable combines information on the fraction of subsistence that is from animal husbandry (measured on a 0-1 scale, from variable v4 in the *Ethnographic Atlas*) with an indicator variable that equals one if the primary large animal is suitable for herding (from variable v40). Animals that require herding include sheep, goats, equine animals, camels, and bovine animals, but not pigs. Becker's measure is constructed as the interaction between these two measures. Thus, it ranges from 0-1 and is a proxy for the fraction of an ethnic group's subsistence that is from herded animals. We denote this variable $Pastoral_e$.

Our measure of 'transhumant pastoralism' is constructed as the interaction between the two components: $Transhumant_e \times Pastoral_e$. The resulting variable, which we denote $TranshumantPastoral_e$, measures the fraction of a transhumant group's subsistence that is from pastoralism.

To assign these variables to spacial units, we match each society from the *Ethnographic Atlas* to ethnic territories in a digitized version of the map from George Peter Murdock's book, *Africa: Its Peoples and their Culture History*. Using a variety of sources, documented in Kincaide, McGuirk and Nunn (2020), we match around 96% of the ethnic territories in the map to corresponding ethnic



(a) Suitability for transhumant pastoralism

(b) Suitability for sedentary agriculture

Figure 5: Ecological Conditions and Transhumant Pastoralism

groups in the *Ethnographic Atlas*. Figure 4 shows the distribution of the transhumant pastoralism indices across ethnic groups using this map.

The location and intensity of transhumant pastoralism is consistent with expectations and determined primarily by the locations of lands that are most suitable for animal grazing rather than agriculture. To confirm this, in Figure 5, we display the spatial distribution of land suitability for transhumant pastoralism and sedentary agriculture. The measures, which are from Beck and Sieber (2010), are displayed with a darker shade indicating greater suitability.[5] Also shown in Figure 5 are the boundaries of ethnic groups from the Murdock map that exhibit some degree of traditional mobility and so are defined as transhumant by our narrow and/or broad definition. From the figure, it is clear that the ecological environment, as captured by the underlying suitability data from Beck and Sieber (2010), is an important determinant of the degree of mobility reported in the *Ethnographic Atlas* and of our measure of transhumant pastoralism.

Rainfall and Phytomass Pastoral groups rely on precipitation to produce the phytomass needed to sustain their livestock. Our main weather shock variable is a 0.5 degree cell-year measure of

[5]Beck and Sieber (2010) use ecological niche modeling to derive spatial predictions of land use types based on climactic and soil input data. The database covers all of the African mainland at a 2.5 arc-minute (approx. 5km) resolution. In the database, transhumant pastoralism is called 'nomadic pastoralism.' Since nearly all nomadic activity today (i.e., movement of populations) is transhumant (i.e., seasonal), we refer to the measure as 'transhumant pastoralism.'

precipitation calculated by the Global Precipitation Climatology Centre (Schneider et al., 2015). It measures land-surface precipitation from rain gauges built on Global Telecommunications System (GTS)-based data, which is an international system for the dissemination of meteorological data from weather stations, satellites and numerical weather prediction centers. This variable covers the full duration of our conflict series (1989–2018). It is measured in centimeters per month.

We verify the importance of rainfall for plant growth using satellite data on dry matter vegetation (i.e., phytomass). The data are at the level of a 1km pixel weekly from 1999–2018 and are taken from *Copernicus*, the European Union's Earth observation program. We aggregate the data to the 0.5 degree cell-year level and measure the final variable in average kilograms per hectare per month.

We estimate the determinants of phytomass at the cell-year level. We model phytomass as a function of average annual precipitation and temperature, while conditioning on cell fixed effects and country-by-year fixed effects.[6] The estimates, which are reported in Appendix Table A1, confirm the importance of precipitation for vegetation growth. We report estimates that include only rainfall, only temperature, and both together. Consistent with the environmental science literature, we find that rainfall is a significant determinant of phytomass growth. In addition, by various metrics, we find rainfall to be a much more important determinant than temperature. First, after partialling out the fixed effects, rainfall explains 3.6% of the residual variation while temperature explains 0.6%; second, the F-statistic for rainfall is 136 while for temperature it is 31; third, we estimate that a within-cell standard deviation rise in rainfall increases phytomass by 1.61% of the mean, while the equivalent rise in temperature decreases phytomass by 0.53%.

Given that rainfall is the main driver of phytomass growth, we proceed using rainfall as our primary climate shock variable. In sensitivity checks, we also report estimates using phytomass directly as a summary measure of the climate shocks experienced in a cell and year.[7]

B. Summary of the Data

The descriptive statistics for our main variables (conflict, transhumant pastoralism, and rainfall), as well as all other covariates used in the analysis, are reported in Table 1. We present in separate panels variables that vary at the cell-year, cell, ethnic-group-year and ethnic group levels. At the cell-year level, the incidence of conflict is 3% when using the UCDP data and 8% when using the ACLED data. The average precipitation is 5.65 centimeters per month and the average temperature is 24.5 degree Celsius. Looking at ethnicity characteristics, one can see that the average measure of transhumant pastoralism is 0.08 when the narrow measure is used and 0.10 when the broad measure is used.

In Table 2, we present summary statistics separately for groups that are transhumant pastoral and groups that are not. In column (1), we report averages for groups with a measure of transhumant pastoralism that is greater than zero; in column (2), we report averages for groups with a measure of transhumant pastoralism that is equal to zero; and in column (3), we estimate

[6] This specification includes the same fixed effects as in our baseline estimating equations.

[7] We use rainfall as our baseline measure since it is available for a much longer time series than phytomass.

Table 1: Descriptive Statistics

	Mean	SD	Count	Min	Median	Max
	Cell-Year Level Variables, 1989-2018					
UCDP: I(Any Conflict), 0/1	0.03	0.18	290730	0.00	0.00	1.00
ACLED: I(Any Conflict), 0/1	0.08	0.27	213202	0.00	0.00	1.00
Precipitation, cm/month	5.65	5.14	290730	0.00	4.38	49.28
Phytomass, kg/ha	30.69	30.35	193820	0.01	23.44	141.11
Temperature, $^{\circ}C$	24.50	3.95	251922	7.51	24.75	39.53
Nighttime Lights, 0-1	0.04	0.03	203511	0.00	0.03	0.96
	Cell Level Variables					
Nearest Neighbor Transhumant Pastoralism (Narrow Definition), 0-1	0.19	0.30	8487	0.00	0.00	0.92
Nearest Neighbor Transhumant Pastoralism (Broad Definition), 0-1	0.21	0.30	8487	0.00	0.00	0.92
B-S: Land Suitability for Transhumant Pastoralism, 0-1	0.32	0.20	9421	0.00	0.29	0.90
B-S: Land Suitability for Agriculture, 0-1	0.24	0.20	9421	0.00	0.22	0.88
ln(Population)	9.55	2.16	9691	0.00	9.88	16.19
	Ethnic-Group-Year Level Variables, 1989-2018					
Precipitation, cm/month	8.54	5.20	23400	0.00	8.27	34.96
Phytomass, kg/ha	44.31	28.53	15600	0.18	43.59	130.71
Temperature, $^{\circ}C$	24.78	3.47	20280	12.20	25.28	37.12
EPR: Political Power, 0-5	2.12	1.16	11116	0.00	2.00	5.00
	Ethnic Group Level Variables					
Transhumant Pastoralism (Narrow Definition), 0-1	0.08	0.23	591	0.00	0.00	0.92
Transhumant Pastoralism (Broad Definition), 0-1	0.10	0.23	591	0.00	0.00	0.92
Avg. Neighbor Transhumant Pastoralism (Narrow Definition), 0-1	0.10	0.18	649	0.00	0.00	0.92
Avg. Neighbor Transhumant Pastoralism (Broad Definition), 0-1	0.12	0.19	649	0.00	0.00	0.92
EA: Agriculture, 0-1	0.55	0.18	618	0.03	0.61	0.92
EA: Jurisdictional Hierarchy, 0-4	1.28	0.97	571	0.00	1.00	4.00
EA: Belief in High Gods, 0/1	0.46	0.50	400	0.00	0.00	1.00
Share Muslim, 0-1	0.29	0.38	574	0.00	0.05	1.00
Share Christian, 0-1	0.45	0.35	574	0.00	0.45	1.00
Segmentary Lineage, 0-1	0.50	0.25	600	0.02	0.48	0.98

Note: This table presents basic descriptive statistics. The first panel presents variables that vary at the level of a cell-year. *UCDP: I(Any Conflict)* and *ACLED: I(Any Conflict)* measure conflict incidence. *Precipitation* is measured in average cm per month. *Phytomass* is the average monthly growth of dry vegetation measured in kg/ha. This is computed using the 'Dry Matter Productivity' variable from the *Copernicus* remote sensing program. *Temperature* is from Fan and van den Dool (2008). *Nighttime Lights* is based on data collected by US Air Force Weather Agency and processed by NOAA's National Geophysical Data Center. The second panel presents cross-sectional variables that vary at the level of a cell. *Nearest Neighbor Transhumant Pastoralism* measures, for each cell, the transhumant pastoralism index score of the nearest ethnic group that is contiguous to the ethnic group in which the cell lies. The narrow measure includes only groups that are classified in the *Ethnographic Atlas* as 'nomadic or fully migratory' or as 'seminomadic.' The broad measure additionally includes groups that are 'semisedentary' or that have 'compact but impermanent settlements.' The *Land Suitability* variables are based on data from Beck and Sieber (2010). *Population* is measured in persons and is taken from CIESIN and CIAT (2005). The third panel presents variables that vary at the level of an ethnic-group-year. *EPR: Political Power* is the score assigned to each ethnic group in the *Ethnic Power Relations* dataset, where 0 indicates that the group is either discriminated against or completely excluded from national politics, while a score of 5 indicates that the group has a monopoly on national political power. In cases where an ethnic group shares power in multiple countries, we compute the average score. In this panel we also present precipitation, phytomass and temperature aggregated to the level of an ethnic-group-year. The fourth panel presents cross-sectional variables that vary at the level of an ethnic group. *Transhumant Pastoralism* is described in the main text. *Avg. Neighbor Transhumant Pastoralism* measures the average transhumant pastoralism index score across an ethnic group's contiguous neighbors. The variable *EA: Agriculture* measures an ethnic group's historical dependence on agriculture for subsistence; the variable *EA: Jurisdictional Hierarchy* measures the number of jurisdictional layers beyond the local community within an ethnic group; *EA: Belief in High Gods* is an indicator equal to one if an ethnic group believed in a moralizing god before contact with European colonizers; all three of these variables are from the *Ethnographic Atlas*. The variables *Share Muslim* and *Share Christian* measure the estimated share of people in each ethnic group that are today Muslims or Christians respectively. This data comes from the *World Religion Database*, which we match to our *Ethnographic Atlas* data using *Ethnologue* identifiers. The variables *Temperature*, *Nighttime Lights* and *Population* are available in the PRIO-GRID v.2.0 dataset (Tollefsen, Strand and Buhaug, 2012).

Table 2: Balance Table, Sub-Samples by THP Classification

Variable	(1) THP > 0	(2) THP = 0	(3) Difference
	Cell-Year Level, 1989-2018		
UCDP: I(Any Conflict), 0/1	0.024	0.042	-0.018***
	(0.152)	(0.200)	(0.002)
ACLED: I(Any Conflict), 0/1	0.051	0.098	-0.047***
	(0.221)	(0.297)	(0.003)
Precipitation, cm/month	2.066	8.513	-6.447***
	(2.715)	(4.857)	(0.078)
Phytomass, kg/ha	9.214	47.835	-38.621***
	(17.333)	(27.446)	(0.475)
Temperature, $^{\circ}C$	25.323	23.859	1.465***
	(4.115)	(3.688)	(0.083)
Nighttime Lights, 0-1	0.037	0.042	-0.006***
	(0.021)	(0.043)	(0.001)
Observations	115,650	148,740	290,730
	Cell Level		
Nearest Neighbor Transhumant Pastoralism (Narrow Definition), 0-1	0.357	0.070	0.287***
	(0.333)	(0.204)	(0.006)
Nearest Neighbor Transhumant Pastoralism (Broad Definition), 0-1	0.378	0.085	0.294***
	(0.323)	(0.214)	(0.006)
B-S: Land Suitability for Transhumant Pastoralism, 0-1	0.390	0.266	0.124***
	(0.196)	(0.186)	(0.004)
B-S: Land Suitability for Agriculture, 0-1	0.099	0.354	-0.255***
	(0.132)	(0.182)	(0.004)
ln(Population)	8.844	10.840	-1.996***
	(1.626)	(1.446)	(0.033)
Observations	3,855	4,958	9,691
	Ethnic-Group-Year Level, 1989-2018		
Precipitation, cm/month	3.840	9.745	-5.905***
	(3.342)	(4.885)	(0.349)
Phytomass	19.923	50.563	-30.640***
	(23.412)	(26.176)	(2.339)
Temperature, $^{\circ}C$	25.171	24.756	0.415
	(4.014)	(3.330)	(0.377)
EPR: Political Power, 0-5	1.843	2.161	-0.318**
	(1.160)	(1.108)	(0.136)
Observations	3,750	17,610	23,400
	Ethnic Group Level		
Avg. Neighbor Transhumant Pastoralism (Narrow Definition), 0-1	0.275	0.049	0.226***
	(0.233)	(0.128)	(0.015)
Avg. Neighbor Transhumant Pastoralism (Broad Definition), 0-1	0.310	0.060	0.250***
	(0.226)	(0.137)	(0.015)
EA: Agriculture, 0-1	0.338	0.593	-0.255***
	(0.208)	(0.133)	(0.015)
EA: Jurisdictional Hierarchy, 0-4	1.555	1.240	0.315***
	(0.852)	(0.980)	(0.100)
EA: Belief in High Gods, 0/1	0.779	0.355	0.424***
	(0.417)	(0.479)	(0.050)
Share Muslim, 0-1	0.565	0.246	0.319***
	(0.478)	(0.337)	(0.039)
Share Christian, 0-1	0.278	0.484	-0.205***
	(0.361)	(0.339)	(0.037)
Segmentary Lineage, 0-1	0.476	0.509	-0.033
	(0.191)	(0.257)	(0.025)
Observations	125	587	780

Note: This tables presents balance tests. Column (1) shows averages across groups where our measure of *Transhumant Pastoralism* (THP) is greater than zero. Column (2) shows averages across groups where this measure is equal to zero. We use the broader definition of THP that includes all pastoral groups without fully permanent settlements. Standard errors are clustered by ethnic group. See Table 1 for variable descriptions.

the difference in means. We find that transhumant pastoralism is associated with less conflict (for both UCDP and ACLED), less precipitation, less phytomass, higher temperatures, less land suitable for agriculture, and more land suitable for transhumant pastoralism. It is also associated with lower population, fewer nighttime lights, less national political power, and a higher share of Muslim people and a lower share of Christian people today. Looking at historical ethnographic traits, we see that transhumant pastoral groups, not surprisingly, practice less agriculture and were more developed politically (as measured by levels of political authority beyond the local community).

These comparisons make clear that transhumant pastoralism is not randomly allocated across the continent. The practice is determined by agricultural conditions. In addition, it is clear that transhumant pastoralism is associated with other factors, namely historical state development and political power today. These facts highlight the importance of our auxiliary analyses which look for evidence of our specific mechanism of interest, test for the importance of other traits, like pre-colonial state centralization, and examine the importance of contemporary political power.

4. Cross-Sectional Relationships

We begin our analysis by presenting cross-sectional evidence on the relationship between being near transhumant pastoral groups and conflict. Motivated by our mechanism of interest, our empirical setup allows transhumant pastoralism to affect conflict in nearby territories. We begin by first estimating variation across ethnic groups before undertaking a finer analysis at the grid-cell level.

A. Ethnicity-level analysis

Looking across ethnic groups, we test whether an ethnic group e experiences more conflict within their territory if they are adjacent to ethnic groups that are transhumant pastoral. We examine this with the following estimating equation:

$$y_{et} = \delta_1 \mathit{TranshumantPastoral}_e^{Neighbor} + \delta_2 \mathit{TranshumantPastoral}_e^{OwnGroup} + \delta_3 \ln(pop_e) + \alpha_t + \varepsilon_{et}, \quad (1)$$

where e indexes ethnic groups and t years (1989–2018); y_{et} is an indicator for the presence of conflict within the traditional territory of ethnicity e during year t; $\mathit{TranshumantPastoral}_e^{Neighbor}$ is the average value of our measure of transhumant pastoralism among all ethnic groups that are a neighbor to (i.e., contiguous to) ethnicity e. We also allow for the possibility that transhumant pastoralism affects the amount of conflict in their own territory by including $\mathit{TranshumantPastoral}_e^{OwnGroup}$, which is the measure of transhumant pastoralism of ethnicity e. Lastly, $\ln(pop_e)$ is the natural log of the population of ethnicity e, averaged over 1990, 1995, 2000, 2005, and 2010, and α_t denote year fixed effects. The parameter of interest, δ_1, describes the effect of having transhumant pastoral neighbors. Standard errors are two-way clustered at the level of an ethnic group (to account for serial correlation within ethnic groups) and climate zone-year (to account for spatial correlation within 14 climate zones).

Table 3: Transhumance-Related Conflict in the Cross-Section: Ethnicity-Level Spillover Analysis

	Indicator for the presence of conflict			
	(1)	(2)	(3)	(4)
	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)
Panel A: Transhumant definition includes only groups that are migratory or nomadic				
Avg. Neighbor Transhumant Pastoral [δ_1]	0.3089***	0.2862***	0.0995**	0.3258***
	(0.0671)	(0.0597)	(0.0442)	(0.0805)
Transhumant Pastoral [δ_2]	0.1269**	0.0707	0.1049**	0.1476**
	(0.0559)	(0.0490)	(0.0419)	(0.0643)
ln(population) [δ_3]	0.0355***	0.0258***	0.0253***	0.0862***
	(0.0063)	(0.0056)	(0.0046)	(0.0083)
Panel B: Transhumant definition includes all groups without fully permanent settlements				
Avg. Neighbor Transhumant Pastoral [δ_1]	0.2928***	0.2768***	0.0884**	0.3316***
	(0.0616)	(0.0549)	(0.0415)	(0.0760)
Transhumant Pastoral [δ_2]	0.1383***	0.0813*	0.1066***	0.1409**
	(0.0522)	(0.0456)	(0.0384)	(0.0616)
ln(population) [δ_3]	0.0363***	0.0267***	0.0253***	0.0871***
	(0.0064)	(0.0057)	(0.0046)	(0.0083)
Dep. Var. Mean	0.174	0.131	0.096	0.374
Year FE	Yes	Yes	Yes	Yes
Climate-Zone-Years	393	393	393	316
Ethnic Groups	711	711	711	711
Observations	21,330	21,330	21,330	17,064

Note: All outcome variables measure conflict incidence at the level of an ethnic group-year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in the territory of an ethnic group in a year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in the territory of an ethnic group in a year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in the territory of an ethnic group in a year. "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in the territory of an ethnic group in a year as coded in the ACLED data. The variable ln(population) is the natural log of average cell-level population measured in 1990, 1995, 2000, 2005, and 2010. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of an ethnic group and a climate zone-year. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Estimates of equation (1) are reported in Table 3. Panel A reports estimates using the more restrictive definition of transhumance that includes two categories, while panel B reports estimates for the broader measure that includes four categories. Each column reports estimates using a different dependent variable. Columns 1–3 report estimates for the incidence of any conflict, state-involved conflicts, and conflicts not involving the state, each measured using the UCDP data. Column 4 reports estimate for the incidence of any conflict using the ACLED data.

In all specifications, we find that an ethnic group is more likely to experience conflict if its neighbors are transhumant pastoralist. While this relationship is present for all conflict measures, it is much smaller – about one-third the magnitude – for conflicts that do not involve the state. Thus, the aggregate conflict results appear to be primarily driven by conflicts that involve state forces, such as the police or military.

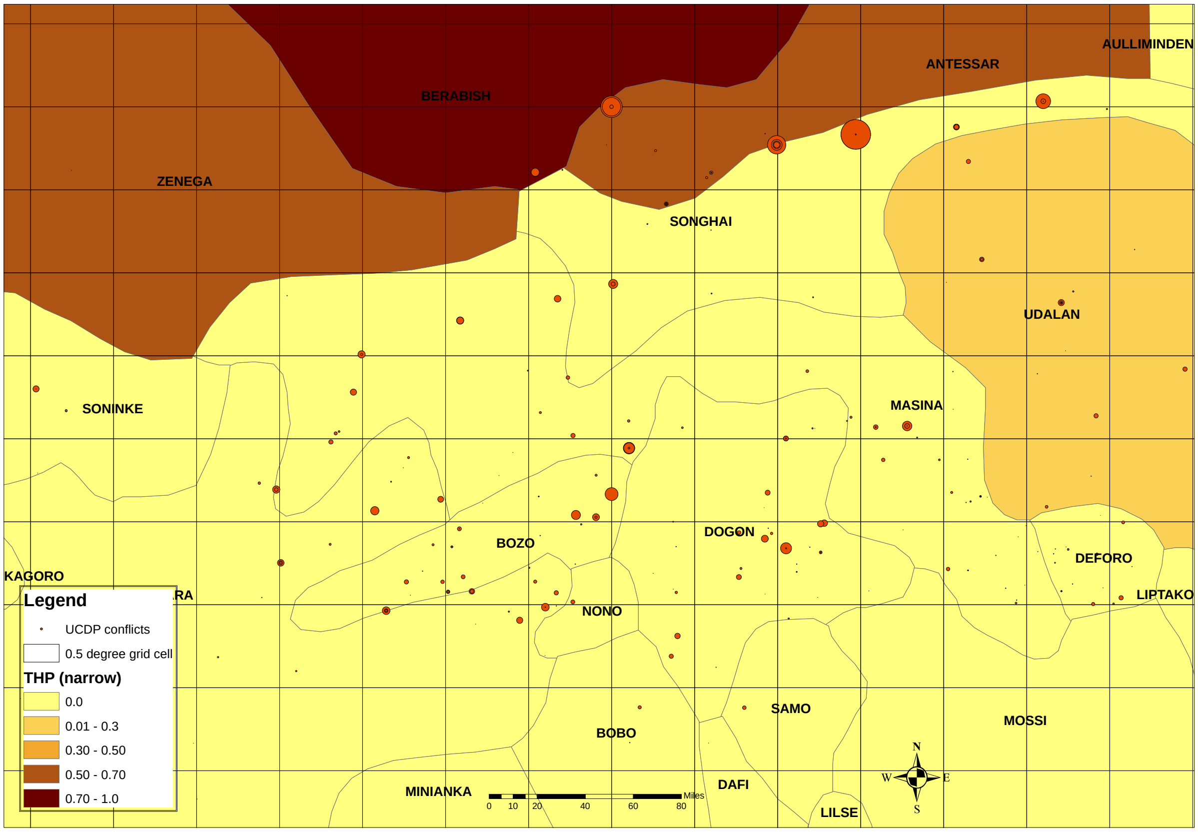


Figure 6: Structure of Data and Analysis. The figures shows 0.5-degree cells, along with the boundaries of the ethnic groups, their names, and their measure of transhumant pastoralism (THP) using the narrow definition of transhumant.

B. Cell-level analysis

We next examine variation at the level of a 0.5 degree grid cell (approx. 55km $\times$ 55km at the equator). The sample comprises 9,691 cells nested in approximately 700 ethnic territories located across Africa. These are shown for a region in Mali in Figure 6 that is traditionally inhabited by the Masina, Dogon, Zenga, Songhai, and others. The map also shows the location of conflicts in the UCDP data from 1989–2018.

Our aim is to study the effect of nearby transhumant pastoralism on conflict in a cell. In the ethnicity-level analysis we resolved the issue of an ethnic group having multiple neighbors by taking an average across all neighbors. The cell-level analysis allows for a more sophisticated treatment of neighbors. Different cells of an ethnic group will have different neighbors that are relevant. This can be seen in Figure 6. Take, for example cell located within the Masina ethnic territory. The relevant neighboring ethnic group varies, depending on which part of the territory a cell is located. For the cells in the northwestern portion of the Masina ethnic territory, the relevant neighbor is the Zenega. In contrast, for the cells in the eastern portion the relevant neighbor is Udalan and for cells in the south eastern portion the relevant neighbor is the Dogon, Mossi, or Deforo.

We exploit the within ethnicity variation in the relevant neighboring ethnicity by identifying the geographically closest (measured by straight line distance) ethnic group that is contiguous to the ethnicity that the cell is located within. We refer to this ethnic group as the cell's 'neighbor' or 'nearest neighbor.'

With this data structure, we then estimate the following equation:

$$y_{iet} = \gamma_1 \, TranshumantPastoral_i^{Neighbor} + \gamma_2 \, TranshumantPastoral_e^{OwnGroup} + \gamma_3 \ln(pop_i) + \alpha_t + \eta_{iet}, \quad (2)$$

where i indexes 0.5-degree grid-cells, e ethnic groups, and t years (1989–2018). The dependent variable, y_{iet}, is conflict incidence in cell i, which lies within the traditional territory of ethnicity e, and in year t. The variable $TranshumantPastoral_i^{Neighbor}$ is the measure of transhumant pastoralism for the nearest neighboring ethnic group to cell i. The variable $TranshumantPastoral_e^{OwnGroup}$ is the same measure of transhumant pastoralism, but for the ethnicity in which the cell is located. Lastly, $\ln(pop_i)$ is the natural log of the population of cell i, averaged over 1990, 1995, 2000, 2005, and 2010. The parameter of interest is γ_1, which represents the effect of the nearest neighboring ethnic group's transhumant pastoralism on conflict in a cell. Standard errors are adjusted for two-way clustering at the level of a cell and a climate zone-year.

Estimates of equation (2) are reported in Table 4, which reports estimates for the same dependent variables as in Table 3 (columns 1–4) and using both transhumant pastoralism measures (panels A and B). The estimates show the same finding: having a nearest neighbor that is transhumant pastoral is associated with significantly more conflict. This is primarily driven by conflicts that involve the state.

5. Spillover Precipitation Shocks and Agro-Pastoral Conflict

We now turn to our baseline estimating equation which studies whether adverse climate events in transhumant pastoral territories result in conflict in neighboring agricultural lands.

Estimating Equation Using rainfall as our primary measure of climate shocks, we estimate a variant of equation (2) that traces the differential effects of rainfall in neighboring transhumant pastoral territories on conflict. Specifically, we continue to exploit cell-level variation in the identity of the nearest neighboring ethnic group to each cell's centroid, and estimate the following equation:

$$\begin{aligned} y_{iet} = \; & \gamma_0^s \, Rain_{it}^{Neighbor} + \gamma_1^s \, Rain_{it}^{Neighbor} \times TranshumantPastoral_i^{Neighbor} \\ & + \gamma_2^s \, Rain_{et}^{OwnGroup} + \gamma_3^s \, Rain_{et}^{OwnGroup} \times TranshumantPastoral_e^{OwnGroup} \\ & + \gamma_4^s \, Rain_{it}^{OwnCell} + \gamma_5^s \, Rain_{it}^{OwnCell} \times TranshumantPastoral_e^{OwnGroup} \\ & + X'_{iet}\Gamma + \alpha_i^s + \alpha_{c(i)t}^s + \eta_{iet}^s, \end{aligned} \quad (3)$$

where y_{iet} is an indicator for the incidence of conflict in cell i in ethnic group e and year t; $Rain_{it}^{Neighbor}$ measures average precipitation in the nearest neighboring ethnic group to cell i in year t; $TranshumantPastoral_i^{Neighbor}$ is the transhumant pastoral index measure for that neighboring ethnic group; $Rain_{et}^{OwnGroup}$ measures precipitation in group e in year t; $TranshumantPastoral_e^{OwnGroup}$

Table 4: Agro-Pastoral Conflict in the Cross-Section: Cell-Level Spillover Analysis

	Indicator for the presence of conflict			
	(1)	(2)	(3)	(4)
	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)
Panel A: Transhumant definition includes only groups that are migratory or nomadic				
Neighbor Transhumant Pastoral [γ_1]	0.0310***	0.0278***	0.0077***	0.0636***
	(0.0053)	(0.0047)	(0.0026)	(0.0097)
Transhumant Pastoral [γ_2]	0.0075	0.0059	0.0013	0.0256***
	(0.0059)	(0.0048)	(0.0029)	(0.0099)
ln(Population) [γ_3]	0.0143***	0.0109***	0.0064***	0.0364***
	(0.0011)	(0.0009)	(0.0006)	(0.0025)
Panel B: Transhumant definition includes all groups without fully permanent settlements				
Neighbor Transhumant Pastoral [γ_1]	0.0335***	0.0311***	0.0069***	0.0603***
	(0.0052)	(0.0047)	(0.0024)	(0.0091)
Transhumant Pastoral [γ_2]	0.0069	0.0053	0.0007	0.0239**
	(0.0056)	(0.0046)	(0.0027)	(0.0094)
ln(Population) [γ_3]	0.0143***	0.0110***	0.0063***	0.0359***
	(0.0011)	(0.0009)	(0.0006)	(0.0025)
Dep. Var. Mean	0.036	0.026	0.016	0.085
Year FE	Yes	Yes	Yes	Yes
Climate-Zone-Years	420	420	420	336
Cells	7,722	7,722	7,722	7,722
Observations	231,660	231,660	231,660	185,328

Note: All outcome variables measure conflict incidence at the level of a cell-year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. The variable ln(Population) is the natural log of average cell-level population measured in 1990, 1995, 2000, 2005, and 2010. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

is the transhumant pastoralism index for ethnicity e; and $Rain_{it}^{OwnCell}$ measures precipitation in cell i in year t. The vector X'_{iet} captures additional covariates that we include in auxiliary robustness and sensitivity checks.

The parameter α_i denotes cell fixed effects, which absorb $\ln(pop_i)$ and also account for time-invariant differences between cells, such as geographic characteristics; $\alpha_{c(i)t}$ denotes country-year fixed effects, which capture any determinant of conflict that varies by country and year, such as nationwide political factors and macroeconomic shocks. To account for spatial and temporal dependence, our standard errors are two-way clustered at the level of cell and at the level of a climate zone-year.

The parameter γ_1^s represents the differential effect of rainfall in a neighboring ethnic territory on conflict in cell i when the neighboring ethnicity is transhumant pastoral relative to when it is not transhumant pastoral. A negative estimate of γ_1^s indicates that, consistent with our hypothesis, dry weather in pastoral territories causes additional conflict in neighboring cells.

It is important to note that this specification accounts flexibly for many factors that have been studied in the conflict literature. The cell fixed effects α_i^s capture all time-invariant determinants of conflict, such as artificial borders, historical conflicts, and ethnic traits (e.g., Besley and Reynal-Querol, 2014, Michalopoulos and Papaioannou, 2016, Moscona et al., 2020). Also included are country-year fixed effects $\alpha_{c(i)t}^s$, which capture time-varying national-level factors such as changes in country GDP, domestic institutions, ethnic polarization, resource endowments, and international geo-political characteristics, all of which have been prominent in the cross-country literature on conflict (e.g., Collier and Hoeffler, 1998, 2004, Fearon and Laitin, 2003, Ross, 2004, Esteban et al., 2012). Lastly, equation (3) also includes controls for the direct effects of rainfall in a cell, $\gamma_4^s Rain_{it}^{OwnCell}$ and in the territory of a cell's ethnic group $\gamma_2^s Rain_{et}^{OwnGroup}$. Thus, the estimates account for the direct effect of rainfall on conflict (Miguel et al., 2004, Hsiang et al., 2013, Burke et al., 2015, Harari and La Ferrara, 2018).

Results Estimates of the parameters in equation (3) are reported in columns 1–4 of Tables 5 and 6. Table 5 reports estimates using our narrow definition of transhumance (first two categories), while Table 6 report estimates using the broader definition (first four categories). In column 1, the outcome variable is an indicator that is equal to 1 if UCDP records any violent event as occurring in a grid cell and year. The first set of coefficients, reported under the heading 'Nearest Neighboring Ethnic Group,' are for the effect of rainfall in the nearest neighboring ethnic group, γ_0^s, and the effect of the variable interacted with the ethnic group's transhumant pastoralism index measure, γ_1^s.

We find that less rainfall in a cell's nearest neighboring ethnic group leads to more conflict in a cell, but only if the nearest neighboring ethnic group is transhumant pastoral. The estimated effect for non-transhumant pastoral groups, $\hat{\gamma}_0^s$, is -0.0006 (in both tables), which is not statistically different from zero. The differential effects for transhumant pastoral neighbors, $\hat{\gamma}_1^s$, is -0.110 and -0.0082, which are both significant at the 1% level. To assess the magnitude of these effects, we calculate the impact of a one standard deviation decrease in rainfall. This adverse shock would cause an increase in conflict that is equal to 39.4% and 29.8% of the mean respectively, which are sizable effects. (These calculations are reported in the second panel of the tables.)

Tables 5 and 6 also report the estimated coefficients for γ_2^s–γ_5^s, which are the estimated effects of rainfall in the own ethnic group and own cell of an observation, as well as the differential effects of the rainfall measures when the own ethnic group is transhumant pastoral. These are reported under the headings 'Own Ethnic Group' and 'Own Cell' in the tables. All of the estimated coefficients are small in magnitude and not statistically different from zero. Thus, while we find that less rainfall in the territory of the nearest neighboring transhumant pastoral groups leads to greater conflict, there is no evidence of effects of own-cell or own-group precipitation shocks.

In columns 2 and 3, we examine the effects on conflicts that involve the state and those that do not. We find that the effects of rainfall in the territory of transhumant pastoral nearest neighbors are largest for conflicts that involve the state. A one-standard-deviation decrease in rainfall in the territory of transhumant pastoral nearest neighbors increases state-involved conflicts by 56.7%

Table 5: Effect of Neighbor's Rainfall when Neighbor is Transhumant Pastoral: Using the Narrow Definition of Transhumance

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1) UCDP I(Any)	(2) UCDP I(State)	(3) UCDP I(Non-State)	(4) ACLED I(Any)	(5) UCDP I(Any)	(6) UCDP I(State)	(7) UCDP I(Non-State)	(8) ACLED I(Any)	(9) UCDP I(Any)	(10) UCDP I(State)	(11) UCDP I(Non-State)	(12) ACLED I(Any)
Nearest Neighboring Ethnic Group												
Rain [γ_0^s]	-0.0006	0.0001	-0.0004	-0.0006	-0.0007	0.0001	-0.0006	-0.0001	-0.0000	-0.0001	0.0007	-0.0105***
	(0.0006)	(0.0006)	(0.0005)	(0.0011)	(0.0007)	(0.0006)	(0.0005)	(0.0011)	(0.0026)	(0.0024)	(0.0019)	(0.0036)
Rain × Transhumant Pastoral [γ_1^s]	-0.0110***	-0.0121***	-0.0012	-0.0096**	-0.0122***	-0.0124***	-0.0030	-0.0172***	-0.0053	-0.0062	-0.0001	0.0052
	(0.0033)	(0.0031)	(0.0021)	(0.0038)	(0.0047)	(0.0038)	(0.0028)	(0.0056)	(0.0056)	(0.0051)	(0.0034)	(0.0064)
Own Ethnic Group												
Rain [γ_2^s]	-0.0000	0.0013	-0.0003	0.0009	-0.0001	0.0012	-0.0002	0.0002	-0.0057	-0.0028	-0.0014	-0.0022
	(0.0010)	(0.0009)	(0.0007)	(0.0014)	(0.0011)	(0.0009)	(0.0007)	(0.0014)	(0.0046)	(0.0038)	(0.0033)	(0.0067)
Rain × Transhumant Pastoral [γ_3^s]	-0.0015	-0.0046	0.0016	-0.0013	0.0089	0.0057	0.0091	-0.0186	0.0043	-0.0013	0.0021	0.0079
	(0.0047)	(0.0047)	(0.0038)	(0.0065)	(0.0134)	(0.0078)	(0.0118)	(0.0175)	(0.0084)	(0.0084)	(0.0060)	(0.0115)
Own Cell												
Rain [γ_4^s]	-0.0002	-0.0004	-0.0001	-0.0004	-0.0002	-0.0004	-0.0001	-0.0006	0.0012	-0.0023	0.0028	-0.0001
	(0.0007)	(0.0006)	(0.0005)	(0.0010)	(0.0007)	(0.0006)	(0.0005)	(0.0010)	(0.0031)	(0.0019)	(0.0026)	(0.0048)
Rain × Transhumant Pastoral [γ_5^s]	0.0039	0.0055*	-0.0009	0.0046	-0.0072	-0.0063	-0.0054	0.0169	-0.0001	0.0065	-0.0056	0.0054
	(0.0035)	(0.0033)	(0.0024)	(0.0051)	(0.0101)	(0.0077)	(0.0085)	(0.0142)	(0.0060)	(0.0048)	(0.0044)	(0.0087)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:												
Rain	-2.02	0.25	-3.31	-0.79	-1.98	0.60	-3.78	-0.13	-0.14	-0.73	8.88	-22.95
p-value	[0.36]	[0.92]	[0.38]	[0.60]	[0.32]	[0.80]	[0.25]	[0.93]	[0.99]	[0.96]	[0.71]	[0.00]
Rain × Transhumant Pastoral	-37.42	-56.94	-9.22	-13.82	-37.27	-52.82	-19.38	-21.65	-25.72	-39.97	-0.97	11.27
p-value	[0.00]	[0.00]	[0.55]	[0.01]	[0.01]	[0.00]	[0.28]	[0.00]	[0.34]	[0.22]	[0.98]	[0.42]
Rain + Rain × Transhumant Pastoral	-39.44	-56.69	-12.53	-14.62	-39.25	-52.22	-23.16	-21.78	-25.86	-40.70	7.91	-11.69
p-value	[0.00]	[0.00]	[0.41]	[0.01]	[0.01]	[0.00]	[0.20]	[0.00]	[0.31]	[0.19]	[0.84]	[0.33]
Dep. Var. Mean	0.0352	0.0254	0.0160	0.0838	0.0394	0.0282	0.0189	0.0956	0.0249	0.0187	0.0092	0.0551
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	420	420	420	322	390	390	390	299	390	390	390	299
Cells	7,667	7,667	7,667	7,667	5,427	5,427	5,427	5,427	2,240	2,240	2,240	2,240
Observations	230,010	230,010	230,010	176,341	162,810	162,810	162,810	124,821	67,200	67,200	67,200	51,520

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. *Own Ethnic Group* refers to the ethnic territory that contains cell i. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 6: Effect of Neighbor's Rainfall when Neighbor is Transhumant Pastoral: Using the Broader Four-Category Definition of Transhumance

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP	UCDP	UCDP	ACLED	UCDP	UCDP	UCDP	ACLED	UCDP	UCDP	UCDP	ACLED
	I(Any)	I(State)	I(Non-State)	I(Any)	I(Any)	I(State)	I(Non-State)	I(Any)	I(Any)	I(State)	I(Non-State)	I(Any)
Nearest Neighboring Ethnic Group												
Rain [γ_0^s]	-0.0006	0.0001	-0.0005	-0.0004	-0.0006	0.0002	-0.0007	-0.0000	0.0002	0.0005	0.0005	-0.0107***
	(0.0006)	(0.0006)	(0.0005)	(0.0011)	(0.0007)	(0.0006)	(0.0005)	(0.0011)	(0.0027)	(0.0025)	(0.0019)	(0.0035)
Rain × Transhumant Pastoral [γ_1^s]	-0.0082***	-0.0105***	0.0007	-0.0093**	-0.0067*	-0.0087***	0.0004	-0.0125**	-0.0053	-0.0074	0.0007	0.0051
	(0.0031)	(0.0028)	(0.0019)	(0.0037)	(0.0038)	(0.0033)	(0.0023)	(0.0056)	(0.0054)	(0.0049)	(0.0035)	(0.0063)
Own Ethnic Group												
Rain [γ_2^s]	0.0002	0.0015*	-0.0002	0.0010	0.0002	0.0014	-0.0001	0.0006	-0.0042	-0.0021	-0.0008	-0.0055
	(0.0011)	(0.0009)	(0.0007)	(0.0014)	(0.0011)	(0.0009)	(0.0007)	(0.0014)	(0.0044)	(0.0041)	(0.0028)	(0.0070)
Rain × Transhumant Pastoral [γ_3^s]	-0.0050	-0.0065	-0.0010	-0.0028	-0.0063	-0.0040	-0.0020	-0.0258**	0.0017	-0.0025	0.0010	0.0133
	(0.0042)	(0.0042)	(0.0035)	(0.0062)	(0.0082)	(0.0063)	(0.0063)	(0.0117)	(0.0080)	(0.0088)	(0.0054)	(0.0119)
Own Cell												
Rain [γ_4^s]	-0.0003	-0.0005	-0.0001	-0.0005	-0.0002	-0.0004	-0.0001	-0.0008	-0.0008	-0.0038*	0.0019	0.0026
	(0.0007)	(0.0006)	(0.0005)	(0.0010)	(0.0007)	(0.0006)	(0.0005)	(0.0010)	(0.0026)	(0.0019)	(0.0019)	(0.0048)
Rain × Transhumant Pastoral [γ_5^s]	0.0048	0.0061**	-0.0000	0.0054	-0.0023	-0.0028	0.0002	0.0183*	0.0034	0.0088*	-0.0039	0.0005
	(0.0033)	(0.0030)	(0.0024)	(0.0048)	(0.0067)	(0.0056)	(0.0051)	(0.0102)	(0.0053)	(0.0048)	(0.0036)	(0.0088)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:												
Rain	-1.97	0.71	-3.93	-0.62	-1.98	0.81	-4.16	-0.01	0.81	2.94	6.37	-23.37
p-value	[0.37]	[0.79]	[0.30]	[0.69]	[0.32]	[0.73]	[0.21]	[0.99]	[0.95]	[0.85]	[0.80]	[0.00]
Rain × Transhumant Pastoral	-27.83	-49.58	5.59	-13.38	-20.30	-36.90	2.65	-15.69	-25.72	-47.62	8.84	11.04
p-value	[0.01]	[0.00]	[0.70]	[0.01]	[0.08]	[0.01]	[0.86]	[0.03]	[0.33]	[0.13]	[0.85]	[0.42]
Rain + Rain × Transhumant Pastoral	-29.80	-48.87	1.66	-14.00	-22.28	-36.09	-1.51	-15.71	-24.90	-44.69	15.21	-12.33
p-value	[0.00]	[0.00]	[0.91]	[0.01]	[0.06]	[0.01]	[0.92]	[0.02]	[0.30]	[0.12]	[0.71]	[0.30]
Dep. Var. Mean	0.0352	0.0254	0.0160	0.0838	0.0394	0.0282	0.0189	0.0956	0.0249	0.0187	0.0092	0.0551
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	420	420	420	322	390	390	390	299	390	390	390	299
Cells	7,667	7,667	7,667	7,667	5,427	5,427	5,427	5,427	2,240	2,240	2,240	2,240
Observations	230,010	230,010	230,010	176,341	162,810	162,810	162,810	124,821	67,200	67,200	67,200	51,520

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. *Own Ethnic Group* refers to the ethnic territory that contains cell i. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

and 48.9% relative to the mean. The same figures for conflicts that do not involve the state are much smaller at an increase of 12.5% and a decrease of 1.7% relative to the mean. Thus, the spillover effects estimated for aggregate conflicts (column 1) appear to be driven by conflicts that involve state actors. This is consistent with the fact that herder-farmer conflicts regularly involve state entities such as police, conservation officers, or even the military.

In column 4, we report estimates using ACLED data. Despite the shorter panel available with these data, we obtain qualitatively similar estimates. The estimated effects suggest that a one-standard-deviation decrease in rainfall in the territory of transhumant pastoral nearest neighbors increases the average incidence of any conflict by 14.6% and 14.0% relative to the mean.

In the remaining columns (5–12) of the tables, we present the same estimation on sub-samples of cells that are agricultural versus those that are not. This is motivated by the mechanism of interest, which is the early movement of herds to agricultural farmlands when adverse rainfall shocks occur. Therefore, we expect the effects of adverse rainfall shocks in a neighboring transhumant pastoral territory to be observed in grid-cells that are located in an agricultural territory but not in grid-cells that are not. Using data from the *Ethnographic Atlas*, we split the sample between cells that are located within the territory of ethnic groups whose traditional reliance on agriculture for subsistence exceeded 50% and those whose reliance was less than 50%.[8]

Columns 5–8 report results from the same specifications as in columns 1–4, but restricting the sample to grid-cells that are nested in majority-agricultural territories, according to our measure. We obtain estimates that are qualitatively identical and quantitively very similar. Columns 9–12 report the same specifications, but restricting the sample to grid-cells that are not located in majority-agricultural territories. We no longer estimate effects that are statistically significant. Thus, consistent with expectations, the estimates show clearly that it is primarily agricultural grid-cells that are responsible for the aggregate effects estimated in columns 1–4.

To understand how much this mechanism is contributing to overall conflict in Africa, we conduct a counterfactual exercise in which we use our estimates to predict the level of conflict that would have occurred during our study period had rainfall in each cell-year been higher by one (within-cell) standard deviation.[9] We estimate that, in this scenario, overall conflict incidence would have been lower by 12% and conflict involving the state would have been lower by 18%.

Robustness and Sensitivity Checks We now turn to an examination of the sensitivity of our estimates. As we have shown, the estimates using the narrower and broader definitions of transhumant pastoralism are qualitatively identical. Thus, for the remainder of the paper, we use the narrower definition as our baseline measure, while reporting all estimates using the broader definition in the appendix.

We check the sensitivity of our findings by accounting for other characteristics of neighboring ethnic groups: including their traditional political complexity, the presence of segmentary lineage organization, and a traditional belief in a religion with a moralizing high god, such as Islam. Pre-colonial political centralization has been shown to be an important determinant of public

[8]This information is obtained from variable v5 of the *Atlas*.

[9]This exercise is described in more detail in Appendix C.

goods provision and economic development (Gennaioli and Rainer, 2007, Michalopoulos and Papaioannou, 2013), both of which are relevant for conflict. Segmentary lineage organization has been shown to be associated with conflict (Moscona et al., 2020). The presence of a moralizing high gods is believed to be an important factor for cooperation, conflict, and long-term economic growth (Norenzayan, 2013) and, as noted, many of the conflicts in the Sahel region of Africa have a religious dimension to them.

To ensure that our estimates of interest are not biased by these characteristics, we additionally control for the interaction between these characteristics of the nearest neighboring ethnic group interacted with the rainfall of the group. The estimates, which we report in Appendix Tables A2 and A3, show that our findings remain robust to the inclusion of these additional controls. The estimated effects are very similar in magnitude and remain highly significant.

The second sensitivity check that we perform is motivated by the potential concern that our measure of rainfall happens to be correlated with other aggregate factors that differentially affect the amount of conflict that is adjacent to transhumant pastoral groups. Given the general increase in the effects of climate change over the period of analysis, a concern is that the rainfall measure could be capturing the effects of any other factor that is also trending over time, such as the availability of firearms, population density, and so forth. To account for this, we include a control for a linear time trend interacted with each cell's nearest neighbor's measure of transhumant pastoralism, which captures any differential effect that trending determinants have on conflict adjacent to transhumant pastoral groups.

Although this captures aggregate time-varying factors that are trending over time, many other factors have more irregular movements. Motivated by this, we also interact the measure of a cell's nearest neighbor's transhumant pastoralism with numerous aggregate price indices that may affect conflict differently across space. These include price indices for energy, for metals and minerals, and for precious metals (Berman, Couttenier, Rohner and Thoenig, 2017), as well as a price index for agricultural products (McGuirk and Burke, 2020).[10] Estimates of equation (3) with these additional covariates are reported in Appendix Tables A4 andA5. Again, we find that the estimates are robust to the inclusion of these variables. The point estimates are similar in magnitude and they remain highly significant.

The next check that we perform builds on the fact that our ethnic characteristic of interest, transhumant pastoralism, can be viewed as an interaction between a measure of transhumance and a measure of pastoralism. Our mechanism of interest suggests that both aspects are important; namely, that the groups moves seasonally and that they engage in animal herding. If an ethnic group is characterized by only one of the two, we do not expect to observe the same effects.

Motivated by this, we estimate a version of equation (3) that also includes each of the components of the measure of transhumant pastoralism interacted with rainfall. This is particularly important given the recent findings in Eberle et al. (2020) which show the importance of mobility for mediating the effects of temperature on conflict. By accounting for the effect of transhumance

[10]The data are from the World Bank's "Pink Sheet" commodity price index dataset. The energy commodities include coal, crude oil, and natural gas; the metals and minerals include aluminum, copper, iron ore, lead, nickel, steel, tin and zinc; the precious metals include gold, platinum and silver; and the agricultural products include oils and meals, grains, and other food such as bananas, meat and sugar. All indices are based on real prices.

of neighboring groups, we are accounting for any effect that mobility alone has in our setting. The exercise also addresses potential concerns arising due to other factors that are associated with pastoralism, such as the presence of a "culture of honor" and revenge-taking (Nisbett and Cohen, 1996, Grosjean, 2014, Cao, Enke, Falk, Giuliano and Nunn, 2021). Such effects are captured by the inclusion of the pastoralism measure (along with relevant interactions) in the equation directly.

The estimates with the components and their interactions included in the equation are reported in Appendix Tables A6 and A7. We find that our estimates of interest are robust to controlling for the components of transhumant pastoralism. This suggests that it is the seasonal movement of migrating herd animals that is important for our findings and not either mobility or the presence of herd animals alone. In addition, both components of the interaction tend to be insignificant, suggesting that these aspects are not important determinants of the effect of rainfall on conflict in neighboring cells. We note that this is not evidence that mobility or pastoralism on their own are unimportant, but that they do not matter differentially through the particular spatial spillover mechanism that we analyze.

The final check that we perform is about inference. We examine the robustness of our main results to various methods of calculating standard errors. We verify the validity of our conclusions to calculating standard errors that are clustered by country, by country and climate-zone-year, and by country and climate-zone. We also check that our standard errors are similar when we allow for spatial correlation within 1,000 kilometers of a cell and for serial correlation throughout the 30-year sample. In addition, we compute standard errors by randomization inference, whereby rainfall in a cell's nearest neighboring territory is randomly permuted 500 times. As we report in Appendix Tables A8–A15, our conclusions are statistically very similar for each of the alternative methods of estimating standard errors.

6. Testing for Mechanisms

The estimates provided to this point are consistent with adverse rainfall shocks inducing transhumant pastoral groups to migrate to nearby agricultural lands before the harvest, which results in conflict. In this section, we undertake a number of tests for this specific causal mechanism.

Phytomass We begin by re-estimating equation (3) using the measure of phytomass in place of rainfall. Our interpretation is that a lack of rainfall in the territory of transhumant pastoral groups leads to conflict because it reduces the amount of vegetation available for herded animals, which are moved to more fertile agricultural lands as a consequence. If this is the case, we should find that less phytomass in the territory of neighboring transhumant pastoral groups should be associated with increased conflict in precisely the same manner as rainfall.

The estimates, which are reported in Table 7 and Appendix Table A16, show that we obtain qualitatively identical estimates when we use phytomass rather than rainfall. The estimates are also very similar quantitatively. For example, when we study all cells, and examine any conflict from the UCDP database (column 1), we find that the predicted effect of a one standard deviation decrease in phytomass in the territory of a transhumant pastoral group is to increase conflict by

37% of the mean incidence when the narrow measure transhumance is used and by 29% when the broad measure is used. The equivalent effects using rainfall are 39% and 30%.

Unlike rainfall, one might be concerned that our satellite measure of phytomass growth is itself endogenous to conflict and indeed to the location of grazing animals. To address this concern, we instrument the six phytomass variables – i.e., phytomass and phytomass interacted with transhumant pastoralism at the level of the cell's nearest neighbor, the cell's own group, and the cell itself – with their analogous rainfall variables. We present the results of this exercise in Appendix Tables A17 and A18. In these specifications, the results are more precisely estimated in the agricultural subsample, and especially for UCDP conflict involving the state and for any ACLED conflict.

Conflict by Season The second test focuses on the timing of conflict. According to the mechanism, the movement of transhumant pastoral groups in response to adverse rainfall shocks leads to conflict if this occurs during the wet season, when the agricultural lands are used for cultivation. During the dry season, when land is fallow, there is no tension as animal grazing is beneficial for both groups.

We perform this test by estimating equation (3) separately for conflict in each of the two seasons. Because the length of each season differs across locations, we measure the dependent variable as a monthly average. We use two measures: the fraction of months during the season for which there is at least one conflict incident and the average number of conflict incidents per month.

To separate wet-season conflict from dry-season conflict, we turn to data on cropping periods around the year 2000 from the MIRCA2000 global dataset (Portmann, Siebert and Döll, 2010). The dataset provides estimates for the beginning and end of the growing season at a high resolution using information from a wide variety of sources. Specifically, we use the starting and final months of the growing season for the 'main crop' in a cell, itself defined as crop with the greatest harvested area in the cell. Our sample is therefore restricted to cells that contain some harvested cropland and that experience both growing seasons and dry seasons within a year. Among these cells, the average duration of the main crop's growing season is 5.75 months.

To ensure that we are capturing all conflict events due to the joint use of resources, we define wet-season conflict as conflict events that begin during either the main crop's growing season or the first month after it ends. This allows for conflict events that coincide with the harvesting period, which may extend beyond the estimated final month of the main crop's growing season according to the MIRCA2000 data. We define dry season conflict as conflict events that begin at any point during the rest of the year.[11]

Using these definitions, the average per-month incidence of wet-season conflict is 0.75% and the average per-month incidence of dry-season conflict is 0.79%. Similarly, the average per-month number of conflict events is 0.0139 in the wet season and 0.0142 in the dry season. Dry season

[11] In generating these variables, we make use of the fine-grained UCDP data on the timing of events. This allows us to make the distinction between the first incident within a conflict event—which is our object of interest—and other incidents that are more likely to be a continuation of previous clashes.

Table 7: Estimates Using Phytomass Rather than Rainfall: Using the Narrow Definition of Transhumance

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP	UCDP	UCDP	ACLED	UCDP	UCDP	UCDP	ACLED	UCDP	UCDP	UCDP	ACLED
	1(Any)	1(State)	1(Non-State)	1(Any)	1(Any)	1(State)	1(Non-State)	1(Any)	1(Any)	1(State)	1(Non-State)	1(Any)
Nearest Neighboring Ethnic Group												
Phytomass	0.0001	0.0000	-0.0000	0.0004	0.0003	0.0001	0.0001	0.0004	-0.0016	-0.0008	-0.0010	0.0000
	(0.0005)	(0.0004)	(0.0003)	(0.0006)	(0.0005)	(0.0004)	(0.0003)	(0.0006)	(0.0011)	(0.0009)	(0.0007)	(0.0013)
Phytomass × Transhumant Pastoral	-0.0043**	-0.0041**	-0.0011	-0.0085***	-0.0040*	-0.0025	-0.0026*	-0.0100***	-0.0016	-0.0031	0.0009	-0.0043*
	(0.0018)	(0.0016)	(0.0010)	(0.0018)	(0.0021)	(0.0017)	(0.0014)	(0.0025)	(0.0023)	(0.0022)	(0.0012)	(0.0022)
Own Ethnic Group												
Phytomass	0.0004	0.0005	0.0001	0.0009	0.0004	0.0005	0.0003	0.0013	-0.0022	-0.0018	-0.0009	-0.0057***
	(0.0005)	(0.0005)	(0.0004)	(0.0008)	(0.0005)	(0.0005)	(0.0004)	(0.0008)	(0.0015)	(0.0012)	(0.0013)	(0.0021)
Phytomass × Transhumant Pastoral	-0.0045**	-0.0025	-0.0018	-0.0090***	0.0043	0.0066	0.0038	-0.0317***	-0.0024	0.0003	-0.0019	0.0000
	(0.0022)	(0.0018)	(0.0016)	(0.0033)	(0.0086)	(0.0079)	(0.0065)	(0.0119)	(0.0032)	(0.0032)	(0.0021)	(0.0045)
Own Cell												
Phytomass	-0.0008*	-0.0006	-0.0002	0.0002	-0.0009*	-0.0006	-0.0002	0.0002	-0.0005	0.0005	-0.0004	-0.0003
	(0.0005)	(0.0005)	(0.0003)	(0.0006)	(0.0005)	(0.0005)	(0.0004)	(0.0007)	(0.0010)	(0.0010)	(0.0008)	(0.0014)
Phytomass × Transhumant Pastoral	0.0010	0.0006	0.0005	0.0001	-0.0031	-0.0023	-0.0020	0.0082	0.0016	-0.0005	0.0011	0.0007
	(0.0019)	(0.0016)	(0.0013)	(0.0024)	(0.0079)	(0.0071)	(0.0051)	(0.0090)	(0.0024)	(0.0023)	(0.0017)	(0.0034)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Phytomass Shock as % of Dep. Var. Mean:												
Phytomass	0.59	0.43	-0.94	1.44	2.36	1.13	2.18	1.45	-17.74	-12.01	-28.61	0.26
p-value	[0.89]	[0.93]	[0.88]	[0.51]	[0.57]	[0.82]	[0.70]	[0.49]	[0.14]	[0.34]	[0.19]	[0.97]
Phytomass × Transhumant Pastoral	-37.93	-51.29	-21.18	-32.47	-33.05	-29.33	-43.35	-33.87	-17.83	-45.67	27.15	-24.58
p-value	[0.02]	[0.01]	[0.26]	[0.00]	[0.06]	[0.15]	[0.07]	[0.00]	[0.49]	[0.16]	[0.45]	[0.05]
Phytomass + Phytomass × Transhumant Pastoral	-37.33	-50.86	-22.11	-31.02	-30.69	-28.20	-41.17	-32.42	-35.57	-57.68	-1.46	-24.32
p-value	[0.02]	[0.01]	[0.21]	[0.00]	[0.08]	[0.18]	[0.08]	[0.00]	[0.10]	[0.05]	[0.95]	[0.06]
Dep. Var. Mean	0.0373	0.0265	0.0174	0.0866	0.0404	0.0281	0.0199	0.0983	0.0297	0.0225	0.0114	0.0585
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	280	280	280	294	260	260	260	273	260	260	260	273
Cells	7,667	7,667	7,667	7,667	5,427	5,427	5,427	5,427	2,240	2,240	2,240	2,240
Observations	153,340	153,340	153,340	161,007	108,540	108,540	108,540	113,967	44,800	44,800	44,800	47,040

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. *Own Ethnic Group* refers to the ethnic territory that contains cell i. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

conflict is therefore marginally more prevalent than wet-season conflict. Despite this, we expect to find that our main results are explained primarily by wet-season conflict.

The estimates are reported in Table 8 and in Appendix Table A19. We estimate the effects of both rainfall and phytomass in separate regressions. Columns 1 and 2 report estimates examining all conflict types during the wet season (for the two monthly measures), while columns 3 and 4 report the same estimates but for the dry season. Whether we use rainfall or phytomass, we find that cells with a transhumant pastoral nearest neighbor that experiences an adverse shock have more conflict. However, this effect is much larger in magnitude, much more precise, and statistically significant only during the wet season. In columns 5–8, we repeat the same exercise but restricting the sample to cells in majority-agricultural territories. We find the same pattern. Lastly, in columns 9–12, we restrict the sample to the remaining cells, finding no significant effect in either the wet or dry seasons.

Temperature The last check that we perform examines the role of temperature. While it is well documented that temperature is linked to conflict through many potential channels (e.g., Burke et al., 2015, Eberle et al., 2020), these underlying mechanisms are orthogonal to our mechanism of interest. Since temperature is a less important determinant of phytomass, we should not expect to observe the same spillover effects when we replace the rainfall variables with the equivalent temperature variables in our main specification.

The estimates are reported in Table 9 and Appendix Table A20. Again, each table reports estimates using a different measure of transhumance. We estimate a fairly precise zero coefficient for the interaction between the temperature of a cell's nearest neighbor and the neighbor's measure of transhumant pastoralism. Thus, we do not observe the same patterns in the data when we use temperature rather than rainfall. This is consistent with our observation that, unlike rainfall, temperature is not a first-order determinant of phytomass growth. This exercise also indicates that the established mechanisms linking temperature to conflict in the literature cannot account for our main spillover effect of interest. Interestingly, we do find evidence of a direct relationship between temperature and conflict, as in the existing literature. Specifically, we estimate that, in general, higher temperatures experienced by the ethnic group of a cell result in more conflict in that cell.

In Appendix Tables A21 and A22, we report estimates from regressions in which the rainfall and temperature variables are included together. Our estimated rainfall spillover effects from transhumant pastoral neighbors remain large and statistically significant, while again we observe no equivalent spillover effect from temperature shocks.

7. Lessons and Implications

We now turn to an examination of what can be learned from our estimates. The first question is whether the channel we have documented can shed light on the dramatic increase in religious-extremist violence on the continent since 2000. If all or even part of the observed variation

Table 8: Effects of Neighbor's Rainfall and Phytomass on Conflict during the Wet and Dry Seasons: NarrowDefinition of Transhumance

	UCDP Conflict per Month: All Grid Cells				Agricultural Cells				Non-Agricultural Cells			
	Wet Season		Dry Season		Wet Season		Dry Season		Wet Season		Dry Season	
	(1) Incidence	(2) Number	(3) Incidence	(4) Number	(5) Incidence	(6) Number	(7) Incidence	(8) Number	(9) Incidence	(10) Number	(11) Incidence	(12) Number
	Panel A: Rainfall and Conflict by Seasons											
Nearest Neighboring Ethnic Group												
Rain	0.0001	0.0003	-0.0001	-0.0002	0.0000	0.0003	-0.0002	-0.0003	0.0005	0.0007	0.0004	0.0021
	(0.0002)	(0.0004)	(0.0003)	(0.0010)	(0.0002)	(0.0004)	(0.0003)	(0.0010)	(0.0010)	(0.0017)	(0.0011)	(0.0016)
Rain × Transhumant Pastoral	-0.0030***	-0.0107**	-0.0014	-0.0057	-0.0032**	-0.0077*	-0.0005	-0.0025	-0.0016	-0.0168	-0.0012	-0.0120
	(0.0011)	(0.0051)	(0.0010)	(0.0037)	(0.0015)	(0.0039)	(0.0013)	(0.0041)	(0.0016)	(0.0144)	(0.0013)	(0.0107)
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:												
Rain	0.83	2.39	-2.12	-1.34	0.36	2.73	-2.56	-2.72	6.44	4.09	5.36	13.74
p-value	[0.79]	[0.48]	[0.59]	[0.86]	[0.91]	[0.48]	[0.54]	[0.76]	[0.64]	[0.69]	[0.73]	[0.19]
Rain × Transhumant Pastoral	-47.12	-92.61	-20.73	-45.57	-52.62	-72.09	-7.40	-20.61	-22.88	-102.23	-16.92	-78.14
p-value	[0.01]	[0.04]	[0.15]	[0.13]	[0.03]	[0.05]	[0.71]	[0.55]	[0.30]	[0.24]	[0.37]	[0.27]
Rain + Rain × Transhumant Pastoral	-46.29	-90.22	-22.86	-46.91	-52.26	-69.36	-9.95	-23.32	-16.44	-98.15	-11.57	-64.40
p-value	[0.01]	[0.04]	[0.12]	[0.11]	[0.03]	[0.06]	[0.62]	[0.50]	[0.45]	[0.26]	[0.57]	[0.33]
Dep. Var. Mean	0.008	0.014	0.008	0.015	0.007	0.013	0.008	0.014	0.009	0.020	0.008	0.018
Climate-Zone-Years	420	420	420	420	390	390	390	390	390	390	390	390
Cells	4,592	4,592	4,592	4,592	3,857	3,857	3,857	3,857	735	735	735	735
Observations	137,760	137,760	137,760	137,760	115,710	115,710	115,710	115,710	22,050	22,050	22,050	22,050
	Panel B: Phytomass and Conflict by Seasons											
Nearest Neighboring Ethnic Group												
Phytomass	0.0001	0.0004	0.0000	0.0003	0.0001	0.0004	0.0000	0.0003	0.0002	-0.0003	-0.0003	-0.0004
	(0.0001)	(0.0003)	(0.0001)	(0.0003)	(0.0001)	(0.0003)	(0.0002)	(0.0003)	(0.0002)	(0.0008)	(0.0002)	(0.0006)
Phytomass × Transhumant Pastoral	-0.0008**	-0.0032*	-0.0001	-0.0014	-0.0008*	-0.0017***	0.0003	0.0006	-0.0005	-0.0047	-0.0003	-0.0034
	(0.0003)	(0.0018)	(0.0004)	(0.0015)	(0.0005)	(0.0006)	(0.0005)	(0.0008)	(0.0005)	(0.0040)	(0.0005)	(0.0032)
Effect of 1 Std. Dev. Phytomass Shock as % of Dep. Var. Mean:												
Phytomass	4.72	7.82	1.80	5.21	2.57	10.25	0.89	5.64	4.75	-3.23	-8.54	-6.13
p-value	[0.37]	[0.22]	[0.72]	[0.37]	[0.68]	[0.19]	[0.88]	[0.45]	[0.52]	[0.76]	[0.23]	[0.46]
Phytomass × Transhumant Pastoral	-32.17	-70.35	-3.47	-27.50	-37.88	-42.09	11.89	13.52	-15.62	-59.07	-9.01	-48.60
p-value	[0.02]	[0.08]	[0.81]	[0.35]	[0.06]	[0.00]	[0.55]	[0.42]	[0.28]	[0.24]	[0.59]	[0.28]
Phytomass + Phytomass × Transhumant Pastoral	-27.45	-62.53	-1.67	-22.30	-35.31	-31.84	12.78	19.17	-10.87	-62.30	-17.55	-54.73
p-value	[0.05]	[0.13]	[0.90]	[0.46]	[0.09]	[0.03]	[0.51]	[0.23]	[0.44]	[0.29]	[0.27]	[0.28]
Dep. Var. Mean	0.008	0.015	0.009	0.016	0.007	0.013	0.008	0.015	0.011	0.026	0.010	0.024
Climate-Zone-Years	280	280	280	280	260	260	260	260	260	260	260	260
Cells	4,592	4,592	4,592	4,592	3,857	3,857	3,857	3,857	735	735	735	735
Observations	91,840	91,840	91,840	91,840	77,140	77,140	77,140	77,140	14,700	14,700	14,700	14,700
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The unit of observation is a 0.5-degree grid-cell and year. "Incidence" is per-month UCDP conflict incidence in either the wet season or the dry season as defined in the main text. "Number" is per-month number of UCDP conflict events. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. *Own Ethnic Group* and *Own Cell* variables are controlled for but not reported. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 9: Estimates using Temperature rather than Rainfall: Narrow Definition of Transhumance

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP	UCDP	UCDP	ACLED	UCDP	UCDP	UCDP	ACLED	UCDP	UCDP	UCDP	ACLED
	I(Any)	I(State)	I(Non-State)	I(Any)	I(Any)	I(State)	I(Non-State)	I(Any)	I(Any)	I(State)	I(Non-State)	I(Any)
Nearest Neighboring Ethnic Group												
Temperature	0.0029*	0.0033**	0.0013	0.0029	0.0029	0.0030*	0.0014	0.0038	0.0029	0.0038	0.0011	0.0031
	(0.0016)	(0.0014)	(0.0011)	(0.0028)	(0.0020)	(0.0017)	(0.0013)	(0.0032)	(0.0029)	(0.0025)	(0.0021)	(0.0046)
Temperature × Transhumant Pastoral	0.0005	0.0033	0.0000	0.0027	0.0007	0.0015	-0.0005	-0.0060	0.0003	0.0041	0.0005	0.0051
	(0.0036)	(0.0035)	(0.0023)	(0.0046)	(0.0062)	(0.0062)	(0.0032)	(0.0080)	(0.0045)	(0.0040)	(0.0032)	(0.0060)
Own Ethnic Group												
Temperature	0.0063**	0.0047**	0.0044***	0.0114***	0.0065***	0.0041*	0.0049***	0.0090**	0.0030	0.0031	0.0009	0.0217**
	(0.0025)	(0.0023)	(0.0016)	(0.0034)	(0.0025)	(0.0023)	(0.0017)	(0.0039)	(0.0061)	(0.0044)	(0.0047)	(0.0093)
Temperature × Transhumant Pastoral	0.0054	0.0047	-0.0024	-0.0118	0.0027	0.0062	-0.0021	-0.0003	0.0077	0.0053	0.0021	-0.0279*
	(0.0058)	(0.0052)	(0.0039)	(0.0085)	(0.0131)	(0.0135)	(0.0077)	(0.0183)	(0.0111)	(0.0085)	(0.0080)	(0.0161)
Own Cell												
Temperature	-0.0022	-0.0025	-0.0015	-0.0029	-0.0020	-0.0021	-0.0013	-0.0017	-0.0017	-0.0012	-0.0025	-0.0096
	(0.0019)	(0.0018)	(0.0011)	(0.0024)	(0.0020)	(0.0019)	(0.0012)	(0.0026)	(0.0037)	(0.0034)	(0.0028)	(0.0067)
Temperature × Transhumant Pastoral	0.0026	0.0031	0.0032	0.0028	0.0040	0.0026	0.0015	-0.0069	0.0012	0.0005	0.0044	0.0107
	(0.0041)	(0.0036)	(0.0032)	(0.0065)	(0.0086)	(0.0081)	(0.0073)	(0.0126)	(0.0077)	(0.0063)	(0.0061)	(0.0137)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Temp. Shock as % of Dep. Var. Mean:												
Temperature	7.04	11.30	7.15	3.42	6.43	9.04	6.38	3.93	10.36	18.43	11.25	5.72
p-value	[0.07]	[0.02]	[0.22]	[0.30]	[0.15]	[0.07]	[0.30]	[0.23]	[0.33]	[0.12]	[0.58]	[0.50]
Temp. × Transhumant Pastoral	1.33	11.01	0.02	3.16	1.43	4.46	-2.47	-6.18	1.27	20.11	4.77	9.39
p-value	[0.88]	[0.36]	[1.00]	[0.56]	[0.92]	[0.81]	[0.87]	[0.46]	[0.94]	[0.30]	[0.88]	[0.40]
Temp. + Temp. × Transhumant Pastoral	8.37	22.31	7.17	6.57	7.86	13.50	3.91	-2.25	11.63	38.55	16.03	15.11
p-value	[0.35]	[0.07]	[0.55]	[0.16]	[0.54]	[0.44]	[0.77]	[0.76]	[0.49]	[0.08]	[0.56]	[0.09]
Dep. Var. Mean	0.032	0.024	0.015	0.068	0.037	0.027	0.017	0.078	0.022	0.017	0.008	0.043
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	364	364	364	252	338	338	338	234	338	338	338	234
Cells	7,667	7,667	7,667	7,667	5,427	5,427	5,427	5,427	2,240	2,240	2,240	2,240
Observations	199,298	199,298	199,298	137,978	141,080	141,080	141,080	97,672	58,218	58,218	58,218	40,306

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. *Own Ethnic Group* refers to the ethnic territory that contains cell i. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

in religious conflict is explained by climate change and farmer-herder tensions, then this may inform efforts to address the underlying grievances and promote peace.

The next question we consider is: what can be done to alleviate the adverse effects that we find? We examine two factors that are commonly cited as potentially important for mitigating the effects of climate change on intergroup violence. The first is equitable representation in government. A lack of representation of pastoral groups in national politics is often cited as a factor that may exacerbate conflict. We therefore ask whether more equal representation helps to alleviate violence between farmers and herders. The second is international aid programs, which may help to ease the resource constraints that ultimately lead to violence.

The final issue we consider is more academic in nature and is relevant for the climate science literature. In our setting, we identify spillover effects of adverse rainfall shocks on conflict by using detailed ethnographic data and ex-ante knowledge of the spillover mechanism of interest. The question remains as to whether one could capture these effects in the absence of prior knowledge by sufficiently aggregating the units of analysis such that the weather shock and the conflict events are contained in the same observation. We examine this in the final part.

A. Religious Extremism, Pastoral Droughts, and Conflict

We begin with the question of whether our estimated relationship can help to explain the rise in religious conflict in Africa in the past two decades. This trend is shown in Figure 7, which reports the average conflict incidence across cells in our UCDP data between 1989 and 2018 for events that involve at least one actor that is labelled as being a jihadist group and for events that do not.[12] From the data it is clear that jihadist conflicts have increased significantly since 2000, while non-jihadist conflicts have remained relatively stable.

One apparent explanation for this is a rise in religious grievances or tensions between Islamic and Christian groups. However, our findings raise the possibility that this trend is instead due to the increased frequency of adverse rainfall shocks in transhumant pastoral territories.[13] In our data, groups with a value of transhumant pastoralism that is non-zero are 56.5% Muslim today, whereas groups with a value of transhumant pastoralism equal to zero are 24.6% Muslim (see Table 2). Since the conflicts that we study often involve a largely Muslim group on one side and a largely Christian group on the other, they may take the appearance of—or soon develop into—an ostensibly religious conflict.

We test for this possibility by estimating our baseline specification – equation (3) – but with effects estimated separately for jihadist and non-jihadist conflicts. The estimates are reported in Table 10 and Appendix Table A23. Columns 1 and 2 report the estimates of interest for all cells and columns 5 and 6 for agricultural cells only. We find statistically significant and quantitatively

[12] Specifically, we identify jihadist conflict events as those for which the word "jihad" is present in either actor's name or in the source headline. We additionally include events involving any group that is explicitly jihadist, which includes the following: Islamic State, Boko Haram, Al-Qaeda in the Islamic Maghreb (AQIM), Movement for Oneness and Jihad in West Africa (MUJAO), Benghazi Revolutionaries Shura Council, Ansar Dine, Ansaroul Islam, Mujahideen, Signed-in-Blood Battalion, Ansar al-Sharia in Libya (ASL), al-Murabitun, Macina Liberation Front (FLM), Jama'at Nasr al-Islam wal Muslimin (JNIM), Ansar al-Sunnah, Derna Protection Force (DPF), and Al-Shabaab.

[13] For case study evidence supportive of this, see Benjaminsen and Ba (2019) who argue that land-use conflicts are a fundamental determinant of the support for jihadist expansion by pastoral groups in the Mopti region of central Mali.

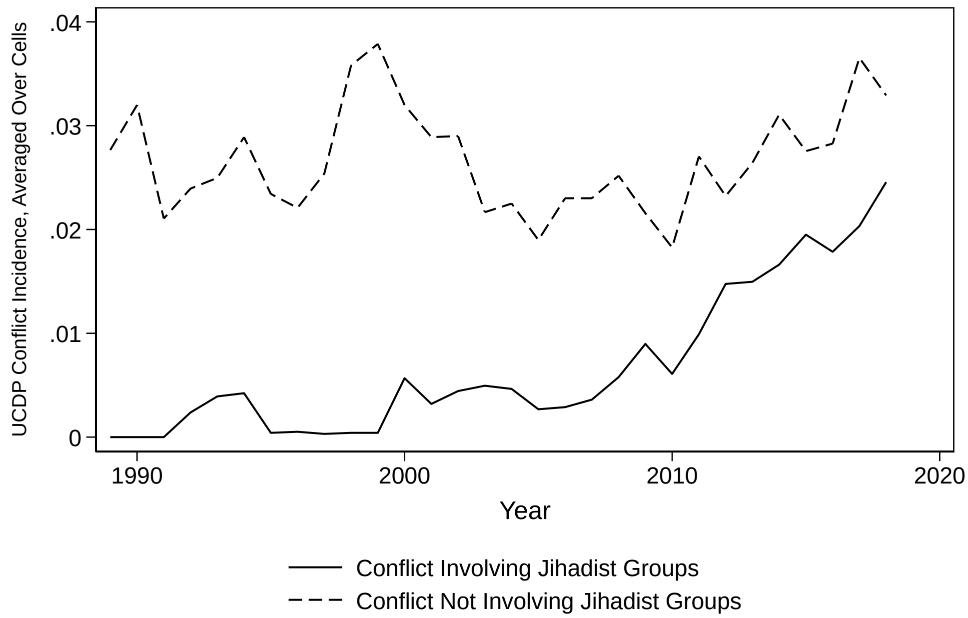


Figure 7: Total Jihadist and non-Jihadist Conflicts over Time in Africa

similar effects of our interaction term of interest on both types of conflict. This suggests that our mechanism applies equally to both jihadist and non-jihadist conflict. The predicted effects of a one-standard-deviation rainfall shock in terms of the dependent variable mean are reported in the second panel of the tables. These show that the effects are much larger for jihadist conflicts than non-jihadist conflicts; about 2.5 to 4 times greater depending on the exact specification. This is because our measure of jihadist conflict has a lower mean incidence.[14]

In columns 3, 4, 7 and 8, we report estimates that check whether our findings are simply due to the fact that transhumant pastoral groups are more likely to be Islamic. To account for the importance of religion explicitly, we measure the estimated proportion of each ethnic group that is Christian and Muslim today and include this, along with the relevant interactions, as a control in equation (3).[15] Our estimated effects of interest are nearly identical in magnitude and significance after accounting for contemporary religion. This suggests that our estimated effects on jihadist conflicts are due directly to transhumant pastoralism and not due to its positive correlation with Islam.[16]

To place the magnitude of this finding into perspective, we estimate in our counterfactual exercise in Appendix C that the incidence of jihadist conflict would have been 31% lower during

[14]This can be seen in Figure 7, where the baseline incidence for jihadist conflicts is much lower, particularly prior to 2000.

[15]The data are constructed using information from the *World Religion Database*, which reports information on the populations of 18 religions for each language group in the world. The data are provided with Ethnologue identifiers which we match to our *Ethnographic Atlas*. There are typically multiple *Ethnologue* groups that match to one *Ethnographic Atlas* group. We create *Ethnographic Atlas* level measures by creating population-weighted averages across all *Ethnologue* groups that match to one *Ethnographic Atlas* group.

[16]We come to the same conclusion if we examine our baseline measure of aggregate conflict incidence. The estimates are reported in Appendix Tables A24 and A25.

Table 10: Jihadist Violence using Narrow Definition of Transhumance

	Conflict in All Grid Cells				Conflict in Agricultural Cells			
	(1) Jihadist	(2) Non-Jihadist	(3) Jihadist	(4) Non-Jihadist	(5) Jihadist	(6) Non-Jihadist	(7) Jihadist	(8) Non-Jihadist
Nearest Neighboring Ethnic Group								
Rain	-0.0001	-0.0005	0.0007	0.0000	0.0000	-0.0007	0.0004	-0.0009
	(0.0003)	(0.0006)	(0.0005)	(0.0021)	(0.0002)	(0.0006)	(0.0005)	(0.0021)
Rain × Transhumant Pastoral	-0.0050**	-0.0066**	-0.0056**	-0.0062**	-0.0041*	-0.0085**	-0.0040	-0.0081*
	(0.0022)	(0.0026)	(0.0025)	(0.0030)	(0.0023)	(0.0040)	(0.0026)	(0.0045)
Rain × Share Muslim			-0.0021	-0.0012			-0.0010	-0.0003
			(0.0013)	(0.0026)			(0.0011)	(0.0026)
Rain × Share Christian			-0.0006	-0.0005			-0.0004	0.0008
			(0.0007)	(0.0028)			(0.0007)	(0.0029)
Own Ethnic Group								
Rain	0.0010**	-0.0010	0.0014	-0.0034	0.0011***	-0.0011	0.0012	-0.0046
	(0.0004)	(0.0010)	(0.0010)	(0.0030)	(0.0004)	(0.0010)	(0.0010)	(0.0030)
Rain × Transhumant Pastoral	-0.0020	0.0003	-0.0028	0.0003	-0.0013	0.0105	-0.0028	0.0040
	(0.0023)	(0.0043)	(0.0027)	(0.0050)	(0.0026)	(0.0127)	(0.0047)	(0.0227)
Rain × Share Muslim			0.0010	0.0037			0.0021	0.0056
			(0.0019)	(0.0036)			(0.0016)	(0.0037)
Rain × Share Christian			-0.0011	0.0030			-0.0008	0.0047
			(0.0011)	(0.0041)			(0.0011)	(0.0041)
Own Cell								
Rain	-0.0001	-0.0001	0.0001	0.0017	-0.0003	0.0001	-0.0001	0.0034
	(0.0002)	(0.0007)	(0.0003)	(0.0021)	(0.0002)	(0.0007)	(0.0003)	(0.0021)
Rain × Transhumant Pastoral	-0.0009	0.0053	-0.0007	0.0063*	0.0003	-0.0077	0.0002	-0.0081
	(0.0013)	(0.0033)	(0.0015)	(0.0037)	(0.0025)	(0.0095)	(0.0037)	(0.0149)
Rain × Share Muslim			-0.0007	-0.0019			-0.0011	-0.0043
			(0.0011)	(0.0028)			(0.0012)	(0.0028)
Rain × Share Christian			-0.0001	-0.0026			0.0001	-0.0046
			(0.0004)	(0.0029)			(0.0004)	(0.0030)
Nearest Neighboring Ethnic Group: Additional Calculations								
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:								
Rain	-1.13	-2.29	10.94	0.14	0.06	-2.45	7.44	-3.22
p-value	[0.82]	[0.36]	[0.17]	[0.99]	[0.99]	[0.27]	[0.39]	[0.67]
Rain × Transhumant Pastoral	-84.90	-28.48	-87.01	-23.87	-76.55	-31.31	-70.02	-28.27
p-value	[0.02]	[0.01]	[0.03]	[0.04]	[0.07]	[0.03]	[0.12]	[0.07]
Rain + Rain × Transhumant Pastoral	-86.03	-30.77	-76.07	-23.72	-76.50	-33.76	-62.58	-31.49
p-value	[0.02]	[0.01]	[0.04]	[0.08]	[0.07]	[0.02]	[0.15]	[0.06]
Dep. Var. Mean	0.0071	0.0278	0.0077	0.0314	0.0065	0.0325	0.0069	0.0345
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	420	420	420	420	390	390	390	390
Cells	7,667	7,667	6,453	6,453	5,427	5,427	4,863	4,863
Observations	230,010	230,010	193,590	193,590	162,810	162,810	145,890	145,890

Note: The unit of observation is a 0.5-degree grid-cell and year. "Jihadist" is an indicator variable that equals one if at least one UCDP conflict event occurs in a cell-year involving a self-styled jihadist group, as defined in the main text. "Non-Jihadist" is an indicator variable that equals one if at least one UCDP conflict event occurs in a cell-year that does not involve a self-styled jihadist group. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. *Own Ethnic Group* refers to the ethnic territory that contains cell i. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

our study period had rainfall in each cell been higher by one standard deviation.

B. Representation in Government, Climate Change, and Conflict

Thus far, we have established that much, if not all, of the conflict induced by droughts in transhumant pastoral territories involves the state. This suggests that national political economy forces may play an important role in either moderating or amplifying this relationship. In this section, we test whether the same spillover effects are present or not when pastoral groups have more political power.

The logic behind the test is that pastoral groups are less likely to be afforded grazing rights when they are excluded from national politics. In this scenario, state forces will serve to protect the property rights of landowning farmers only. On the other hand, if pastoral groups occupy a greater share of national political power, then property rights are more likely to be balanced between the interests of both farmers and herders.

Numerous studies have documented cases of policy bias against pastoral groups. Typically, this stance is explicit, with transhumant pastoralism being viewed as inefficient or outdated. For example, the former president of Tanzania, Jakaya Kikwete, has expressed his views in numerous public statements or in parliament. In his 2005 inaugural speech to Parliament, he conveyed his view that: "Our people must change from being nomadic cattle herders to being modern livestock keepers." In a 2006 press conference: "We are producing little milk, export very little beef, and our livestock keepers roam throughout the country with their animals in search for grazing grounds. We have to do away with archaic ways of livestock farming." (Mattee and Shem, 2006, p. 4).

We measure the extent to which political power in a country is held by transhumant pastoral groups using information from the Ethnic Power Relations (EPR) Database, which documents the nature of political power held by ethnic groups. We use this information to construct a measure of the total amount of political power held by an ethnic group e in country c in year t, which we denote by $Power_{ect}$. The categories and values of the variable are given by: (0) Fully excluded from politics (self exclusion or discrimination); (1) Powerless; (2) Junior partner in government; (3) Senior partner in government; (4) Dominant power; and (5) Monopoly power.

Our interest is in the share of political power in a country that is held by groups that are transhumant pastoral. We measure the total amount of political power in a country by aggregating the power of all ethnic groups: $\sum_e Power_{ec(i)t}$. We measure the amount of power held by transhumant pastoral groups by: $\sum_e TranshumantPastoral_e \times Power_{ec(i)t}$. Our measure of the share of power held by transhumant pastoral groups is then:

$$Power^{THP}_{c(i)t} = \frac{\sum_e TranshumantPastoral_e \times Power_{ec(i)t}}{\sum_e Power_{ec(i)t}}.$$

In our sample, a third of the countries have a measure of $Power^{THP}_{c(i)t}$ that is equal to zero, indicating that there are no transhumant pastoral groups in the country who hold political power. The highest value of the measure is 0.61, which is for Mauritania from 1989–2017, when the Delim, Trarza, Regeibat, Zenega, Tajakant, and Berabish pastoral groups were represented by junior partners in government.

Using the transhumant political power measure, we estimate a variant of equation (3) that allows our effect of interest to differ depending on the extent to which transhumant pastoral groups hold political power in that country and year, $Power^{THP}_{c(i)t}$. The estimating equation is:

$$\begin{aligned}
y_{iet} \quad = \quad & \phi^s_0\, Rain^{Neighbor}_{it} + \phi^s_1\, Rain^{Neighbor}_{it} \times TranshumantPastoral^{Neighbor}_i \\
& + \phi^s_2\, Rain^{Neighbor}_{it} \times TranshumantPastoral^{Neighbor}_i \times Power^{THP}_{c(i)t-1} \\
& + \phi^s_3 Rain^{Neighbor}_{it} \times Power^{THP}_{c(i)t-1} + \phi^s_4 TranshumantPastoral^{Neighbor}_i \times Power^{THP}_{c(i)t-1} \\
& + \phi^s_5\, Rain^{OwnGroup}_{et} + \phi^s_6\, Rain^{OwnGroup}_{et} \times TranshumantPastoral^{OwnGroup}_e \\
& + \phi^s_7\, Rain^{OwnCell}_{it} + \phi^s_8\, Rain^{OwnCell}_{it} \times TranshumantPastoral^{OwnGroup}_e \\
& + \alpha^s_i + \alpha^s_{c(i)t} + \xi^s_{iet},
\end{aligned} \tag{4}$$

where all indices and variables are as in equation (3). The estimates of interest are ϕ_1^s, which is our main spillover effect when transhumant pastoral groups have no political power, and ϕ_2^s, which determines how much the main spillover effect changes as transhumant pastoral groups gain more political power.

Estimates of equation (4) are reported in Table 11 and Appendix Table A26. We examine only the outcome variables for which we find a significant effect in the main analysis, and we present estimates using the full sample and using the agricultural sample. We find that the estimated coefficient for the interaction between a nearest neighbor's rainfall and that neighbor's measure of transhumant pastoralism, $\hat{\phi}_1^s$, is negative and significant for state-involved UCDP conflict and all types of ACLED conflict. This is the estimated effect for a country where the share of power held by transhumant pastoral groups is zero. The estimated coefficient for the triple interaction, $\hat{\phi}_2^s$, is positive and generally significant using the narrower definition of transhumance, indicating that the effect of rainfall in the territory of neighboring transhumant pastoral groups on conflict is lower when transhumant pastoral groups have more national political power. In some specifications, the interaction terms lack statistical power, but in all the estimated effect is positive and meaningful.

To assess the importance of the estimated heterogeneity, in the bottom panel of each table we calculate the predicted effect and statistical significance of $Rain_{it}^{Neighbor} \times TranshumantPastoral_i^{Neighbor}$ at different values of $Power_{c(i)t-1}^{THP}$. The first predicted effect that we report is for a value of $Power_{c(i)t-1}^{THP}$ that is equal to the 25th percentile of its distribution, which is zero. Below this, we report the same statistic calculated at the 50th percentile (0.094) and the 75th percentile (0.284).

We find that for country-years in which no transhumant pastoral groups share political power, the spillover effect is very large. For example, a one-standard-deviation decrease in rainfall is associated with an increase of conflict of 30–56% for all conflicts using the UCDP measure and 67–82% for all conflicts using the ACLED measure (depending on the definition of transhumance used). When a country is at the 75th percentile of transhumant pastoral political power, these effects are not statistically different from zero. In addition, they are very small: 13–14% for UCDP and 0–1% for ACLED.[17]

Overall, these results suggest that political power plays an important role in explaining our main results. When transhumant pastoral groups have a higher share of political power, droughts in their home territories cease to induce the same outbreak of conflict in neighboring areas.

C. Aid Projects

In recent decades, organizations have devised projects and interventions that attempt to combat the adverse effects of climate change. In this section, we ask whether such projects have been

[17] Although the estimates for the double interactions involving transhumant pastoral political power are not directly of interest, it is noteworthy that the estimated effect of $TranshumantPastoral_i^{Neighbor} \times Power_{ct-1}^{THP}$ is negative and generally significant. Thus, there is less conflict in the neighborhood of transhumant pastoral groups when transhumant pastoral groups hold political power.

Table 11: Heterogeneity by Share of Political Power Held by Transhumant Pastoral Groups: Using the Narrow Definition of Transhumance

	Conflict in All Grid Cells			Conflict in Agricultural Cells		
	(1)	(2)	(3)	(4)	(5)	(6)
	UCDP	UCDP	ACLED	UCDP	UCDP	ACLED
	I(Any)	I(State)	I(Any)	I(Any)	I(State)	I(Any)
Nearest Neighboring Ethnic Group						
Rain	-0.0007	0.0006	-0.0046***	-0.0008	0.0004	-0.0032**
	(0.0008)	(0.0007)	(0.0014)	(0.0008)	(0.0007)	(0.0015)
Rain × Transhumant Pastoral	-0.0153**	-0.0146***	-0.0510***	-0.0188**	-0.0214***	-0.0607***
	(0.0061)	(0.0054)	(0.0091)	(0.0086)	(0.0074)	(0.0114)
Rain × Transhumant Pastoral × THP Power Share	0.0411*	0.0330	0.1790***	0.0466	0.0579*	0.2247***
	(0.0227)	(0.0206)	(0.0391)	(0.0346)	(0.0333)	(0.0511)
Rain × THP Power Share	-0.0007	-0.0056	0.0533***	0.0003	-0.0016	0.0495***
	(0.0075)	(0.0072)	(0.0140)	(0.0088)	(0.0082)	(0.0164)
Transhumant Pastoral × THP Power Share	-0.2401**	-0.2224**	-1.0375***	-0.4210**	-0.4319***	-1.3999***
	(0.1056)	(0.1029)	(0.1657)	(0.1691)	(0.1619)	(0.2243)
Nearest Neighboring Ethnic Group: Additional Calculations						
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:						
Rain × Transhumant Pastoral when THP Power at 25 pctile	-57.3	-73.1	-82.1	-61.0	-93.7	-80.3
p-value	[0.01]	[0.01]	[0.00]	[0.03]	[0.00]	[0.00]
Rain × Transhumant Pastoral when THP Power at 50 pctile	-42.9	-57.6	-55.0	-46.8	-69.9	-52.4
p-value	[0.01]	[0.00]	[0.00]	[0.02]	[0.00]	[0.00]
Rain × Transhumant Pastoral when THP Power at 75 pctile	-13.7	-26.3	-0.1	-18.1	-21.8	4.1
p-value	[0.34]	[0.15]	[0.99]	[0.36]	[0.38]	[0.73]
Dep. Var. Mean	0.032	0.024	0.074	0.037	0.027	0.091
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	406	406	308	377	377	286
Cells	6,965	6,965	6,962	5,089	5,089	5,086
Observations	194,442	194,442	148,128	140,923	140,923	107,000

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. This regression controls for the corresponding variables at the *Own Ethnic Group* level and the *Own Cell* level. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

helpful in mitigating the effects that we document here. To do this, we allow our effects of interest to differ depending on the stock of aid projects present in a country and year.[18]

We begin by examining two specific types of aid that are intended to curb environmental degradation directly. The first is irrigation projects, which are generally aimed at maintaining or improving the arability of marginal land that is particularly prone to adverse rainfall shocks. The second is conservation and/or reforestation projects, which, in addition to absorbing CO_2, are designed to combat the loss of vegetation due to soil erosion.

There has been significant debate over the efficacy of these policies in agro-pastoral areas. While both are intended to have benefits, they have also been criticized for exacerbating problems. Some have argued that irrigation projects encourage the use of marginal lands for agriculture when they are better suited for pastoralism. Thus, due to a bias towards agriculture, the projects may actually result in greater conflict between pastoralists and farmers. Similarly, conservation projects have been charged with being disruptive for pastoral groups. Lands that are converted into conservation areas are often transhumant pastoral corridors or grazing pastures. Since conservation leases typically either forbid the use of conservation lands for grazing, or impose regulations or fees when use is allowed, conservation lands may disrupt pre-existing transhumant migration routes and cooperative arrangements with farmers (Bergius, Benjaminsen, Manganga and Buhaug, 2020, Cavanagh, Weldemichel and Benjaminsen, 2020).

We measure the presence of aid projects in a country over time using data at the level of a project location from the *Aid Data* repository, which reports detailed information on all completed World Bank projects from 1995–2014. We identify irrigation projects as those contain the stem "irrigat-" in the project title and conservation projects as those that contain either of the stems "conserv-" or "forest-". For both types of projects, we then create a variable that is equal to the cumulative number of project locations in a country-year since 1995. With these measures, we estimate a variant of equation (4) where the lagged country-year variable $Power^{THP}_{c(i)t-1}$ is replaced with a lagged county-year variable that measures instead the cumulative presence of World Bank aid projects.[19]

The estimates are reported in Table 12 and Appendix Table A27. The top panel reports estimates for irrigation projects and the bottom panel reports estimates for conservation projects. Beneath the estimates, we present the predicted effect of a one standard deviation rainfall shock in terms of the dependent variable mean in countries where the cumulative number of projects is zero and where the cumulative number is one. For irrigation projects, we find that when we consider all cells (columns 1–3), the triple interaction of interest is positive but imprecisely estimated. The estimated importance of irrigation projects is larger and more precisely estimated when we focus on conflict in agricultural cells (columns 4–6). This is consistent with irrigation projects relaxing resource constraints in agricultural territories, which reduces conflict. The estimated effects are sizable. Each additional irrigation project reduces our estimated effect of drought on conflict by between 10% and 20% of the outcome variable mean, depending on the

[18]This follows the same econometric logic as our examination of political representation in the previous subsection.

[19]As in the previous exercise, we use a lagged variable to account for the possibility that conflict events may affect the implementation of new aid projects.

specification.

In contrast to irrigation projects, we find no evidence that conservation projects help to reduce the effects of rainfall on conflict. Although imprecise, our estimates suggest that, if anything, conservation projects may exacerbate the effect of droughts on conflict. The differential conservation effect is concentrated in non-agricultural cells, which are more likely to be converted into conservation lands, and not in agricultural cells. This effect is statistically significant only when we use the broader four-category measure of transhumance.

Having found evidence for the importance of irrigation projects, we next broaden our focus to aid projects more generally, distinguishing between agricultural and non-agricultural projects.[20] Estimates are reported in Appendix Tables A28 and A29. For both types of projects we estimate differential effects that are very small in magnitude and typically not statistically different from zero. Thus, we find that, unlike irrigation projects, aid projects more generally do not appear to help alleviate the effects of climate change on conflict that we identify.

D. Estimating Direct Effects of Rainfall on Conflict at Varying Cell Sizes

While our findings document one particular conflict mechanism in Africa, they also provide a broader lesson for estimating the effects of weather shocks on conflict more generally.

In our setting, we find evidence of substantial spillover (or *indirect*) effects but we do not find evidence of substantial own-cell (or *direct*) effects. One implication of this finding is that estimates of the direct effect of rainfall in a location on conflict in the same location may be sensitive to the unit of analysis chosen by the researcher. If one uses smaller units, then the spillover effects are less likely to be captured since the rainfall shock and the conflict event may occur in different cells. If one uses larger units, however, then the spillover effects are more likely to be captured. Thus, the unit of analysis is crucial in a setting with spillover effects.

Our study identifies these spillover effects by relying on a particular structure that is motivated by contextual knowledge. The question remains as to whether one could also obtain fairly accurate estimates without knowledge of this structure by instead conducting the analysis with larger units of analysis. This is particularly important for estimates in other settings where the nature of the spatial spillovers may be different or potentially unknown.

To address this question, we estimate the direct effect of rainfall on conflict at different levels of analysis, ranging in 0.5 intervals from cells that are 0.5-degree by 0.5-degree to cells that are 8-degree by 8-degree, which is just larger than the average country size on the continent. For each of the 16 different-sized grid-cells, we estimate the following equation:

$$y_{it} = \alpha_i + \alpha_t + \gamma_0 \, Rain_{it} + \epsilon_{it}. \tag{5}$$

where i indexes 0.5 to 8.0 degree grid-cells and t indexes a year. The dependent variable, y_{it}, measures the average incidence of UCDP conflict events in each 0.5-degree cell within cell i. We measure the outcome in this way so that it is not mechanically affected by the size of the unit of

[20] We identify agricultural aid projects as those containing "agricultur-" in the description of the project sector or title. This constitutes 25% of the 16,591 project-locations in Africa over this period.

Table 12: Heterogeneity by Presence of World Bank Irrigation and Conservation Aid Projects: Using the Narrow Definition of Transhumance

	Conflict in All Grid Cells			Conflict in Agricultural Cells		
	(1)	(2)	(3)	(4)	(5)	(6)
	UCDP I(Any)	UCDP I(State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	ACLED I(Any)
	Irrigation Aid Projects					
Nearest Neighboring Ethnic Group						
Rain	-0.00034	0.00071	-0.00016	-0.00049	0.00070	0.00036
	(0.00083)	(0.00067)	(0.00121)	(0.00085)	(0.00066)	(0.00125)
Rain × Transhumant Pastoral	-0.01270***	-0.01510***	-0.00838**	-0.02487***	-0.02506***	-0.01546**
	(0.00395)	(0.00369)	(0.00378)	(0.00596)	(0.00524)	(0.00633)
Rain × Transhumant Pastoral × Irrigation Aid Projects	0.00092	0.00140	0.00038	0.00257**	0.00340**	0.00201
	(0.00113)	(0.00126)	(0.00104)	(0.00126)	(0.00145)	(0.00176)
Rain × Irrigation Aid Projects	-0.00049***	-0.00046***	-0.00011	-0.00051***	-0.00046***	-0.00014
	(0.00017)	(0.00016)	(0.00014)	(0.00016)	(0.00015)	(0.00013)
Transhumant Pastoral × Irrigation Aid Projects	-0.00216**	-0.00211**	0.00504	-0.00296**	-0.00263**	0.00112
	(0.00093)	(0.00096)	(0.00325)	(0.00133)	(0.00122)	(0.00539)
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:						
Rain × Transhumant Pastoral when Aid Projects = 0	-45.7	-74.8	-14.3	-81.5	-114.2	-23.1
p-value	[0.00]	[0.00]	[0.03]	[0.00]	[0.00]	[0.02]
Rain × Transhumant Pastoral when Aid Projects = 1	-42.4	-67.9	-13.6	-73.1	-98.7	-20.1
p-value	[0.00]	[0.00]	[0.02]	[0.00]	[0.00]	[0.02]
	Conservation/Forestry Aid Projects					
Nearest Neighboring Ethnic Group						
Rain	-0.00086	0.00029	-0.00033	-0.00098	0.00034	0.00021
	(0.00080)	(0.00064)	(0.00121)	(0.00083)	(0.00065)	(0.00127)
Rain × Transhumant Pastoral	-0.01070***	-0.01265***	-0.00747**	-0.02177***	-0.02083***	-0.01458**
	(0.00387)	(0.00351)	(0.00345)	(0.00585)	(0.00500)	(0.00592)
Rain × Transhumant Pastoral × Conservation/Forestry Aid Projects	-0.00094	-0.00084	0.00081	0.00058	0.00062	0.00212
	(0.00086)	(0.00081)	(0.00181)	(0.00050)	(0.00044)	(0.00216)
Rain × Conservation/Forestry Aid Projects	0.00010	0.00004	0.00004	0.00013	0.00005	0.00006
	(0.00009)	(0.00007)	(0.00010)	(0.00010)	(0.00007)	(0.00011)
Transhumant Pastoral × Conservation/Forestry Aid Projects	0.00891	0.00776	-0.00317	-0.00334	-0.00402	-0.01320
	(0.00605)	(0.00572)	(0.01240)	(0.00338)	(0.00296)	(0.01505)
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:						
Rain × Transhumant Pastoral when Aid Projects = 0	-38.5	-62.7	-12.7	-71.4	-94.9	-21.8
p-value	[0.01]	[0.00]	[0.03]	[0.00]	[0.00]	[0.01]
Rain × Transhumant Pastoral when Aid Projects = 1	-41.9	-66.9	-11.3	-69.5	-92.1	-18.6
p-value	[0.00]	[0.00]	[0.07]	[0.00]	[0.00]	[0.03]
Dep. Var. Mean	0.034	0.024	0.071	0.037	0.026	0.081
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	280	280	266	260	260	247
Cells	7,667	7,667	7,667	5,427	5,427	5,427
Observations	153,340	153,340	145,673	108,540	108,540	103,113

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. This regression controls for the corresponding variables at the *Own Ethnic Group* level and the *Own Cell* level. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

analysis. The variable $Rain_{it}$ is average precipitation in cell i in year t. The parameter γ_0 captures the effect of rainfall on conflict.

Our interest is in how the estimated effect of rainfall on conflict varies by cell size. There are multiple ways that one can create grids for each cell size.[21] Since the creation of these grids will affect the estimate of γ_0, we generate estimates for all possible grid configurations and plot the *mean* coefficent estimate against the corresponding unit of analysis i in Figure 8a. This mean estimate at each cell size is close to zero and does not appear to vary appreciably with cell size. Thus, producing estimates that capture the effect of rainfall on conflict that we document in this paper does not appear to be possible by simply varying the size of the units of analysis.

While this may be surprising at first, a plausible explanation for the absence of a relationship is that the underlying regression estimates average effects across the whole continent of Africa, masking important heterogeneity. By contrast, the spillover effects that we identify are due to conflict in areas that are used by both agriculturalists and transhumant pastoralists. Thus, for much of the continent, these spillovers are not present.

To improve the precision of this test, we consider whether one can provide estimates that are consistent with the effects that we identify in our main analysis, but without the use of ethnographic data or the spillover structure our analysis imposes. We presume the researcher only has access to geo-climatic data on locations that are suitable for both agriculture and transhumant pastoralism. We define a *dual-use* 0.5-degree grid-cell as one that is above the 25th percentile for both agriculture and pastoralism as constructed by Beck and Sieber (2010). By this measure, 56% of the 0.5-degree cells in Africa are suitable for dual use. We then calculate the fraction of 0.5-degree cells within our unit of analysis that are suitable for dual-use. We denote this measure $\textit{Dual Suitability}_i$. We then allow the effect of rainfall on conflict to differ by this measure. Specifically, we estimate:

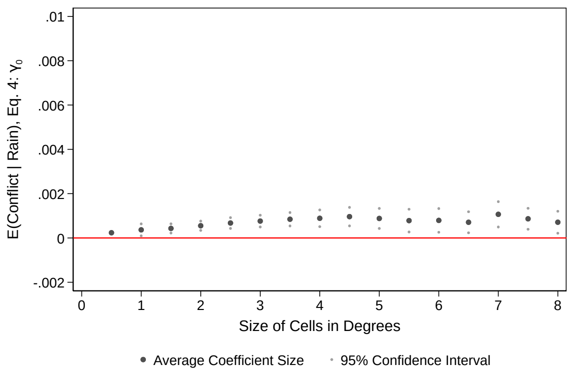
$$y_{it} = \alpha_i + \alpha_t + \beta_0 \, Rain_{it} + \beta_1 \, Rain_{it} \times \textit{Dual Suitability}_i + \varepsilon_{it}, \tag{6}$$

where, as before, i indexes 0.5 to 8.0 degree grid-cells and t years; y_{it}, measures the average incidence of UCDP conflict events in each 0.5-degree cell within cell i; $Rain_{it}$ is average precipitation in cell i in year t; and $\textit{Dual Suitability}_i$ is the share of 0.5-degree cells that are suitable for both agriculture and transhumant pastoralism.

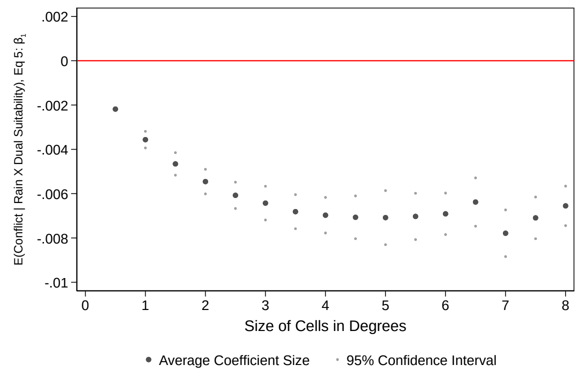
We plot the mean estimates of β_1, along with confidence intervals, for each cell size in Figure 8b. (For comparability, the scale of the y-axis is the same as in Figure 8a.) We find clear evidence of a differential effect of own-cell rainfall on conflict for cells that are suitable for both agriculture and transhumant pastoralism. Importantly, we now find that cell size matters. The magnitude of the estimated effect for dual-use cells tends to be greater the larger the cells, which we expect will better capture spatial spillovers. The magnitude of the differential effect monotonically increases up to about four degrees, after which it stays fairly flat. Thus, the spillovers appear to be well captured by four-degree grid cells and there is little gain to increasing cells beyond this.[22]

[21] Specifically, for a cell size i, we can create $(\frac{i}{0.5})^2$ different grids.

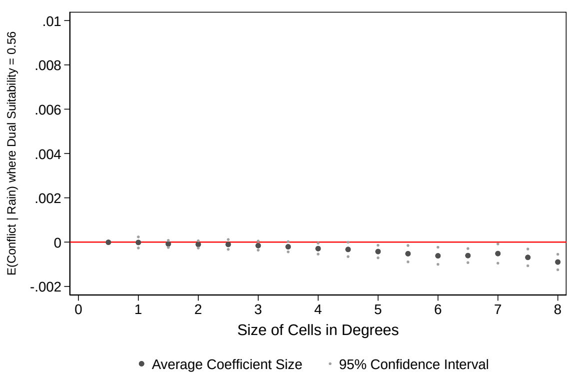
[22] In fact, if we increase cell sizes beyond 8 degrees the estimates begin to attenuate slightly towards zero, which is consistent with an increase in the amount of measurement error relative to real variation as cell sizes are enlarged.



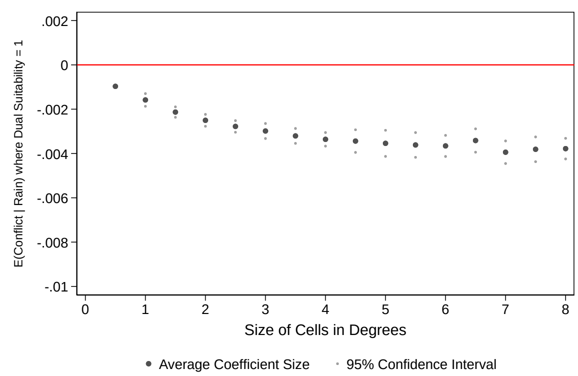
(a) Estimated effect of rainfall: γ_0 from equation (5)



(b) Estimated differential effect of rainfall in dual-use cells: β_1 from equation (6)



(c) Estimated effect of rainfall evaluated at the mean of dual-use share



(d) Estimated effect of rainfall evaluated at dual-use share = 1

Figure 8: Effects of Rainfall on Conflict at Various Levels of Analysis

We report estimated effects for different values of average dual-use share of cells in Figures 8c and 8d. Figure 8c reports estimated effects of rainfall on conflict for cells that are equal to the average value of dual use in our sample, which is 0.56. Here, we see that for the typical cell on the continent rainfall has a pretty small effect that is generally insignificant. However, if we calculate the effect for cells that are fully dual use, which are reported in Figure 8d, then we find rainfall has negative effects on conflict and that this is captured best by cell sizes that are four degrees or larger.

Taken together, the results are consistent with our main finding that adverse rainfall shocks lead to more conflict in Africa due to a spillover mechanism rather than a direct mechanism. Beyond this, the exercise highlights the pitfalls of ignoring spillover effects in granular data. It also indicates that in the presence of spatial spillovers, simply adjusting the size of the cells being studied is not sufficient to obtain accurate estimates. In settings where the spillover effects are not universal across space, one needs also to have a minimal understanding of the source of the spillovers.

8. Conclusions

We have studied the question of whether climate change is responsible for disrupting longstanding relationships between transhumant pastoralists and neighboring sedentary agriculturalists in Africa. Traditionally, transhumant pastoralists benefit from a cooperative relationship with sedentary agriculturalists whereby arable land is used for farming in the wet season and grazing in the dry season. Our findings confirmed anecdotal accounts of adverse rainfall shocks in transhumant pastoral territories forcing herders to migrate to neighboring agricultural territories before harvest, resulting in damage to crops by grazing animals and the emergence of conflict.

The core of our analysis documented a relationship between adverse rainfall shocks in the territories of transhumant pastoralists and conflict in the territory of neighboring ethnic groups. To test for the mechanism of interest – disruption to the seasonal migrations of transhumant pastoralists – we examined the effects further. We found that the conflicts induced by the shocks are concentrated in nearby agricultural lands and occur during the wet season, which is when land is still used to cultivate crops, and not during the dry season, when land is available for grazing. We also found that the effect of rainfall operates though its influence on phytomass growth, which grazing animals require for sustenance.

While we found robust evidence for these spillover effects, we did not find evidence for direct effects; namely that rainfall in a location affects conflict in the same location. This implies that our inter-ethnic spillover mechanism accounts for much of the established relationship between adverse rainfall shocks and conflict in Africa. Viewed from the perspective of the determinants of conflict, our findings are also quantitatively important. We estimate that if rainfall were higher by one standard deviation in each cell during the thirty-year period from 1989–2018, the overall incidence of conflict in Africa would be lower by 12%. The same figure for civil conflicts is even larger at 18%, as herder-farmer conflicts often involve government forces operating on the side of agricultural groups.

Our estimates also shed light on a specific form of conflict that has become more pervasive in Africa in recent decades, namely jihadist violence. Transhumant pastoral groups tend to be Islamic while sedentary agriculturalists tend to be Christian. Our estimates indicate that a large proportion of extremist-religious violence involving jihadist groups is in fact due to the mechanism that we document rather than primordial grievances alone. Our counterfactual exercise implies that if rainfall were one standard deviation higher during our study period, jihadist conflict would be lower by 31%.

Our analysis also provides important policy implications. The effects that we estimate are reduced when pastoral ethnic groups have a greater share of national political power. Since transhumant pastoral groups are typically under-represented in politics, this suggests that a more equitable distribution of national political power will have significant benefits. Indeed, if taken literally, our estimates imply that this change could eliminate fully the effects of drought on conflict that we identify.

Our findings also point to the importance of irrigation projects. Our estimated effects are lower in magnitude after projects are constructed in agricultural areas, suggesting that easing resource constraints may help to reduce clashes between farmers and herders that are caused by droughts in pastoral territories. We do not find evidence that conservation projects are similarly beneficial and, if anything, they may exacerbate the effects. This is consistent with anecdotal accounts that conservation lands may disrupt traditional grazing practices.

Taken as a whole, our findings highlight the importance of the ethnic and cultural context of locations for understanding the effects of climate change on conflict. This is particularly important for identifying spillover effects, whereby rainfall in one location affects conflict in another location that is often very distant. Our findings also stress the role that policies and institutions can play in combating the deleterious effects of climate change. As we have shown, institutions that help to provide the appropriate balance of grazing and cultivating rights can play an important role in mitigating the costs of climate change in agro-pastoral zones across the African continent. Our findings suggest that this is more likely to be achieved if pastoral groups are given greater political representation.

References

Barrios, Salvador, Luisito Bartinelli, and Eric Strobl, "Climate Change and Rural-Urban Migration: The Case of Sub-Saharan Africa," *Journal of Urban Economics*, 2006, *60* (3), 357–371.

Baysan, Ceren, Marshall Burke, Felipe González, Solomon Hsiang, and Edward Miguel, "Non-Economic Factors in Violence: Evidence from Organized Crime, Suicides and Climate in Mexico," *Journal of Economic Behavior & Organization*, 2019, *168*, 434–452.

Beck, Jan and Andrea Sieber, "Is the Spatial Distribution of Mankind's Most Basic Economic Traits Determined by Climate and Soil Alone?," *PLoS ONE*, 2010, *5* (5).

Becker, Anke, "On the Economic Origins of Restrictions on Women's Sexuality," 2019. Working Paper, Harvard University.

Benjaminsen, Tor A. and Boubacar Ba, "Why Do Pastoralists in Mali Join Jihadist Groups? A Political Ecology Explanation," *Journal of Peasant Studies*, 2019, *46* (1), 1–20.

_, Koffi Alinon, Halvard Buhaug, and Jill Tove Buseth, "Does Climate Change Drive Land-Use Conflicts in the Sahel?," *Journal of Peace Research*, 2012, *49* (1), 97–111.

Bergius, Mikael, Tor A. Benjaminsen, Faustin Manganga, and Halvard Buhaug, "Green Economy, Degredation Narratives, and Land-Use Conflicts in Tanzania," *World Development*, 2020, *129*, 104850.

Berman, Nicolas, Mathieu Couttenier, Dominic Rohner, and Mathias Thoenig, "This Mine Is Mine! How Minerals Fuel Conflicts in Africa," *American Economic Review*, 2017, *107* (6), 1564–1610.

Besley, Timothy and Marta Reynal-Querol, "The Legacy of Historical Conflict: Evidence from Africa," *American Political Science Review*, 2014, *108* (2), 319–336.

Biasutti, Michela, "Rainfall Trends in the African Sahel: Characteristics, Processes, and Causes," *WIREs Climate Change*, 2018, *10* (4), e591.

Black, Richard, Stephen R.G. Bennett, Sandy M. Thomas, and John R. Beddington, "Migration as Adaptation," *Nature*, 2011, *478*, 447–449.

Blattman, Christopher and Edward Miguel, "Civil War," *Journal of Economic Literature*, March 2010, *48* (1), 3–57.

Bollig, Michael, *Risk Management in a Hazardous Environment: A Comparative Study of Two Pastoral Societies*, New York: Springer, 2006.

Bosetti, Valentina, Cristina Cattaneo, and Giovanni Peri, "Should They Stay or Should They Go? Climate Migrants and Local Conflicts," 2018. NBER Working Paper No. 24447.

Brottem, Leif V., "Environmental Change and Farmer-Herder Conflict in Agro-Pastoral West Africa," *Human Ecology*, 2016, *44* (5), 547–563.

Burke, Marshall B., Edward Miguel, Shanker Satyanath, John A. Dykema, and David B. Lobell, "Warming Increases the Risk of Civil War in Africa," *Proceedings of the National Academy of sciences*, 2009, *106* (49), 20670–20674.

Burke, Marshall, Solomon M. Hsiang, and Edward Miguel, "Climate and Conflict," *Annual Review of Economics*, 2015, *7* (1), 577–617.

Cao, Yiming, Benjamin Enke, Armin Falk, Paola Giuliano, and Nathan Nunn, "Herding, Warfare, and a Culture of Honor: Global Evidence," 2021. Working paper, Harvard University.

Cattaneo, Cristina and Giovanni Peri, "The Migration Response to Increasing Temperatures," *Journal of Development Economics*, 2016, *122*, 127–146.

Cavanagh, Connor J., Teklehaymanot Weldemichel, and Tor A. Benjaminsen, "Gentrifying the African Landscape: The Performance and Powers of for-Profit Conservation on Southern Kenya's Conservancy Frontier," *Annals of the American Association of Geographers*, 2020, *110* (5), 1594–1612.

CIESIN and CIAT, *Gridded Population of the World, Version 3 (GPWv3): Population Count Grid*, Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC), 2005.

Collier, Paul and Anke Hoeffler, "On Economic Causes of Civil War," *Oxford Economic Papers*, 1998, *50* (4), 563–573.

— **and** — , "Greed and Grievance in Civil War," *Oxford Economic Papers*, 2004, *56* (4), 563–595.

Cook, Kerry H. and Edward K. Vizy, "Projected Changes in East African Rainy Seasons," *Journal of Climate*, 2013, *26*, 5931–5948.

Dal Bó, Ernesto and Pedro Dal Bó, "Workers, Warriors, And Criminals: Social Conflict In General Equilibrium," *Journal of the European Economic Association*, 2011, *9* (4), 646–677.

Depetris-Chauvin, Emilio, "State History and Contemporary Conflict: Evidence from Sub-Saharan Africa," 2015. Working paper, Pontifical Catholic University of Chile.

— **and Ömer Özak**, "Borderline Disorder: (De Facto) Historical Ethnic Borders and Contemporary Conflict in Africa," 2020. Working paper, Pontificia Universidad Católica de Chile.

Dube, Oeindrila and Juan F. Vargas, "Commodity Price Shocks and Civil Conflict: Evidence from Colombia," *The Review of Economic Studies*, 2013, *80* (4), 1384–1421.

Dyson-Hudson, Rada and Neville Dyson-Hudson, "Nomadic Pastoralism," *Annual Review of Anthropology*, 1980, *9*, 15–61.

Eberle, Ulrich, Dominic Rohner, and Matthias Thoenig, "Heat and Hate: Climate Security and Farmer-Herder Conflicts in Africa," 2020. CEPR Working paper.

Esteban, Joan, Laura Mayoral, and Debraj Ray, "Ethnicity and Conflict: An Empirical Study," *American Economic Review*, 2012, *102* (4), 1310–1342.

Fan, Yun and Huug van den Dool, "A Global Monthly Land Surface Air Temperature Analysis for 1948-present," *Journal of Geographical Research*, 2008, *113.*

FAO, *Pastoralism in Africa's Drylands: Reducing Risks, Addressing Vulnerability, and Enhancing Resilience*, Rome: Food and Agriculture Organization of the United Nations, 2018.

Fearon, James D. and David D. Laitin, "Ethnicity, Insurgency, and Civil War," *American Political Science Review*, 2003, *97* (1), 75–90.

Fetzer, Thiemo, "Can Workfare Programs Moderate Conflict? Evidence from India," *Journal of the European Economic Association*, 02 2020.

Gennaioli, Nicola and Ilia Rainer, "The Modern Impact of Precolonial Centralization in Africa," *Journal of Economic Growth*, 2007, *12* (3), 185–234.

Grosjean, Pauline, "A History of Violence: The Culture of Honor as a Determinant of Homicide in the U.S. South," *Journal of the European Economic Association*, 2014, *12* (5), 1285–1316.

Harari, Mariaflavia and Eliana La Ferrara, "Conflict, Climate, and Cells: A Disaggregated Analysis," *Review of Economics and Statistics*, 2018, *100* (4), 594–608.

Hein, L., "The Impacts of Grazing and Rainfall Variability on the Dynamics of a Sahelian Rangeland," *Journal of Arid Environments*, 2006, *64*, 488–504.

Herrmann, Stefanie M. and Karen I. Mohr, "A Continental-Scale Classification of Rainfall Seasonality Regimes in Africa Based on Gridded Precipitation and Land Surface Temperature Products," *Journal of Applied Meteorology and Climatology*, 2012, *50*, 2504–2513.

Hsiang, Solomon M., Marshall Burke, and Edward Miguel, "Quantifying the Influence of Climate on Human Conflict," *Science*, 2013, *341* (6151), 12353–67.

Jacobs, Alan H., "African Pastoralists: Some General Remarks," *Anthropological Quarterly*, 1965, *38* (3), 144–154.

Kincaide, Laura, Eoin McGuirk, and Nathan Nunn, "A Comprehensive Concordance between Murdock's Map of Ethnic Groups and the *Ethnographic Atlas*," 2020. Mimeo, Harvard University.

Kitchell, Erin, Matthew D. Turner, and John G. McPeak, "Mapping of Pastoral Corridors: Practices and Politics in Eastern Senegal," *Pastoralism*, 2014, *4* (17).

Konczacki, Z.A., *The Economics of Pastoralism: A Case Study of Sub-Saharan Africa*, London: Frank Cass & Company Ltd., 1978.

König, Michael D., Dominic Rohner, Mathias Thoenig, and Fabrizio Zilibotti, "Networks in Conflict: Theory and Evidence from the Great War of Africa," *Econometrica*, 2017, *85* (4), 1093–1132.

Lewis, I.M., *A Pastoral Democracy: A Study of Pastoralism and Politics*, Oxford: Oxford University Press, 1961.

Little, Peter D., Kevin Smith, Barbara A. Cellarius, D. Layne Coppock, and Christopher B. Barrett, "Avoiding Disaster: Diversification and Risk Management Among East African Herders," *Economic Development and Cultural Change*, 2001, *32*, 401–433.

Mach, Katharine J., Caroline M. Kraan, W. Neil Adger, Halvard Buhaug, Marshall Burke, James D. Fearon, Christopher B. Field, Cullen S. Hendrix, Jean-Francois Maystadt, John O'Loughlin, Philip Roessler, Jürgen Scheffran, Kenneth A. Schultz, and Nina von Uexkull, "Climate as a risk factor for armed conflict," *Nature*, 2019, *571* (7764), 193–197.

Marchiori, Luca, Jean-Francois Maystadt, and Ingmar Schumacher, "The Impact of Weather Anomalies on Migration in Sub-Saharan Africa," *Journal of Environmental Economics and Management*, 2012, *63* (3), 355–374.

Mattee, A.Z. and M. Shem, "Ambivalence and Contradiction: A Review of the Policy Environment in Tanzania in Relation to Pastoralism," 2006. Drylands Issue Paper No. 140. International Institute for Environment and Development (IIED).

Maystadt, Jean-Francois and Olivier Ecker, "Extreme Weather and Civil War: Does Drought Fuel Conflict in Somalia Through Livestock Price Shocks?," *American Journal of Agricultural Economics*, 2004, *96* (4), 1157–1182.

McGuirk, Eoin and Marshall Burke, "The Economic Origins of Conflict in Africa," *Journal of Political Economy*, 2020, *128* (10), 3940–3997.

McPeak, John G. and Christopher Barrett, "Differential Risk Exposure and Stochastic Poverty Traps Among East African Pastoralists," *American Journal of Agricultural Economics*, 2001, *83* (3), 674–679.

Michalopoulos, Stelios and Elias Papaioannou, "Precolonial Ethnic Institutions and Contemporary African Development," *Econometrica*, 2013, *81* (1), 113–152.

_ **and** _ , "The Long-Run Effects of the Scramble in Africa," *American Economic Review*, 2016, *106* (7), 1802–1848.

Miguel, Edward, Shanker Satyanath, and Ernest Sergenti, "Economic Shocks and Civil Conflict: An Instrumental Variables Approach," *Journal of Political Economy*, 2004, *112* (4), 725–753.

Montalvo, José G. and Marta Reynal-Querol, "Ethnic Polarization, Potential Conflict, and Civil Wars," *American Economic Review*, 2005, *95*, 796–816.

Moritz, Mark, "Understanding Herder-Farmer Conflicts in West Africa: Outline of a Processual Approach," *Human Organization*, 2010, *69*, 138–148.

Moscona, Jacob, Nathan Nunn, and James A. Robinson, "Segmentary Lineage Organization and Conflict in Sub-Saharan Africa," *Econometrica*, 2020, *88* (5), 1999–2036.

Murdock, George Peter, *Africa: Its Peoples and Their Cultural History*, New York: McGraw-Hill Book Company, 1959.

_ , *Ethnographic Atlas*, Pittsburgh: University of Pittsburgh Press, 1967.

Nicholson, Sharon E., Andreas H. Fink, and Chris Funk, "Assessing Recory and Change in West Africa's Rainfall Regime from a 161-Year Record," *International Journal of Climatology*, 2018, *38*, 3770–3786.

Nisbett, Richard E. and Dov Cohen, *Culture of Honor: The Psychology of Violence in the South*, Boulder: Westview Press, 1996.

Norenzayan, Ara, *Big Gods: How Religion Transformed Cooperation and Conflict*, Princeton: Princeton University Press, 2013.

Portmann, Felix T., Stefan Siebert, and Petra Döll, "MIRCA2000—Global monthly irrigated and rainfed crop areas around the year 2000: A new high-resolution data set for agricultural and hydrological modeling," *Global Biogeochemical Cycles*, 2010, *24* (1).

Raleigh, Clionadh, Andrew Linke, Håvard Hegre, and Joakim Karlsen, "Introducing ACLED-Armed Conflict Location and Event Data," *Journal of Peace Research*, 2010, *47* (5), 651–660.

Rohner, Dominic, Mathias Thoenig, and Fabrizio Zilibotti, "War Signals: A Theory of Trade, Trust, and Conflict," *Review of Economic Studies*, 2013, *80*, 1114–1147.

Ross, Michael L., "What Do We Know about Natural Resources and Civil War?," *Journal of Peace Research*, 2004, *41* (3), 337–356.

Schneider, Udo, Andreas Becker, Peter Finger, Anja Meyer-Christoffer, Bruno Rudolf, and Markus Ziese, "GPCC Full Data Reanalysis Version 7.0 at 0.5°: Monthly Land-Surface Precipitation from Rain-Gauges built on GTS-based and Historic Data," 2015. Unpublished Manuscript.

Shanahan, T.M., J.T. Overpeck, K.J. Anchukaitis, J.W. Beck, J.E. Cole, D.L. Dettman, J.A. Peck, C.A. Scholz, and J.W. King, "Atlantic Forcing of Persistent Drought in West Africa," *Science*, 2009, *324*, 377–380.

Solow, Andrew R., "A Call for Peace on Climate and Conflict," *Nature*, 2013, *497*, 179–180.

Stenning, Derrick J., *Savannah Nomads: A Study of the Wod̄aab̄e Pastoral Fulani of Western Bornu Province, Northern Region, Nigeria*, Oxford: Oxford University Press, 1959.

Sundberg, Ralph and Erik Melander, "Introducing the UCDP Georeferenced Event Dataset," *Journal of Peace Research*, 2013, *50* (4), 523–532.

Thomas, Natalie and Sumant Nigam, "Twentieth-Century Climate Change over Africa: Seasonal Hydroclimate Trends and Sahara Desert Expansion," *Journal of Climate*, 2018, *31*, 3349–3370.

Tollefsen, Andreas Forø, Håvard Strand, and Halvard Buhaug, "PRIO-GRID: A Unified Spatial Data Structure," *Journal of Peace Research*, 2012, *49* (2), 363–374.

For Online Publication: Appendix

Appendix A. Figures

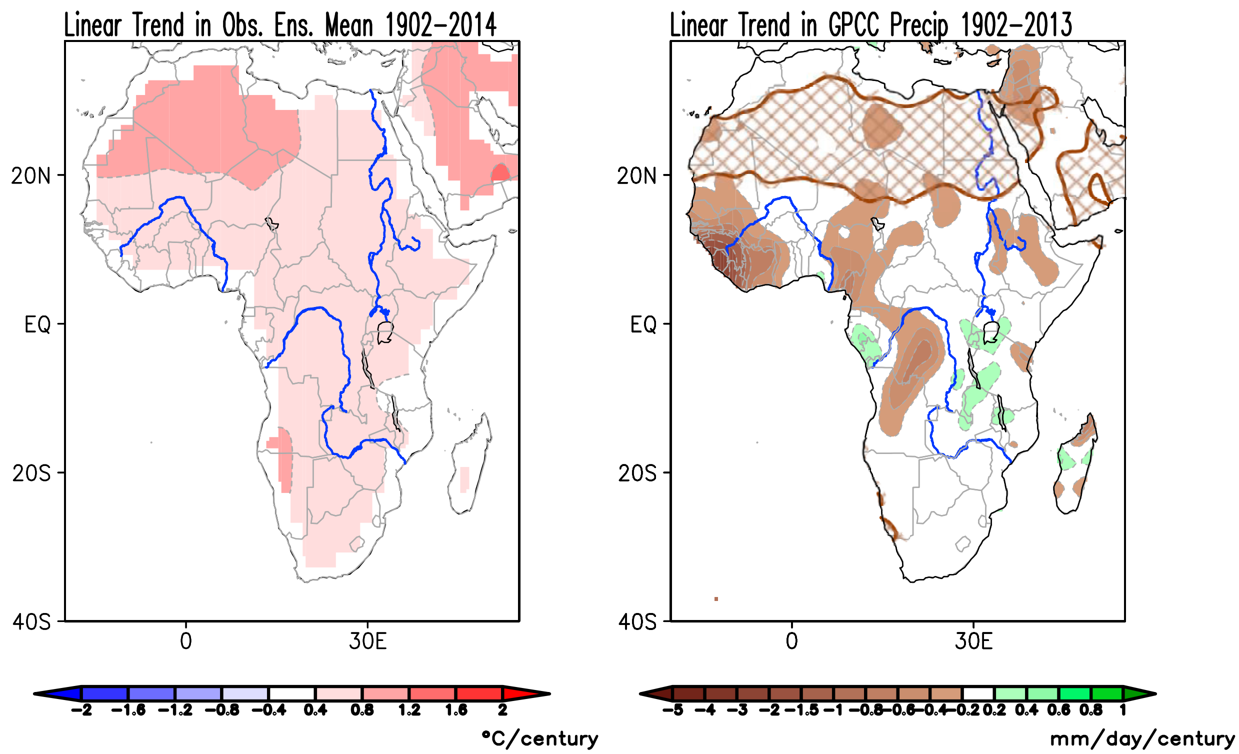


FIG. C1. Linear trend in annual-mean (left) SAT (°C century^{-1}) and (right) precipitation (mm day^{-1} century^{-1}) over the 1902–2014

Figure A1: Comparing spatial variation in temperature and rainfall anomalies. Variation for rainfall is much greater at a finer spatial scale than for temperature. Source: Thomas and Nigam (2018).

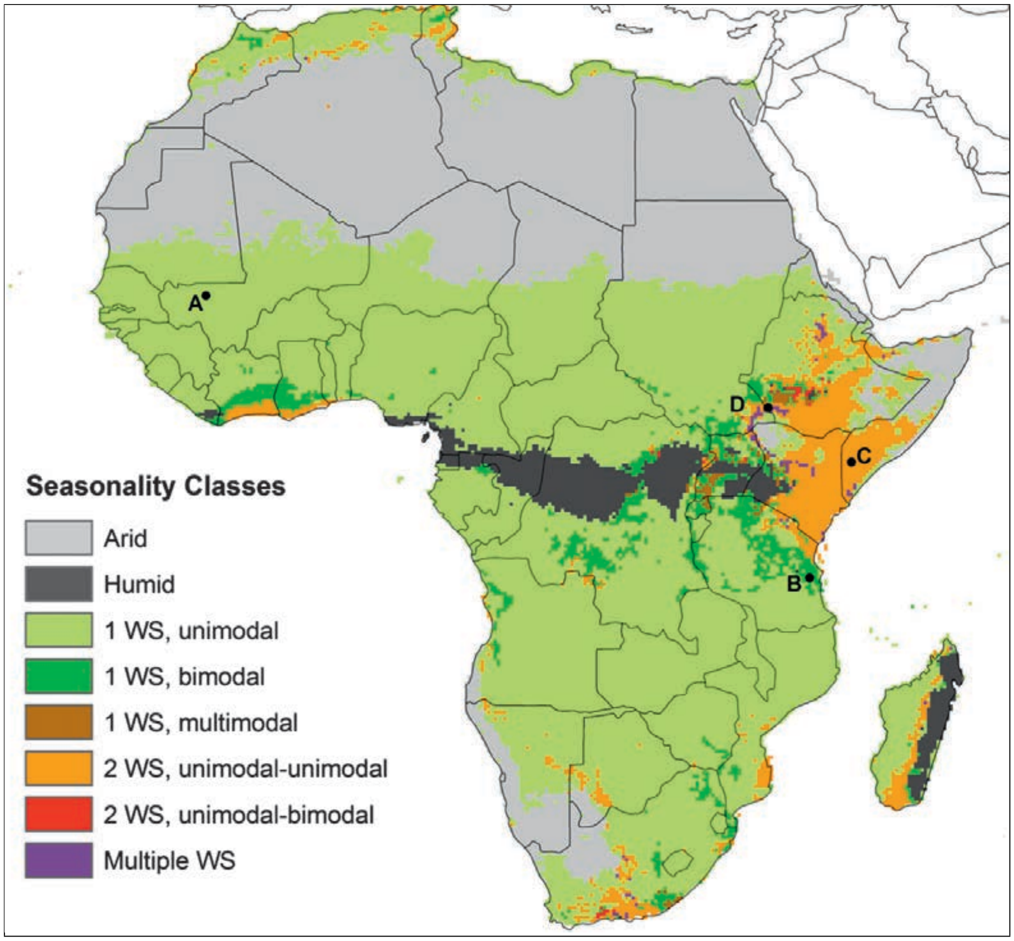


Figure A2: Distribution of types of rainy seasons across the African Continent. Source: Herrmann and Mohr (2012).

Appendix B. Tables

Table A1: Phytomass

	Phytomass		
	(1)	(2)	(3)
Rain	0.4151***		0.4092***
	(0.0357)		(0.0350)
Temp		-0.2223***	-0.2018***
		(0.0400)	(0.0383)
Share of RSS explained by weather variable(s) (in %)	3.63	0.61	4.13
F statistic	135.55	30.84	75.07
Effect of 1 Std. Dev. Shock as % of Dep. Var. Mean:			
Rain	1.63		1.61
p-value	[0.00]		[0.00]
Temp		-0.58	-0.53
p-value		[0.00]	[0.00]
Dep. Var. Mean	30.571	30.571	30.571
Cell FE	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes
Climate-Zone-Years	224	224	224
Cells	9,691	9,691	9,691
Observations	155,032	155,032	155,032

Note: This table presents phytomass (in kg/ha) as a function of rainfall (in cm/month) and temperature (in °C), conditional on cell fixed effects and country-by-year fixed effects. *RSS* refers to the residual sum of squares after partialling out the cell fixed effects and country-by-year fixed effects. Standard errors (in parentheses) are adjusted for serial correlation at the level of a cell and spatial correlation at the level of a climate zone. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A2: Robustness to Additional Controls for Ethnicity-Level Characteristics: Using the Narrow Definition of Transhumance

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)
Nearest Neighboring Ethnic Group												
Rain [γ_0^s]	-0.0026*	-0.0011	-0.0015	-0.0025	-0.0032**	-0.0015	-0.0017	-0.0029	0.0078	0.0059	0.0016	-0.0032
	(0.0015)	(0.0013)	(0.0012)	(0.0023)	(0.0016)	(0.0013)	(0.0012)	(0.0024)	(0.0053)	(0.0054)	(0.0033)	(0.0052)
Rain × Transhumant Pastoral [γ_1^s]	-0.0117***	-0.0123***	-0.0026	-0.0094**	-0.0124**	-0.0117***	-0.0045	-0.0151***	-0.0070	-0.0097*	0.0005	0.0028
	(0.0036)	(0.0031)	(0.0023)	(0.0038)	(0.0052)	(0.0039)	(0.0032)	(0.0053)	(0.0059)	(0.0051)	(0.0039)	(0.0065)
Rain × Jurisdictional Hierarchy	0.0005	0.0000	0.0001	-0.0002	0.0007	0.0002	0.0001	-0.0003	-0.0025	-0.0023	-0.0007	-0.0002
	(0.0006)	(0.0005)	(0.0005)	(0.0008)	(0.0007)	(0.0005)	(0.0005)	(0.0009)	(0.0020)	(0.0019)	(0.0012)	(0.0026)
Rain × Segmentary Lineage	0.0025	0.0020	0.0012	0.0032	0.0030	0.0024	0.0010	0.0049	-0.0087	-0.0074	-0.0000	-0.0168**
	(0.0019)	(0.0016)	(0.0014)	(0.0029)	(0.0019)	(0.0016)	(0.0014)	(0.0031)	(0.0053)	(0.0050)	(0.0040)	(0.0080)
Rain × High Gods: Active, Not Supportive	0.0021	0.0014	0.0033	0.0030	0.0024	0.0015	0.0038	0.0044	-0.0043	-0.0013	-0.0034	0.0023
	(0.0021)	(0.0016)	(0.0022)	(0.0036)	(0.0024)	(0.0018)	(0.0025)	(0.0038)	(0.0045)	(0.0039)	(0.0031)	(0.0097)
Rain × High Gods: Active, Supportive	0.0014	0.0018*	0.0012	-0.0009	0.0010	0.0013	0.0010	-0.0028	0.0011	0.0041	-0.0011	0.0052
	(0.0013)	(0.0010)	(0.0011)	(0.0022)	(0.0015)	(0.0011)	(0.0012)	(0.0025)	(0.0040)	(0.0035)	(0.0030)	(0.0065)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:												
Rain	-8.71	-5.28	-10.63	-3.41	-10.01	-6.66	-10.15	-3.61	33.02	33.26	19.05	-6.12
p-value	[0.10]	[0.39]	[0.19]	[0.28]	[0.04]	[0.25]	[0.18]	[0.24]	[0.14]	[0.27]	[0.62]	[0.54]
Rain × Transhumant Pastoral	-39.23	-58.80	-18.29	-13.08	-38.66	-53.06	-27.60	-19.06	-29.73	-54.57	5.54	5.44
p-value	[0.00]	[0.00]	[0.26]	[0.01]	[0.02]	[0.00]	[0.16]	[0.01]	[0.23]	[0.06]	[0.90]	[0.66]
Rain + Rain × Transhumant Pastoral	-47.94	-64.07	-28.93	-16.49	-48.67	-59.73	-37.75	-22.67	3.29	-21.31	24.59	-0.68
p-value	[0.00]	[0.00]	[0.10]	[0.01]	[0.01]	[0.00]	[0.08]	[0.00]	[0.91]	[0.53]	[0.66]	[0.96]
Dep. Var. Mean	0.0357	0.0251	0.0172	0.0865	0.0384	0.0264	0.0197	0.0952	0.0282	0.0214	0.0104	0.0624
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	420	420	420	322	390	390	390	299	360	360	360	276
Cells	6,554	6,554	6,554	6,554	4,812	4,812	4,812	4,812	1,742	1,742	1,742	1,742
Observations	196,620	196,620	196,620	150,742	144,360	144,360	144,360	110,676	52,260	52,260	52,260	40,066

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. This regression controls for the corresponding variables at the *Own Ethnic Group* level and the *Own Cell* level. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A3: Robustness to Additional Controls for Ethnicity-Level Characteristics: Using the Broad Definition of Transhumance

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)
Nearest Neighboring Ethnic Group												
Rain [γ_0^s]	-0.0025	-0.0009	-0.0015	-0.0023	-0.0031**	-0.0013	-0.0017	-0.0027	0.0079	0.0063	0.0014	-0.0030
	(0.0016)	(0.0013)	(0.0012)	(0.0023)	(0.0016)	(0.0013)	(0.0012)	(0.0024)	(0.0052)	(0.0054)	(0.0033)	(0.0051)
Rain × Transhumant Pastoral [γ_1^s]	-0.0075**	-0.0098***	-0.0003	-0.0081**	-0.0045	-0.0065**	-0.0003	-0.0081	-0.0072	-0.0116**	0.0015	0.0020
	(0.0031)	(0.0029)	(0.0020)	(0.0040)	(0.0040)	(0.0032)	(0.0025)	(0.0057)	(0.0054)	(0.0046)	(0.0038)	(0.0069)
Rain × Jurisdictional Hierarchy	0.0006	0.0001	0.0001	-0.0002	0.0007	0.0002	0.0001	-0.0002	-0.0023	-0.0021	-0.0006	-0.0005
	(0.0006)	(0.0005)	(0.0004)	(0.0008)	(0.0006)	(0.0005)	(0.0005)	(0.0009)	(0.0019)	(0.0018)	(0.0012)	(0.0026)
Rain × Segmentary Lineage	0.0023	0.0018	0.0011	0.0030	0.0027	0.0021	0.0009	0.0046	-0.0084	-0.0066	-0.0003	-0.0167**
	(0.0018)	(0.0015)	(0.0014)	(0.0029)	(0.0019)	(0.0016)	(0.0014)	(0.0031)	(0.0053)	(0.0050)	(0.0039)	(0.0081)
Rain × High Gods: Active, Not Supportive	0.0020	0.0012	0.0033	0.0028	0.0024	0.0014	0.0038	0.0043	-0.0042	-0.0015	-0.0032	0.0020
	(0.0022)	(0.0016)	(0.0022)	(0.0036)	(0.0025)	(0.0018)	(0.0025)	(0.0038)	(0.0045)	(0.0038)	(0.0031)	(0.0096)
Rain × High Gods: Active, Supportive	0.0006	0.0011	0.0009	-0.0015	0.0005	0.0009	0.0008	-0.0034	0.0005	0.0036	-0.0014	0.0057
	(0.0013)	(0.0011)	(0.0010)	(0.0022)	(0.0015)	(0.0011)	(0.0012)	(0.0025)	(0.0041)	(0.0038)	(0.0029)	(0.0069)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:												
Rain	-8.37	-4.54	-10.66	-3.23	-9.76	-6.14	-10.17	-3.44	33.45	35.49	16.46	-5.68
p-value	[0.11]	[0.46]	[0.19]	[0.31]	[0.05]	[0.29]	[0.18]	[0.27]	[0.14]	[0.24]	[0.67]	[0.57]
Rain × Transhumant Pastoral	-25.32	-47.05	-1.99	-11.26	-14.13	-29.60	-1.96	-10.21	-30.54	-65.20	17.12	3.92
p-value	[0.02]	[0.00]	[0.89]	[0.04]	[0.26]	[0.04]	[0.90]	[0.16]	[0.18]	[0.01]	[0.70]	[0.77]
Rain + Rain × Transhumant Pastoral	-33.69	-51.60	-12.65	-14.49	-23.89	-35.74	-12.12	-13.64	2.91	-29.71	33.59	-1.76
p-value	[0.00]	[0.00]	[0.40]	[0.02]	[0.07]	[0.02]	[0.47]	[0.07]	[0.91]	[0.37]	[0.50]	[0.91]
Dep. Var. Mean	0.0357	0.0251	0.0172	0.0865	0.0384	0.0264	0.0197	0.0952	0.0282	0.0214	0.0104	0.0624
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	420	420	420	322	390	390	390	299	360	360	360	276
Cells	6,554	6,554	6,554	6,554	4,812	4,812	4,812	4,812	1,742	1,742	1,742	1,742
Observations	196,620	196,620	196,620	150,742	144,360	144,360	144,360	110,676	52,260	52,260	52,260	40,066

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. This regression controls for the corresponding variables at the *Own Ethnic Group* level and the *Own Cell* level. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A4: Robustness to Additional Controls for Time-Varying Characteristics: Using the Narrow Definition of Transhumance

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)
Nearest Neighboring Ethnic Group												
Rain [γ_0^s]	-0.0006	0.0001	-0.0004	-0.0006	-0.0006	0.0002	-0.0006	-0.0001	0.0002	-0.0000	0.0008	-0.0100***
	(0.0006)	(0.0006)	(0.0005)	(0.0011)	(0.0007)	(0.0006)	(0.0005)	(0.0011)	(0.0027)	(0.0025)	(0.0019)	(0.0036)
Rain × Transhumant Pastoral [γ_1^s]	-0.0114***	-0.0126***	-0.0013	-0.0096***	-0.0125***	-0.0135***	-0.0028	-0.0176***	-0.0066	-0.0072	-0.0005	0.0031
	(0.0033)	(0.0031)	(0.0020)	(0.0036)	(0.0048)	(0.0040)	(0.0029)	(0.0054)	(0.0057)	(0.0052)	(0.0034)	(0.0059)
Year × Transhumant Pastoral	-0.0002	0.0001	-0.0003	-0.0064***	-0.0000	0.0002	0.0000	-0.0055**	-0.0017**	-0.0013*	-0.0008*	-0.0075***
	(0.0006)	(0.0006)	(0.0003)	(0.0018)	(0.0011)	(0.0011)	(0.0005)	(0.0026)	(0.0008)	(0.0007)	(0.0004)	(0.0022)
Price Index: Energy × Transhumant Pastoral	0.0004**	0.0002	0.0001	0.0005**	0.0002	-0.0002	0.0001	0.0002	0.0004	0.0003	0.0000	0.0004
	(0.0002)	(0.0002)	(0.0001)	(0.0002)	(0.0003)	(0.0003)	(0.0002)	(0.0005)	(0.0003)	(0.0002)	(0.0001)	(0.0003)
Price Index: Metals and Minerals × Transhumant Pastoral	0.0001	0.0003	-0.0001	-0.0003	0.0002	0.0006**	-0.0002	-0.0002	0.0003	0.0003	0.0002	0.0002
	(0.0002)	(0.0002)	(0.0001)	(0.0003)	(0.0003)	(0.0003)	(0.0002)	(0.0005)	(0.0004)	(0.0003)	(0.0002)	(0.0003)
Price Index: Precious Metals × Transhumant Pastoral	-0.0006*	-0.0006**	0.0001	0.0005	0.0006	0.0005	0.0007***	0.0007	-0.0006*	-0.0006**	-0.0000	0.0006
	(0.0003)	(0.0003)	(0.0002)	(0.0005)	(0.0005)	(0.0005)	(0.0002)	(0.0007)	(0.0003)	(0.0003)	(0.0002)	(0.0007)
Price Index: Agriculture × Transhumant Pastoral	0.0004	0.0006	-0.0001	0.0006	-0.0018**	-0.0013*	-0.0011**	-0.0000	0.0006	0.0006	0.0000	-0.0001
	(0.0005)	(0.0005)	(0.0003)	(0.0007)	(0.0008)	(0.0007)	(0.0005)	(0.0012)	(0.0005)	(0.0005)	(0.0003)	(0.0009)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:												
Rain	-2.02	0.31	-3.27	-0.88	-1.96	0.75	-3.79	-0.17	0.92	-0.12	11.00	-21.75
p-value	[0.36]	[0.91]	[0.39]	[0.56]	[0.33]	[0.75]	[0.25]	[0.90]	[0.94]	[0.99]	[0.65]	[0.01]
Rain × Transhumant Pastoral	-38.88	-59.31	-9.74	-13.71	-38.04	-57.51	-17.89	-22.10	-31.68	-46.42	-6.30	6.65
p-value	[0.00]	[0.00]	[0.52]	[0.01]	[0.01]	[0.00]	[0.34]	[0.00]	[0.25]	[0.17]	[0.89]	[0.61]
Rain + Rain × Transhumant Pastoral	-40.90	-59.01	-13.01	-14.60	-40.00	-56.75	-21.67	-22.27	-30.76	-46.54	4.70	-15.10
p-value	[0.00]	[0.00]	[0.39]	[0.00]	[0.01]	[0.00]	[0.25]	[0.00]	[0.23]	[0.14]	[0.91]	[0.18]
Dep. Var. Mean	0.0352	0.0254	0.0160	0.0838	0.0394	0.0282	0.0189	0.0956	0.0249	0.0187	0.0092	0.0551
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	420	420	420	322	390	390	390	299	390	390	390	299
Cells	7,667	7,667	7,667	7,667	5,427	5,427	5,427	5,427	2,240	2,240	2,240	2,240
Observations	230,010	230,010	230,010	176,341	162,810	162,810	162,810	124,821	67,200	67,200	67,200	51,520

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. This regression controls for the corresponding variables at the *Own Ethnic Group* level and the *Own Cell* level. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A5: Robustness to Additional Controls for Time-Varying Characteristics: Using the Broad Definition of Transhumance

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)
Nearest Neighboring Ethnic Group												
Rain [γ_0^s]	-0.0006	0.0002	-0.0005	-0.0006	-0.0007	0.0002	-0.0006	-0.0001	0.0005	0.0008	0.0006	-0.0100***
	(0.0006)	(0.0006)	(0.0005)	(0.0011)	(0.0007)	(0.0006)	(0.0005)	(0.0011)	(0.0027)	(0.0025)	(0.0019)	(0.0036)
Rain × Transhumant Pastoral [γ_1^s]	-0.0086***	-0.0110***	0.0007	-0.0092**	-0.0072*	-0.0096***	0.0003	-0.0122**	-0.0066	-0.0086*	0.0004	0.0031
	(0.0031)	(0.0028)	(0.0019)	(0.0036)	(0.0040)	(0.0034)	(0.0024)	(0.0054)	(0.0055)	(0.0050)	(0.0035)	(0.0061)
Year × Transhumant Pastoral	0.0003	0.0004	-0.0001	-0.0055***	0.0003	0.0004	0.0004	-0.0037	-0.0013**	-0.0010**	-0.0007*	-0.0071***
	(0.0006)	(0.0005)	(0.0003)	(0.0017)	(0.0010)	(0.0010)	(0.0005)	(0.0024)	(0.0006)	(0.0005)	(0.0004)	(0.0022)
Price Index: Energy × Transhumant Pastoral	0.0005***	0.0003*	0.0001	0.0006***	0.0002	-0.0001	0.0001	0.0004	0.0005**	0.0004**	0.0001	0.0004*
	(0.0002)	(0.0002)	(0.0001)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0004)	(0.0002)	(0.0002)	(0.0001)	(0.0003)
Price Index: Metals and Minerals × Transhumant Pastoral	0.0000	0.0002	-0.0001	-0.0004*	0.0002	0.0005*	-0.0001	-0.0003	0.0003	0.0002	0.0001	0.0001
	(0.0002)	(0.0002)	(0.0001)	(0.0003)	(0.0003)	(0.0003)	(0.0002)	(0.0004)	(0.0003)	(0.0003)	(0.0001)	(0.0003)
Price Index: Precious Metals × Transhumant Pastoral	-0.0007**	-0.0007**	0.0000	0.0003	0.0005	0.0003	0.0005**	0.0002	-0.0006*	-0.0006**	-0.0001	0.0005
	(0.0003)	(0.0003)	(0.0001)	(0.0005)	(0.0004)	(0.0004)	(0.0002)	(0.0007)	(0.0003)	(0.0003)	(0.0002)	(0.0007)
Price Index: Agriculture × Transhumant Pastoral	0.0005	0.0007	0.0000	0.0009	-0.0017**	-0.0011*	-0.0009**	0.0006	0.0007	0.0005	0.0001	-0.0002
	(0.0006)	(0.0005)	(0.0003)	(0.0007)	(0.0007)	(0.0006)	(0.0004)	(0.0010)	(0.0005)	(0.0005)	(0.0003)	(0.0009)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:												
Rain	-1.96	0.75	-3.87	-0.83	-1.99	0.90	-4.12	-0.16	2.54	4.81	8.06	-21.76
p-value	[0.38]	[0.78]	[0.31]	[0.59]	[0.32]	[0.70]	[0.22]	[0.91]	[0.85]	[0.77]	[0.75]	[0.01]
Rain × Transhumant Pastoral	-29.51	-52.09	4.93	-13.25	-21.83	-41.06	2.12	-15.31	-31.94	-55.31	5.48	6.82
p-value	[0.00]	[0.00]	[0.73]	[0.01]	[0.07]	[0.01]	[0.89]	[0.02]	[0.23]	[0.08]	[0.90]	[0.61]
Rain + Rain × Transhumant Pastoral	-31.47	-51.34	1.06	-14.08	-23.81	-40.16	-2.00	-15.46	-29.40	-50.50	13.54	-14.94
p-value	[0.00]	[0.00]	[0.94]	[0.01]	[0.05]	[0.01]	[0.90]	[0.02]	[0.22]	[0.08]	[0.73]	[0.20]
Dep. Var. Mean	0.0352	0.0254	0.0160	0.0838	0.0394	0.0282	0.0189	0.0956	0.0249	0.0187	0.0092	0.0551
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	420	420	420	322	390	390	390	299	390	390	390	299
Cells	7,667	7,667	7,667	7,667	5,427	5,427	5,427	5,427	2,240	2,240	2,240	2,240
Observations	230,010	230,010	230,010	176,341	162,810	162,810	162,810	124,821	67,200	67,200	67,200	51,520

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. This regression controls for the corresponding variables at the *Own Ethnic Group* level and the *Own Cell* level. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A6: Robustness to Controlling for the Components of Transhumant Pastoralism: Using the Narrow Definition of Transhumance

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)
Nearest Neighboring Ethnic Group												
Rain [γ_0^s]	-0.0015	0.0003	-0.0019**	-0.0019	-0.0018*	0.0000	-0.0021**	-0.0022	0.0024	0.0032	0.0017	-0.0101
	(0.0011)	(0.0008)	(0.0009)	(0.0015)	(0.0011)	(0.0008)	(0.0009)	(0.0016)	(0.0049)	(0.0049)	(0.0036)	(0.0087)
Rain × Pastoral	0.0046	-0.0016	0.0078**	0.0068	0.0063	0.0003	0.0084**	0.0117*	-0.0095	-0.0131	-0.0038	-0.0032
	(0.0044)	(0.0035)	(0.0035)	(0.0062)	(0.0047)	(0.0036)	(0.0038)	(0.0065)	(0.0130)	(0.0141)	(0.0106)	(0.0290)
Rain × Transhumant	0.0041	0.0022	0.0038**	0.0029	0.0029	0.0007	0.0038	0.0026	0.0011	0.0015	-0.0007	0.0060
	(0.0025)	(0.0018)	(0.0019)	(0.0039)	(0.0028)	(0.0020)	(0.0024)	(0.0060)	(0.0055)	(0.0056)	(0.0038)	(0.0096)
Rain × Transhumant Pastoral [γ_1^s]	-0.0195***	-0.0135**	-0.0119**	-0.0186**	-0.0208***	-0.0131**	-0.0146**	-0.0298**	-0.0008	0.0002	0.0034	-0.0006
	(0.0069)	(0.0056)	(0.0049)	(0.0088)	(0.0078)	(0.0064)	(0.0057)	(0.0119)	(0.0156)	(0.0167)	(0.0116)	(0.0305)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:												
Rain	-5.13	1.30	-14.13	-2.67	-5.51	0.13	-13.12	-2.79	11.76	20.38	21.85	-22.08
p-value	[0.16]	[0.74]	[0.03]	[0.22]	[0.10]	[0.97]	[0.02]	[0.16]	[0.62]	[0.52]	[0.65]	[0.25]
Rain × Transhumant Pastoral	-66.47	-63.64	-88.73	-26.64	-63.23	-55.83	-93.08	-37.46	-3.96	1.21	44.41	-1.23
p-value	[0.00]	[0.02]	[0.02]	[0.04]	[0.01]	[0.04]	[0.01]	[0.01]	[0.96]	[0.99]	[0.77]	[0.99]
Rain + Rain × Transhumant Pastoral	-71.60	-62.35	-102.86	-29.31	-68.74	-55.70	-106.20	-40.26	7.80	21.60	66.26	-23.31
p-value	[0.01]	[0.03]	[0.01]	[0.04]	[0.01]	[0.06]	[0.01]	[0.01]	[0.93]	[0.87]	[0.73]	[0.78]
Dep. Var. Mean	0.0352	0.0254	0.0160	0.0838	0.0394	0.0282	0.0189	0.0956	0.0249	0.0187	0.0092	0.0551
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	420	420	420	322	390	390	390	299	390	390	390	299
Cells	7,667	7,667	7,667	7,667	5,427	5,427	5,427	5,427	2,240	2,240	2,240	2,240
Observations	230,010	230,010	230,010	176,341	162,810	162,810	162,810	124,821	67,200	67,200	67,200	51,520

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. This regression controls for the corresponding variables at the *Own Ethnic Group* level and the *Own Cell* level. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A7: Robustness to Controlling for the Components of Transhumant Pastoralism: Using the Broad Definition of Transhumance

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)
Nearest Neighboring Ethnic Group												
Rain [γ_0^s]	-0.0016	0.0002	-0.0017*	-0.0020	-0.0018	0.0001	-0.0019**	-0.0020	0.0042	0.0029	0.0031	-0.0081
	(0.0011)	(0.0009)	(0.0009)	(0.0015)	(0.0011)	(0.0008)	(0.0009)	(0.0016)	(0.0053)	(0.0048)	(0.0038)	(0.0080)
Rain × Pastoral	0.0045	-0.0010	0.0063	0.0084	0.0057	0.0000	0.0071*	0.0113*	-0.0168	-0.0108	-0.0111	-0.0109
	(0.0047)	(0.0037)	(0.0038)	(0.0059)	(0.0048)	(0.0038)	(0.0041)	(0.0066)	(0.0149)	(0.0127)	(0.0108)	(0.0246)
Rain × Transhumant	0.0053***	0.0030**	0.0034**	0.0013	0.0044**	0.0021	0.0029**	0.0025	-0.0006	0.0009	-0.0011	0.0006
	(0.0018)	(0.0014)	(0.0013)	(0.0030)	(0.0017)	(0.0013)	(0.0013)	(0.0036)	(0.0063)	(0.0061)	(0.0045)	(0.0105)
Rain × Transhumant Pastoral [γ_1^s]	-0.0191***	-0.0141***	-0.0088*	-0.0171**	-0.0179***	-0.0119**	-0.0094*	-0.0246**	0.0062	-0.0016	0.0097	0.0113
	(0.0063)	(0.0053)	(0.0046)	(0.0084)	(0.0066)	(0.0055)	(0.0050)	(0.0104)	(0.0175)	(0.0152)	(0.0126)	(0.0282)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:												
Rain	-5.37	0.73	-12.91	-2.81	-5.38	0.27	-12.14	-2.54	20.15	18.63	40.20	-17.68
p-value	[0.16]	[0.86]	[0.06]	[0.19]	[0.12]	[0.94]	[0.04]	[0.20]	[0.43]	[0.55]	[0.41]	[0.31]
Rain × Transhumant Pastoral	-65.34	-66.62	-65.54	-24.51	-54.35	-50.90	-60.12	-30.94	30.04	-10.37	126.97	24.56
p-value	[0.00]	[0.01]	[0.06]	[0.04]	[0.01]	[0.03]	[0.06]	[0.02]	[0.72]	[0.92]	[0.44]	[0.69]
Rain + Rain × Transhumant Pastoral	-70.71	-65.89	-78.45	-27.32	-59.73	-50.64	-72.26	-33.48	50.19	8.26	167.17	6.88
p-value	[0.00]	[0.02]	[0.04]	[0.04]	[0.01]	[0.05]	[0.05]	[0.02]	[0.63]	[0.95]	[0.41]	[0.93]
Dep. Var. Mean	0.0352	0.0254	0.0160	0.0838	0.0394	0.0282	0.0189	0.0956	0.0249	0.0187	0.0092	0.0551
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	420	420	420	322	390	390	390	299	390	390	390	299
Cells	7,667	7,667	7,667	7,667	5,427	5,427	5,427	5,427	2,240	2,240	2,240	2,240
Observations	230,010	230,010	230,010	176,341	162,810	162,810	162,810	124,821	67,200	67,200	67,200	51,520

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. This regression controls for the corresponding variables at the *Own Ethnic Group* level and the *Own Cell* level. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A8: Clustering by Country using Narrow Definition of Transhumant Pastoralism

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)
Nearest Neighboring Ethnic Group												
Rain	-0.0006	0.0001	-0.0004	-0.0006	-0.0007	0.0001	-0.0006	-0.0001	-0.0000	-0.0001	0.0007	-0.0105**
	(0.0006)	(0.0005)	(0.0006)	(0.0011)	(0.0007)	(0.0005)	(0.0007)	(0.0012)	(0.0025)	(0.0012)	(0.0025)	(0.0042)
Rain × Transhumant Pastoral	-0.0110**	-0.0121***	-0.0012	-0.0096***	-0.0122**	-0.0124**	-0.0030	-0.0172***	-0.0053	-0.0062	-0.0001	0.0052
	(0.0044)	(0.0039)	(0.0022)	(0.0022)	(0.0052)	(0.0051)	(0.0019)	(0.0041)	(0.0064)	(0.0049)	(0.0036)	(0.0052)
Own Ethnic Group												
Rain	-0.0000	0.0013	-0.0003	0.0009	-0.0001	0.0012	-0.0002	0.0002	-0.0057	-0.0028	-0.0014	-0.0022
	(0.0009)	(0.0011)	(0.0006)	(0.0012)	(0.0010)	(0.0012)	(0.0006)	(0.0012)	(0.0049)	(0.0042)	(0.0040)	(0.0049)
Rain × Transhumant Pastoral	-0.0015	-0.0046	0.0016	-0.0013	0.0089	0.0057	0.0091	-0.0186	0.0043	-0.0013	0.0021	0.0079
	(0.0051)	(0.0036)	(0.0035)	(0.0035)	(0.0085)	(0.0070)	(0.0070)	(0.0153)	(0.0096)	(0.0059)	(0.0063)	(0.0081)
Own Cell												
Rain	-0.0002	-0.0004	-0.0001	-0.0004	-0.0002	-0.0004	-0.0001	-0.0006	0.0012	-0.0023	0.0028	-0.0001
	(0.0006)	(0.0005)	(0.0005)	(0.0010)	(0.0006)	(0.0004)	(0.0006)	(0.0010)	(0.0033)	(0.0023)	(0.0031)	(0.0040)
Rain × Transhumant Pastoral	0.0039	0.0055	-0.0009	0.0046	-0.0072	-0.0063*	-0.0054	0.0169	-0.0001	0.0065	-0.0056	0.0054
	(0.0051)	(0.0043)	(0.0031)	(0.0046)	(0.0091)	(0.0037)	(0.0092)	(0.0128)	(0.0087)	(0.0062)	(0.0058)	(0.0095)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:												
Rain	-2.02	0.25	-3.31	-0.79	-1.98	0.60	-3.78	-0.13	-0.14	-0.73	8.88	-22.95
p-value	[0.35]	[0.92]	[0.44]	[0.61]	[0.35]	[0.77]	[0.37]	[0.93]	[0.99]	[0.92]	[0.79]	[0.02]
Rain × Transhumant Pastoral	-37.42	-56.94	-9.22	-13.82	-37.27	-52.82	-19.38	-21.65	-25.72	-39.97	-0.97	11.27
p-value	[0.02]	[0.00]	[0.58]	[0.00]	[0.02]	[0.02]	[0.12]	[0.00]	[0.42]	[0.21]	[0.98]	[0.33]
Rain + Rain × Transhumant Pastoral	-39.44	-56.69	-12.53	-14.62	-39.25	-52.22	-23.16	-21.78	-25.86	-40.70	7.91	-11.69
p-value	[0.01]	[0.00]	[0.45]	[0.00]	[0.02]	[0.02]	[0.08]	[0.00]	[0.37]	[0.22]	[0.82]	[0.26]
Dep. Var. Mean	0.0352	0.0254	0.0160	0.0838	0.0394	0.0282	0.0189	0.0956	0.0249	0.0187	0.0092	0.0551
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Countries	49	49	49	49	48	48	48	48	26	26	26	26
Observations	230,010	230,010	230,010	176,341	162,810	162,810	162,810	124,821	67,200	67,200	67,200	51,520

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. *Own Ethnic Group* refers to the ethnic territory that contains cell i. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a country. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A9: Clustering by Country using Broad Definition of Transhumant Pastoralism

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)
Nearest Neighboring Ethnic Group												
Rain	-0.0006	0.0001	-0.0005	-0.0004	-0.0006	0.0002	-0.0007	-0.0000	0.0002	0.0005	0.0005	-0.0107**
	(0.0006)	(0.0005)	(0.0006)	(0.0011)	(0.0007)	(0.0005)	(0.0007)	(0.0012)	(0.0027)	(0.0014)	(0.0027)	(0.0046)
Rain × Transhumant Pastoral	-0.0082*	-0.0105***	0.0007	-0.0093***	-0.0067	-0.0087**	0.0004	-0.0125***	-0.0053	-0.0074	0.0007	0.0051
	(0.0041)	(0.0037)	(0.0020)	(0.0022)	(0.0045)	(0.0041)	(0.0018)	(0.0045)	(0.0063)	(0.0054)	(0.0037)	(0.0057)
Own Ethnic Group												
Rain	0.0002	0.0015	-0.0002	0.0010	0.0002	0.0014	-0.0001	0.0006	-0.0042	-0.0021	-0.0008	-0.0055
	(0.0009)	(0.0011)	(0.0006)	(0.0013)	(0.0010)	(0.0012)	(0.0006)	(0.0013)	(0.0051)	(0.0044)	(0.0037)	(0.0051)
Rain × Transhumant Pastoral	-0.0050	-0.0065*	-0.0010	-0.0028	-0.0063	-0.0040	-0.0020	-0.0258**	0.0017	-0.0025	0.0010	0.0133
	(0.0051)	(0.0038)	(0.0031)	(0.0032)	(0.0080)	(0.0075)	(0.0037)	(0.0106)	(0.0102)	(0.0066)	(0.0061)	(0.0079)
Own Cell												
Rain	-0.0003	-0.0005	-0.0001	-0.0005	-0.0002	-0.0004	-0.0001	-0.0008	-0.0008	-0.0038	0.0019	0.0026
	(0.0006)	(0.0005)	(0.0006)	(0.0010)	(0.0006)	(0.0004)	(0.0006)	(0.0010)	(0.0031)	(0.0027)	(0.0025)	(0.0036)
Rain × Transhumant Pastoral	0.0048	0.0061	-0.0000	0.0054	-0.0023	-0.0028	0.0002	0.0183*	0.0034	0.0088	-0.0039	0.0005
	(0.0047)	(0.0039)	(0.0030)	(0.0044)	(0.0030)	(0.0036)	(0.0030)	(0.0100)	(0.0083)	(0.0064)	(0.0053)	(0.0093)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:												
Rain	-1.97	0.71	-3.93	-0.62	-1.98	0.81	-4.16	-0.01	0.81	2.94	6.37	-23.37
p-value	[0.36]	[0.78]	[0.36]	[0.70]	[0.35]	[0.71]	[0.33]	[0.99]	[0.95]	[0.74]	[0.86]	[0.03]
Rain × Transhumant Pastoral	-27.83	-49.58	5.59	-13.38	-20.30	-36.90	2.65	-15.69	-25.72	-47.62	8.84	11.04
p-value	[0.05]	[0.01]	[0.71]	[0.00]	[0.14]	[0.04]	[0.82]	[0.01]	[0.40]	[0.18]	[0.86]	[0.38]
Rain + Rain × Transhumant Pastoral	-29.80	-48.87	1.66	-14.00	-22.28	-36.09	-1.51	-15.71	-24.90	-44.69	15.21	-12.33
p-value	[0.04]	[0.01]	[0.91]	[0.00]	[0.11]	[0.03]	[0.90]	[0.01]	[0.34]	[0.18]	[0.64]	[0.22]
Dep. Var. Mean	0.0352	0.0254	0.0160	0.0838	0.0394	0.0282	0.0189	0.0956	0.0249	0.0187	0.0092	0.0551
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Countries	49	49	49	49	48	48	48	48	26	26	26	26
Observations	230,010	230,010	230,010	176,341	162,810	162,810	162,810	124,821	67,200	67,200	67,200	51,520

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. *Own Ethnic Group* refers to the ethnic territory that contains cell i. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a country. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A10: Clustering by Country and Climate-Zone-Year using Narrow Definition of Transhumant Pastoralism

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)
Nearest Neighboring Ethnic Group												
Rain	-0.0006	0.0001	-0.0004	-0.0006	-0.0007	0.0001	-0.0006	-0.0001	-0.0000	-0.0001	0.0007	-0.0105**
	(0.0006)	(0.0005)	(0.0005)	(0.0011)	(0.0007)	(0.0005)	(0.0006)	(0.0012)	(0.0025)	(0.0013)	(0.0025)	(0.0043)
Rain × Transhumant Pastoral	-0.0110**	-0.0121***	-0.0012	-0.0096***	-0.0122**	-0.0124**	-0.0030	-0.0172***	-0.0053	-0.0062	-0.0001	0.0052
	(0.0043)	(0.0037)	(0.0021)	(0.0018)	(0.0054)	(0.0051)	(0.0020)	(0.0028)	(0.0065)	(0.0050)	(0.0036)	(0.0052)
Own Ethnic Group												
Rain	-0.0000	0.0013	-0.0003	0.0009	-0.0001	0.0012	-0.0002	0.0002	-0.0057	-0.0028	-0.0014	-0.0022
	(0.0010)	(0.0012)	(0.0006)	(0.0012)	(0.0011)	(0.0013)	(0.0006)	(0.0012)	(0.0047)	(0.0041)	(0.0039)	(0.0053)
Rain × Transhumant Pastoral	-0.0015	-0.0046	0.0016	-0.0013	0.0089	0.0057	0.0091	-0.0186	0.0043	-0.0013	0.0021	0.0079
	(0.0049)	(0.0040)	(0.0039)	(0.0038)	(0.0094)	(0.0071)	(0.0075)	(0.0159)	(0.0092)	(0.0062)	(0.0063)	(0.0089)
Own Cell												
Rain	-0.0002	-0.0004	-0.0001	-0.0004	-0.0002	-0.0004	-0.0001	-0.0006	0.0012	-0.0023	0.0028	-0.0001
	(0.0006)	(0.0005)	(0.0005)	(0.0009)	(0.0006)	(0.0005)	(0.0006)	(0.0010)	(0.0034)	(0.0023)	(0.0031)	(0.0042)
Rain × Transhumant Pastoral	0.0039	0.0055	-0.0009	0.0046	-0.0072	-0.0063	-0.0054	0.0169	-0.0001	0.0065	-0.0056	0.0054
	(0.0050)	(0.0040)	(0.0031)	(0.0047)	(0.0090)	(0.0041)	(0.0092)	(0.0130)	(0.0087)	(0.0060)	(0.0058)	(0.0102)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:												
Rain	-2.02	0.25	-3.31	-0.79	-1.98	0.60	-3.78	-0.13	-0.14	-0.73	8.88	-22.95
p-value	[0.32]	[0.92]	[0.39]	[0.62]	[0.33]	[0.78]	[0.32]	[0.93]	[0.99]	[0.93]	[0.79]	[0.02]
Rain × Transhumant Pastoral	-37.42	-56.94	-9.22	-13.82	-37.27	-52.82	-19.38	-21.65	-25.72	-39.97	-0.97	11.27
p-value	[0.01]	[0.00]	[0.56]	[0.00]	[0.03]	[0.02]	[0.13]	[0.00]	[0.42]	[0.23]	[0.98]	[0.33]
Rain + Rain × Transhumant Pastoral	-39.44	-56.69	-12.53	-14.62	-39.25	-52.22	-23.16	-21.78	-25.86	-40.70	7.91	-11.69
p-value	[0.01]	[0.00]	[0.43]	[0.00]	[0.02]	[0.02]	[0.10]	[0.00]	[0.38]	[0.23]	[0.82]	[0.26]
Dep. Var. Mean	0.0352	0.0254	0.0160	0.0838	0.0394	0.0282	0.0189	0.0956	0.0249	0.0187	0.0092	0.0551
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	420	420	420	322	390	390	390	299	390	390	390	299
Countries	49	49	49	49	48	48	48	48	26	26	26	26
Observations	230,010	230,010	230,010	176,341	162,810	162,810	162,810	124,821	67,200	67,200	67,200	51,520

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. *Own Ethnic Group* refers to the ethnic territory that contains cell i. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a country and a climate-zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A11: Clustering by Country and Climate-Zone-Year using Broad Definition of Transhumant Pastoralism

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)
Nearest Neighboring Ethnic Group												
Rain	-0.0006	0.0001	-0.0005	-0.0004	-0.0006	0.0002	-0.0007	-0.0000	0.0002	0.0005	0.0005	-0.0107**
	(0.0006)	(0.0005)	(0.0005)	(0.0011)	(0.0007)	(0.0005)	(0.0006)	(0.0013)	(0.0028)	(0.0015)	(0.0027)	(0.0046)
Rain × Transhumant Pastoral	-0.0082**	-0.0105***	0.0007	-0.0093***	-0.0067	-0.0087**	0.0004	-0.0125***	-0.0053	-0.0074	0.0007	0.0051
	(0.0040)	(0.0036)	(0.0019)	(0.0021)	(0.0046)	(0.0040)	(0.0017)	(0.0044)	(0.0062)	(0.0051)	(0.0037)	(0.0059)
Own Ethnic Group												
Rain	0.0002	0.0015	-0.0002	0.0010	0.0002	0.0014	-0.0001	0.0006	-0.0042	-0.0021	-0.0008	-0.0055
	(0.0011)	(0.0012)	(0.0006)	(0.0013)	(0.0011)	(0.0013)	(0.0006)	(0.0013)	(0.0049)	(0.0044)	(0.0036)	(0.0056)
Rain × Transhumant Pastoral	-0.0050	-0.0065	-0.0010	-0.0028	-0.0063	-0.0040	-0.0020	-0.0258**	0.0017	-0.0025	0.0010	0.0133
	(0.0048)	(0.0039)	(0.0034)	(0.0035)	(0.0072)	(0.0070)	(0.0029)	(0.0101)	(0.0097)	(0.0068)	(0.0061)	(0.0090)
Own Cell												
Rain	-0.0003	-0.0005	-0.0001	-0.0005	-0.0002	-0.0004	-0.0001	-0.0008	-0.0008	-0.0038	0.0019	0.0026
	(0.0007)	(0.0005)	(0.0006)	(0.0009)	(0.0006)	(0.0005)	(0.0006)	(0.0009)	(0.0031)	(0.0026)	(0.0025)	(0.0038)
Rain × Transhumant Pastoral	0.0048	0.0061*	-0.0000	0.0054	-0.0023**	-0.0028	0.0002	0.0183*	0.0034	0.0088	-0.0039	0.0005
	(0.0045)	(0.0036)	(0.0030)	(0.0044)	(0.0011)	(0.0031)	(0.0026)	(0.0099)	(0.0084)	(0.0061)	(0.0054)	(0.0100)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:												
Rain	-1.97	0.71	-3.93	-0.62	-1.98	0.81	-4.16	-0.01	0.81	2.94	6.37	-23.37
p-value	[0.34]	[0.78]	[0.31]	[0.71]	[0.33]	[0.70]	[0.28]	[0.99]	[0.95]	[0.76]	[0.86]	[0.03]
Rain × Transhumant Pastoral	-27.83	-49.58	5.59	-13.38	-20.30	-36.90	2.65	-15.69	-25.72	-47.62	8.84	11.04
p-value	[0.05]	[0.01]	[0.69]	[0.00]	[0.15]	[0.04]	[0.81]	[0.01]	[0.40]	[0.16]	[0.86]	[0.40]
Rain + Rain × Transhumant Pastoral	-29.80	-48.87	1.66	-14.00	-22.28	-36.09	-1.51	-15.71	-24.90	-44.69	15.21	-12.33
p-value	[0.04]	[0.01]	[0.90]	[0.00]	[0.12]	[0.03]	[0.90]	[0.00]	[0.33]	[0.16]	[0.63]	[0.24]
Dep. Var. Mean	0.0352	0.0254	0.0160	0.0838	0.0394	0.0282	0.0189	0.0956	0.0249	0.0187	0.0092	0.0551
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	420	420	420	322	390	390	390	299	390	390	390	299
Countries	49	49	49	49	48	48	48	48	26	26	26	26
Observations	230,010	230,010	230,010	176,341	162,810	162,810	162,810	124,821	67,200	67,200	67,200	51,520

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. *Own Ethnic Group* refers to the ethnic territory that contains cell i. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a country and a climate-zone-year. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A12: Clustering by Country and Climate-Zone using Narrow Definition of Transhumant Pastoralism

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)
Nearest Neighboring Ethnic Group												
Rain	-0.0006	0.0001	-0.0004	-0.0006	-0.0007	0.0001	-0.0006	-0.0001	-0.0000	-0.0001	0.0007	-0.0105*
	(0.0006)	(0.0005)	(0.0005)	(0.0009)	(0.0006)	(0.0004)	(0.0006)	(0.0012)	(0.0024)	(0.0013)	(0.0025)	(0.0050)
Rain × Transhumant Pastoral	-0.0110***	-0.0121***	-0.0012	-0.0096***	-0.0122**	-0.0124**	-0.0030	-0.0172***	-0.0053	-0.0062	-0.0001	0.0052
	(0.0033)	(0.0029)	(0.0015)	(0.0014)	(0.0048)	(0.0047)	(0.0019)	(0.0035)	(0.0051)	(0.0040)	(0.0037)	(0.0070)
Own Ethnic Group												
Rain	-0.0000	0.0013	-0.0003	0.0009	-0.0001	0.0012	-0.0002	0.0002	-0.0057	-0.0028	-0.0014	-0.0022
	(0.0008)	(0.0010)	(0.0006)	(0.0008)	(0.0008)	(0.0010)	(0.0007)	(0.0008)	(0.0059)	(0.0052)	(0.0035)	(0.0032)
Rain × Transhumant Pastoral	-0.0015	-0.0046	0.0016	-0.0013	0.0089	0.0057	0.0091	-0.0186	0.0043	-0.0013	0.0021	0.0079
	(0.0036)	(0.0039)	(0.0020)	(0.0056)	(0.0082)	(0.0050)	(0.0104)	(0.0140)	(0.0081)	(0.0089)	(0.0023)	(0.0071)
Own Cell												
Rain	-0.0002	-0.0004	-0.0001	-0.0004	-0.0002	-0.0004	-0.0001	-0.0006	0.0012	-0.0023	0.0028	-0.0001
	(0.0006)	(0.0004)	(0.0005)	(0.0009)	(0.0006)	(0.0004)	(0.0005)	(0.0011)	(0.0030)	(0.0020)	(0.0027)	(0.0026)
Rain × Transhumant Pastoral	0.0039	0.0055	-0.0009	0.0046	-0.0072	-0.0063	-0.0054	0.0169	-0.0001	0.0065	-0.0056	0.0054
	(0.0044)	(0.0040)	(0.0024)	(0.0047)	(0.0099)	(0.0057)	(0.0089)	(0.0142)	(0.0072)	(0.0059)	(0.0045)	(0.0074)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:												
Rain	-2.02	0.25	-3.31	-0.79	-1.98	0.60	-3.78	-0.13	-0.14	-0.73	8.88	-22.95
p-value	[0.33]	[0.91]	[0.41]	[0.56]	[0.26]	[0.73]	[0.31]	[0.93]	[0.99]	[0.93]	[0.79]	[0.06]
Rain × Transhumant Pastoral	-37.42	-56.94	-9.22	-13.82	-37.27	-52.82	-19.38	-21.65	-25.72	-39.97	-0.97	11.27
p-value	[0.01]	[0.00]	[0.43]	[0.00]	[0.02]	[0.02]	[0.13]	[0.00]	[0.31]	[0.15]	[0.98]	[0.48]
Rain + Rain × Transhumant Pastoral	-39.44	-56.69	-12.53	-14.62	-39.25	-52.22	-23.16	-21.78	-25.86	-40.70	7.91	-11.69
p-value	[0.01]	[0.00]	[0.36]	[0.00]	[0.02]	[0.02]	[0.12]	[0.00]	[0.24]	[0.10]	[0.83]	[0.25]
Dep. Var. Mean	0.0352	0.0254	0.0160	0.0838	0.0394	0.0282	0.0189	0.0956	0.0249	0.0187	0.0092	0.0551
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zones	14	14	14	14	13	13	13	13	13	13	13	13
Countries	49	49	49	49	48	48	48	48	26	26	26	26
Observations	230,010	230,010	230,010	176,341	162,810	162,810	162,810	124,821	67,200	67,200	67,200	51,520

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. *Own Ethnic Group* refers to the ethnic territory that contains cell i. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a country and a climate-zone. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A13: Clustering by Country and Climate-Zone using Broad Definition of Transhumant Pastoralism

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)
Nearest Neighboring Ethnic Group												
Rain	-0.0006	0.0001	-0.0005	-0.0004	-0.0006	0.0002	-0.0007	-0.0000	0.0002	0.0005	0.0005	-0.0107*
	(0.0006)	(0.0005)	(0.0005)	(0.0010)	(0.0006)	(0.0004)	(0.0005)	(0.0012)	(0.0027)	(0.0014)	(0.0026)	(0.0055)
Rain × Transhumant Pastoral	-0.0082**	-0.0105***	0.0007	-0.0093***	-0.0067	-0.0087*	0.0004	-0.0125***	-0.0053	-0.0074*	0.0007	0.0051
	(0.0035)	(0.0032)	(0.0014)	(0.0016)	(0.0049)	(0.0046)	(0.0016)	(0.0026)	(0.0054)	(0.0041)	(0.0041)	(0.0088)
Own Ethnic Group												
Rain	0.0002	0.0015	-0.0002	0.0010	0.0002	0.0014	-0.0001	0.0006	-0.0042	-0.0021	-0.0008	-0.0055*
	(0.0009)	(0.0012)	(0.0006)	(0.0010)	(0.0009)	(0.0011)	(0.0007)	(0.0010)	(0.0055)	(0.0054)	(0.0030)	(0.0028)
Rain × Transhumant Pastoral	-0.0050	-0.0065	-0.0010	-0.0028	-0.0063	-0.0040	-0.0020	-0.0258***	0.0017	-0.0025	0.0010	0.0133**
	(0.0034)	(0.0040)	(0.0019)	(0.0064)	(0.0065)	(0.0033)	(0.0025)	(0.0066)	(0.0077)	(0.0094)	(0.0018)	(0.0057)
Own Cell												
Rain	-0.0003	-0.0005	-0.0001	-0.0005	-0.0002	-0.0004	-0.0001	-0.0008	-0.0008	-0.0038*	0.0019	0.0026
	(0.0006)	(0.0005)	(0.0005)	(0.0010)	(0.0006)	(0.0004)	(0.0005)	(0.0012)	(0.0021)	(0.0020)	(0.0017)	(0.0025)
Rain × Transhumant Pastoral	0.0048	0.0061	-0.0000	0.0054	-0.0023	-0.0028	0.0002	0.0183*	0.0034	0.0088	-0.0039	0.0005
	(0.0040)	(0.0035)	(0.0027)	(0.0051)	(0.0026)	(0.0020)	(0.0024)	(0.0096)	(0.0061)	(0.0057)	(0.0034)	(0.0064)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:												
Rain	-1.97	0.71	-3.93	-0.62	-1.98	0.81	-4.16	-0.01	0.81	2.94	6.37	-23.37
p-value	[0.35]	[0.76]	[0.31]	[0.67]	[0.28]	[0.67]	[0.24]	[0.99]	[0.95]	[0.75]	[0.86]	[0.08]
Rain × Transhumant Pastoral	-27.83	-49.58	5.59	-13.38	-20.30	-36.90	2.65	-15.69	-25.72	-47.62	8.84	11.04
p-value	[0.04]	[0.01]	[0.61]	[0.00]	[0.20]	[0.09]	[0.79]	[0.00]	[0.34]	[0.10]	[0.87]	[0.57]
Rain + Rain × Transhumant Pastoral	-29.80	-48.87	1.66	-14.00	-22.28	-36.09	-1.51	-15.71	-24.90	-44.69	15.21	-12.33
p-value	[0.03]	[0.01]	[0.89]	[0.00]	[0.15]	[0.07]	[0.90]	[0.00]	[0.24]	[0.07]	[0.69]	[0.33]
Dep. Var. Mean	0.0352	0.0254	0.0160	0.0838	0.0394	0.0282	0.0189	0.0956	0.0249	0.0187	0.0092	0.0551
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zones	14	14	14	14	13	13	13	13	13	13	13	13
Countries	49	49	49	49	48	48	48	48	26	26	26	26
Observations	230,010	230,010	230,010	176,341	162,810	162,810	162,810	124,821	67,200	67,200	67,200	51,520

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. *Own Ethnic Group* refers to the ethnic territory that contains cell i. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a country and a climate-zone. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A14: Adjusting for Spatial and Serial Correlation within 1000km using Narrow Definition of Transhumant Pastoralism

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)
Nearest Neighboring Ethnic Group												
Rain	-0.0006	0.0001	-0.0004	-0.0006	-0.0007	0.0001	-0.0006	-0.0001	-0.0000	-0.0001	0.0007	-0.0105***
	(0.0007)	(0.0006)	(0.0005)	(0.0010)	(0.0007)	(0.0006)	(0.0006)	(0.0010)	(0.0028)	(0.0025)	(0.0018)	(0.0038)
Rain × Transhumant Pastoral	-0.0110***	-0.0121***	-0.0012	-0.0096**	-0.0122**	-0.0124***	-0.0030	-0.0172**	-0.0053	-0.0062	-0.0001	0.0052
	(0.0040)	(0.0035)	(0.0025)	(0.0043)	(0.0053)	(0.0048)	(0.0032)	(0.0071)	(0.0058)	(0.0051)	(0.0037)	(0.0063)
Own Ethnic Group												
Rain	-0.0000	0.0013	-0.0003	0.0009	-0.0001	0.0012	-0.0002	0.0002	-0.0057	-0.0028	-0.0014	-0.0022
	(0.0010)	(0.0008)	(0.0007)	(0.0013)	(0.0010)	(0.0008)	(0.0007)	(0.0013)	(0.0049)	(0.0040)	(0.0034)	(0.0065)
Rain × Transhumant Pastoral	-0.0015	-0.0046	0.0016	-0.0013	0.0089	0.0057	0.0091	-0.0186	0.0043	-0.0013	0.0021	0.0079
	(0.0054)	(0.0059)	(0.0033)	(0.0071)	(0.0124)	(0.0083)	(0.0102)	(0.0169)	(0.0092)	(0.0099)	(0.0056)	(0.0118)
Own Cell												
Rain	-0.0002	-0.0004	-0.0001	-0.0004	-0.0002	-0.0004	-0.0001	-0.0006	0.0012	-0.0023	0.0028	-0.0001
	(0.0007)	(0.0005)	(0.0005)	(0.0010)	(0.0007)	(0.0005)	(0.0005)	(0.0010)	(0.0030)	(0.0020)	(0.0024)	(0.0042)
Rain × Transhumant Pastoral	0.0039	0.0055	-0.0009	0.0046	-0.0072	-0.0063	-0.0054	0.0169	-0.0001	0.0065	-0.0056	0.0054
	(0.0040)	(0.0036)	(0.0022)	(0.0046)	(0.0081)	(0.0068)	(0.0055)	(0.0129)	(0.0061)	(0.0050)	(0.0043)	(0.0082)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:												
Rain	-2.12	0.27	-3.41	-0.82	-2.02	0.61	-3.83	-0.13	-0.16	-0.81	9.71	-25.46
p-value	[0.39]	[0.93]	[0.41]	[0.58]	[0.36]	[0.82]	[0.29]	[0.92]	[0.99]	[0.96]	[0.70]	[0.01]
Rain × Transhumant Pastoral	-39.18	-60.30	-9.49	-14.34	-37.96	-54.08	-19.63	-21.86	-28.40	-44.47	-1.06	12.50
p-value	[0.01]	[0.00]	[0.62]	[0.02]	[0.02]	[0.01]	[0.34]	[0.02]	[0.36]	[0.22]	[0.98]	[0.41]
Rain + Rain × Transhumant Pastoral	-41.29	-60.03	-12.90	-15.17	-39.98	-53.47	-23.46	-21.99	-28.56	-45.28	8.65	-12.96
p-value	[0.00]	[0.00]	[0.50]	[0.02]	[0.02]	[0.01]	[0.26]	[0.01]	[0.35]	[0.20]	[0.86]	[0.31]
Dep. Var. Mean	0.0336	0.0240	0.0156	0.0807	0.0387	0.0275	0.0186	0.0947	0.0225	0.0168	0.0084	0.0497
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	230,010	230,010	230,010	176,341	162,810	162,810	162,810	124,821	67,200	67,200	67,200	51,520

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. *Own Ethnic Group* refers to the ethnic territory that contains cell i. Standard errors, which are reported in parentheses, are adjusted for spatial and serial clustering within 1000km of a cell and over 30 years . * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A15: Adjusting for Spatial and Serial Correlation within 1000km using Broad Definition of Transhumant Pastoralism

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)
Nearest Neighboring Ethnic Group												
Rain	-0.0006	0.0001	-0.0005	-0.0004	-0.0006	0.0002	-0.0007	-0.0000	0.0002	0.0005	0.0005	-0.0107***
	(0.0007)	(0.0006)	(0.0005)	(0.0010)	(0.0007)	(0.0006)	(0.0006)	(0.0011)	(0.0029)	(0.0026)	(0.0018)	(0.0039)
Rain × Transhumant Pastoral	-0.0082**	-0.0105***	0.0007	-0.0093**	-0.0067	-0.0087**	0.0004	-0.0125*	-0.0053	-0.0074	0.0007	0.0051
	(0.0036)	(0.0032)	(0.0022)	(0.0041)	(0.0044)	(0.0039)	(0.0027)	(0.0065)	(0.0059)	(0.0051)	(0.0036)	(0.0061)
Own Ethnic Group												
Rain	0.0002	0.0015*	-0.0002	0.0010	0.0002	0.0014*	-0.0001	0.0006	-0.0042	-0.0021	-0.0008	-0.0055
	(0.0010)	(0.0008)	(0.0007)	(0.0013)	(0.0010)	(0.0008)	(0.0007)	(0.0013)	(0.0048)	(0.0042)	(0.0030)	(0.0067)
Rain × Transhumant Pastoral	-0.0050	-0.0065	-0.0010	-0.0028	-0.0063	-0.0040	-0.0020	-0.0258**	0.0017	-0.0025	0.0010	0.0133
	(0.0047)	(0.0052)	(0.0028)	(0.0066)	(0.0089)	(0.0069)	(0.0062)	(0.0121)	(0.0089)	(0.0103)	(0.0050)	(0.0120)
Own Cell												
Rain	-0.0003	-0.0005	-0.0001	-0.0005	-0.0002	-0.0004	-0.0001	-0.0008	-0.0008	-0.0038*	0.0019	0.0026
	(0.0007)	(0.0005)	(0.0005)	(0.0010)	(0.0007)	(0.0005)	(0.0005)	(0.0010)	(0.0026)	(0.0021)	(0.0019)	(0.0042)
Rain × Transhumant Pastoral	0.0048	0.0061*	-0.0000	0.0054	-0.0023	-0.0028	0.0002	0.0183	0.0034	0.0088*	-0.0039	0.0005
	(0.0036)	(0.0033)	(0.0021)	(0.0045)	(0.0062)	(0.0051)	(0.0040)	(0.0115)	(0.0056)	(0.0050)	(0.0036)	(0.0081)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:												
Rain	-2.06	0.75	-4.05	-0.64	-2.01	0.83	-4.22	-0.01	0.90	3.27	6.96	-25.93
p-value	[0.40]	[0.81]	[0.33]	[0.67]	[0.36]	[0.76]	[0.24]	[0.99]	[0.95]	[0.86]	[0.79]	[0.01]
Rain × Transhumant Pastoral	-29.13	-52.50	5.75	-13.88	-20.68	-37.78	2.68	-15.84	-28.40	-52.98	9.67	12.25
p-value	[0.02]	[0.00]	[0.73]	[0.02]	[0.13]	[0.02]	[0.88]	[0.05]	[0.36]	[0.15]	[0.85]	[0.41]
Rain + Rain × Transhumant Pastoral	-31.19	-51.75	1.71	-14.52	-22.69	-36.95	-1.53	-15.85	-27.50	-49.72	16.64	-13.68
p-value	[0.02]	[0.00]	[0.92]	[0.01]	[0.10]	[0.03]	[0.93]	[0.05]	[0.35]	[0.13]	[0.72]	[0.27]
Dep. Var. Mean	0.0336	0.0240	0.0156	0.0807	0.0387	0.0275	0.0186	0.0947	0.0225	0.0168	0.0084	0.0497
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	230,010	230,010	230,010	176,341	162,810	162,810	162,810	124,821	67,200	67,200	67,200	51,520

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. *Own Ethnic Group* refers to the ethnic territory that contains cell i. Standard errors, which are reported in parentheses, are adjusted for spatial and serial clustering within 1000km of a cell and over 30 years . * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A16: Estimates using Phytomass rather than Rainfall: Using the Broad Definition of Transhumance

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP 1(Any)	UCDP 1(State)	UCDP 1(Non-State)	ACLED 1(Any)	UCDP 1(Any)	UCDP 1(State)	UCDP 1(Non-State)	ACLED 1(Any)	UCDP 1(Any)	UCDP 1(State)	UCDP 1(Non-State)	ACLED 1(Any)
Nearest Neighboring Ethnic Group												
Phytomass	0.0001	0.0001	-0.0000	0.0006	0.0003	0.0002	0.0002	0.0006	-0.0016	-0.0007	-0.0012*	-0.0001
	(0.0005)	(0.0004)	(0.0003)	(0.0006)	(0.0005)	(0.0004)	(0.0003)	(0.0006)	(0.0010)	(0.0009)	(0.0007)	(0.0013)
Phytomass × Transhumant Pastoral	-0.0034**	-0.0038***	-0.0008	-0.0078***	-0.0028*	-0.0025	-0.0021*	-0.0099***	-0.0014	-0.0032	0.0016	-0.0028
	(0.0014)	(0.0013)	(0.0009)	(0.0017)	(0.0017)	(0.0016)	(0.0011)	(0.0025)	(0.0020)	(0.0020)	(0.0011)	(0.0022)
Own Ethnic Group												
Phytomass	0.0002	0.0003	0.0002	0.0010	0.0002	0.0002	0.0003	0.0012	-0.0023	-0.0018	-0.0009	-0.0055**
	(0.0005)	(0.0005)	(0.0004)	(0.0008)	(0.0005)	(0.0006)	(0.0004)	(0.0009)	(0.0016)	(0.0013)	(0.0011)	(0.0021)
Phytomass × Transhumant Pastoral	-0.0025	-0.0002	-0.0019	-0.0069**	0.0047	0.0075	-0.0001	-0.0100	-0.0022	0.0004	-0.0018	-0.0000
	(0.0022)	(0.0019)	(0.0016)	(0.0028)	(0.0049)	(0.0049)	(0.0033)	(0.0065)	(0.0032)	(0.0032)	(0.0019)	(0.0045)
Own Cell												
Phytomass	-0.0006	-0.0004	-0.0001	0.0002	-0.0006	-0.0004	-0.0002	0.0001	-0.0002	0.0004	-0.0003	-0.0008
	(0.0005)	(0.0005)	(0.0003)	(0.0007)	(0.0005)	(0.0005)	(0.0004)	(0.0007)	(0.0010)	(0.0009)	(0.0006)	(0.0013)
Phytomass × Transhumant Pastoral	-0.0008	-0.0009	0.0002	0.0007	-0.0064	-0.0058	-0.0002	0.0058	0.0009	-0.0004	0.0009	0.0014
	(0.0018)	(0.0017)	(0.0012)	(0.0023)	(0.0045)	(0.0044)	(0.0026)	(0.0057)	(0.0025)	(0.0023)	(0.0015)	(0.0034)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Phytomass Shock as % of Dep. Var. Mean:												
Phytomass	1.00	1.67	-0.95	2.22	2.84	2.30	3.13	2.11	-17.60	-9.76	-34.28	-0.52
p-value	[0.81]	[0.73]	[0.88]	[0.31]	[0.50]	[0.64]	[0.59]	[0.30]	[0.13]	[0.44]	[0.09]	[0.94]
Phytomass × Transhumant Pastoral	-30.17	-47.11	-15.15	-29.77	-23.32	-29.60	-34.43	-33.50	-15.64	-47.26	47.28	-16.02
p-value	[0.02]	[0.01]	[0.35]	[0.00]	[0.10]	[0.12]	[0.06]	[0.00]	[0.49]	[0.12]	[0.13]	[0.20]
Phytomass + Phytomass × Transhumant Pastoral	-29.18	-45.44	-16.10	-27.55	-20.48	-27.29	-31.30	-31.39	-33.24	-57.02	13.00	-16.54
p-value	[0.01]	[0.01]	[0.30]	[0.00]	[0.15]	[0.15]	[0.09]	[0.00]	[0.09]	[0.04]	[0.62]	[0.20]
Dep. Var. Mean	0.0373	0.0265	0.0174	0.0866	0.0404	0.0281	0.0199	0.0983	0.0297	0.0225	0.0114	0.0585
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	280	280	280	294	260	260	260	273	260	260	260	273
Cells	7,667	7,667	7,667	7,667	5,427	5,427	5,427	5,427	2,240	2,240	2,240	2,240
Observations	153,340	153,340	153,340	161,007	108,540	108,540	108,540	113,967	44,800	44,800	44,800	47,040

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. *Own Ethnic Group* refers to the ethnic territory that contains cell i. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A17: IV 2SLS Estimates: Instrumenting Phytomass with Rain and using the Narrow Definition of Transhumant Pastoralism

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP 1(Conflict)	*UCDP: State*	*UCDP: Non-State*	ACLED 1(Conflict)	UCDP 1(Conflict)	*UCDP: State*	*UCDP: Non-State*	ACLED 1(Conflict)	UCDP 1(Conflict)	*UCDP: State*	*UCDP: Non-State*	ACLED 1(Conflict)
Nearest Neighboring Ethnic Group												
Phytomass	-0.0036	-0.0013	-0.0007	-0.0048	-0.0029	0.0003	-0.0008	-0.0035	-0.0023	-0.0019	0.0002	-0.0138***
	(0.0026)	(0.0021)	(0.0021)	(0.0036)	(0.0033)	(0.0025)	(0.0027)	(0.0047)	(0.0039)	(0.0034)	(0.0030)	(0.0046)
Phytomass × Transhumant Pastoral	-0.0031	-0.0076**	0.0012	-0.0061	-0.0101*	-0.0134***	-0.0027	-0.0117**	0.0027	-0.0005	0.0028	0.0049
	(0.0038)	(0.0036)	(0.0024)	(0.0039)	(0.0059)	(0.0049)	(0.0038)	(0.0052)	(0.0057)	(0.0054)	(0.0032)	(0.0053)
Own Ethnic Group												
Phytomass	-0.0029	0.0024	-0.0014	0.0030	-0.0034	0.0025	-0.0010	0.0017	-0.0040	0.0019	-0.0051	0.0106
	(0.0051)	(0.0044)	(0.0036)	(0.0068)	(0.0058)	(0.0051)	(0.0040)	(0.0078)	(0.0065)	(0.0048)	(0.0054)	(0.0100)
Phytomass × Transhumant Pastoral	0.0030	-0.0042	0.0025	-0.0117	0.0323	0.0130	0.0347	-0.1370	0.0112	0.0052	0.0064	-0.0107
	(0.0114)	(0.0099)	(0.0086)	(0.0154)	(0.0777)	(0.0608)	(0.0464)	(0.1004)	(0.0139)	(0.0112)	(0.0100)	(0.0192)
Own Cell												
Phytomass	0.0042	0.0001	0.0019	0.0007	0.0027	-0.0021	0.0012	-0.0006	0.0027	-0.0020	0.0045	-0.0039
	(0.0054)	(0.0045)	(0.0044)	(0.0077)	(0.0063)	(0.0053)	(0.0050)	(0.0094)	(0.0060)	(0.0040)	(0.0047)	(0.0089)
Phytomass × Transhumant Pastoral	0.0014	0.0081	-0.0025	0.0153	-0.0240	-0.0153	-0.0242	0.1351	-0.0049	0.0032	-0.0076	0.0200
	(0.0115)	(0.0101)	(0.0083)	(0.0145)	(0.0776)	(0.0648)	(0.0450)	(0.1009)	(0.0136)	(0.0119)	(0.0102)	(0.0185)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Phytomass Shock as % of Dep. Var. Mean:												
Phytomass	-31.74	-16.06	-14.16	-18.31	-23.51	3.96	-12.65	-11.68	-25.11	-27.53	4.94	-78.36
p-value	[0.18]	[0.54]	[0.72]	[0.18]	[0.39]	[0.90]	[0.78]	[0.46]	[0.56]	[0.59]	[0.96]	[0.00]
Phytomass × Transhumant Pastoral	-27.25	-94.67	22.73	-23.42	-82.53	-157.72	-45.06	-39.55	30.00	-7.04	82.75	27.84
p-value	[0.42]	[0.04]	[0.62]	[0.11]	[0.09]	[0.01]	[0.47]	[0.03]	[0.64]	[0.93]	[0.37]	[0.35]
Phytomass + Phytomass × Transhumant Pastoral	-58.99	-110.72	8.57	-41.73	-106.04	-153.76	-57.71	-51.23	4.89	-34.57	87.69	-50.52
p-value	[0.13]	[0.02]	[0.87]	[0.01]	[0.07]	[0.01]	[0.47]	[0.02]	[0.94]	[0.69]	[0.45]	[0.14]
First Stage Kleibergen-Paap LM Test Stat.	35.71	35.71	35.71	33.36	30.34	30.34	30.34	27.40	28.66	28.66	28.66	30.67
p-value	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Dep. Var. Mean	0.04	0.03	0.02	0.09	0.04	0.03	0.02	0.10	0.03	0.02	0.01	0.06
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	280	280	280	294	260	260	260	273	260	260	260	273
Cells	7,667	7,667	7,667	7,667	5,427	5,427	5,427	5,427	2,240	2,240	2,240	2,240
Observations	153,340	153,340	153,340	161,007	108,540	108,540	108,540	113,967	44,800	44,800	44,800	47,040

Note: All phytomass variables and interactions are instrumented with their corresponding rainfall variables. The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. *Own Ethnic Group* refers to the ethnic territory that contains cell i. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A18: IV 2SLS Estimates: Instrumenting Phytomass with Rain and using the Broad Definition of Transhumant Pastoralism

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP 1(Conflict)	*UCDP: State*	*UCDP: Non-State*	ACLED 1(Conflict)	UCDP 1(Conflict)	*UCDP: State*	*UCDP: Non-State*	ACLED 1(Conflict)	UCDP 1(Conflict)	*UCDP: State*	*UCDP: Non-State*	ACLED 1(Conflict)
Nearest Neighboring Ethnic Group												
Phytomass	-0.0038	-0.0013	-0.0009	-0.0048	-0.0032	0.0002	-0.0011	-0.0036	-0.0029	-0.0023	-0.0000	-0.0144***
	(0.0027)	(0.0021)	(0.0022)	(0.0037)	(0.0033)	(0.0025)	(0.0027)	(0.0047)	(0.0040)	(0.0035)	(0.0031)	(0.0047)
Phytomass × Transhumant Pastoral	0.0000	-0.0052*	0.0021	-0.0051	-0.0037	-0.0091**	-0.0001	-0.0082*	0.0051	0.0018	0.0033	0.0064
	(0.0036)	(0.0032)	(0.0024)	(0.0037)	(0.0048)	(0.0039)	(0.0031)	(0.0049)	(0.0055)	(0.0051)	(0.0032)	(0.0056)
Own Ethnic Group												
Phytomass	-0.0021	0.0033	-0.0007	0.0039	-0.0030	0.0030	-0.0003	0.0043	-0.0023	0.0031	-0.0046	0.0044
	(0.0054)	(0.0047)	(0.0039)	(0.0074)	(0.0061)	(0.0053)	(0.0044)	(0.0085)	(0.0063)	(0.0052)	(0.0054)	(0.0103)
Phytomass × Transhumant Pastoral	-0.0011	-0.0081	-0.0014	-0.0145	-0.0026	-0.0101	-0.0037	-0.0765**	0.0087	0.0037	0.0058	0.0015
	(0.0109)	(0.0095)	(0.0088)	(0.0155)	(0.0240)	(0.0206)	(0.0174)	(0.0300)	(0.0133)	(0.0113)	(0.0099)	(0.0196)
Own Cell												
Phytomass	0.0034	-0.0009	0.0013	-0.0002	0.0027	-0.0022	0.0008	-0.0028	0.0004	-0.0038	0.0036	0.0018
	(0.0057)	(0.0047)	(0.0047)	(0.0081)	(0.0066)	(0.0055)	(0.0054)	(0.0097)	(0.0055)	(0.0040)	(0.0043)	(0.0089)
Phytomass × Transhumant Pastoral	0.0043	0.0112	0.0005	0.0170	0.0008	0.0055	0.0049	0.0726**	-0.0010	0.0057	-0.0058	0.0079
	(0.0110)	(0.0096)	(0.0085)	(0.0145)	(0.0239)	(0.0210)	(0.0171)	(0.0306)	(0.0127)	(0.0116)	(0.0098)	(0.0188)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Phytomass Shock as % of Dep. Var. Mean:												
Phytomass	-33.69	-16.61	-17.08	-18.43	-26.62	2.06	-18.39	-12.13	-32.10	-34.47	-0.42	-81.38
p-value	[0.16]	[0.53]	[0.68]	[0.19]	[0.32]	[0.94]	[0.68]	[0.44]	[0.47]	[0.51]	[1.00]	[0.00]
Phytomass × Transhumant Pastoral	0.06	-65.25	40.11	-19.32	-30.29	-107.10	-2.08	-27.77	56.54	26.07	95.28	36.28
p-value	[1.00]	[0.10]	[0.38]	[0.18]	[0.44]	[0.02]	[0.97]	[0.10]	[0.36]	[0.73]	[0.30]	[0.25]
Phytomass + Phytomass × Transhumant Pastoral	-33.63	-81.86	23.02	-37.75	-56.91	-105.04	-20.47	-39.90	24.43	-8.39	94.87	-45.10
p-value	[0.33]	[0.06]	[0.64]	[0.01]	[0.21]	[0.04]	[0.74]	[0.04]	[0.72]	[0.92]	[0.42]	[0.20]
First Stage Kleibergen-Paap LM Test Stat.	31.85	31.85	31.85	29.84	25.87	25.87	25.87	23.54	29.82	29.82	29.82	31.89
p-value	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Dep. Var. Mean	0.04	0.03	0.02	0.09	0.04	0.03	0.02	0.10	0.03	0.02	0.01	0.06
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	280	280	280	294	260	260	260	273	260	260	260	273
Cells	7,667	7,667	7,667	7,667	5,427	5,427	5,427	5,427	2,240	2,240	2,240	2,240
Observations	153,340	153,340	153,340	161,007	108,540	108,540	108,540	113,967	44,800	44,800	44,800	47,040

Note: All phytomass variables and interactions are instrumented with their corresponding rainfall variables. The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. *Own Ethnic Group* refers to the ethnic territory that contains cell i. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A19: Effects of Neighbor's Rainfall and Phytomass on Conflict during the Wet and Dry Seasons: Using the Broad Definition of Transhumance

	UCDP Conflict per Month: All Grid Cells				Agricultural Cells				Non-Agricultural Cells			
	Wet Season		Dry Season		Wet Season		Dry Season		Wet Season		Dry Season	
	(1) Incidence	(2) Number	(3) Incidence	(4) Number	(5) Incidence	(6) Number	(7) Incidence	(8) Number	(9) Incidence	(10) Number	(11) Incidence	(12) Number
	Panel A: Rainfall and Conflict by Seasons											
Nearest Neighboring Ethnic Group												
Rain	0.0001	0.0004	-0.0001	-0.0002	0.0000	0.0003	-0.0002	-0.0003	0.0005	0.0011	0.0004	0.0020
	(0.0002)	(0.0004)	(0.0003)	(0.0010)	(0.0002)	(0.0004)	(0.0003)	(0.0011)	(0.0010)	(0.0017)	(0.0011)	(0.0018)
Rain × Transhumant Pastoral	-0.0022**	-0.0082**	-0.0011	-0.0034	-0.0018	-0.0049	-0.0003	-0.0010	-0.0016	-0.0149	-0.0009	-0.0089
	(0.0009)	(0.0038)	(0.0009)	(0.0028)	(0.0011)	(0.0030)	(0.0011)	(0.0033)	(0.0017)	(0.0122)	(0.0014)	(0.0087)
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:												
Rain	1.13	3.07	-1.92	-1.33	0.49	3.06	-2.48	-2.70	7.26	6.44	5.44	13.29
p-value	[0.72]	[0.38]	[0.63]	[0.87]	[0.88]	[0.44]	[0.56]	[0.76]	[0.61]	[0.54]	[0.73]	[0.27]
Rain × Transhumant Pastoral	-35.18	-70.43	-16.58	-27.32	-30.07	-45.99	-3.76	-8.41	-22.18	-90.35	-13.49	-57.88
p-value	[0.01]	[0.03]	[0.21]	[0.22]	[0.11]	[0.10]	[0.82]	[0.76]	[0.34]	[0.22]	[0.52]	[0.31]
Rain + Rain × Transhumant Pastoral	-34.05	-67.37	-18.51	-28.65	-29.58	-42.93	-6.25	-11.11	-14.92	-83.91	-8.05	-44.59
p-value	[0.02]	[0.04]	[0.15]	[0.17]	[0.12]	[0.12]	[0.68]	[0.67]	[0.49]	[0.25]	[0.70]	[0.40]
Dep. Var. Mean	0.008	0.014	0.008	0.015	0.007	0.013	0.008	0.014	0.009	0.020	0.008	0.018
Climate-Zone-Years	420	420	420	420	390	390	390	390	390	390	390	390
Cells	4,592	4,592	4,592	4,592	3,857	3,857	3,857	3,857	735	735	735	735
Observations	137,760	137,760	137,760	137,760	115,710	115,710	115,710	115,710	22,050	22,050	22,050	22,050
	Panel B: Phytomass and Conflict by Seasons											
Nearest Neighboring Ethnic Group												
Phytomass	0.0001	0.0004	0.0000	0.0003	0.0001	0.0005	0.0000	0.0003	0.0001	-0.0001	-0.0003	-0.0004
	(0.0001)	(0.0003)	(0.0001)	(0.0003)	(0.0001)	(0.0003)	(0.0002)	(0.0003)	(0.0002)	(0.0006)	(0.0002)	(0.0004)
Phytomass × Transhumant Pastoral	-0.0006**	-0.0026*	0.0000	-0.0009	-0.0008**	-0.0016***	0.0001	0.0003	-0.0002	-0.0043	0.0001	-0.0030
	(0.0003)	(0.0015)	(0.0003)	(0.0013)	(0.0004)	(0.0006)	(0.0005)	(0.0011)	(0.0005)	(0.0043)	(0.0005)	(0.0035)
Effect of 1 Std. Dev. Phytomass Shock as % of Dep. Var. Mean:												
Phytomass	5.29	9.41	1.58	5.61	4.10	11.85	1.53	6.19	3.30	-1.80	-11.02	-5.43
p-value	[0.31]	[0.13]	[0.77]	[0.35]	[0.50]	[0.14]	[0.81]	[0.41]	[0.66]	[0.83]	[0.12]	[0.39]
Phytomass × Transhumant Pastoral	-26.26	-57.54	0.92	-18.01	-34.86	-39.49	5.72	7.68	-5.14	-54.15	4.48	-42.01
p-value	[0.03]	[0.08]	[0.94]	[0.49]	[0.04]	[0.01]	[0.76]	[0.74]	[0.73]	[0.31]	[0.77]	[0.40]
Phytomass + Phytomass × Transhumant Pastoral	-20.97	-48.13	2.50	-12.40	-30.76	-27.64	7.25	13.87	-1.84	-55.94	-6.54	-47.44
p-value	[0.09]	[0.15]	[0.83]	[0.63]	[0.08]	[0.04]	[0.68]	[0.53]	[0.90]	[0.34]	[0.65]	[0.37]
Dep. Var. Mean	0.008	0.015	0.009	0.016	0.007	0.013	0.008	0.015	0.011	0.026	0.010	0.024
Climate-Zone-Years	280	280	280	280	260	260	260	260	260	260	260	260
Cells	4,592	4,592	4,592	4,592	3,857	3,857	3,857	3,857	735	735	735	735
Observations	91,840	91,840	91,840	91,840	77,140	77,140	77,140	77,140	14,700	14,700	14,700	14,700
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The unit of observation is a 0.5-degree grid-cell and year. "Incidence" is per-month UCDP conflict incidence in either the wet season or the dry season as defined in the main text. "Number" is per-month number of UCDP conflict events. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. *Own Ethnic Group* and *Own Cell* variables are controlled for but not reported. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A20: Estimates using Temperature rather than Rainfall: Using the Broad Definition of Transhumance

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)
Nearest Neighboring Ethnic Group												
Temperature	0.0026	0.0030**	0.0014	0.0033	0.0031	0.0031*	0.0018	0.0045	0.0014	0.0024	0.0004	0.0024
	(0.0016)	(0.0014)	(0.0011)	(0.0028)	(0.0021)	(0.0017)	(0.0014)	(0.0033)	(0.0026)	(0.0021)	(0.0018)	(0.0043)
Temperature × Transhumant Pastoral	0.0017	0.0045	-0.0002	0.0011	-0.0006	0.0009	-0.0030	-0.0102	0.0029	0.0065	0.0019	0.0054
	(0.0037)	(0.0036)	(0.0023)	(0.0047)	(0.0061)	(0.0061)	(0.0030)	(0.0076)	(0.0045)	(0.0041)	(0.0030)	(0.0060)
Own Ethnic Group												
Temperature	0.0049**	0.0032	0.0041**	0.0121***	0.0049*	0.0026	0.0044**	0.0093**	0.0041	0.0038	0.0014	0.0338***
	(0.0024)	(0.0022)	(0.0016)	(0.0035)	(0.0026)	(0.0023)	(0.0018)	(0.0041)	(0.0071)	(0.0051)	(0.0052)	(0.0103)
Temperature × Transhumant Pastoral	0.0098*	0.0093*	-0.0011	-0.0132	0.0205	0.0224	0.0044	-0.0039	0.0060	0.0044	0.0013	-0.0444***
	(0.0059)	(0.0051)	(0.0040)	(0.0087)	(0.0172)	(0.0154)	(0.0085)	(0.0182)	(0.0123)	(0.0095)	(0.0087)	(0.0158)
Own Cell												
Temperature	-0.0015	-0.0016	-0.0013	-0.0033	-0.0012	-0.0010	-0.0011	-0.0025	-0.0008	-0.0004	-0.0020	-0.0092
	(0.0018)	(0.0017)	(0.0011)	(0.0023)	(0.0019)	(0.0017)	(0.0012)	(0.0025)	(0.0040)	(0.0036)	(0.0031)	(0.0068)
Temperature × Transhumant Pastoral	-0.0001	-0.0000	0.0025	0.0039	-0.0070	-0.0112	-0.0009	0.0057	-0.0000	-0.0007	0.0038	0.0104
	(0.0043)	(0.0036)	(0.0034)	(0.0066)	(0.0126)	(0.0120)	(0.0079)	(0.0126)	(0.0080)	(0.0066)	(0.0065)	(0.0141)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Temp. Shock as % of Dep. Var. Mean:												
Temperature	6.46	10.25	7.80	3.86	6.78	9.19	8.17	4.69	5.14	11.87	3.54	4.37
p-value	[0.11]	[0.03]	[0.18]	[0.24]	[0.15]	[0.08]	[0.21]	[0.17]	[0.58]	[0.26]	[0.84]	[0.59]
Temp. × Transhumant Pastoral	4.30	15.17	-1.30	1.30	-1.37	2.72	-13.94	-10.50	10.58	31.55	18.37	10.02
p-value	[0.63]	[0.21]	[0.92]	[0.81]	[0.92]	[0.88]	[0.32]	[0.18]	[0.51]	[0.11]	[0.53]	[0.36]
Temp. + Temp. × Transhumant Pastoral	10.76	25.42	6.51	5.16	5.41	11.91	-5.77	-5.81	15.72	43.42	21.91	14.39
p-value	[0.22]	[0.03]	[0.57]	[0.28]	[0.65]	[0.48]	[0.63]	[0.38]	[0.36]	[0.06]	[0.44]	[0.11]
Dep. Var. Mean	0.032	0.024	0.015	0.068	0.037	0.027	0.017	0.078	0.022	0.017	0.008	0.043
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	364	364	364	252	338	338	338	234	338	338	338	234
Cells	7,667	7,667	7,667	7,667	5,427	5,427	5,427	5,427	2,240	2,240	2,240	2,240
Observations	199,298	199,298	199,298	137,978	141,080	141,080	141,080	97,672	58,218	58,218	58,218	40,306

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. *Own Ethnic Group* refers to the ethnic territory that contains cell i. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A21: Estimates including Temperature in addition to Rainfall: Using the Narrow Definition of Transhumance

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)
Nearest Neighboring Ethnic Group												
Rain [γ_0^s]	-0.0005	0.0002	-0.0007	-0.0001	-0.0006	0.0002	-0.0008	0.0006	0.0001	-0.0003	0.0002	-0.0110***
	(0.0007)	(0.0006)	(0.0005)	(0.0012)	(0.0007)	(0.0006)	(0.0005)	(0.0012)	(0.0026)	(0.0025)	(0.0019)	(0.0040)
Rain × Transhumant Pastoral [γ_1^s]	-0.0117***	-0.0127***	-0.0005	-0.0073**	-0.0151***	-0.0158***	-0.0028	-0.0138**	-0.0045	-0.0044	0.0008	0.0069
	(0.0035)	(0.0033)	(0.0022)	(0.0036)	(0.0047)	(0.0041)	(0.0030)	(0.0054)	(0.0062)	(0.0057)	(0.0037)	(0.0068)
Temperature	0.0029*	0.0035**	0.0012	0.0030	0.0029	0.0031*	0.0013	0.0039	0.0029	0.0038	0.0011	0.0026
	(0.0016)	(0.0014)	(0.0011)	(0.0027)	(0.0021)	(0.0017)	(0.0013)	(0.0032)	(0.0029)	(0.0025)	(0.0020)	(0.0045)
Temperature × Transhumant Pastoral	-0.0000	0.0026	0.0000	0.0023	-0.0004	0.0003	-0.0006	-0.0071	0.0001	0.0040	0.0005	0.0058
	(0.0036)	(0.0035)	(0.0023)	(0.0045)	(0.0061)	(0.0062)	(0.0032)	(0.0080)	(0.0044)	(0.0040)	(0.0032)	(0.0059)
Own Ethnic Group												
Rain [γ_2^s]	0.0000	0.0011	-0.0004	0.0013	0.0002	0.0011	-0.0001	0.0010	-0.0107*	-0.0052	-0.0051	-0.0025
	(0.0011)	(0.0010)	(0.0007)	(0.0016)	(0.0011)	(0.0010)	(0.0007)	(0.0016)	(0.0056)	(0.0043)	(0.0039)	(0.0083)
Rain × Transhumant Pastoral [γ_3^s]	0.0022	-0.0016	0.0028	0.0061	0.0184	0.0162*	0.0114	0.0038	0.0137	0.0039	0.0080	0.0142
	(0.0050)	(0.0050)	(0.0042)	(0.0062)	(0.0139)	(0.0083)	(0.0125)	(0.0169)	(0.0092)	(0.0083)	(0.0067)	(0.0128)
Temperature	0.0061**	0.0046**	0.0043***	0.0114***	0.0063**	0.0041*	0.0048***	0.0089**	0.0018	0.0021	0.0006	0.0214**
	(0.0025)	(0.0023)	(0.0016)	(0.0034)	(0.0025)	(0.0023)	(0.0017)	(0.0039)	(0.0061)	(0.0044)	(0.0047)	(0.0093)
Temperature × Transhumant Pastoral	0.0055	0.0046	-0.0023	-0.0115	0.0034	0.0067	-0.0017	0.0007	0.0091	0.0062	0.0025	-0.0272*
	(0.0058)	(0.0052)	(0.0039)	(0.0086)	(0.0132)	(0.0134)	(0.0077)	(0.0184)	(0.0111)	(0.0085)	(0.0080)	(0.0162)
Own Cell												
Rain [γ_4^s]	-0.0003	-0.0004	-0.0002	-0.0008	-0.0003	-0.0003	-0.0002	-0.0010	0.0012	-0.0028	0.0035	-0.0009
	(0.0008)	(0.0006)	(0.0006)	(0.0011)	(0.0008)	(0.0006)	(0.0006)	(0.0012)	(0.0033)	(0.0019)	(0.0028)	(0.0053)
Rain × Transhumant Pastoral [γ_5^s]	0.0023	0.0046	-0.0018	0.0002	-0.0079	-0.0064	-0.0059	0.0115	-0.0016	0.0065	-0.0071	0.0036
	(0.0040)	(0.0037)	(0.0026)	(0.0054)	(0.0098)	(0.0077)	(0.0089)	(0.0122)	(0.0066)	(0.0052)	(0.0047)	(0.0095)
Temperature	-0.0023	-0.0025	-0.0015	-0.0029	-0.0020	-0.0021	-0.0012	-0.0017	-0.0018	-0.0015	-0.0023	-0.0099
	(0.0019)	(0.0018)	(0.0011)	(0.0024)	(0.0020)	(0.0019)	(0.0012)	(0.0026)	(0.0037)	(0.0034)	(0.0028)	(0.0067)
Temperature × Transhumant Pastoral	0.0029	0.0034	0.0032	0.0030	0.0040	0.0027	0.0015	-0.0070	0.0015	0.0010	0.0042	0.0113
	(0.0041)	(0.0036)	(0.0032)	(0.0065)	(0.0085)	(0.0080)	(0.0073)	(0.0124)	(0.0077)	(0.0063)	(0.0061)	(0.0137)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:												
Rain	-1.75	0.92	-5.58	-0.26	-1.84	0.99	-5.45	0.89	0.36	-2.52	2.34	-30.55
p-value	[0.47]	[0.75]	[0.18]	[0.90]	[0.40]	[0.70]	[0.14]	[0.63]	[0.98]	[0.89]	[0.93]	[0.01]
Rain × Transhumant Pastoral	-43.34	-63.90	-4.46	-12.99	-49.48	-71.06	-19.42	-21.35	-24.63	-32.12	11.59	19.06
p-value	[0.00]	[0.00]	[0.80]	[0.04]	[0.00]	[0.00]	[0.35]	[0.01]	[0.46]	[0.44]	[0.83]	[0.31]
Rain + Rain × Transhumant Pastoral	-45.10	-62.98	-10.03	-13.24	-51.32	-70.07	-24.87	-20.45	-24.27	-34.64	13.93	-11.49
p-value	[0.00]	[0.00]	[0.57]	[0.03]	[0.00]	[0.00]	[0.23]	[0.01]	[0.43]	[0.37]	[0.78]	[0.49]
Dep. Var. Mean	0.032	0.024	0.015	0.068	0.037	0.027	0.017	0.078	0.022	0.017	0.008	0.043
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	364	364	364	252	338	338	338	234	338	338	338	234
Cells	7,667	7,667	7,667	7,667	5,427	5,427	5,427	5,427	2,240	2,240	2,240	2,240
Observations	199,298	199,298	199,298	137,978	141,080	141,080	141,080	97,672	58,218	58,218	58,218	40,306

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. *Own Ethnic Group* refers to the ethnic territory that contains cell i. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A22: Estimates Including Temperature in Addition to Rainfall: Using the Broad Definition of Transhumance

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)
Nearest Neighboring Ethnic Group												
Rain [γ_0^s]	-0.0005	0.0003	-0.0008	-0.0001	-0.0005	0.0003	-0.0008	0.0006	0.0002	0.0002	-0.0000	-0.0112***
	(0.0007)	(0.0006)	(0.0005)	(0.0012)	(0.0007)	(0.0006)	(0.0005)	(0.0012)	(0.0028)	(0.0026)	(0.0020)	(0.0040)
Rain × Transhumant Pastoral [γ_1^s]	-0.0085***	-0.0105***	0.0011	-0.0068*	-0.0084**	-0.0101***	0.0005	-0.0089*	-0.0049	-0.0062	0.0011	0.0060
	(0.0032)	(0.0030)	(0.0020)	(0.0036)	(0.0040)	(0.0036)	(0.0024)	(0.0051)	(0.0057)	(0.0052)	(0.0038)	(0.0069)
Temperature	0.0026	0.0032**	0.0013	0.0033	0.0030	0.0032*	0.0016	0.0046	0.0015	0.0025	0.0003	0.0019
	(0.0016)	(0.0014)	(0.0011)	(0.0028)	(0.0022)	(0.0017)	(0.0014)	(0.0033)	(0.0026)	(0.0022)	(0.0018)	(0.0043)
Temperature × Transhumant Pastoral	0.0013	0.0039	-0.0001	0.0007	-0.0013	-0.0000	-0.0029	-0.0109	0.0027	0.0063	0.0019	0.0062
	(0.0037)	(0.0036)	(0.0023)	(0.0046)	(0.0061)	(0.0062)	(0.0030)	(0.0075)	(0.0044)	(0.0041)	(0.0030)	(0.0060)
Own Ethnic Group												
Rain [γ_2^s]	0.0002	0.0013	-0.0002	0.0014	0.0005	0.0013	0.0000	0.0012	-0.0088	-0.0047	-0.0039	-0.0026
	(0.0011)	(0.0010)	(0.0007)	(0.0016)	(0.0011)	(0.0010)	(0.0007)	(0.0016)	(0.0055)	(0.0048)	(0.0034)	(0.0089)
Rain × Transhumant Pastoral [γ_3^s]	-0.0023	-0.0041	-0.0001	0.0035	-0.0036	-0.0008	-0.0022	-0.0094	0.0098	0.0029	0.0057	0.0154
	(0.0046)	(0.0044)	(0.0038)	(0.0059)	(0.0084)	(0.0070)	(0.0065)	(0.0112)	(0.0090)	(0.0088)	(0.0062)	(0.0134)
Temperature	0.0048*	0.0032	0.0040**	0.0121***	0.0049*	0.0026	0.0044**	0.0092**	0.0023	0.0022	0.0010	0.0330***
	(0.0024)	(0.0022)	(0.0016)	(0.0035)	(0.0026)	(0.0023)	(0.0018)	(0.0041)	(0.0072)	(0.0052)	(0.0053)	(0.0106)
Temperature × Transhumant Pastoral	0.0096	0.0089*	-0.0011	-0.0132	0.0199	0.0220	0.0042	-0.0036	0.0082	0.0061	0.0018	-0.0432***
	(0.0060)	(0.0052)	(0.0040)	(0.0087)	(0.0172)	(0.0154)	(0.0085)	(0.0183)	(0.0124)	(0.0096)	(0.0087)	(0.0161)
Own Cell												
Rain [γ_4^s]	-0.0004	-0.0005	-0.0002	-0.0008	-0.0003	-0.0004	-0.0003	-0.0012	-0.0010	-0.0042**	0.0023	0.0021
	(0.0008)	(0.0006)	(0.0006)	(0.0012)	(0.0008)	(0.0006)	(0.0006)	(0.0012)	(0.0027)	(0.0020)	(0.0020)	(0.0052)
Rain × Transhumant Pastoral [γ_5^s]	0.0032	0.0050	-0.0007	0.0006	-0.0014	-0.0016	0.0005	0.0123	0.0025	0.0088*	-0.0047	-0.0015
	(0.0037)	(0.0034)	(0.0026)	(0.0050)	(0.0064)	(0.0056)	(0.0052)	(0.0090)	(0.0059)	(0.0052)	(0.0039)	(0.0098)
Temperature	-0.0015	-0.0016	-0.0013	-0.0033	-0.0012	-0.0010	-0.0011	-0.0025	-0.0010	-0.0008	-0.0019	-0.0095
	(0.0018)	(0.0017)	(0.0011)	(0.0023)	(0.0019)	(0.0017)	(0.0012)	(0.0025)	(0.0040)	(0.0036)	(0.0031)	(0.0068)
Temperature × Transhumant Pastoral	0.0002	0.0003	0.0025	0.0041	-0.0068	-0.0110	-0.0009	0.0057	0.0004	-0.0001	0.0036	0.0109
	(0.0043)	(0.0036)	(0.0034)	(0.0066)	(0.0126)	(0.0120)	(0.0079)	(0.0126)	(0.0080)	(0.0066)	(0.0065)	(0.0141)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:												
Rain	-1.74	1.28	-6.21	-0.11	-1.78	1.23	-5.81	0.99	1.17	1.55	-0.19	-30.90
p-value	[0.47]	[0.65]	[0.14]	[0.96]	[0.42]	[0.63]	[0.12]	[0.60]	[0.94]	[0.94]	[0.99]	[0.01]
Rain × Transhumant Pastoral	-31.60	-52.92	9.07	-12.09	-27.41	-45.26	3.24	-13.82	-26.62	-44.66	16.47	16.54
p-value	[0.01]	[0.00]	[0.58]	[0.06]	[0.04]	[0.00]	[0.85]	[0.08]	[0.39]	[0.24]	[0.77]	[0.39]
Rain + Rain × Transhumant Pastoral	-33.33	-51.64	2.86	-12.20	-29.20	-44.04	-2.56	-12.83	-25.45	-43.10	16.27	-14.36
p-value	[0.00]	[0.00]	[0.86]	[0.05]	[0.03]	[0.01]	[0.88]	[0.09]	[0.35]	[0.20]	[0.73]	[0.40]
Dep. Var. Mean	0.032	0.024	0.015	0.068	0.037	0.027	0.017	0.078	0.022	0.017	0.008	0.043
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	364	364	364	252	338	338	338	234	338	338	338	234
Cells	7,667	7,667	7,667	7,667	5,427	5,427	5,427	5,427	2,240	2,240	2,240	2,240
Observations	199,298	199,298	199,298	137,978	141,080	141,080	141,080	97,672	58,218	58,218	58,218	40,306

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. *Own Ethnic Group* refers to the ethnic territory that contains cell i. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A23: Jihadist Violence: Using the Broad Definition of Transhumance

	Conflict in All Grid Cells				Conflict in Agricultural Cells			
	(1) Jihadist	(2) Non-Jihadist	(3) Jihadist	(4) Non-Jihadist	(5) Jihadist	(6) Non-Jihadist	(7) Jihadist	(8) Non-Jihadist
Nearest Neighboring Ethnic Group								
Rain	0.0000	-0.0006	0.0007	-0.0001	0.0000	-0.0007	0.0004	-0.0012
	(0.0003)	(0.0006)	(0.0005)	(0.0021)	(0.0002)	(0.0006)	(0.0005)	(0.0021)
Rain × Transhumant Pastoral	-0.0049**	-0.0037	-0.0052**	-0.0027	-0.0030	-0.0038	-0.0024	-0.0027
	(0.0021)	(0.0023)	(0.0022)	(0.0027)	(0.0018)	(0.0034)	(0.0020)	(0.0037)
Rain × Share Muslim			-0.0019	-0.0013			-0.0010	-0.0002
			(0.0013)	(0.0026)			(0.0011)	(0.0026)
Rain × Share Christian			-0.0005	-0.0003			-0.0003	0.0011
			(0.0007)	(0.0028)			(0.0007)	(0.0029)
Own Ethnic Group								
Rain	0.0011**	-0.0009	0.0016	-0.0031	0.0011***	-0.0010	0.0014	-0.0042
	(0.0004)	(0.0010)	(0.0010)	(0.0030)	(0.0004)	(0.0010)	(0.0010)	(0.0031)
Rain × Transhumant Pastoral	-0.0031	-0.0023	-0.0042	-0.0027	-0.0025	-0.0037	-0.0060	-0.0088
	(0.0025)	(0.0039)	(0.0030)	(0.0047)	(0.0030)	(0.0076)	(0.0039)	(0.0105)
Rain × Share Muslim			0.0013	0.0039			0.0022	0.0057
			(0.0019)	(0.0037)			(0.0016)	(0.0039)
Rain × Share Christian			-0.0012	0.0027			-0.0010	0.0042
			(0.0011)	(0.0042)			(0.0011)	(0.0043)
Own Cell								
Rain	-0.0001	-0.0002	0.0000	0.0018	-0.0002	-0.0000	0.0000	0.0031
	(0.0002)	(0.0007)	(0.0003)	(0.0021)	(0.0002)	(0.0007)	(0.0003)	(0.0022)
Rain × Transhumant Pastoral	-0.0002	0.0054*	-0.0000	0.0062*	-0.0020	-0.0003	-0.0016	0.0006
	(0.0015)	(0.0031)	(0.0017)	(0.0036)	(0.0033)	(0.0063)	(0.0040)	(0.0084)
Rain × Share Muslim			-0.0008	-0.0023			-0.0011	-0.0043
			(0.0011)	(0.0028)			(0.0011)	(0.0030)
Rain × Share Christian			-0.0001	-0.0028			-0.0000	-0.0043
			(0.0004)	(0.0029)			(0.0004)	(0.0031)
Nearest Neighboring Ethnic Group: Additional Calculations								
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:								
Rain	0.04	-2.53	11.08	-0.56	0.59	-2.55	6.87	-4.10
p-value	[0.99]	[0.32]	[0.17]	[0.94]	[0.90]	[0.25]	[0.42]	[0.58]
Rain × Transhumant Pastoral	-83.40	-15.76	-80.54	-10.40	-54.92	-14.05	-40.87	-9.22
p-value	[0.02]	[0.12]	[0.02]	[0.31]	[0.10]	[0.26]	[0.25]	[0.47]
Rain + Rain × Transhumant Pastoral	-83.36	-18.29	-69.47	-10.96	-54.34	-16.60	-34.00	-13.32
p-value	[0.02]	[0.07]	[0.03]	[0.39]	[0.11]	[0.19]	[0.32]	[0.35]
Dep. Var. Mean	0.0071	0.0278	0.0077	0.0314	0.0065	0.0325	0.0069	0.0345
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	420	420	420	420	390	390	390	390
Cells	7,667	7,667	6,453	6,453	5,427	5,427	4,863	4,863
Observations	230,010	230,010	193,590	193,590	162,810	162,810	145,890	145,890

Note: The unit of observation is a 0.5-degree grid-cell and year. "Jihadist" is an indicator variable that equals one if at least one UCDP conflict event occurs in a cell-year involving a self-styled jihadist group, as defined in the main text. "Non-Jihadist" is an indicator variable that equals one if at least one UCDP conflict event occurs in a cell-year that does not involve a self-styled jihadist group. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. *Own Ethnic Group* refers to the ethnic territory that contains cell i. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A24: Controlling for Contemporary Religion: Using the Narrow Definition of Transhumance

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)
Nearest Neighboring Ethnic Group												
Rain	0.0006	0.0013	0.0002	0.0004	-0.0006	0.0010	-0.0010	0.0004	0.0084	0.0003	0.0125**	-0.0038
	(0.0021)	(0.0017)	(0.0015)	(0.0030)	(0.0022)	(0.0017)	(0.0015)	(0.0032)	(0.0070)	(0.0068)	(0.0053)	(0.0088)
Rain × Transhumant Pastoral	-0.0111***	-0.0128***	-0.0006	-0.0074*	-0.0117**	-0.0126***	-0.0023	-0.0139**	-0.0066	-0.0062	-0.0009	0.0046
	(0.0038)	(0.0035)	(0.0025)	(0.0039)	(0.0051)	(0.0042)	(0.0032)	(0.0054)	(0.0065)	(0.0062)	(0.0039)	(0.0076)
Rain × Share Muslim	-0.0031	-0.0031	-0.0017	-0.0044	-0.0013	-0.0017	-0.0007	-0.0037	-0.0094	-0.0029	-0.0116*	-0.0087
	(0.0028)	(0.0023)	(0.0020)	(0.0035)	(0.0028)	(0.0023)	(0.0020)	(0.0039)	(0.0080)	(0.0073)	(0.0061)	(0.0105)
Rain × Share Christian	-0.0009	-0.0012	-0.0004	0.0006	0.0006	-0.0009	0.0011	0.0013	-0.0105	0.0018	-0.0164**	-0.0124
	(0.0028)	(0.0022)	(0.0020)	(0.0043)	(0.0030)	(0.0024)	(0.0021)	(0.0046)	(0.0088)	(0.0077)	(0.0067)	(0.0111)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:												
Rain	1.89	5.57	1.16	0.46	-1.72	3.97	-5.94	0.54	31.91	1.54	122.91	-6.23
p-value	[0.77]	[0.43]	[0.91]	[0.91]	[0.79]	[0.57]	[0.52]	[0.89]	[0.23]	[0.96]	[0.02]	[0.67]
Rain × Transhumant Pastoral	-34.39	-54.76	-3.92	-9.62	-34.31	-51.29	-14.00	-16.84	-25.17	-31.80	-8.73	7.67
p-value	[0.00]	[0.00]	[0.81]	[0.06]	[0.02]	[0.00]	[0.46]	[0.01]	[0.30]	[0.32]	[0.82]	[0.54]
Rain + Rain × Transhumant Pastoral	-32.51	-49.19	-2.76	-9.16	-36.04	-47.32	-19.94	-16.30	6.74	-30.25	114.18	1.44
p-value	[0.01]	[0.00]	[0.88]	[0.11]	[0.02]	[0.01]	[0.33]	[0.02]	[0.84]	[0.45]	[0.09]	[0.94]
Dep. Var. Mean	0.0388	0.0280	0.0179	0.0926	0.0411	0.0294	0.0198	0.0992	0.0317	0.0235	0.0122	0.0727
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	420	420	420	322	390	390	390	299	390	390	390	299
Cells	6,453	6,453	6,453	6,453	4,863	4,863	4,863	4,863	1,589	1,589	1,589	1,589
Observations	193,590	193,590	193,590	148,419	145,890	145,890	145,890	111,849	47,670	47,670	47,670	36,547

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "UCDP I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. This regression controls for the corresponding variables at the *Own Ethnic Group* level and the *Own Cell* level. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A25: Controlling for Contemporary Religion: Using the Broad Definition of Transhumance

	Conflict in All Grid Cells				Conflict in Agricultural Cells				Conflict in Non-Agricultural Cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	UCDP I(Non-State)	ACLED I(Any)
Nearest Neighboring Ethnic Group												
Rain	0.0004	0.0013	0.0000	0.0004	-0.0009	0.0008	-0.0012	0.0002	0.0087	0.0009	0.0125**	-0.0036
	(0.0021)	(0.0017)	(0.0015)	(0.0030)	(0.0021)	(0.0017)	(0.0015)	(0.0032)	(0.0070)	(0.0068)	(0.0052)	(0.0090)
Rain × Transhumant Pastoral	-0.0074**	-0.0108***	0.0017	-0.0069*	-0.0049	-0.0080**	0.0017	-0.0085	-0.0081	-0.0091	-0.0004	0.0026
	(0.0035)	(0.0032)	(0.0023)	(0.0039)	(0.0042)	(0.0036)	(0.0026)	(0.0055)	(0.0064)	(0.0060)	(0.0040)	(0.0071)
Rain × Share Muslim	-0.0031	-0.0029	-0.0019	-0.0042	-0.0012	-0.0015	-0.0008	-0.0034	-0.0087	-0.0017	-0.0119*	-0.0082
	(0.0028)	(0.0023)	(0.0020)	(0.0035)	(0.0028)	(0.0023)	(0.0020)	(0.0039)	(0.0081)	(0.0075)	(0.0061)	(0.0103)
Rain × Share Christian	-0.0006	-0.0010	-0.0002	0.0006	0.0010	-0.0006	0.0014	0.0017	-0.0106	0.0015	-0.0165**	-0.0126
	(0.0028)	(0.0022)	(0.0020)	(0.0043)	(0.0029)	(0.0023)	(0.0021)	(0.0046)	(0.0087)	(0.0077)	(0.0066)	(0.0112)
Nearest Neighboring Ethnic Group: Additional Calculations												
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:												
Rain	1.38	5.45	0.05	0.50	-2.52	3.29	-7.15	0.20	33.07	4.40	123.20	-5.88
p-value	[0.83]	[0.44]	[1.00]	[0.90]	[0.69]	[0.63]	[0.44]	[0.96]	[0.21]	[0.90]	[0.02]	[0.69]
Rain × Transhumant Pastoral	-23.01	-46.13	11.39	-9.00	-14.20	-32.77	10.35	-10.29	-30.72	-46.47	-3.83	4.34
p-value	[0.03]	[0.00]	[0.46]	[0.08]	[0.24]	[0.03]	[0.51]	[0.12]	[0.20]	[0.13]	[0.92]	[0.71]
Rain + Rain × Transhumant Pastoral	-21.63	-40.68	11.44	-8.50	-16.73	-29.48	3.20	-10.09	2.35	-42.07	119.37	-1.54
p-value	[0.08]	[0.01]	[0.50]	[0.14]	[0.21]	[0.06]	[0.85]	[0.15]	[0.94]	[0.31]	[0.07]	[0.93]
Dep. Var. Mean	0.0388	0.0280	0.0179	0.0926	0.0411	0.0294	0.0198	0.0992	0.0317	0.0235	0.0122	0.0727
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	420	420	420	322	390	390	390	299	390	390	390	299
Cells	6,453	6,453	6,453	6,453	4,863	4,863	4,863	4,863	1,589	1,589	1,589	1,589
Observations	193,590	193,590	193,590	148,419	145,890	145,890	145,890	111,849	47,670	47,670	47,670	36,547

Note: The unit of observation is a 0.5-degree grid-cell and year. “UCDP I(Any)” is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. “UCDP I(State)” is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; “UCDP I(Non-State)” is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year; “ACLED I(Any)” is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. This regression controls for the corresponding variables at the *Own Ethnic Group* level and the *Own Cell* level. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A26: Heterogeneity by Share of Political Power Held by Transhumant Pastoral Groups: Using the Broad Definition of Transhumance

	Conflict in All Grid Cells			Conflict in Agricultural Cells		
	(1)	(2)	(3)	(4)	(5)	(6)
	UCDP	UCDP	ACLED	UCDP	UCDP	ACLED
	I(Any)	I(State)	I(Any)	I(Any)	I(State)	I(Any)
Nearest Neighboring Ethnic Group						
Rain	-0.0008	0.0006	-0.0044***	-0.0010	0.0003	-0.0031**
	(0.0008)	(0.0007)	(0.0015)	(0.0008)	(0.0007)	(0.0015)
Rain × Transhumant Pastoral	-0.0081	-0.0097**	-0.0417***	-0.0075	-0.0120**	-0.0408***
	(0.0052)	(0.0045)	(0.0080)	(0.0067)	(0.0058)	(0.0097)
Rain × Transhumant Pastoral × THP Power Share	0.0150	0.0144	0.1452***	0.0089	0.0226	0.1603***
	(0.0203)	(0.0185)	(0.0359)	(0.0292)	(0.0276)	(0.0470)
Rain × THP Power Share	0.0021	-0.0033	0.0565***	0.0038	0.0014	0.0535***
	(0.0073)	(0.0070)	(0.0144)	(0.0086)	(0.0080)	(0.0170)
Transhumant Pastoral × THP Power Share	-0.1589	-0.1622	-0.9318***	-0.2786	-0.3117*	-1.2088***
	(0.1080)	(0.1051)	(0.1581)	(0.1740)	(0.1681)	(0.2144)
Nearest Neighboring Ethnic Group: Additional Calculations						
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:						
Rain × Transhumant Pastoral when THP Power at 25 pctile	-30.3	-48.5	-67.2	-24.4	-52.5	-53.9
p-value	[0.12]	[0.03]	[0.00]	[0.26]	[0.04]	[0.00]
Rain × Transhumant Pastoral when THP Power at 50 pctile	-25.1	-41.8	-45.2	-21.7	-43.2	-34.0
p-value	[0.09]	[0.02]	[0.00]	[0.18]	[0.02]	[0.00]
Rain × Transhumant Pastoral when THP Power at 75 pctile	-14.4	-28.1	-0.7	-16.2	-24.5	6.3
p-value	[0.31]	[0.12]	[0.94]	[0.36]	[0.28]	[0.58]
Dep. Var. Mean	0.032	0.024	0.074	0.037	0.027	0.091
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	406	406	308	377	377	286
Cells	6,965	6,965	6,962	5,089	5,089	5,086
Observations	194,442	194,442	148,128	140,923	140,923	107,000

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. This regression controls for the corresponding variables at the *Own Ethnic Group* level and the *Own Cell* level. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A27: Heterogeneity by Presence of World Bank Irrigation and Conservation Aid Projects: Using the Broad Definition of Transhumance

	Conflict in All Grid Cells			Conflict in Agricultural Cells		
	(1)	(2)	(3)	(4)	(5)	(6)
	UCDP I(Any)	UCDP I(State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	ACLED I(Any)
	Irrigation Aid Projects					
Nearest Neighboring Ethnic Group						
Rain	-0.00010	0.00087	0.00049	-0.00029	0.00083	0.00111
	(0.00081)	(0.00068)	(0.00127)	(0.00082)	(0.00068)	(0.00132)
Rain × Transhumant Pastoral	-0.01151***	-0.01441***	-0.00981***	-0.01567***	-0.01685***	-0.01187**
	(0.00368)	(0.00353)	(0.00373)	(0.00502)	(0.00449)	(0.00529)
Rain × Transhumant Pastoral × Irrigation Aid Projects	0.00210**	0.00226***	0.00132	0.00258**	0.00273**	0.00233*
	(0.00082)	(0.00081)	(0.00094)	(0.00118)	(0.00117)	(0.00130)
Rain × Irrigation Aid Projects	-0.00049**	-0.00038**	-0.00042**	-0.00049***	-0.00040**	-0.00045**
	(0.00019)	(0.00018)	(0.00021)	(0.00019)	(0.00019)	(0.00022)
Transhumant Pastoral × Irrigation Aid Projects	-0.00243**	-0.00226**	0.00476	-0.00389	-0.00359	-0.00226
	(0.00095)	(0.00094)	(0.00308)	(0.00244)	(0.00240)	(0.00519)
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:						
Rain × Transhumant Pastoral when Aid Projects = 0	-42.6	-73.0	-17.4	-52.5	-77.6	-18.3
p-value	[0.00]	[0.00]	[0.01]	[0.00]	[0.00]	[0.03]
Rain × Transhumant Pastoral when Aid Projects = 1	-34.8	-61.6	-15.0	-43.9	-65.0	-14.7
p-value	[0.01]	[0.00]	[0.02]	[0.01]	[0.00]	[0.06]
	Conservation/Forestry Aid Projects					
Nearest Neighboring Ethnic Group						
Rain	-0.00095	0.00027	-0.00024	-0.00112	0.00025	0.00042
	(0.00076)	(0.00062)	(0.00123)	(0.00078)	(0.00061)	(0.00128)
Rain × Transhumant Pastoral	-0.00794**	-0.01096***	-0.00765**	-0.01180**	-0.01307***	-0.01044**
	(0.00366)	(0.00341)	(0.00357)	(0.00497)	(0.00435)	(0.00521)
Rain × Transhumant Pastoral × Conservation/Forestry Aid Projects	-0.00096**	-0.00064	-0.00003	-0.00036	-0.00010	0.00106
	(0.00049)	(0.00043)	(0.00104)	(0.00043)	(0.00036)	(0.00112)
Rain × Conservation/Forestry Aid Projects	0.00019*	0.00007	0.00008	0.00022*	0.00009	0.00009
	(0.00010)	(0.00008)	(0.00012)	(0.00011)	(0.00008)	(0.00012)
Transhumant Pastoral × Conservation/Forestry Aid Projects	0.00880***	0.00663**	-0.00327	0.00223	0.00042	-0.01445
	(0.00327)	(0.00302)	(0.00901)	(0.00241)	(0.00206)	(0.00990)
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:						
Rain × Transhumant Pastoral when Aid Projects = 0	-29.4	-55.6	-13.5	-39.5	-60.2	-16.1
p-value	[0.03]	[0.00]	[0.03]	[0.02]	[0.00]	[0.05]
Rain × Transhumant Pastoral when Aid Projects = 1	-32.9	-58.8	-13.6	-40.8	-60.6	-14.5
p-value	[0.01]	[0.00]	[0.03]	[0.01]	[0.00]	[0.06]
Dep. Var. Mean	0.032	0.024	0.068	0.036	0.026	0.078
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	280	280	252	260	260	234
Cells	7,667	7,667	7,667	5,427	5,427	5,427
Observations	153,340	153,340	138,006	108,540	108,540	97,686

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. This regression controls for the corresponding variables at the *Own Ethnic Group* level and the *Own Cell* level. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A28: Heterogeneity by Presence of World Bank Aid Projects: Using the Narrow Definition of Transhumance

	Conflict in All Grid Cells			Conflict in Agricultural Cells		
	(1)	(2)	(3)	(4)	(5)	(6)
	UCDP I(Any)	UCDP I(State)	ACLED I(Any)	UCDP I(Any)	UCDP I(State)	ACLED I(Any)
	Agricultural Aid Projects					
Nearest Neighboring Ethnic Group						
Rain	0.00098	0.00167**	0.00056	0.00076	0.00164**	0.00095
	(0.00092)	(0.00077)	(0.00126)	(0.00095)	(0.00078)	(0.00129)
Rain × Transhumant Pastoral	-0.01316***	-0.01401***	-0.00687*	-0.02036***	-0.01644***	-0.00874
	(0.00369)	(0.00345)	(0.00388)	(0.00541)	(0.00468)	(0.00563)
Rain × Transhumant Pastoral × Agricultural Aid Projects	0.00003	0.00001	-0.00001	-0.00000	-0.00006*	-0.00007
	(0.00004)	(0.00004)	(0.00005)	(0.00005)	(0.00004)	(0.00006)
Rain × Agricultural Aid Projects	-0.00004***	-0.00003***	-0.00002*	-0.00004***	-0.00003***	-0.00002
	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)
Transhumant Pastoral × Agricultural Aid Projects	-0.00015	-0.00007	0.00008	0.00017	0.00039	0.00033
	(0.00016)	(0.00016)	(0.00023)	(0.00027)	(0.00026)	(0.00031)
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:						
Rain × Transhumant Pastoral when Aid Projects = 0	-47.4	-69.4	-11.7	-66.8	-74.9	-13.1
p-value	[0.00]	[0.00]	[0.08]	[0.00]	[0.00]	[0.12]
Rain × Transhumant Pastoral when Aid Projects = 1	-47.3	-69.4	-11.7	-66.8	-75.2	-13.2
p-value	[0.00]	[0.00]	[0.08]	[0.00]	[0.00]	[0.12]
	Non-Agricultural Aid Projects					
Nearest Neighboring Ethnic Group						
Rain	0.00079	0.00159**	0.00023	0.00058	0.00160*	0.00067
	(0.00096)	(0.00080)	(0.00130)	(0.00100)	(0.00081)	(0.00135)
Rain × Transhumant Pastoral	-0.01124***	-0.01262***	-0.00317	-0.01887***	-0.01679***	-0.00782
	(0.00358)	(0.00338)	(0.00386)	(0.00545)	(0.00469)	(0.00571)
Rain × Transhumant Pastoral × Non-Agricultural Aid Projects	-0.00000	-0.00001	-0.00004**	-0.00002	-0.00003**	-0.00004*
	(0.00002)	(0.00002)	(0.00002)	(0.00001)	(0.00001)	(0.00002)
Rain × Non-Agricultural Aid Projects	-0.00001***	-0.00001***	-0.00000	-0.00001***	-0.00001***	-0.00000
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Transhumant Pastoral × Non-Agricultural Aid Projects	0.00004	0.00005	0.00017**	0.00010	0.00013	0.00017
	(0.00007)	(0.00007)	(0.00008)	(0.00009)	(0.00008)	(0.00011)
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:						
Rain × Transhumant Pastoral when Aid Projects = 0	-40.5	-62.5	-5.4	-61.9	-76.5	-11.7
p-value	[0.00]	[0.00]	[0.41]	[0.00]	[0.00]	[0.17]
Rain × Transhumant Pastoral when Aid Projects = 1	-40.5	-62.6	-5.5	-61.9	-76.6	-11.7
p-value	[0.00]	[0.00]	[0.41]	[0.00]	[0.00]	[0.17]
Dep. Var. Mean	0.034	0.024	0.071	0.037	0.026	0.081
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	280	280	266	260	260	247
Cells	7,667	7,667	7,667	5,427	5,427	5,427
Observations	153,340	153,340	145,673	108,540	108,540	103,113

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. This regression controls for the corresponding variables at the *Own Ethnic Group* level and the *Own Cell* level. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A29: Heterogeneity by Presence of World Bank Aid Projects: Using the Broad Definition of Transhumance

	Conflict in All Grid Cells			Conflict in Agricultural Cells		
	(1) UCDP I(Any)	(2) UCDP I(State)	(3) ACLED I(Any)	(4) UCDP I(Any)	(5) UCDP I(State)	(6) ACLED I(Any)
	Agricultural Aid Projects					
Nearest Neighboring Ethnic Group						
Rain	0.00046	0.00129*	0.00036	0.00020	0.00124	0.00095
	(0.00087)	(0.00075)	(0.00128)	(0.00089)	(0.00076)	(0.00133)
Rain × Transhumant Pastoral	-0.01307***	-0.01499***	-0.00973***	-0.01628***	-0.01667***	-0.01118**
	(0.00378)	(0.00375)	(0.00357)	(0.00505)	(0.00480)	(0.00486)
Rain × Transhumant Pastoral × Agricultural Aid Projects	0.00008***	0.00006**	0.00004	0.00007	0.00006	0.00004
	(0.00003)	(0.00003)	(0.00003)	(0.00004)	(0.00004)	(0.00003)
Rain × Agricultural Aid Projects	-0.00003***	-0.00002**	-0.00001	-0.00003**	-0.00002**	-0.00001
	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)
Transhumant Pastoral × Agricultural Aid Projects	-0.00009	-0.00006	0.00004	-0.00004	-0.00005	-0.00008
	(0.00016)	(0.00015)	(0.00017)	(0.00026)	(0.00025)	(0.00024)
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:						
Rain × Transhumant Pastoral when Aid Projects = 0	-48.3	-76.0	-17.2	-54.6	-76.8	-17.2
p-value	[0.00]	[0.00]	[0.01]	[0.00]	[0.00]	[0.02]
Rain × Transhumant Pastoral when Aid Projects = 1	-48.0	-75.7	-17.1	-54.4	-76.5	-17.2
p-value	[0.00]	[0.00]	[0.01]	[0.00]	[0.00]	[0.02]
	Non-Agricultural Aid Projects					
Nearest Neighboring Ethnic Group						
Rain	0.00023	0.00117	0.00012	0.00005	0.00124	0.00078
	(0.00089)	(0.00077)	(0.00133)	(0.00091)	(0.00078)	(0.00138)
Rain × Transhumant Pastoral	-0.01082***	-0.01345***	-0.00681*	-0.01431***	-0.01530***	-0.00982*
	(0.00380)	(0.00375)	(0.00368)	(0.00490)	(0.00448)	(0.00500)
Rain × Transhumant Pastoral × Non-Agricultural Aid Projects	0.00002*	0.00002	-0.00000	0.00002	0.00002	0.00001
	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)
Rain × Non-Agricultural Aid Projects	-0.00001**	-0.00001**	-0.00000	-0.00001*	-0.00001**	-0.00000
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Transhumant Pastoral × Non-Agricultural Aid Projects	0.00005	0.00005	0.00012*	0.00001	-0.00002	0.00000
	(0.00007)	(0.00006)	(0.00007)	(0.00009)	(0.00008)	(0.00010)
Effect of 1 Std. Dev. Rain Shock as % of Dep. Var. Mean:						
Rain × Transhumant Pastoral when Aid Projects = 0	-40.0	-68.2	-12.1	-48.0	-70.5	-15.1
p-value	[0.00]	[0.00]	[0.06]	[0.00]	[0.00]	[0.05]
Rain × Transhumant Pastoral when Aid Projects = 1	-40.0	-68.1	-12.1	-47.9	-70.4	-15.1
p-value	[0.00]	[0.00]	[0.06]	[0.00]	[0.00]	[0.05]
Dep. Var. Mean	0.032	0.024	0.068	0.036	0.026	0.078
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes
Country × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone-Years	280	280	252	260	260	234
Cells	7,667	7,667	7,667	5,427	5,427	5,427
Observations	153,340	153,340	138,006	108,540	108,540	97,686

Note: The unit of observation is a 0.5-degree grid-cell and year. "UCDP I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the UCDP data. "UCDP I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "ACLED I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year as coded in the ACLED data. *Nearest Neighboring Ethnic Group* refers to the nearest neighboring ethnic territory to cell i. This regression controls for the corresponding variables at the *Own Ethnic Group* level and the *Own Cell* level. Standard errors, which are reported in parentheses, are adjusted for clustering at the level of a grid-cell and a climate zone-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Appendix C. Calculation of Counterfactuals

To understand how we calculate our counterfactual, consider equation (2), which we reproduce here for convenience:

$$\begin{aligned} y_{iet} \quad = \quad & \gamma_0^s\, Rain_{it}^{Neighbor} + \gamma_1^s\, Rain_{it}^{Neighbor} \times TranshumantPastoral_i^{Neighbor} \\ & + \gamma_2^s\, Rain_{et}^{OwnGroup} + \gamma_3^s\, Rain_{et}^{OwnGroup} \times TranshumantPastoral_e^{OwnGroup} \\ & + \gamma_4^s\, Rain_{it}^{OwnCell} + \gamma_5^s\, Rain_{it}^{OwnCell} \times TranshumantPastoral_e^{OwnGroup} \\ & + X_{iet}'\Gamma + \alpha_i^s + \alpha_{c(i)t}^s + \eta_{iet}^s. \end{aligned}$$

The predicted spillover effects of rainfall due to transhumant pastoralism is given by γ_1^s. In this exercise, we use our estimate of γ_1^s to determine what proportion of the observed incidence of conflict across the African continent during our period of analysis can be explained by the effect of adverse rainfall shocks through this mechanism.

To address this question, we calculate for each grid-cell a counterfactual level of conflict that would have occurred had rainfall been at pre-climate change levels each year rather than at the observed levels. We define pre-climate-change rainfall in each cell-year as the observed level plus one within-cell standard deviation. This would increase average rainfall across Africa from 5.86 cm/month (which is roughly equal to Germany or the United States in 2017) to 7.06 cm/month (which is roughly equal to Portugal or Ethiopia). We additionally assume that the mechanism of interest is the only mechanism through which rainfall affects conflict.

The predicted counterfactual value of conflict in cell i and year t, which we denote by $\tilde{y}_{iet}$, is calculated as:

$$\widetilde{y}_{iet} = y_{iet} + \hat{\gamma}_1^s\, TranshumantPastoral_i^{Neighbor} \times \left[\overline{Rain_{it}^{Neighbor}} - Rain_{it}^{Neighbor} \right]$$

where all variables are as defined in equation equation (2) and $\overline{Rain_{it}^{Neighbor}}$ is a counterfactual level of rainfall for grid-cell i in year t, which is calculated as explained above.

After calculating $\widetilde{y_{iet}}$ we then aggregate across grid-cells to get a counterfactual measure of the total incidence of conflicts across the African continent. This yields the following results: if rainfall were at this counterfactual level in each grid cell from 1989–2018, we estimate that overall conflict incidence across the continent would be lower by 12%; conflict involving the state would be lower by 18%; and conflict involving jihadist groups would be lower by 31%.