NBER WORKING PAPER SERIES

NOMADIC 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

We thank various seminar audiences at Tufts University, CEPR Macroeconomics and Growth Programme Meeting, the Research Institute for Development, Growth and Economics, Towards Sustainable Growth Workshop, especially Elias Papaioannou. We also thank Mohammad Ahmad and Laura Kincaide 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.

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

ABSTRACT

Arid regions of Africa are expanding by thousands of square kilometers a year, potentially disturbing pastoral routes that have been forged over a long period of time. This disturbance is often said to explain why "herder-farmer" conflicts have erupted in recent years, as pastoralists and agriculturalists compete for increasingly scarce resources. We examine this hypothesis by combining ecological and ethnographic data on the location of pastoral ethnic groups with grid-cell level data on violent conflict in Africa from 1989 to 2018. First, using ecological data, (i) we confirm that areas suited to both agriculture and pastoralism are particularly prone to conflict relative to either agricultural or pastoral areas alone; and (ii) we find that the effect of precipitation shocks on conflict in these agro-pastoral zones is negative at the country-level, but not at the cell-level. To explain this pattern, we compile data on the historical location of borders between both types of ethnic groups. We find that droughts in pastoral areas lead to conflict in neighboring agricultural areas. This spillover mechanism appears to explain much of the negative overall relationship between precipitation and conflict in the sample. It implies that agro-pastoral conflict is caused by the displacement of pastoral groups due to low precipitation in their homelands. This finding establishes one mechanism through which climate change can lead to more conflict in agro-pastoral zones.

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 to 2018.[1]

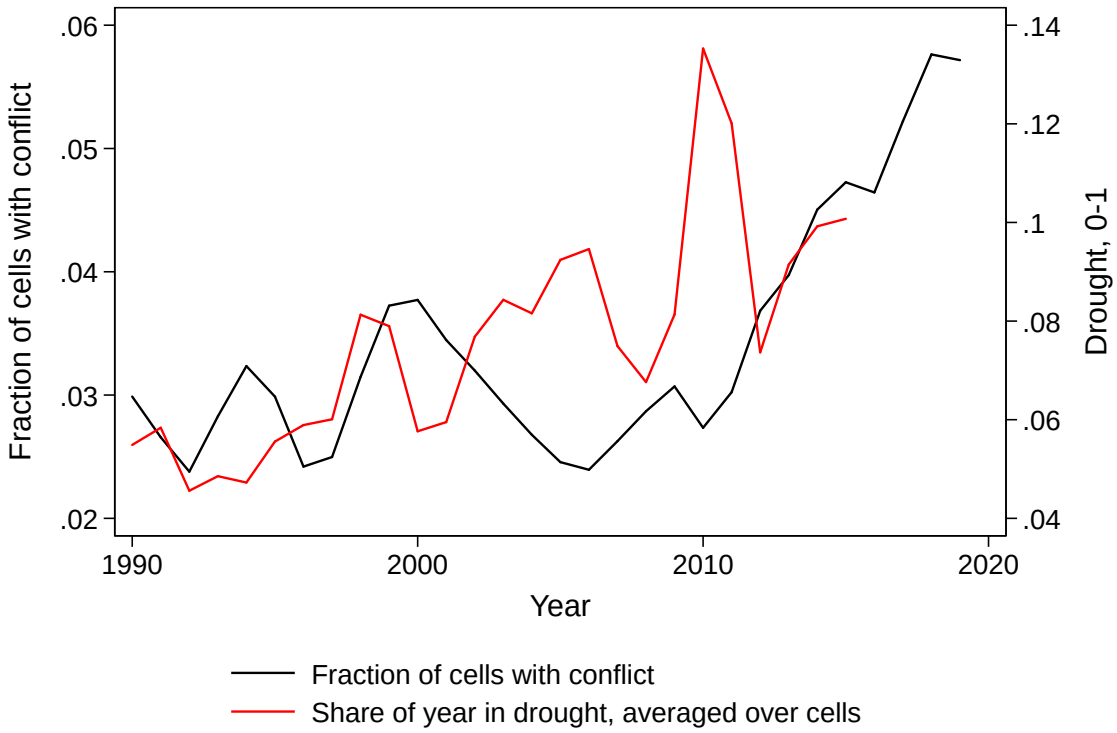
Conflict has also become more widespread in Africa during this period. In Figure 1, we show that the share of 0.5 degree cells (around 55km $\times$ 55km at the equator) in which at least one violent conflict event occurred in the calendar year has increased from just over 3% in 1989 to almost 6% in 2018. In the same figure, we also show that droughts have become more severe over the same period. The average duration of droughts has increased from around 5% of months per year to around 10%. 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 Ferrara, 2018, Fetzer, 2020).

Due to a relative dearth of evidence on specific casual 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 propose and test a mechanism linking weather shocks to violent conflict between agricultural and pastoral ethnic groups in Africa. Agricultural groups are those who practice crop agriculture in sedentary settlements. Pastoral groups are those who practice animal husbandry as nomadic or semi-nomadic herders. In typical years, agricultural and pastoral neighbors coexist in a symbiotic relationship due to seasonal migration (Moritz, 2010). In the rainy season, pastoralists exploit marginal lands that produce sufficient biomass for their livestock while agriculturalists farm more productive lands. Pastoralists then migrate along well-established corridors to arrive at agricultural farmlands after the final harvest, where they remain for the dry season. These journeys can range from hundreds of meters to hundreds of kilometers (Kitchell, Turner and McPeak, 2014). In low precipitation years, there is not enough rainfall to produce the biomass required to sustain livestock during the rainy season. As a result, pastoralists are forced to migrate early to agricultural farmlands, where conflict can emerge due to damaged crops and competition for resources such as water and pasture (Brottem, 2016).

This mechanism generates a clear hypothesis: droughts in pastoral lands lead to conflict in nearby agricultural lands. Since the hypothesis is that weather events in one area cause conflict in another, testing it requires a spillover design. Failing to correctly model the spillover effects could lead researchers to underestimate the true impact of droughts on conflict. The extent of such a bias will depends on the level of analysis. 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 and the spillover effects will be captured. However, when analyzing high-resolution

[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).

Figure 1: **Drought and Conflict over Time in Africa**



Note: The red line depicts the annual the share of drought months per year in Africa, averaged over 0.5 degree cells. It is based on the Standardized Precipitation and Evapotranspiration Index (SPEI-1) from the SPEI Global Drought Monitor. The black line depicts the annual average incidence of violent conflict at the level of a 0.5 degree cell, as measured by the Uppsala Conflict Data Program version 19.1 (Sundberg and Melander, 2013).

(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.

To illustrate this problem, we estimate the country-level and cell-level effects of local precipitation shocks on conflict in areas suited to both agriculture and nomadic pastoralism, which we call 'agro-pastoral' areas. We combine high-resolution data on land-use suitability from Beck and Sieber (2010) with two sets of geocoded conflict measures that vary at the level of a cell-year, 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). Consistent with the importance of spillover effects, we come to very different conclusions when we vary our level of analysis. When we aggregate data to the level of a country-year, we find that lower rainfall is associated with more conflict in areas that are suited to both agriculture and pastoralism, but not in areas that are suited to either agriculture or pastoralism alone. When we analyze the data at the subnational cell-year level, the estimated effect is zero.

Motivated by the importance of spillover effects, we examine the effect of precipitation shocks in pastoral territories on conflict in nearby agricultural cells. Our design allows us to test the hypothesis while still maintaining the precision present in the cell-level data. To determine the

identity of pastoral groups, we use data from the *Ethnographic Atlas* (Murdock, 1967), which contains information on the economic and cultural practices of precolonial ethnic societies worldwide. We construct two ethnicity-level variables that measure nomadic pastoralism. The first is an indicator variable that equals one if the group is historically nomadic. The second is an index taken from Becker (2019) that measures the historical importance of animal herding in the society. Next, we assign these values to grid cells in Africa using a digitized version of George Peter Murdock's map of precolonial ethnic societies (Murdock, 1959). We develop a new technique that allows us to match around 96% of societies, representing a sizeable improvement on previous efforts in the literature.[2]

We find that, relative to the same shock in neighboring agricultural societies, a one standard deviation decrease in precipitation in a neighboring pastoral societies raises the risk of conflict in a grid-cell by 29.6%. The estimates are statistically significant and economically meaningful using any of the four combinations of outcome and pastoral variables. In addition, the spillover effects are much greater than the direct own-cell effects of precipitation. Consistent with on-the-ground accounts, we also find that the spillover effect from weather shocks felt in neighboring pastoral territories is only observed for grid-cells that are agricultural. Overall, the findings are consistent with periods of low precipitation inducing pastoralists to migrate early to agricultural farmlands, which results in damaged crops, competition for water and pasture, and conflict.

The conflict datasets allow us to analyze the various conflict types and actors that contribute to the main overall result. Our results suggest that most agro-pastoral conflict involves either state forces (such as police or army units) battling against internal forces (such as rebel groups) or external forces (such as ethnic militia from neighboring countries). This is consistent with several media accounts in which state forces represent agricultural landowners and non-state forces represent pastoral groups, depending on their origin.[3]

The paper is organized as follows. In Section 2, we describe the data used in the main analysis. We also present maps displaying the spatial distribution of our main variables. We note that (i) the distribution of pastoral groups from the *Ethnographic Atlas* aligns well with the distribution of land-use suitability for nomadic pastoralism from Beck and Sieber (2010); and (ii) the distribution of conflict events from UCDP aligns well with the overlap in land suitability for agriculture and nomadic pastoralism.

In Section 3, we present cross-sectional evidence on the prevalence of conflict in agro-pastoral areas. Using ecological data, we show that violent conflict is significantly and substantially more likely to emerge in cells that are suited to both agriculture and nomadic pastoralism relative to areas that are suited to either type alone. For example, in cells with no pastoral suitability, a one standard deviation rise in agricultural suitability is associated with a 15.8% decrease in the

[2]This matching process is detailed in a companion article (Kincaide, McGuirk and Nunn, 2020).

[3]The 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`).

risk of conflict. However, in cells with the median level of pastoral suitability, the same rise in agricultural suitability is associated with a 11.7% *increase* in the risk of conflict. We note a similar pattern using the ethnographic data. Agricultural ethnic societies are 11.34 percentage points more likely to experience conflict if one of their bordering societies is pastoral. This magnitude translates to almost two-thirds of the sample average of conflict incidence across all societies in the sample.

In Section 4, we estimate the impact of local precipitation shocks on conflict in agro-pastoral areas. First, using ecological data aggregated at the country-level, we show that precipitation significantly reduces conflict in countries that are more suited to both agriculture *and* pastoralism; that is, we estimate a negative coefficient on a triple interaction between rainfall, suitability for agriculture and suitability for nomadic pastoralism. On average, we find no significant effect for either the rainfall-agriculture or rainfall-pastoral double interactions, which suggests that the effect of droughts on conflict in Africa is primarily explained by conflict between nomadic pastoralists and sedentary agriculturalists. In an attempt to assess the importance of spillovers, we then move to a finer level of disaggregation and repeat the exercise using 0.5-degree cell-level variation in conflict, precipitation, and land suitability. At this level of granularity, we find no evidence of the same patterns found at the country level. This is consistent with the spillover effects of interest occurring within countries but not with 0.5-degree cells.

In Section 5, we provide an explicit structure for spillovers in our cell-level analysis. The analysis assumes that a cell is potentially influenced by the precipitation of the nearest neighboring ethnic group. All specifications include cell fixed effects and either climate-zone-by-year fixed effects or country-by-year fixed effects, which account for time-invariant factors, as well as common shocks within a country in a year. We find clear evidence that higher precipitation in the nearest neighbor reduces conflict in a given cell, but only if the neighbor is pastoral. The estimated effects are sizeable and significant and are found whether we measure pastoralism using a binary variable indicating that a group is historically nomadic, or whether we measure pastoralism using a continuous variable capturing the intensity of pastoralism based on the group's historical dependance on animal husbandry. In these specifications, our estimated average local (i.e., within-cell) effect of precipitation on conflict is not significant.

Our findings add to the existing ethnographic literature on the relationship between sedentary farmers and nomadic herders in Africa, historically and in the post-colonial period (Lewis, 1961, Jacobs, 1965, Konczacki, 1978, Dyson-Hudson and Dyson-Hudson, 1980). We also contribute to our existing understanding of how African pastoral groups are affected by climate shocks (Little, Smith, Cellarius, Coppock and Barrett, 2001, McPeak and Barrett, 2001, Maystadt and Ecker, 2004, Bollig, 2006).

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); 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.

Our study identifies a specific mechanism through which climate change can affect violent conflict in areas where pastoralists and agriculturalists come into contact. This mechanism appears to explain most of the overall relationship between precipitation and conflict in Africa. It implies that sufficiently adverse weather shocks can reduce the opportunity cost of conflict for pastoral groups to the extent that it is worth bearing the risk of violence in order to access water and pasture. It points ultimately to the importance of establishing seasonal grazing rights for pastoral groups that can obviate the emergence of destructive conflict. Finally, our analysis highlights the pitfalls of using granular data in the presence of spillover effects.

2. Data

A. Definitions and Sources

Structure While we undertake analyses at different levels of observation, our most granular estimates rely on an annual panel at the level of 0.5 degree (approx. 55km) grid cells. The sample comprises 9,691 cells nested in 798 precolonial ethnic territories located on the African mainland.[4] The location of the ethnic territories is taken from a digitized version of the map from George Peter Murdock's book *Africa: Its Peoples and their Culture History*. The data run from 1989–2018, depending on the datasets in operation.

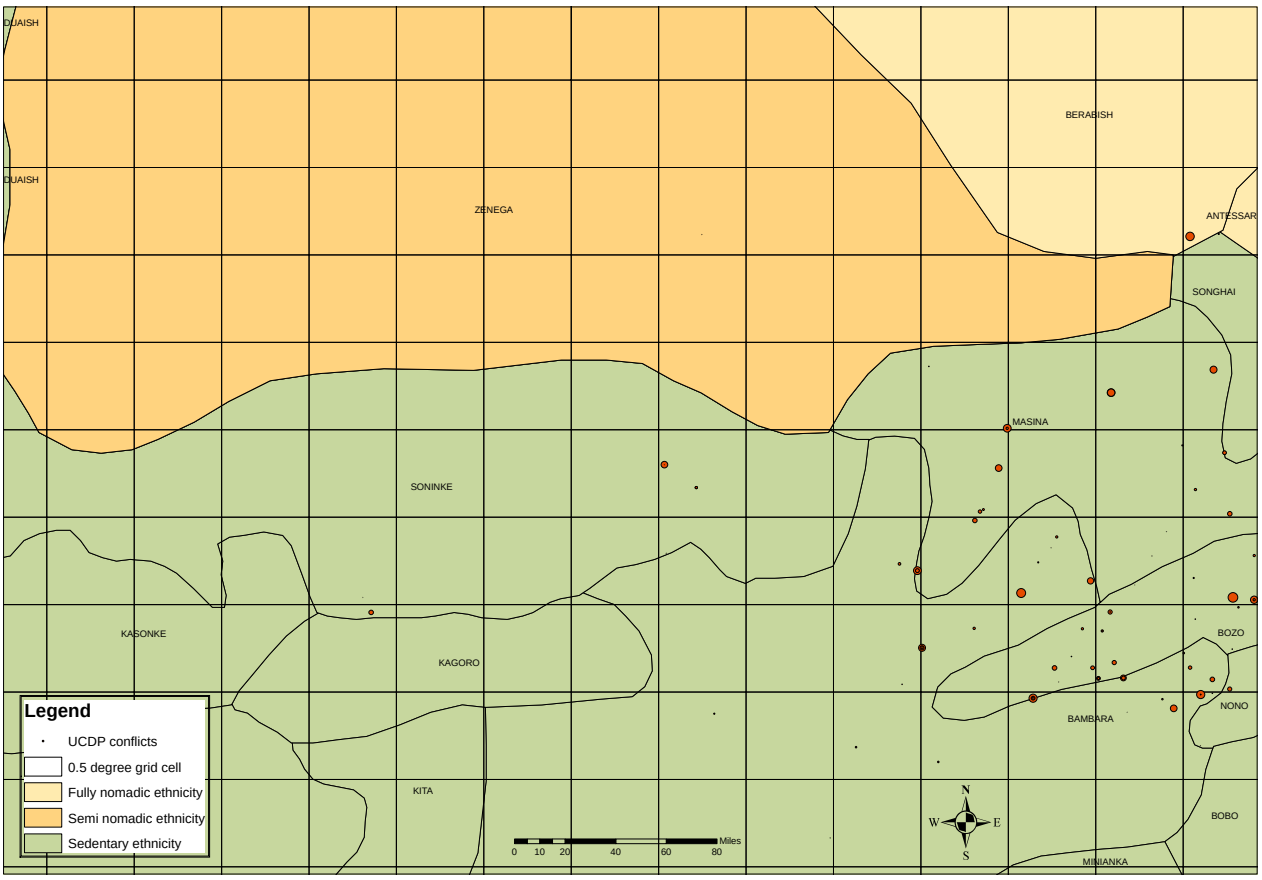
A sample of data, located in Western Africa, is shown in Figure 2. The map shows the gridded 0.5-degree cells and the traditional boundaries of the ethnic groups in the region (Zenega, Soninke, Masina, etc), as well as conflicts in the UCDP data.

Nearest Neighbors For each cell, we determine the identity of the nearest ethnic group that is contiguous to the ethnicity to which the cell belongs. This is our definition of a *Neighbor*. As an illustration of this, consider Figure 2. For the cells in the northern portion of the Soninke ethnic territory, the *Neighbor* is Zenega. For those that are in the southern portion, the *Neighbor* is either Kasonke, Kagoro or Bambara depending on the east-west location of the cell.

Conflict: Baseline Measures using UCDP 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. There are two mutually exclusive categories of conflict *Actors*: *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. There are also two mutually exclusive types of *Event*: *Battle* implies a two-sided battle;

[4]We do not consider islands given their limited size and our focus on inter-society conflict.

Figure 2: **Structure of Data and Analysis**



Note: The figure displays the data used in our cell-level analysis. The 0.5-degree cells are shown, along with the boundaries of the ethnic groups, their names of ethnic groups, and the extent to which they are nomadic or sedentary (from variable v30 of the *Ethnographic Atlas*).

Attack implies a one-sided attack. UCDP conflict data run from 1989 to 2018. In keeping with the literature, we code all conflict variables as cell-year measures of conflict incidence in our regressions: $1(Conflict)$.

Conflict: Auxiliary Measures using ACLED 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). One advantage of ACLED is the richness of information for each conflict event. This allows us to generate three (overlapping) subcategories of actors: *State Forces* implies that state forces (such as police or army units) were involved in at least one conflict event in a cell-year; *Internal Forces* implies that internal forces (such as rebel groups or ethnic militia) were involved in at least one conflict event in a cell-year; and *External Forces* implies that external forces (foreign-based groups, including mercenaries) were involved in at least one conflict event in a cell-year. Again, all variables are measured as conflict incidence at the level of a cell-year: $1(Conflict)$.

Pastoralism: *Ecological Data* We employ land suitability data computed by Beck and Sieber (2010), who use ecological niche modeling to derive spatial predictions of land use types based on climactic and soil input data. We use their measure of the suitability of land for *agriculture* and for *nomadic pastoralism*.[5] These variables cover 100% of the African mainland. As there are large regions suited to both land types, this data does not indicate the precise location of pastoral and agricultural groups.

Nomadic Pastoralism: *Ethnographic Atlas* In order to identify the location of nomadic pastoral societies, use information from the *Ethnographic Atlas*, a database of 1,265 ethnic groups assembled and published by Murdock from 1962–1980. We construct two variables to identify nomadic pastoral groups. The first focuses on the key aspect of nomadic pastoralism, which is that the group is mobile. Using variable v30 from the *Ethnographic Atlas*, we create an indicator variable that equals one if the group is described as having a settlement pattern that is either fully nomadic or semi-nomadic. It is equal to zero for six remaining settlement types, which range from semi-sedentary to complex settlements. We call this variable $Nomad_e$. This coding is indicated in Figure 2 by the shading of the ethnic groups. As shown, Zenega and Berabish are semi-nomadic and fully nomadic, respectively, and so for both groups $Nomad_e = 1$. All of the groups to the south are sedentary, and so neither semi or fully-nomadic; therefore $Nomad_e = 0$.

The second variable that we use explicitly accounts for a measure of pastoralism. We build on a measure developed by Becker (2019), which combines information on the fraction of subsistence

[5]The other land use types computed by Beck and Sieber are *hunting-and-gathering* and *sedentary animal husbandry*.

that is from animal husbandry (measured on a 0-1 scale and from v4 in the EA) with an indicator variable that equals one if the primary large animal is suitable for herding (from variable v40 of the EA).[6] Becker's variable, which is constructed as an interaction between these two measures, ranges from 0-1. We combine Becker's 0-1 index of pastoralism with our 0/1 indicator of a group being nomadic by interacting the two measures. We call this variable $Herder_e$. A value of 0 implies that the group either does not engage in animal herding or that the group is not (at least partially) nomadic. A positive value implies that the group is dependent on herding animals for subsistence to some extent and that they are also nomadic.

While the two measures are highly correlated ($\rho = 0.89$), conceptually they are different. The first measures only whether a group is mobile and the second measures whether they are mobile and engage in herding.

In order to assign these variables to spacial units, we match the *Ethnographic Atlas* societies to the Murdock map territories. A crude match by name only returns a match rate of around 50.4%. This is because some of the groups named in the ethnographic dataset are subgroups of those named on the map and vice versa. Some reachers have improved significantly on the crude match rate; for example, Michalopoulos and Papaioannou (2013) assign *Ethnographic Atlas* values to 58.1% of the map territories. Using a variety of sources, documented in Kincaide et al. (2020), we achieve a match rate of 96%.

Precipitation Pastoral groups reply on precipitation to produce the biomass needed to sustain their livestock. Our shock variable is a 0.5 degree cell-year measure of precipitation calculated by the Global Precipitation Climatology Centre. It measures land-surface precipitation from rain gauges built on Global Telecommunications System (GTS)-based data.[7]

B. Summary of the Raw Data

In the upper left panel of Figure 3, we display the spatial distribution of land suitability for nomadic pastoralism, with dark blue representing the cells with higher shares of suitable land. The upper right figure displays the spatial distribution of land suitability for sedentary agriculture. The data are from Beck and Sieber (2010). Also shown in the figures are the boundaries of ethnic groups from the Murdock map that are either fully nomadic or semi-nomadic as reported in the matched *Ethnographic Atlas*. (The two categories define the *Nomad* indicator.) It is clear that the underlying suitability data from Beck and Sieber (2010) is highly correlated with the traditional degree of mobility reported in the *Ethnographic Atlas*.

The figures also show that there exists substantial overlap in land-suitability for agriculture and nomadic pastoralism. In the lower left panel, we display the *Index of Shared Suitability*, which measures the extent to which a cell is jointly suitable for both agriculture and nomadic

[6] This includes sheep, goats, equine animals, camels, and bovine animals, but not pigs.

[7] The GTS is an international system for the dissemination of meteorological data from weather stations, satellites and numerical weather prediction centers. The URL for their website is `www.wmo.int`.

pastoralism.[8] It is equal to 0 if the cell is not at all suited to one of the land-use types and equal to 1 if it is fully suited to both. In the lower right panel, we overlay this map with the presence of UCDP conflict events from 1989–2018. A higher number of events per cell is represented by larger and darker points. Visually, conflicts appear to be clustered in areas that are suitable for both agriculture and pastoralism. We formally estimate this cross-sectional relationship in the next section.

We next turn to Figure 4, which displays evidence in support of our main hypothesis. The upper panel presents annual precipitation averaged over cells for all of Africa. The lower panel presents the annual prevalence of conflict in agro-pastoral cells—that is, cells that are suited to both agriculture and pastoralism—relative to agricultural or pastoral cells alone during the same period. We plot, for each year, the coefficients from a regression of conflict incidence on agricultural and pastoral suitability as well as their interaction. The interaction effect is positive and significant for most of the series, indicating that violence is especially high in areas where farmers and herders come into contact.[9] The peak of this interaction effect appears to coincide with an extremely low average precipitation value in the mid 2000s.

The descriptive statistics for our main variables are reported in Table 1. The tables include two additional variables from the *Ethnographic Atlas*. One representing an ethnic group's traditional dependence on crop agriculture for subsistence. The variable, which we denote $Farmer_e$, is an index that ranges from 0-1. The other variable measures the levels of jurisdictional hierarchy beyond the local community. The variable, $Jurisdictional\,Hierarchy_e$, takes on integer values ranging from 1-5. We also report statistics for measures of cell-level temperature, nighttime lights, gross cell product, the log of population and infant mortality. These are all gathered from version 2 of the PRIO-GRID dataset (Tollefsen, Strand and Buhaug, 2012).

Using our $Nomad_e$ variable, the share of cells that belong to ethnic groups that are historically nomadic pastoral is 41%. The sample mean of our $Herder_e$ variable is 26%. Using the Beck-Sieber ecological data, the share of land suited to *nomadic pastoralism* is 32%.

In Table 2, we report summary statistics separately for cells for which $Nomad_e = 0$ and cells for which $Nomad_e = 1$. The share of land suited to *agriculture* is 8% in pastoral cells and 35% in non-pastoral cells. Pastoral cells have lower precipitation, fewer night lights, lower populations and less conflict than non-pastoral cells.

3. Agro-Pastoral Conflict in the Cross-Section

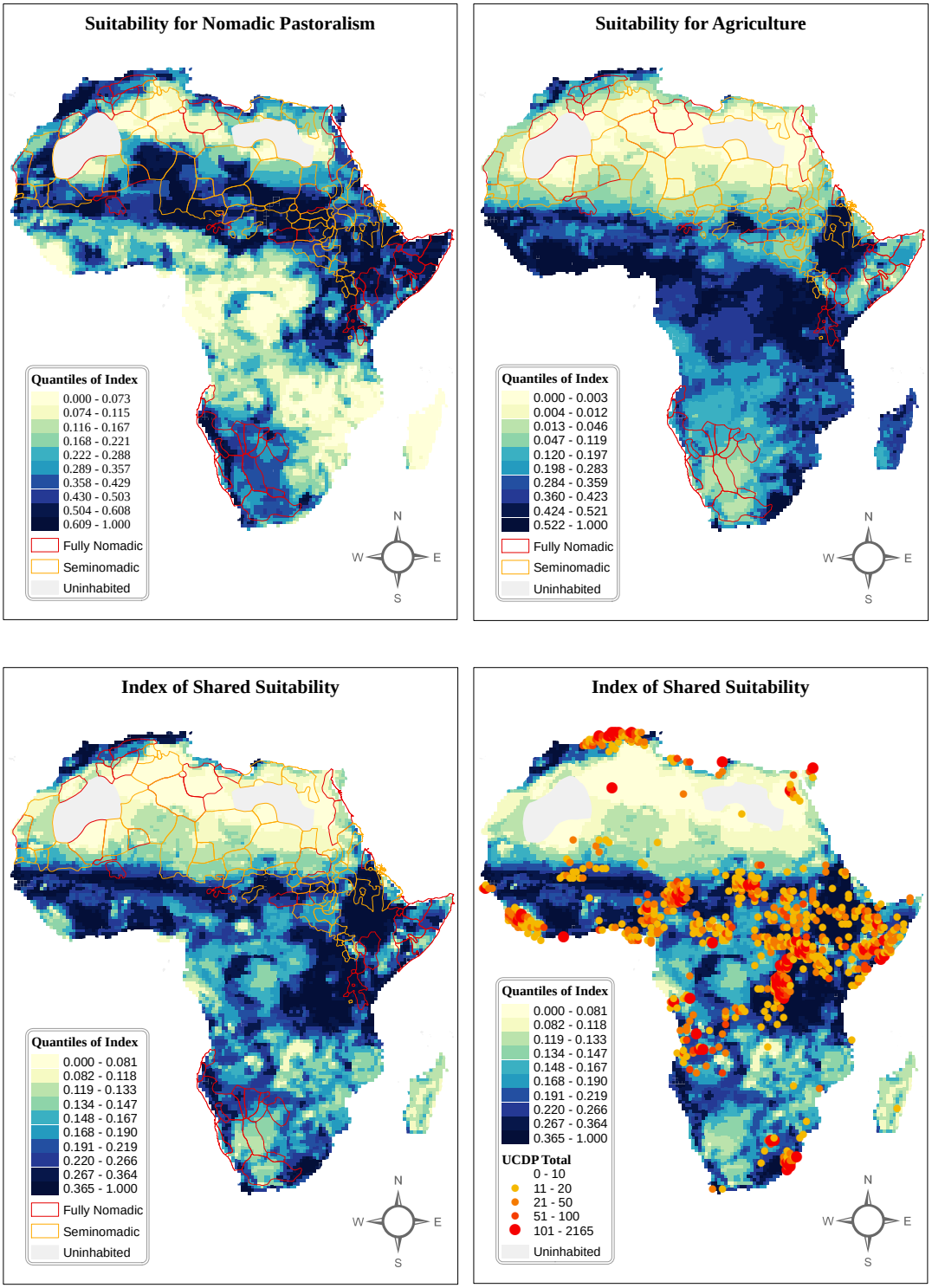
We begin our analysis by first presenting cross-sectional evidence on the prevalence of conflict in locations suitable for both agriculture and nomadic pastoralism.

[8]This is defined in Beck and Sieber (2010) as follows, where ag and np represent land suitability for agriculture and nomadic pastoralism respectively

$$ISS = (1 - \sqrt{(ag - np)^2} \times \frac{ag + np}{2}$$

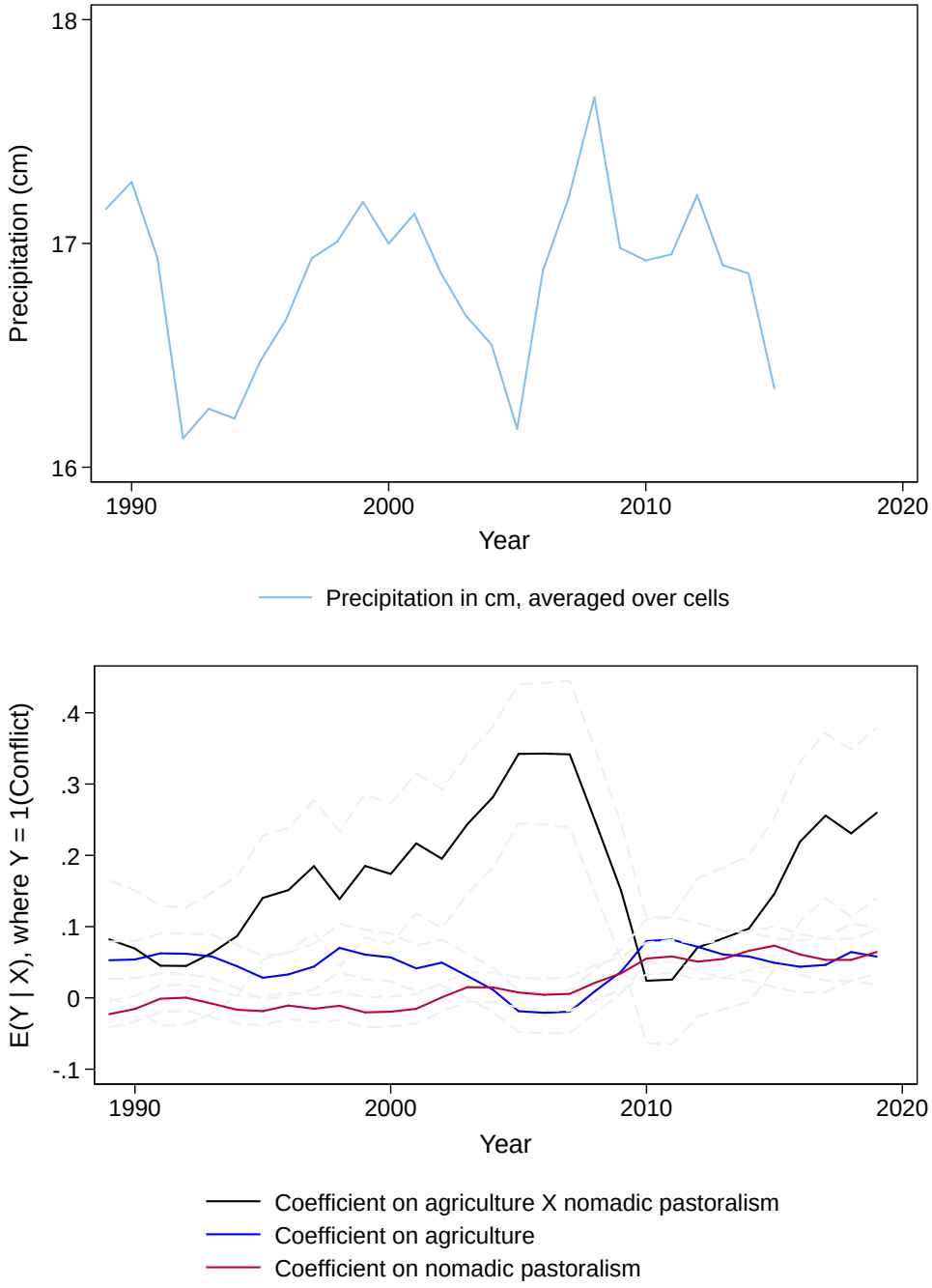
[9]For the remainder of this study, *farmers* practice sedentary agriculture and *herders* practice nomadic pastoralism.

Figure 3: **Nomadic Pastoralism, Agriculture and Conflict across Space**



Note: The upper left figure displays the spatial distribution of land suitability for nomadic pastoralism, with dark blue representing the cells with higher shares of suitable land. The upper right figure displays the spatial distribution of land suitability for sedentary agriculture. These variables are from Beck and Sieber (2010). Overlying both figures is the outline of fully nomadic and seminomadic territories from the *Ethnographic Atlas*. The bottom left figure displays the spatial distribution of "shared suitability", which is equal to 1 if land is perfectly suited to both agriculture and pastoralism, and zero if it is not suited to either. The lower right hand side figure overlays this distribution with markers representing the number of violent conflict events in each cell from 1989–2018, as measured by UCDP.

Figure 4: **Agro-Pastoral Conflict and Precipitation over Time in Africa**



Note: The upper figure presents ground precipitation in cm, averaged over cells. The lower figure depicts, for each year, the coefficients and 90% confidence intervals from a regression of conflict incidence on land suitability variables for sedentary agriculture, nomadic pastoralism, and their interaction (from Beck and Sieber (2010)). These regressions are at the level of a 0.5 cell. Estimates are smoothed using a ± 2 year moving average.

Table 1: Descriptive Statistics, Full Sample

	Full Sample					
	Mean	SD	Count	Min	Median	Max
UCDP 1(Conflict)	0.03	0.18	290730	0.00	0.00	1.00
ACLED 1(Conflict)	0.08	0.27	232584	0.00	0.00	1.00
EA: 1(Nomad)	0.41	0.49	316512	0.00	0.00	1.00
EA: Herder, 0-1	0.26	0.36	316476	0.00	0.00	1.00
EA: Farmer, 0-1	0.49	0.24	330696	0.00	0.56	1.00
EA: Jurisdictional Hierarchy, 1-5	2.46	0.93	306144	1.00	2.00	5.00
B-S: Nomadic Pastoralism, 0-1	0.32	0.20	339156	0.00	0.29	0.90
B-S: Agriculture, 0-1	0.24	0.20	339156	0.00	0.22	0.88
Temperature °C	24.46	3.94	280989	7.51	24.71	39.53
Ground Precipitation, cm	16.82	15.28	271348	0.00	13.16	147.81
Nighttime Lights	0.32	1.84	213202	0.00	0.00	61.26
Gross Cell Product, USD PPP	0.15	0.68	36587	0.00	0.02	21.26
ln(Population)	9.55	2.16	348876	0.00	9.88	16.19
Cell Infant Mortality Rate	927.00	426.07	275297	100.00	1020.00	2031.00

Table 2: Descriptive Statistics, Sub-Samples by Nomad Classification

	Nomad $= 1$						***Nomad*** $= 0$					
	Mean	SD	Count	Min	Median	Max	Mean	SD	Count	Min	Median	Max
UCDP 1(Conflict)	0.02	0.14	107400	0.00	0.00	1.00	0.04	0.20	156360	0.00	0.00	1.00
ACLED 1(Conflict)	0.05	0.21	85920	0.00	0.00	1.00	0.11	0.31	125088	0.00	0.00	1.00
EA: Herder, 0-1	0.64	0.26	128880	0.00	0.60	1.00	0.00	0.00	187596	0.00	0.00	0.00
EA: Farmer, 0-1	0.27	0.20	128880	0.00	0.22	0.67	0.64	0.12	187632	0.11	0.67	1.00
EA: Jurisdictional Hierarchy, 1-5	2.40	0.84	121860	1.00	2.00	4.00	2.50	0.98	184212	1.00	3.00	5.00
B-S: Nomadic Pastoralism, 0-1	0.40	0.19	126108	0.05	0.40	0.90	0.27	0.19	182196	0.00	0.22	0.86
B-S: Agriculture, 0-1	0.08	0.11	126108	0.00	0.03	0.73	0.35	0.18	182196	0.00	0.36	0.88
Temperature °C	25.17	4.19	103820	9.17	25.83	38.09	23.98	3.69	151098	7.51	24.21	39.53
Ground Precipitation, cm	4.54	5.58	100240	0.00	2.36	48.57	25.49	14.14	145936	0.00	25.44	147.81
Nighttime Lights	0.12	0.81	78760	0.00	0.00	28.75	0.48	2.37	114664	0.00	0.00	61.26
Gross Cell Product, USD PPP	0.06	0.40	12902	0.00	0.01	21.26	0.21	0.82	20220	0.00	0.04	21.26
ln(Population)	7.97	1.97	128880	0.00	7.87	14.32	10.61	1.61	187632	0.00	10.69	16.19
Cell Infant Mortality Rate	794.81	480.82	100659	100.00	593.00	2019.69	1014.73	354.42	148596	170.00	1105.00	2031.00

Ecological data We first estimate the cell-level relationship between conflict and the joint presence of land suitability for agriculture and pastoralism, measured using the Beck-Sieber ecological data described above. We propose the following specification:

$$1(conflict_{it}) = \alpha_t + \beta_1 L_i^a \times L_i^p + \beta_2 L_i^a + \beta_3 L_i^p + \beta_4 \ln(pop_i) + \epsilon_{it}, \tag{1}$$

where i indexes 9,691 0.5-degree grid-cells and t years (1989–2018). The dependent variable, $1(conflict_{it})$, is the incidence of conflict in cell i in year t; α_t denote year fixed effects, which account for time-varying factors that affect all cells similarly; L_i^a is the average index of suitability for agriculture of land within cell i; and L_i^p is the index of suitability of cell i for nomadic pastoralism. β_1 represents the interaction effect of interest. A positive estimate indicates that conflict is significantly higher in cells suited to both types relative to cells suited to either type.

We also control for the natural log of the average population across cells between 1990–2010, $\ln(pop_i)$. Population is potentially correlated with subsistence activities and is expected to affect conflict incidence. Standard errors are clustered at the level of a cell (to account for serial correlation) and climate zone-year (to account for spatial correlation). There are 14 climate zones in the sample that are based on the Köppen-Geiger climate classification (Rubel and Kottek, 2010).

In Table 3, we present estimates of equation (1) with UCDP conflict variables as the outcome. In column 1, we estimate a large, positive and significant interaction effect. In column 2, we add $\ln(population)$ as a control variable, as settlements are likely to be more dense in agricultural and agro-pastoral areas, and conflict is likely a function of population. This addition accounts entirely for the positive coefficient on agriculture in the first column, but the interaction effect

Table 3: Agro-Pastoral Conflict in the Cross-Section: Cell-Level Analysis Using UCDP Conflict and Ecological Data

	UCDP 1(Conflict)		*Actor: State*		*Actor: Non-State*		*Event: Battle*		*Event: Attack*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Agriculture × Nomadic Pastoralism	0.1632***	0.1511***	0.1422***	0.1321***	0.0822***	0.0763***	0.1299***	0.1195***	0.0699***	0.0657***
	(0.0345)	(0.0347)	(0.0303)	(0.0301)	(0.0270)	(0.0271)	(0.0282)	(0.0284)	(0.0236)	(0.0236)
Agriculture	0.0433***	-0.0256*	0.0294***	-0.0280**	0.0463***	0.0128	0.0244**	-0.0348***	0.0360***	0.0123
	(0.0127)	(0.0137)	(0.0107)	(0.0119)	(0.0102)	(0.0106)	(0.0101)	(0.0110)	(0.0084)	(0.0091)
Nomadic Pastoralism	0.0153*	0.0169**	0.0101	0.0115	0.0045	0.0053	0.0182**	0.0196**	-0.0019	-0.0014
	(0.0086)	(0.0086)	(0.0075)	(0.0075)	(0.0052)	(0.0053)	(0.0077)	(0.0077)	(0.0042)	(0.0042)
ln(Population)		0.0101***		0.0085***		0.0049***		0.0087***		0.0035***
		(0.0009)		(0.0008)		(0.0006)		(0.0008)		(0.0005)
Constant	0.0054*	-0.0741***	0.0059**	-0.0604***	0.0001	-0.0386***	0.0043	-0.0641***	0.0009	-0.0265***
	(0.0031)	(0.0085)	(0.0027)	(0.0074)	(0.0021)	(0.0053)	(0.0026)	(0.0075)	(0.0017)	(0.0043)
Mean dep. var.	0.033	0.033	0.027	0.027	0.019	0.019	0.026	0.026	0.014	0.014
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	282630	282630	282630	282630	282630	282630	282630	282630	282630	282630

Note: All outcome variables measure conflict incidence at the level of a cell-year. UCDP 1(Conflict) indicates at least one violent conflict event in a cell-year. The two *Actor* outcomes are mutually exclusive subcategories: *State* indicates at least one conflict event involving the state; *Non-State* indicates at least one conflict event not involving the state. The two *Event* outcomes are also mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. *Agriculture* and *Nomadic Pastoralism* are cell-level variables measuring the share of land suitable for each land use type; *ln(Population)* is the natural log of average cell-level population measured in five-year intervals from 1990 to 2010. 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.

is unchanged. We see similar results for all conflict actors and event types from the UCDP data (columns 3–10). We also check the robustness of our estimates to the use of ACLED conflict data. The estimates, which are reported in Appendix Table A1, show that we find the same general pattern is found.

Ethnographic data: group level We now turn to a preliminary exploration of the presence of spatial spillovers. As noted, accounts of conflicts with nomadic pastoralists indicate that conflicts typically occur outside of the territories of pastoralists and in the territories of neighboring groups. Motivated by this, we examine cross-ethnicity variation and ask whether nomadic pastoralism is associated with greater conflict in neighboring ethnic groups. Our estimating equation is given by:

$$1(conflict_{et}) = \alpha_t + \delta_1 pastoral_e^n + \delta_2 pastoral_e + \delta_3 pastoral_e \times pastoral_e^n + \delta_4 \ln(pop_e) + \varepsilon_{et} \quad (2)$$

where e indexes ethnic groups and t years (1989–2018); $1(conflict_{et})$ is a conflict incidence indicator for ethnicity e at time t; α_t denote year fixed effects; $pastoral_e^n$ is either an indicator that equals one if group e has at least one contiguous neighbor for which $Nomad_e = 1$ or it is the average value of $Herder_e$ among all neighbors of an ethnic group; $pastoral_e$ is either $Nomad_e$ or $Herder_e$. The parameter of interest, δ_1, describes the effect of having at least one pastoral neighbor for a non-pastoral group. Standard errors are clustered at the level of an ethnic society (to account for serial correlation) and climate zone-year (to account for spatial correlation).

Estimates of equation (2) are reported in Table 4. The estimate of δ_1 is reported in the first row when $pastoral_e^n$ is measured as having at least one nomadic neighbor, and in the fourth row when it is measured as the average value of $Herder$ for all neighbors. In almost every specification, the estimates are positive and significant. This is also the case when we use ACLED conflict data rather than the UCDP conflict data (see Appendix Table A2).

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

	UCDP 1(Conflict)		*Actor: State*		*Actor: Non-State*		*Event: Battle*		*Event: Attack*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Any Neighbor Nomad	0.1134***		0.1001***		0.0544***		0.1072***		0.0404***	
	(0.0235)		(0.0226)		(0.0168)		(0.0214)		(0.0151)	
Nomad	0.0155		0.0182		0.0124		0.0190		-0.0056	
	(0.0829)		(0.0719)		(0.0673)		(0.0664)		(0.0497)	
Nomad × Any Neighbor Nomad	0.0766		0.0287		0.0602		0.0741		0.0243	
	(0.0915)		(0.0796)		(0.0744)		(0.0758)		(0.0545)	
Avg. Neighbor Herder		0.2453***		0.2163***		0.1009**		0.2297***		0.0585
		(0.0643)		(0.0613)		(0.0430)		(0.0597)		(0.0356)
Herder		0.0483		0.0212		0.0429		0.0490		0.0253
		(0.0769)		(0.0653)		(0.0706)		(0.0739)		(0.0477)
Herder × Avg. Neighbor Herder		0.1682		0.1021		0.1194		0.1841		0.0113
		(0.1560)		(0.1334)		(0.1480)		(0.1513)		(0.0893)
ln(Population)	0.0380***	0.0354***	0.0256***	0.0243***	0.0353***	0.0325***	0.0310***	0.0288***	0.0236***	0.0218***
	(0.0069)	(0.0064)	(0.0065)	(0.0060)	(0.0053)	(0.0052)	(0.0063)	(0.0058)	(0.0046)	(0.0045)
Constant	-0.2947***	-0.2540***	-0.1771**	-0.1519**	-0.2967***	-0.2583***	-0.2512***	-0.2140***	-0.1819***	-0.1550***
	(0.0777)	(0.0712)	(0.0737)	(0.0671)	(0.0589)	(0.0576)	(0.0715)	(0.0649)	(0.0512)	(0.0501)
Sum of *Neighbor Pastoral* estimates	0.1899	0.4135	0.1288	0.3184	0.1146	0.2204	0.1813	0.4138	0.0646	0.0698
p-value	0.035	0.003	0.097	0.006	0.117	0.112	0.014	0.003	0.223	0.390
Mean dep. var.	0.174	0.174	0.145	0.145	0.121	0.121	0.139	0.139	0.095	0.095
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	21330	21300	21330	21300	21330	21300	21330	21300	21330	21300

Note: All outcome variables measure conflict incidence at the level of an ethnic society-year. UCDP 1(Conflict) indicates at least one violent conflict event in a society-year. The two *Actor* outcomes are mutually exclusive subcategories: *State* indicates at least one conflict event involving the state; *Non-State* indicates at least one conflict event not involving the state. The two *Event* outcomes are also mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. *Nomad* indicates that the ethnic society is nomadic; *Any Neighbor Nomad* indicates that any neighboring ethnic society is nomadic; *Herder* measures the intensity of nomadic pastoralism from 0-1; *Avg. Neighbor Herder* is the average *Herder* value over all neighboring ethnic societies; *ln(Population)* is the natural log of average cell-level population measured in five-year intervals from 1990 to 2010. 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.

Ethnographic data: nearest neighbor Lastly, we use the granularity of the conflict data to check for the presence of spillover effects from having neighboring ethnic groups who are nomadic-pastoralists. Rather than looking for spillovers from all neighboring ethnic groups, we examine variation across cells and look for spillovers from the neighboring ethnic group that is closest to the cell centroid. We estimate the following equation:

$$1(conflict_{iet}) = \alpha_t + \gamma_1 pastoral_i^n + \gamma_2 pastoral_e + \gamma_3 pastoral_e \times pastoral_i^n + \gamma_4 \ln(pop_i) + \eta_{iet}, \quad (3)$$

where i indexes 0.5-degree grid-cells, e ethnic groups, and t years (1989–2018). The dependent variable, $1(conflict_{iet})$, is conflict incidence in cell i in ethnic society e at time t; $pastoral_i^n$ is a measure of whether the neighboring ethnic group that is geographically closest to cell i traditionally engages in nomadic pastoralism, measured either using either the indicator variable $Nomad$ or the index $Herder$. The variable $pastoral_e$ is either of these two measures, but measured for the ethnicity in which the cell is located; $\ln(pop_i)$ is the natural log of the average population of cell i from 1990–2010.

The parameter of interest, γ_1, represents the effect of neighboring nomadic pastoralists on conflict in the cells of non-pastoral groups. Standard errors are adjusted for two-way clustering at the level of a cell and a climate zone-year.

Estimates of equation (3) using the UCDP data are presented in Table 5, while estimates using the ACLED data are presented in Appendix Table A3. The estimate of interest, $\hat{\gamma_1}$, is reported in the first row using the $Nomad$ indicator and in the fourth row using the $Herder$ index. The interpretation is again clear: having a nomadic pastoral nearest neighbor is associated with

Table 5: Agro-Pastoral Conflict in the Cross-Section: Cell-Level Spillover Analysis

	UCDP 1(Conflict)		*Actor: State*		*Actor: Non-State*		*Event: Battle*		*Event: Attack*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Neighbor Nomad	0.0279***		0.0234***		0.0077**		0.0285***		0.0023	
	(0.0054)		(0.0050)		(0.0033)		(0.0049)		(0.0027)	
Nomad	0.0131***		0.0082**		0.0036		0.0155***		-0.0024	
	(0.0046)		(0.0038)		(0.0029)		(0.0040)		(0.0021)	
Nomad × Neighbor Nomad	-0.0189***		-0.0165***		-0.0039		-0.0194***		-0.0008	
	(0.0061)		(0.0055)		(0.0037)		(0.0055)		(0.0029)	
Neighbor Herder		0.0328***		0.0279***		0.0095**		0.0336***		0.0035
		(0.0073)		(0.0067)		(0.0043)		(0.0066)		(0.0036)
Herder		0.0108*		0.0062		0.0016		0.0147***		-0.0042
		(0.0060)		(0.0049)		(0.0037)		(0.0053)		(0.0027)
Herder × Neighbor Herder		-0.0131		-0.0116		-0.0037		-0.0139		-0.0018
		(0.0112)		(0.0102)		(0.0068)		(0.0103)		(0.0051)
ln(Population)	0.0151***	0.0146***	0.0119***	0.0118***	0.0085***	0.0082***	0.0127***	0.0122***	0.0058***	0.0057***
	(0.0012)	(0.0011)	(0.0011)	(0.0010)	(0.0008)	(0.0007)	(0.0011)	(0.0010)	(0.0006)	(0.0006)
Constant	-0.1192***	-0.1140***	-0.0924***	-0.0905***	-0.0654***	-0.0612***	-0.1051***	-0.0996***	-0.0397***	-0.0394***
	(0.0128)	(0.0116)	(0.0112)	(0.0102)	(0.0081)	(0.0072)	(0.0112)	(0.0101)	(0.0067)	(0.0060)
Sum of *Neighbor Pastoral* estimates	0.0090	0.0197	0.0069	0.0162	0.0038	0.0058	0.0091	0.0197	0.0015	0.0017
p-value	0.006	0.006	0.013	0.012	0.055	0.154	0.002	0.004	0.270	0.522
Mean dep. var.	0.036	0.036	0.030	0.030	0.020	0.020	0.028	0.028	0.016	0.016
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	230460	230430	230460	230430	230460	230430	230460	230430	230460	230430

Note: All outcome variables measure conflict incidence at the level of a cell-year. UCDP 1(Conflict) indicates at least one violent conflict event in a cell-year. The two *Actor* outcomes are mutually exclusive subcategories: *State* indicates at least one conflict event involving the state; *Non-State* indicates at least one conflict event not involving the state. The two *Event* outcomes are also mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. *Nomad* indicates that the ethnic society containing cell i is nomadic; *Neighbor Nomad* indicates that the nearest neighboring ethnic society to cell i is nomadic; *Herder* measures the intensity of nomadic pastoralism from 0-1 in the ethnic society containing cell i; *Neighbor Herder* is the value of *Herder* in the nearest neighboring ethnic society to cell i; *ln(Population)* is the natural log of average cell-level population measured from 1990–2010. The raw data are reported for five-year intervals. 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.

significantly more conflict in almost every specification. Focusing on columns 1 and 2 in each table, the effect is positive and significant in both pastoral and non-pastoral cells.

Whether we use ecological or ethnographic data, and whether we use cell- or group-level variation, we see clear evidence that violent conflict is prevalent in agro-pastoral areas. It appears to be driven mostly by the presence of a pastoral neighbor in non-pastoral areas.

4. Local Precipitation Shocks and Agro-Pastoral Conflict: Scale Matters

We next examine whether changes in precipitation affect agro-pastoral conflict. To further motivate the importance of modeling spillover effects, we show in this section that the estimated *direct* effects are very different depending on the granularity of the analysis.

To do this, we estimate the following equation at different levels of spatial aggregation:

$$1(conflict_{it}) = \alpha_i + \alpha_t + \beta_0^s\, rain_{it} + \beta_1^s\, rain_{it} \times L_c^a \times L_c^p + \beta_2^s\, rain_{it} \times L_c^a + \beta_3^s\, rain_{it} \times L_c^p + \epsilon_{it}^s, \quad (4)$$

where i indexes geographic units (either cells or countries), t indexes years. $1(conflict_{it})$ is conflict incidence in location i in year t; α_i denote location fixed effects; α_t denote year fixed effects; $rain_{it}$ measures average precipitation in location i in year t; and L_i^a and L_i^p are averages of the Beck-Sieber land suitability measures for agriculture and nomadic pastoralism respectively. The parameter β_1^s describes the additional effect of precipitation in locations suited to *both* agriculture and pastoralism relative to the effect in countries suited to either agriculture or pastoralism alone.

Country-level We first estimate equation (4) when i is measured at the country level. For these estimates, we cluster the standard errors at the country-level. The estimates are presented in Table 6 (UCDP) and Appendix Table A4 (ACLED). They indicate that precipitation lowers conflict significantly more in agro-pastoral areas (or, alternatively, that droughts induce more conflict in agro-pastoral areas). This is true for all types of conflict examined. The effects are very different when areas are only agricultural or only pastoral: we find that the two double interaction effects, $\hat{\beta}_2^s$ and $\hat{\beta}_3^s$, are positive, in contrast to $\hat{\beta}_1^s$, which is negative. They are also significant in some specifications, but not all.

Cell-level We turn next to estimates, where i in equation (4) is measured at the cell level. Differences in the estimates at the different levels of analysis provide insights into the potential importance of spillovers in our setting. More aggregate estimates, like the country-level estimates, are expected to capture many of the spillover effects, while more micor-level estimates, like the 0.5-degree cell-level estimates, which are less likely to capture important spillover effects.

The cell-level estimates of equation 4 are reported in Table 7 (UCDP) and Appendix Table A5 (ACLED). Due to the potential of spatial correlation across fine grid cells, we cluster standard errors at the level of a cell and at the level of a climate zone-year. We find that, in contrast to the country-level estimates, the cell-level estimates are not significant. We no longer observe a negative differential effect of precipitation on conflict in agro-pastoral areas. These results indicate that the country-level effect of precipitation on conflict does not operate through a local channel that occurs within 0.5 degree (55km) cells. Instead, it is likely that a spillover mechanism is at play. We now turn to an explicit examination of this mechanism.

Table 6: Country-Level Analysis of Agro-pastoralism, Precipitation, and Conflict: Using Ecological Data

	UCDP 1(Conflict)	*Actor: State*	*Actor: Non-State*	*Type: Battle*	*Type: Attack*
	(1)	(2)	(3)	(4)	(5)
Precipitation × Agriculture × Nomadic Pastoralism	-0.1385*	-0.1676**	-0.2132**	-0.1899**	-0.2502***
	(0.0823)	(0.0679)	(0.0805)	(0.0800)	(0.0756)
Precipitation × Agriculture	0.0624	0.0817**	0.0932**	0.0740**	0.1212***
	(0.0378)	(0.0351)	(0.0387)	(0.0344)	(0.0376)
Precipitation × Nomadic Pastoralism	0.0512	0.0614*	0.0779*	0.0705*	0.0965**
	(0.0430)	(0.0322)	(0.0395)	(0.0397)	(0.0371)
Precipitation	-0.0183	-0.0285*	-0.0340*	-0.0244	-0.0487**
	(0.0182)	(0.0164)	(0.0189)	(0.0165)	(0.0183)
Mean dep. var.	0.501	0.460	0.433	0.411	0.384
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1225	1225	1225	1225	1225

Note: All outcome variables measure conflict incidence at the level of a country-year. UCDP 1(Conflict) indicates at least one violent conflict event in a country-year. The two *Actor* outcomes are mutually exclusive subcategories: *State* indicates at least one conflict event involving the state; *Non-State* indicates at least one conflict event not involving the state. The two *Event* outcomes are also mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. *Agriculture* and *Nomadic Pastoralism* are country-level variables measuring the share of land suitable for each land use type. *Precipitation* is annual ground precipitation measured in centimeters. Standard errors (in parentheses) are adjusted for serial correlation at the level of a country and spatial correlation at the level of a climate zone. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 7: Cell-Level Analysis of Agro-pastoralism, Precipitation, and Conflict: Using Ecological Data

	UCDP 1(Conflict)	*Actor: State*	*Actor: Non-State*	*Event: Battle*	*Event: Attack*
	(1)	(2)	(3)	(4)	(5)
Precipitation × Agriculture × Nomadic Pastoralism	0.0009	0.0013	0.0004	-0.0011	-0.0008
	(0.0055)	(0.0047)	(0.0046)	(0.0049)	(0.0040)
Precipitation × Agriculture	0.0001	-0.0000	-0.0001	0.0014	0.0003
	(0.0019)	(0.0017)	(0.0018)	(0.0015)	(0.0016)
Precipitation × Nomadic Pastoralism	-0.0002	-0.0000	-0.0002	-0.0000	0.0004
	(0.0020)	(0.0017)	(0.0015)	(0.0018)	(0.0013)
Precipitation	-0.0002	-0.0001	-0.0002	-0.0003	-0.0002
	(0.0007)	(0.0006)	(0.0006)	(0.0005)	(0.0005)
Mean dep. var.	0.029	0.024	0.016	0.023	0.012
Cell FE	Yes	Yes	Yes	Yes	Yes
Country × year FE	Yes	Yes	Yes	Yes	Yes
Observations	235525	235525	235525	235525	235525

Note: All outcome variables measure conflict incidence at the level of a cell-year. UCDP 1(Conflict) indicates at least one violent conflict event in a cell-year. The two *Actor* outcomes are mutually exclusive subcategories: *State* indicates at least one conflict event involving the state; *Non-State* indicates at least one conflict event not involving the state. The two *Event* outcomes are also mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. *Agriculture* and *Nomadic Pastoralism* are cell-level variables measuring the share of land suitable for each land use type. *Precipitation* is annual ground precipitation measured in centimeters. 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.

5. Spillover Precipitation Shocks and Agro-Pastoral Conflict

To explicitly examine spillovers between pastoral and agricultural areas, we combine information on the precise location of conflicts relative to the traditional borders between ethnic groups with information on each group's traditional subsistence activities; namely agriculture and nomadic-pastoralism.

We exploit cell-level variation in the identity of the nearest neighboring ethnic group to each cell's centroid. We estimate the following equation:

$$\begin{aligned} 1(conflict_{iet}) = \alpha_i^s + \alpha_{k(i)t}^s + \alpha_{c(i)}^s \, Year_t + \gamma_0^s rain_{it}^n + \gamma_1^s rain_{it}^n \times pastoral_i^n \\ + \gamma_2^s rain_{et} + \gamma_3^s rain_{et} \times pastoral_e \\ + \gamma_4^s rain_{it} + \gamma_5^s rain_{it} \times pastoral_e + \eta_{iet}^s, \end{aligned} \tag{5}$$

where $1(conflict_{iet})$ is an indicator for the incidence of conflict in cell i in ethnic society e in year t; α_i represents cell fixed effects; $\alpha_{k(i)y}$ denotes climate-zone-by-year fixed effects; $\alpha_{c(i)}^s \, Year_t$ denote country-specific linear time trends; $rain_{it}^n$ measures average precipitation in the most proximate neighboring ethnic society to cell i; $pastoral_i^n$ measures either *Nomad* or *Herder* in that neighboring ethnic society; $rain_{et}$ measures precipitation in group e in year t; $pastoral_e$ measures either *Nomad* or *Herder* for ethnicity e; and $rain_{it}$ measures precipitation in cell i in year t. Standard errors are 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 pastoral relative to when it is not 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. The inclusion of cell fixed effects controls flexibly for all time-invariant characteristics that vary at the level of a 0.5 degree cell or higher. The inclusion of climate-zone $\times$ year fixed effects controls flexibly for all common shocks and trends that vary at the level of a climate zone, of which there are 14 in the sample.

We also estimate an even more stringent version of equation (5) where the climate-zone-by-year year fixed effects and the country-specific time trend are replaced by country-by-year fixed effects.

Results In Table 8, we present results from our estimation of equation (5) using *Nomad* as the measure of nomadic pastoralism and UCDP to measure conflict. In column 1, the outcome variable is $1(Conflict)$, which is equal to 1 if UCDP records any violent two-sided or one-sided event. We estimate no significant effects of own-cell or own-group precipitation shocks; nor do we estimate significant effects of non-pastoral nearest neighbor shocks. The only significant estimate is $\hat{\gamma_1^s}$, which is negative in each of the ten specifications and generally significant.

In the middle panel, we show that the total effect of a neighboring pastoral shock is negative and significant ($p = 0.02$). In the lower panel, we translate the $\hat{\gamma_1^s}$ estimate into the equivalent of a temporal (i.e., within-cell) standard deviation shock on conflict incidence in terms of the dependent variable mean (henceforth "SD impact"). A one standard deviation increase in precipitation in neighboring pastoral societies reduces conflict by 22.5% of the mean. In the second column, we reduce the sample to non-pastoral (i.e. agricultural) cells alone. The same shock reduces conflict

by 40.6% in agricultural cells. In Appendix Table A6, we reduce the sample to pastoral cells alone and find no significant effect. This implies that the overall effect of neighboring pastoral shocks in column 1 is explained entirely by conflict in agricultural cells.

In the remaining columns, we note that the main finding is driven predominantly by two-sided battles involving the state. The interaction effect on state-based conflict in column 4 has an SD impact of -43.9% ($p < 0.01$). The effect on two-sided battles is -51.2% ($p < 0.01$).

In Table 9, we include country-year fixed effects (CYFE). This controls flexibly for factors that vary at the country level over time, including macroeconomic shocks and events in national politics. The main disadvantage of including these fixed effects is that our main estimates are computed using only the residualized variation that exists after we partial out these factors. Despite this, we report statistically significant estimates with broadly similar coefficients and only marginally larger standard errors. This stands in contrast to Table 7, where we do not model the spillover effects.

In Table 10, we see similar effects using the *Herder* pastoral variable. The first column presents the effect on overall violence. Our main estimate is again negative (SD impact = -36.3%) and significant ($p < 0.01$). Again, the effect is explained entirely by conflict in non-pastoral cells (SD impact = -63.8%, $p < 0.01$) rather than pastoral cells (Table A6), and is driven mainly by state-based two-sided battles. We find similar results when we include CYFEs (Table 11 and Appendix Table A7).

In Appendix Tables A8 to A11, we check the robustness of our findings to using the ACLED conflict data. Despite the shorter length of the ACLED panel, we still find quantitatively and statistically similar results. The overall SD impact on conflict using the *Nomad* indicator is -8% ($p < 0.05$) in the main specification and -10.1% ($p < 0.01$) in the CYFE specification, all of which is explained by conflict in non-pastoral cells (Appendix Table A12 and Table A13). This is driven mainly by two-sided battles that involve both domestic and external non-state forces. The results are similar when we use the *Herder* measure.

Additional Robustness We now turn to an examination of the sensitivity of our estimates. First, while we assume that the timing of precipitation shocks are random conditional on cell fixed effects, we test the sensitivity of our estimates to the inclusion of a linear time trend that varies by $pastoral_i^n$. This accounts for factors that trend differentially at the level of nearest neighboring groups that are pastoral or not.

Second, we might be concerned about the role of other factors that are correlated with pastoralism. If any of these interact with rainfall shocks in a way that affects spillover conflict, they may explain some or all of our $\hat{\gamma}_1^s$ estimate. One potential factor is related to a "culture of honor," which tends to be present in pastoral groups (Nisbett and Cohen, 1996). However, were this driving our results, we would expect to also estimate large (or even larger) pastoral-pastoral effects rather than (or in addition to) agro-pastoral effects. Our results very clearly indicate that pastoral shocks lead to conflict in neighboring agricultural cells and not in pastoral cells.

A closely related concern is that pastoral groups do not have high levels of state centralization, which could also manifest itself in spillover violence of the type that we identify. This is

Table 8: Effect of Neighbor's Rainfall when Neighbor is Nomadic

	UCDP 1(Conflict)		*Actor: State*		*Actor: Non-State*		*Event: Battle*		*Event: Attack*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Nearest Neighbor										
Precipitation	-0.0001	-0.0001	0.0000	0.0000	-0.0001	-0.0001	-0.0002	-0.0002	0.0000	0.0001
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Precipitation × Nomad	-0.0020***	-0.0035***	-0.0016***	-0.0031***	-0.0007	-0.0011*	-0.0017***	-0.0035***	-0.0006*	-0.0008
	(0.0006)	(0.0010)	(0.0005)	(0.0009)	(0.0004)	(0.0007)	(0.0006)	(0.0009)	(0.0003)	(0.0005)
Own Group										
Precipitation	0.0004	0.0004	0.0005	0.0005	0.0001	0.0001	0.0004	0.0004	0.0004	0.0004
	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Precipitation × Nomad	0.0006		0.0005		0.0010		-0.0002		-0.0000	
	(0.0009)		(0.0009)		(0.0007)		(0.0008)		(0.0007)	
Own Cell										
Precipitation	-0.0001	-0.0000	-0.0002	-0.0001	0.0000	-0.0000	0.0001	0.0002	-0.0002	-0.0002
	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Precipitation × Nomad	-0.0002		-0.0001		-0.0010*		0.0002		-0.0001	
	(0.0007)		(0.0007)		(0.0005)		(0.0006)		(0.0005)	
Nearest Neighbor										
Precipitation + Precipitation × Nomad	-0.0020	-0.0036	-0.0016	-0.0031	-0.0008	-0.0012	-0.0019	-0.0037	-0.0005	-0.0008
p-value	0.002	0.000	0.003	0.001	0.080	0.092	0.002	0.000	0.104	0.163
Impact (%):										
Neighbor Precipitation (SD)	-1.0	-0.9	0.2	0.1	-2.4	-1.1	-2.8	-3.6	0.7	1.6
× Nomad	-22.5	-40.6	-23.1	-43.9	-13.2	-22.5	-25.4	-51.2	-15.0	-22.1
Mean dep. var.	0.032	0.040	0.027	0.035	0.018	0.024	0.025	0.030	0.014	0.020
Sample: Nomad = 0	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate Zone × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Time Trend FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	190675	116250	190675	116250	190675	116250	190675	116250	190675	116250

Note: All outcome variables measure conflict incidence at the level of a cell-year. UCDP 1(Conflict) indicates at least one violent conflict event in a cell-year. The two *Actor* outcomes are mutually exclusive subcategories: *State* indicates at least one conflict event involving the state; *Non-State* indicates at least one conflict event not involving the state. The two *Event* outcomes are also mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. *Own Group* refers to the ethnic society that contains cell i. *Nearest Neighbor* refers to the nearest neighboring ethnic society to cell i. *Nomad* indicates that an ethnic society is nomadic. *Precipitation* is annual ground precipitation measured in centimeters. 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 9: Effect of Neighbor's Rainfall when Neighbor is Nomadic: With Country-Year FE

	UCDP 1(Conflict)		*Actor: State*		*Actor: Non-State*		*Event: Battle*		*Event: Attack*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Nearest Neighbor										
Precipitation	-0.0002	-0.0002	-0.0000	-0.0000	-0.0003**	-0.0003*	-0.0001	-0.0002	-0.0001	-0.0001
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0001)
Precipitation × Nomad	-0.0015**	-0.0026**	-0.0016***	-0.0025***	-0.0001	-0.0006	-0.0012*	-0.0024**	-0.0005	-0.0005
	(0.0007)	(0.0011)	(0.0006)	(0.0008)	(0.0005)	(0.0008)	(0.0007)	(0.0010)	(0.0003)	(0.0006)
Own Group										
Precipitation	0.0000	0.0000	0.0001	0.0001	-0.0002	-0.0002	0.0002	0.0002	0.0000	0.0001
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Precipitation × Nomad	0.0009		0.0003		0.0015**		0.0003		-0.0000	
	(0.0008)		(0.0008)		(0.0008)		(0.0008)		(0.0007)	
Own Cell										
Precipitation	-0.0002	-0.0002	-0.0003	-0.0003	-0.0000	-0.0001	-0.0000	0.0000	-0.0002	-0.0002
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Precipitation × Nomad	-0.0001		0.0003		-0.0010*		0.0002		0.0001	
	(0.0006)		(0.0006)		(0.0005)		(0.0006)		(0.0005)	
Nearest Neighbor										
Precipitation + Precipitation × Nomad	-0.0017	-0.0028	-0.0016	-0.0025	-0.0004	-0.0008	-0.0014	-0.0026	-0.0006	-0.0005
p-value	0.026	0.014	0.006	0.003	0.393	0.310	0.050	0.014	0.101	0.347
Impact (%):										
Neighbor Precipitation (SD)	-1.9	-2.0	-0.5	-0.6	-6.1	-5.1	-2.1	-2.9	-3.5	-2.4
× Nomad	-17.0	-29.6	-22.6	-34.6	-2.7	-11.7	-18.2	-35.4	-12.0	-12.1
Mean dep. var.	0.032	0.040	0.027	0.035	0.018	0.024	0.025	0.030	0.014	0.020
Sample: Nomad = 0	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	190675	116250	190675	116250	190675	116250	190675	116250	190675	116250

Note: All outcome variables measure conflict incidence at the level of a cell-year. UCDP 1(Conflict) indicates at least one violent conflict event in a cell-year. The two *Actor* outcomes are mutually exclusive subcategories: *State* indicates at least one conflict event involving the state; *Non-State* indicates at least one conflict event not involving the state. The two *Event* outcomes are also mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. *Own Group* refers to the ethnic society that contains cell i. *Nearest Neighbor* refers to the nearest neighboring ethnic society to cell i. *Nomad* indicates that an ethnic society is nomadic. *Precipitation* is annual ground precipitation measured in centimeters. 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.

particularly important given the previously documented importance of precolonial state centralization for contemporary development outcomes (Gennaioli and Rainer, 2007, Michalopoulos and Papaioannou, 2013). To gauge this possibility, we also include a $rain^n_{it} \times Jurisdictional\ Hierarchy^n_e$ interaction variable, where the n superscript again indicates that the variable measures jurisdictional hierarchy in the nearest neighboring ethnic society.

To check the robustness of our estimates to the inclusion of these covariates, we add them to the more stringent specification that includes country-year fixed effects. The estimates, which are reported in Tables 12 and 13, show that the inclusion of these additional variables makes little difference to our main estimates. In fact, they are slightly larger in magnitude and more statistically significant in most cases. The stability of our estimates is reassuring in this regard. The estimates are similarly robust if we estimate the same specification but use the ACLED conflict data. Th estimates are reported in Appendix Tables A14 and A15.

Table 10: Effect of Neighbor's Rainfall when Neighbor is a Herder

	UCDP 1(Conflict)		*Actor: State*		*Actor: Non-State*		*Event: Battle*		*Event: Attack*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Nearest Neighbor										
Precipitation	-0.0001	-0.0001	0.0000	0.0000	-0.0001	-0.0000	-0.0002	-0.0002	0.0000	0.0001
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Precipitation × Herder	-0.0032***	-0.0055***	-0.0027***	-0.0049***	-0.0011*	-0.0017*	-0.0028***	-0.0055***	-0.0009*	-0.0013
	(0.0010)	(0.0015)	(0.0009)	(0.0013)	(0.0006)	(0.0009)	(0.0009)	(0.0014)	(0.0005)	(0.0008)
Own Group										
Precipitation	0.0004	0.0004	0.0005	0.0005	0.0001	0.0001	0.0004	0.0004	0.0004	0.0004
	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Precipitation × Herder	0.0008		0.0008		0.0013		-0.0001		-0.0004	
	(0.0014)		(0.0016)		(0.0011)		(0.0013)		(0.0009)	
Own Cell										
Precipitation	-0.0001	-0.0001	-0.0002	-0.0001	0.0000	-0.0000	0.0001	0.0002	-0.0002	-0.0002
	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Precipitation × Herder	-0.0002		0.0002		-0.0014*		0.0004		0.0003	
	(0.0010)		(0.0011)		(0.0007)		(0.0010)		(0.0008)	
Nearest Neighbor										
Precipitation + Precipitation × Herder	-0.0032	-0.0056	-0.0026	-0.0049	-0.0012	-0.0017	-0.0030	-0.0057	-0.0008	-0.0012
p-value	0.001	0.000	0.002	0.000	0.047	0.055	0.001	0.000	0.071	0.126
Impact (%):										
Neighbor Precipitation (SD)	-1.0	-0.7	0.2	0.2	-2.5	-0.9	-2.8	-3.3	0.6	1.7
× Herder	-36.3	-63.8	-37.4	-69.4	-21.7	-33.5	-41.6	-81.2	-23.0	-34.4
Mean dep. var.	0.032	0.039	0.027	0.034	0.018	0.023	0.025	0.029	0.014	0.019
Sample: Herder = 0	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate Zone × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Time Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	190650	120075	190650	120075	190650	120075	190650	120075	190650	120075

Note: All outcome variables measure conflict incidence at the level of a cell-year. UCDP 1(Conflict) indicates at least one violent conflict event in a cell-year. The two *Actor* outcomes are mutually exclusive subcategories: *State* indicates at least one conflict event involving the state; *Non-State* indicates at least one conflict event not involving the state. The two *Event* outcomes are also mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. *Own Group* refers to the ethnic society that contains cell i. *Nearest Neighbor* refers to the nearest neighboring ethnic society to cell i. *Herder* measures the intensity of nomadic pastoralism in an ethnic group from 0-1. *Precipitation* is annual ground precipitation measured in centimeters. 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 11: Effect of Neighbor's Rainfall when Neighbor is a Herder: With Country-Year FE

	UCDP 1(Conflict)		*Actor: State*		*Actor: Non-State*		*Event: Battle*		*Event: Attack*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Nearest Neighbor										
Precipitation	-0.0002	-0.0002	-0.0000	-0.0001	-0.0003**	-0.0003*	-0.0001	-0.0002	-0.0001	-0.0001
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0001)
Precipitation × Herder	-0.0028**	-0.0041***	-0.0030***	-0.0041***	-0.0004	-0.0008	-0.0023**	-0.0039***	-0.0010*	-0.0009
	(0.0011)	(0.0016)	(0.0010)	(0.0013)	(0.0007)	(0.0011)	(0.0011)	(0.0015)	(0.0005)	(0.0009)
Own Group										
Precipitation	0.0001	0.0000	0.0002	0.0001	-0.0002	-0.0002	0.0002	0.0002	0.0001	0.0001
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Precipitation × Herder	0.0007		-0.0003		0.0018		0.0002		-0.0009	
	(0.0012)		(0.0014)		(0.0011)		(0.0012)		(0.0010)	
Own Cell										
Precipitation	-0.0002	-0.0002	-0.0003	-0.0003	-0.0001	-0.0001	-0.0000	0.0000	-0.0002	-0.0002
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Precipitation × Herder	0.0003		0.0012		-0.0012*		0.0004		0.0008	
	(0.0010)		(0.0010)		(0.0007)		(0.0010)		(0.0007)	
Nearest Neighbor										
Precipitation + Precipitation × Herder	-0.0030	-0.0043	-0.0030	-0.0042	-0.0007	-0.0011	-0.0024	-0.0041	-0.0011	-0.0010
p-value	0.010	0.008	0.002	0.002	0.304	0.328	0.027	0.007	0.039	0.289
Impact (%):										
Neighbor Precipitation (SD)	-1.8	-2.1	-0.2	-0.8	-6.1	-5.2	-2.0	-2.9	-3.2	-2.5
× Herder	-32.1	-47.6	-42.5	-57.7	-8.6	-16.6	-33.9	-58.1	-25.6	-23.1
Mean dep. var.	0.032	0.039	0.027	0.034	0.018	0.023	0.025	0.029	0.014	0.019
Sample: Herder = 0	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	190650	120075	190650	120075	190650	120075	190650	120075	190650	120075

Note: All outcome variables measure conflict incidence at the level of a cell-year. UCDP 1(Conflict) indicates at least one violent conflict event in a cell-year. The two *Actor* outcomes are mutually exclusive subcategories: *State* indicates at least one conflict event involving the state; *Non-State* indicates at least one conflict event not involving the state. The two *Event* outcomes are also mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. *Own Group* refers to the ethnic society that contains cell i. *Nearest Neighbor* refers to the nearest neighboring ethnic society to cell i. *Herder* measures the intensity of nomadic pastoralism in an ethnic group from 0-1. *Precipitation* is annual ground precipitation measured in centimeters. 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 12: Effect of Neighbor's Rainfall when Neighbor is Nomadic: With Country-Year FE and Additional Covariates

	UCDP 1(Conflict)		*Actor: State*		*Actor: Non-State*		*Event: Battle*		*Event: Attack*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Nearest Neighbor										
Precipitation	0.0006	0.0006	0.0006	0.0007**	0.0001	0.0002	0.0005	0.0004	0.0004	0.0005*
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0004)	(0.0004)	(0.0003)	(0.0003)
Precipitation × Nomad	-0.0021***	-0.0035***	-0.0021***	-0.0031***	-0.0005	-0.0011	-0.0018**	-0.0032***	-0.0007*	-0.0007
	(0.0008)	(0.0011)	(0.0006)	(0.0008)	(0.0005)	(0.0008)	(0.0007)	(0.0011)	(0.0004)	(0.0006)
Own Group										
Precipitation	0.0000	0.0000	0.0001	0.0001	-0.0002	-0.0001	0.0002	0.0002	0.0001	0.0001
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Precipitation × Nomad	0.0010		0.0004		0.0016**		0.0003		0.0000	
	(0.0008)		(0.0008)		(0.0008)		(0.0008)		(0.0007)	
Own Cell										
Precipitation	-0.0002	-0.0002	-0.0003	-0.0003	-0.0000	-0.0001	-0.0000	0.0000	-0.0002	-0.0002
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Precipitation × Nomad	0.0001		0.0004		-0.0009		0.0003		0.0002	
	(0.0006)		(0.0006)		(0.0006)		(0.0006)		(0.0006)	
Additional Controls										
Neighbor Precipitation × Jurisdictional Hierarchy	-0.0003	-0.0003*	-0.0003*	-0.0004**	-0.0002	-0.0002	-0.0002	-0.0003*	-0.0002**	-0.0003**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0001)	(0.0001)
Year × Neighbor Nomad	0.0011***	0.0009	0.0007**	-0.0000	0.0006***	0.0008*	0.0010***	0.0011*	0.0001	-0.0002
	(0.0003)	(0.0006)	(0.0003)	(0.0006)	(0.0002)	(0.0004)	(0.0003)	(0.0006)	(0.0002)	(0.0004)
Nearest Neighbor										
Precipitation + Precipitation × Nomad	-0.0016	-0.0029	-0.0015	-0.0024	-0.0004	-0.0010	-0.0013	-0.0028	-0.0003	-0.0002
p-value	0.047	0.014	0.017	0.007	0.535	0.274	0.072	0.009	0.516	0.728
Impact (%):										
Neighbor Precipitation (SD)	6.4	7.0	9.1	10.5	2.5	3.2	6.6	6.4	11.2	13.4
× Nomad	-24.4	-40.0	-29.8	-43.7	-9.8	-23.0	-26.2	-47.3	-18.6	-19.6
Mean dep. var.	0.031	0.039	0.026	0.033	0.018	0.024	0.024	0.029	0.014	0.020
Sample: Nomad = 0	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	183500	113500	183500	113500	183500	113500	183500	113500	183500	113500

Note: All outcome variables measure conflict incidence at the level of a cell-year. UCDP 1(Conflict) indicates at least one violent conflict event in a cell-year. The two *Actor* outcomes are mutually exclusive subcategories: *State* indicates at least one conflict event involving the state; *Non-State* indicates at least one conflict event not involving the state. The two *Event* outcomes are also mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. *Own Group* refers to the ethnic society that contains cell i. *Nearest Neighbor* refers to the nearest neighboring ethnic society to cell i. *Nomad* indicates that an ethnic society is nomadic. *Precipitation* is annual ground precipitation measured in centimeters. 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 13: Effect of Neighbor's Rainfall when Neighbor is a Herder: With Country-Year FE and Additional Covariates

	UCDP 1(Conflict)		*Actor: State*		*Actor: Non-State*		*Event: Battle*		*Event: Attack*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Nearest Neighbor										
Precipitation	0.0004	0.0006	0.0005	0.0007*	0.0001	0.0002	0.0003	0.0004	0.0004	0.0005*
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0004)	(0.0004)	(0.0003)	(0.0003)
Precipitation × Herder	-0.0033***	-0.0050***	-0.0035***	-0.0048***	-0.0006	-0.0013	-0.0028**	-0.0047***	-0.0011*	-0.0011
	(0.0012)	(0.0016)	(0.0010)	(0.0014)	(0.0007)	(0.0011)	(0.0011)	(0.0015)	(0.0006)	(0.0009)
Own Group										
Precipitation	0.0001	0.0000	0.0002	0.0001	-0.0002	-0.0002	0.0002	0.0002	0.0001	0.0001
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Precipitation × Herder	0.0008		-0.0003		0.0019*		0.0002		-0.0008	
	(0.0012)		(0.0014)		(0.0011)		(0.0012)		(0.0010)	
Own Cell										
Precipitation	-0.0002	-0.0002	-0.0003	-0.0003	-0.0001	-0.0001	-0.0001	0.0000	-0.0003	-0.0002
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Precipitation × Herder	0.0005		0.0014		-0.0012		0.0005		0.0010	
	(0.0010)		(0.0010)		(0.0008)		(0.0010)		(0.0008)	
Additional Controls										
Neighbor Precipitation × Jurisdictional Hierarchy	-0.0003	-0.0003*	-0.0002	-0.0003**	-0.0002	-0.0002	-0.0002	-0.0003*	-0.0002*	-0.0003**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0001)	(0.0001)
Year × Neighbor Herder	0.0012***	0.0012	0.0008*	0.0002	0.0004*	0.0011**	0.0011***	0.0013*	-0.0001	-0.0001
	(0.0004)	(0.0008)	(0.0004)	(0.0008)	(0.0002)	(0.0005)	(0.0004)	(0.0008)	(0.0002)	(0.0004)
Nearest Neighbor										
Precipitation + Precipitation × Herder	-0.0029	-0.0044	-0.0030	-0.0041	-0.0005	-0.0011	-0.0024	-0.0043	-0.0007	-0.0006
p-value	0.019	0.008	0.004	0.003	0.521	0.352	0.037	0.006	0.261	0.557
Impact (%):										
Neighbor Precipitation (SD)	5.0	6.4	7.4	9.7	2.0	3.7	5.2	5.4	10.0	13.8
× Herder	-38.2	-57.3	-48.9	-67.2	-12.6	-25.8	-40.7	-68.7	-29.0	-29.5
Mean dep. var.	0.031	0.038	0.026	0.033	0.018	0.023	0.024	0.028	0.014	0.019
Sample: Herder = 0	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	183475	117325	183475	117325	183475	117325	183475	117325	183475	117325

Note: All outcome variables measure conflict incidence at the level of a cell-year. UCDP 1(Conflict) indicates at least one violent conflict event in a cell-year. The two *Actor* outcomes are mutually exclusive subcategories: *State* indicates at least one conflict event involving the state; *Non-State* indicates at least one conflict event not involving the state. The two *Event* outcomes are also mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. *Own Group* refers to the ethnic society that contains cell i. *Nearest Neighbor* refers to the nearest neighboring ethnic society to cell i. *Herder* measures the intensity of nomadic pastoralism in an ethnic group from 0-1. *Precipitation* is annual ground precipitation measured in centimeters. 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.

6. Conclusions

In this paper, we have combined ethnographic data and ecological data on pastoralism with cell-year level data on conflict to examine the origins of agro-pastoral conflict in Africa. Using several combinations of data sources, we found evidence that low precipitation in pastoral areas leads to more violent conflict in agro-pastoral zones.

This spillover mechanism appears to explain most of the country-level association between precipitation and conflict in Africa, and it accounts for the differences between country-level and cell-level estimates of local shocks on conflict.

Our findings point to the significant efficiency costs of incomplete property rights for both farmers and herders in Africa. Institutions that enforce the right balance of grazing and cultivating rights will play an important role in mitigating the costs of climate change in agro-pastoral zones.

References

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.

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

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.

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.

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.

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.

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

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.

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

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.

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.

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.

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.

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

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.

Rubel, Franz and Markus Kottek, "Observed and Projected Climate Shifts 1901–2100 Depicted by World Maps of the Köppen-Geiger Climate Classification," *Meteorologische Zeitschrift*, 2010, *19* (2), 135–141.

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

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

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. Tables

Table A1: Agro-Pastoral Conflict in the Cross-Section: Cell-Level Analysis Using ACLED Conflict and Ecological Data

	ACLED 1(Conflict)		*Event: Battle*		*Event: Attack*		*State Forces*		*Internal Forces*		*External Forces*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Agriculture × Nomadic Pastoralism	0.2020***	0.1706***	0.1937***	0.1736***	0.1449***	0.1221**	0.2669***	0.2367***	0.2039***	0.1857***	0.0308*	0.0258
	(0.0577)	(0.0583)	(0.0472)	(0.0477)	(0.0500)	(0.0504)	(0.0485)	(0.0485)	(0.0484)	(0.0491)	(0.0180)	(0.0181)
Agriculture	0.1788***	-0.0001	0.0908***	-0.0234	0.1377***	0.0079	0.1083***	-0.0636***	0.0775***	-0.0262	0.0146**	-0.0137*
	(0.0238)	(0.0228)	(0.0176)	(0.0184)	(0.0212)	(0.0200)	(0.0198)	(0.0196)	(0.0177)	(0.0186)	(0.0062)	(0.0073)
Nomadic Pastoralism	0.0431***	0.0473***	0.0409***	0.0436***	0.0210*	0.0240**	0.0088	0.0129	0.0585***	0.0610***	0.0145***	0.0151***
	(0.0151)	(0.0154)	(0.0128)	(0.0129)	(0.0113)	(0.0115)	(0.0118)	(0.0120)	(0.0144)	(0.0146)	(0.0047)	(0.0047)
ln(Population)		0.0264***		0.0168***		0.0191***		0.0253***		0.0153***		0.0042***
		(0.0023)		(0.0016)		(0.0019)		(0.0022)		(0.0015)		(0.0006)
Constant	0.0064	-0.2003***	0.0017	-0.1303***	0.0028	-0.1472***	0.0134**	-0.1852***	-0.0017	-0.1216***	0.0013	-0.0314***
	(0.0065)	(0.0230)	(0.0048)	(0.0157)	(0.0056)	(0.0188)	(0.0054)	(0.0216)	(0.0052)	(0.0153)	(0.0015)	(0.0055)
Mean dep. var.	0.078	0.078	0.051	0.051	0.054	0.054	0.062	0.062	0.051	0.051	0.012	0.012
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	226104	226104	226104	226104	226104	226104	226104	226104	226104	226104	226104	226104

Note: All outcome variables measure conflict incidence at the level of a cell-year. ACLED 1(Conflict) indicates at least one violent conflict event in a cell-year. The two *Event* outcomes are mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. The following three outcomes are not mutually exclusive. They indicate respectively conflict incidence involving *State Forces*, *Internal Forces* not including the state, and *External Forces* involving state and non-state forces acting outside of their main country of operation, including mercenaries. *Agriculture* and *Nomadic Pastoralism* are cell-level variables measuring the share of land suitable for each land use type; *ln(Population)* is the natural log of average cell-level population measured in five-year intervals from 1990 to 2010. 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: Agro-Pastoral Conflict in the Cross-Section: Ethnicity-Level Spillover Analysis Using ACLED Conflict and Ethnographic Atlas Data

	ACLED 1(Conflict)		*Event: Battle*		*Event: Attack*		*State Forces*		*Internal Forces*		*External Forces*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Any Neighbor Nomad	0.1280***		0.1332***		0.1068***		0.1374***		0.1640***		0.0424***	
	(0.0296)		(0.0275)		(0.0261)		(0.0280)		(0.0274)		(0.0158)	
Nomad	-0.0182		0.0531		-0.0019		-0.0111		0.0816		0.0396	
	(0.1593)		(0.1394)		(0.1376)		(0.1436)		(0.1487)		(0.0741)	
Nomad × Any Neighbor Nomad	0.1346		0.0619		0.1017		0.1419		0.0112		0.0074	
	(0.1649)		(0.1458)		(0.1436)		(0.1487)		(0.1550)		(0.0786)	
Avg. Neighbor Herder		0.2848***		0.2905***		0.2107***		0.3506***		0.3397***		0.0923**
		(0.0775)		(0.0728)		(0.0669)		(0.0771)		(0.0761)		(0.0462)
Herder		0.1099		0.1027		0.1000		0.1443*		0.1099		-0.0632
		(0.0927)		(0.0910)		(0.0893)		(0.0821)		(0.0870)		(0.0585)
Herder × Avg. Neighbor Herder		0.0636		0.0936		0.0728		-0.0371		0.0175		0.3187**
		(0.1839)		(0.1820)		(0.1825)		(0.1614)		(0.1766)		(0.1410)
ln(Population)	0.0908***	0.0873***	0.0731***	0.0696***	0.0837***	0.0801***	0.0911***	0.0879***	0.0653***	0.0611***	0.0121**	0.0121**
	(0.0085)	(0.0084)	(0.0081)	(0.0079)	(0.0077)	(0.0077)	(0.0082)	(0.0080)	(0.0082)	(0.0081)	(0.0048)	(0.0048)
Constant	-0.6887***	-0.6346***	-0.5964***	-0.5414***	-0.6836***	-0.6287***	-0.7310***	-0.6806***	-0.5332***	-0.4665***	-0.0721	-0.0679
	(0.0963)	(0.0945)	(0.0918)	(0.0892)	(0.0869)	(0.0862)	(0.0912)	(0.0890)	(0.0932)	(0.0910)	(0.0545)	(0.0544)
Sum of *Neighbor Pastoral* estimates	0.2626	0.3484	0.1951	0.3841	0.2086	0.2835	0.2793	0.3135	0.1751	0.3572	0.0497	0.4110
p-value	0.109	0.036	0.177	0.020	0.143	0.092	0.057	0.028	0.255	0.025	0.520	0.002
Mean dep. var.	0.373	0.373	0.271	0.271	0.291	0.291	0.339	0.340	0.255	0.255	0.082	0.082
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17064	17040	17064	17040	17064	17040	17064	17040	17064	17040	17064	17040

Note: All outcome variables measure conflict incidence at the level of an ethnic society-year. ACLED 1(Conflict) indicates at least one violent conflict event in a society-year. The two *Event* outcomes are mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. The following three outcomes are not mutually exclusive. They indicate respectively conflict incidence involving *State Forces*, *Internal Forces* not including the state, and *External Forces* involving state and non-state forces acting outside of their main country of operation, including mercenaries. *Nomad* indicates that the ethnic society is nomadic; *Any Neighbor Nomad* indicates that any contiguous ethnic society is nomadic; *Herder* measures the intensity of nomadic pastoralism from 0-1; *Avg. Neighbor Herder* is the average *Herder* value over all neighboring ethnic societies; *ln(Population)* is the natural log of average cell-level population measured in five-year intervals from 1990 to 2010. 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 A3: Agro-Pastoral Conflict in the Cross-Section: Cell-Level Spillover Analysis Using ACLED Conflict Data

	ACLED 1(Conflict)		*Event: Battle*		*Event: Attack*		*State Forces*		*Internal Forces*		*External Forces*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Neighbor Nomad	0.0469***		0.0444***		0.0300***		0.0527***		0.0431***		0.0175***	
	(0.0094)		(0.0080)		(0.0074)		(0.0084)		(0.0080)		(0.0042)	
Nomad	0.0274***		0.0287***		0.0171***		0.0252***		0.0304***		0.0095***	
	(0.0084)		(0.0068)		(0.0061)		(0.0067)		(0.0074)		(0.0028)	
Nomad × Neighbor Nomad	-0.0200**		-0.0259***		-0.0103		-0.0287***		-0.0264***		-0.0125***	
	(0.0101)		(0.0086)		(0.0080)		(0.0091)		(0.0087)		(0.0043)	
Neighbor Herder		0.0555***		0.0506***		0.0369***		0.0722***		0.0436***		0.0190***
		(0.0132)		(0.0111)		(0.0106)		(0.0112)		(0.0114)		(0.0059)
Herder		0.0228*		0.0257***		0.0135		0.0279***		0.0254**		0.0084**
		(0.0121)		(0.0095)		(0.0091)		(0.0094)		(0.0104)		(0.0040)
Herder × Neighbor Herder		0.0003		-0.0067		-0.0018		-0.0482***		0.0060		-0.0018
		(0.0211)		(0.0175)		(0.0169)		(0.0158)		(0.0201)		(0.0083)
ln(Population)	0.0382***	0.0367***	0.0260***	0.0249***	0.0278***	0.0266***	0.0350***	0.0337***	0.0239***	0.0227***	0.0060***	0.0058***
	(0.0028)	(0.0026)	(0.0020)	(0.0019)	(0.0023)	(0.0021)	(0.0027)	(0.0025)	(0.0019)	(0.0018)	(0.0008)	(0.0007)
Constant	-0.3056***	-0.2875***	-0.2153***	-0.2019***	-0.2248***	-0.2096***	-0.2892***	-0.2736***	-0.1950***	-0.1813***	-0.0508***	-0.0494***
	(0.0292)	(0.0272)	(0.0210)	(0.0197)	(0.0236)	(0.0219)	(0.0284)	(0.0262)	(0.0202)	(0.0188)	(0.0082)	(0.0079)
Sum of *Neighbor Pastoral* Estimates	0.0269	0.0558	0.0185	0.0439	0.0197	0.0350	0.0241	0.0240	0.0167	0.0496	0.0050	0.0172
p-value	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.017	0.001	0.000	0.039	0.004
Mean dep. var.	0.085	0.085	0.056	0.056	0.058	0.058	0.069	0.069	0.055	0.055	0.013	0.013
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	184368	184344	184368	184344	184368	184344	184368	184344	184368	184344	184368	184344

Note: All outcome variables measure conflict incidence at the level of a cell-year. ACLED 1(Conflict) indicates at least one violent conflict event in a cell-year. The two *Event* outcomes are mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. The following three outcomes are not mutually exclusive. They indicate respectively conflict incidence involving *State Forces*, *Internal Forces* not including the state, and *External Forces* involving state and non-state forces acting outside of their main country of operation, including mercenaries. *Nomad* indicates that the ethnic society containing cell i is nomadic; *Neighbor Nomad* indicates that the nearest neighboring ethnic society to cell i is nomadic; *ln(Population)* is the natural log of average cell-level population measured in five-year intervals from 1990 to 2010. 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 A4: Country-Level Analysis of Agro-pastoralism, Precipitation, and Conflict: Using Ecological Data and ACLED Conflict Data

	ACLED 1(Conflict)	*Type: Battles*	*Type: One-Sided*	*State Forces*	*Internal Forces*	*External Forces*
	(1)	(2)	(3)	(4)	(5)	(6)
Precipitation × Agriculture × Nomadic Pastoralism	-0.1643	-0.2684**	-0.0377	-0.0827	-0.2542***	-0.2302***
	(0.1269)	(0.1025)	(0.1860)	(0.1177)	(0.0823)	(0.0824)
Precipitation × Agriculture	0.0531	0.0867**	-0.0042	-0.0121	0.1124***	0.1318***
	(0.0373)	(0.0409)	(0.0558)	(0.0307)	(0.0269)	(0.0348)
Precipitation × Nomadic Pastoralism	0.0984	0.1410**	0.0404	0.0488	0.1050**	0.1440***
	(0.0697)	(0.0574)	(0.1054)	(0.0671)	(0.0460)	(0.0423)
Precipitation	-0.0270	-0.0361	-0.0027	0.0044	-0.0417***	-0.0572***
	(0.0201)	(0.0221)	(0.0310)	(0.0178)	(0.0153)	(0.0181)
Mean dep. var.	0.849	0.672	0.789	0.868	0.567	0.372
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	833	833	833	833	833	833

Note: All outcome variables measure conflict incidence at the level of a country-year. ACLED 1(Conflict) indicates at least one violent conflict event in a country-year. The two *Event* outcomes are mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. The following three outcomes are not mutually exclusive. They indicate respectively conflict incidence involving *State Forces*, *Internal Forces* not including the state, and *External Forces* involving state and non-state forces acting outside of their main country of operation, including mercenaries. *Agriculture* and *Nomadic Pastoralism* are cell-level variables measuring the share of land suitable for each land use type. *Precipitation* is annual ground precipitation measured in centimeters. Standard errors (in parentheses) are adjusted for serial correlation at the level of a country and spatial correlation at the level of a climate zone. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A5: Cell-Level Analysis of Agro-pastoralism, Precipitation, and Conflict: Using Ecological Data and ACLED Conflict Data

	ACLED 1(Conflict)	*Event: Battle*	*Event: Attack*	*State Forces*	*Internal Forces*	*External Forces*
	(1)	(2)	(3)	(4)	(5)	(6)
Precipitation × Agriculture × Nomadic Pastoralism	-0.0009	0.0031	-0.0059	0.0041	0.0064	0.0043
	(0.0074)	(0.0068)	(0.0055)	(0.0062)	(0.0068)	(0.0027)
Precipitation × Agriculture	0.0019	0.0013	0.0031*	0.0015	0.0011	0.0006
	(0.0024)	(0.0020)	(0.0018)	(0.0023)	(0.0022)	(0.0008)
Precipitation × Nomadic Pastoralism	0.0004	-0.0003	0.0016	-0.0011	-0.0014	-0.0022**
	(0.0028)	(0.0025)	(0.0021)	(0.0022)	(0.0027)	(0.0011)
Precipitation	-0.0006	-0.0004	-0.0011	-0.0005	-0.0003	0.0000
	(0.0009)	(0.0007)	(0.0007)	(0.0009)	(0.0008)	(0.0003)
Mean dep. var.	0.059	0.039	0.038	0.044	0.038	0.008
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes
Country × year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	160157	160157	160157	160157	160157	160157

Note: All outcome variables measure conflict incidence at the level of a cell-year. ACLED 1(Conflict) indicates at least one violent conflict event in a cell-year. The two *Event* outcomes are mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. The following three outcomes are not mutually exclusive. They indicate respectively conflict incidence involving *State Forces*, *Internal Forces* not including the state, and *External Forces* involving state and non-state forces acting outside of their main country of operation, including mercenaries. *Agriculture* and *Nomadic Pastoralism* are cell-level variables measuring the share of land suitable for each land use type. *Precipitation* is annual ground precipitation measured in centimeters. 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 A6: Effect of Nearest Neighbor's Rainfall when Nomadic: Estimates for Nomadic Pastoral Cells Only

	UCDP 1(Conflict)		*Actor: State*		*Actor: Non-State*		*Event: Battle*		*Event: Attack*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Nearest Neighbor										
Precipitation	-0.0003	0.0002	-0.0002	0.0001	-0.0006	-0.0003	0.0001	0.0006	-0.0002	-0.0002
	(0.0007)	(0.0005)	(0.0007)	(0.0005)	(0.0006)	(0.0004)	(0.0007)	(0.0005)	(0.0005)	(0.0003)
Precipitation × Nomad	-0.0007		-0.0004		-0.0001		-0.0007		-0.0003	
	(0.0009)		(0.0008)		(0.0006)		(0.0008)		(0.0005)	
Precipitation × Herder		-0.0007		-0.0001		-0.0007		-0.0006		-0.0003
		(0.0014)		(0.0012)		(0.0009)		(0.0014)		(0.0006)
Own Group										
Precipitation	0.0005	-0.0003	0.0007	-0.0000	0.0009	0.0002	-0.0001	-0.0005	0.0003	0.0001
	(0.0009)	(0.0007)	(0.0009)	(0.0006)	(0.0007)	(0.0005)	(0.0009)	(0.0006)	(0.0006)	(0.0004)
Own Cell										
Precipitation	-0.0002	0.0001	-0.0003	-0.0000	-0.0005	-0.0001	0.0001	0.0000	0.0000	0.0001
	(0.0006)	(0.0005)	(0.0007)	(0.0005)	(0.0005)	(0.0004)	(0.0006)	(0.0004)	(0.0005)	(0.0003)
Nearest Neighbor										
Precipitation + Precipitation × Pastoral	-0.0010	-0.0005	-0.0006	-0.0000	-0.0008	-0.0010	-0.0006	-0.0000	-0.0005	-0.0006
p-value	0.222	0.701	0.459	0.974	0.138	0.227	0.467	0.972	0.226	0.234
Impact (%):										
Neighbor Precipitation (SD)	-3.8	2.8	-2.4	0.9	-13.1	-5.5	1.3	8.8	-5.4	-6.0
× Pastoral	-7.8	-8.4	-5.4	-1.4	-2.1	-14.0	-9.9	-9.5	-8.1	-9.3
Mean dep. var.	0.019	0.021	0.015	0.016	0.009	0.010	0.017	0.018	0.005	0.006
Sample: Pastoral variable > 0	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Time Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	74400	90250	74400	90250	74400	90250	74400	90250	74400	90250

Note: All outcome variables measure conflict incidence at the level of a cell-year. UCDP 1(Conflict) indicates at least one violent conflict event in a cell-year. The two *Actor* outcomes are mutually exclusive subcategories: *State* indicates at least one conflict event involving the state; *Non-State* indicates at least one conflict event not involving the state. The two *Event* outcomes are also mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. *Own Group* refers to the ethnic society that contains cell i. *Nearest Neighbor* refers to the nearest neighboring ethnic society to cell i. *Nomad* indicates that an ethnic society is nomadic. *Precipitation* is annual ground precipitation measured in centimeters. 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 A7: Effect of Nearest Neighbor's Rainfall when Nomadic With Country-Year FE: Estimates for Nomadic Pastoral Cells Only

	UCDP 1(Conflict)		*Actor: State*		*Actor: Non-State*		*Event: Battle*		*Event: Attack*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Nearest Neighbor										
Precipitation	-0.0001	0.0005	-0.0001	0.0004	-0.0009	-0.0001	0.0005	0.0007	-0.0006	-0.0001
	(0.0008)	(0.0005)	(0.0007)	(0.0005)	(0.0006)	(0.0004)	(0.0007)	(0.0005)	(0.0005)	(0.0003)
Precipitation × Nomad	-0.0006		-0.0007		0.0003		-0.0006		-0.0003	
	(0.0009)		(0.0008)		(0.0006)		(0.0008)		(0.0005)	
Precipitation × Herder		-0.0010		-0.0011		-0.0005		-0.0003		-0.0011**
		(0.0015)		(0.0012)		(0.0010)		(0.0014)		(0.0005)
Own Group										
Precipitation	0.0006	-0.0002	0.0002	-0.0001	0.0010	0.0005	0.0001	-0.0004	-0.0003	0.0000
	(0.0009)	(0.0007)	(0.0008)	(0.0006)	(0.0008)	(0.0005)	(0.0009)	(0.0006)	(0.0007)	(0.0004)
Own Cell										
Precipitation	-0.0004	0.0002	-0.0002	0.0001	-0.0007	-0.0001	-0.0003	0.0001	0.0002	0.0002
	(0.0006)	(0.0004)	(0.0006)	(0.0004)	(0.0005)	(0.0004)	(0.0006)	(0.0004)	(0.0005)	(0.0003)
Nearest Neighbor										
Precipitation + Precipitation × Pastoral	-0.0007	-0.0005	-0.0008	-0.0007	-0.0006	-0.0006	-0.0001	0.0004	-0.0010	-0.0012
p-value	0.426	0.736	0.341	0.558	0.287	0.493	0.950	0.804	0.033	0.014
Impact (%):										
Neighbor Precipitation (SD)	-1.5	5.4	-1.1	6.0	-17.6	-1.8	7.8	10.2	-16.9	-2.1
× Pastoral	-7.1	-11.0	-10.0	-15.8	5.6	-11.0	-8.6	-5.0	-8.6	-29.3
Mean dep. var.	0.019	0.021	0.015	0.016	0.009	0.010	0.017	0.018	0.005	0.006
Sample: Pastoral variable > 0	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	74425	90250	74425	90250	74425	90250	74425	90250	74425	90250

Note: All outcome variables measure conflict incidence at the level of a cell-year. UCDP 1(Conflict) indicates at least one violent conflict event in a cell-year. The two *Actor* outcomes are mutually exclusive subcategories: *State* indicates at least one conflict event involving the state; *Non-State* indicates at least one conflict event not involving the state. The two *Event* outcomes are also mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. *Own Group* refers to the ethnic society that contains cell i. *Nearest Neighbor* refers to the nearest neighboring ethnic society to cell i. *Nomad* indicates that an ethnic society is nomadic. *Precipitation* is annual ground precipitation measured in centimeters. 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 A8: Effect of Neighbor's Rainfall when Neighbor is Nomadic: Using ACLED Conflict Data

	ACLED 1(Conflict)		*Event: Battle*		*Event: Attack*		*State Forces*		*Internal Forces*		*External Forces*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Nearest Neighbor												
Precipitation	0.0003	0.0006*	0.0000	0.0002	0.0002	0.0005*	0.0002	0.0004	0.0002	0.0004	0.0003**	0.0003***
	(0.0004)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0001)	(0.0001)
Precipitation × Nomad	-0.0017**	-0.0020	-0.0013*	-0.0020	-0.0013*	-0.0006	-0.0007	-0.0001	-0.0005	-0.0011	-0.0008*	-0.0003
	(0.0008)	(0.0016)	(0.0008)	(0.0013)	(0.0007)	(0.0014)	(0.0008)	(0.0013)	(0.0009)	(0.0012)	(0.0004)	(0.0008)
Own Group												
Precipitation	0.0006	0.0005	0.0008**	0.0007*	0.0005	0.0004	0.0002	0.0001	0.0005	0.0005	0.0005**	0.0005**
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0002)	(0.0002)
Precipitation × Nomad	0.0011		0.0001		0.0010		0.0011		0.0017		-0.0003	
	(0.0011)		(0.0009)		(0.0011)		(0.0010)		(0.0011)		(0.0006)	
Own Cell												
Precipitation	-0.0003	-0.0004	-0.0002	-0.0003	-0.0001	-0.0003	-0.0002	-0.0003	-0.0000	-0.0001	-0.0001	-0.0001
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0002)	(0.0002)
Precipitation × Nomad	-0.0005		0.0003		-0.0005		-0.0004		-0.0018*		0.0002	
	(0.0009)		(0.0009)		(0.0009)		(0.0008)		(0.0010)		(0.0005)	
Nearest Neighbor												
Precipitation + Precipitation × Nomad	-0.0014	-0.0014	-0.0013	-0.0018	-0.0011	-0.0001	-0.0005	0.0003	-0.0003	-0.0008	-0.0005	0.0000
p-value	0.098	0.382	0.089	0.169	0.156	0.917	0.490	0.816	0.747	0.533	0.205	0.986
Impact (%):												
Neighbor Precipitation (SD)	1.3	2.8	0.1	1.2	1.4	3.5	1.2	2.2	1.4	2.6	8.3	9.9
× Nomad	-8.0	-9.5	-9.6	-14.7	-8.9	-4.5	-4.4	-0.3	-3.5	-8.5	-24.8	-9.4
Mean dep. var.	0.064	0.083	0.042	0.052	0.041	0.054	0.049	0.065	0.042	0.051	0.009	0.011
Sample: Nomad = 0	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate Zone × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Time Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	129659	79050	129659	79050	129659	79050	129659	79050	129659	79050	129659	79050

Note: All outcome variables measure conflict incidence at the level of a cell-year. ACLED 1(Conflict) indicates at least one violent conflict event in a cell-year. The two *Event* outcomes are mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. The following three outcomes are not mutually exclusive. They indicate respectively conflict incidence involving *State Forces*, *Internal Forces* not including the state, and *External Forces* involving state and non-state forces acting outside of their main country of operation, including mercenaries. *Own Group* refers to the ethnic society that contains cell i. *Nearest Neighbor* refers to the nearest neighboring ethnic society to cell i. *Nomad* indicates that an ethnic society is nomadic. *Precipitation* is annual ground precipitation measured in centimeters. 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 A9: Effect of Neighbor's Rainfall when Neighbor is Nomadic: With Country-Year Fixed Effects and Using ACLED Conflict Data

	ACLED 1(Conflict)		*Event: Battle*		*Event: Attack*		*State Forces*		*Internal Forces*		*External Forces*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Nearest Neighbor												
Precipitation	0.0004	0.0006*	0.0003	0.0003	0.0000	0.0003	0.0005*	0.0006**	0.0005	0.0006*	0.0002	0.0002*
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0001)	(0.0001)
Precipitation × Nomad	-0.0021***	-0.0021	-0.0019**	-0.0031**	-0.0015**	-0.0004	-0.0017**	-0.0008	-0.0012	-0.0023*	-0.0013***	-0.0014*
	(0.0007)	(0.0014)	(0.0008)	(0.0013)	(0.0007)	(0.0013)	(0.0008)	(0.0013)	(0.0008)	(0.0014)	(0.0005)	(0.0007)
Own Group												
Precipitation	0.0006	0.0005	0.0009***	0.0008**	0.0003	0.0003	0.0005	0.0004	0.0007*	0.0006	0.0002	0.0002
	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0004)	(0.0004)	(0.0002)	(0.0002)
Precipitation × Nomad	0.0005		-0.0006		0.0009		-0.0005		0.0012		-0.0011	
	(0.0012)		(0.0011)		(0.0010)		(0.0012)		(0.0011)		(0.0008)	
Own Cell												
Precipitation	-0.0005	-0.0006	-0.0004	-0.0005	-0.0002	-0.0004	-0.0004	-0.0005	-0.0003	-0.0003	-0.0000	-0.0000
	(0.0004)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0003)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0002)	(0.0002)
Precipitation × Nomad	-0.0002		0.0005		-0.0004		0.0003		-0.0017*		0.0004	
	(0.0009)		(0.0009)		(0.0009)		(0.0008)		(0.0010)		(0.0005)	
Nearest Neighbor												
Precipitation + Precipitation × Nomad	-0.0018	-0.0015	-0.0016	-0.0028	-0.0014	-0.0001	-0.0012	-0.0002	-0.0008	-0.0017	-0.0011	-0.0012
p-value	0.022	0.280	0.034	0.033	0.081	0.927	0.140	0.890	0.338	0.228	0.018	0.114
Impact (%):												
Neighbor Precipitation (SD)	1.7	2.8	1.8	2.4	0.3	2.1	3.2	3.8	3.7	4.3	5.0	5.7
× Nomad	-10.1	-10.1	-13.8	-23.0	-10.2	-2.9	-10.2	-4.9	-9.3	-17.2	-41.0	-43.4
Mean dep. var.	0.064	0.083	0.042	0.052	0.041	0.054	0.049	0.065	0.042	0.051	0.009	0.011
Sample: Nomad = 0	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
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	129659	79050	129659	79050	129659	79050	129659	79050	129659	79050	129659	79050

Note: All outcome variables measure conflict incidence at the level of a cell-year. ACLED 1(Conflict) indicates at least one violent conflict event in a cell-year. The two *Event* outcomes are mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. The following three outcomes are not mutually exclusive. They indicate respectively conflict incidence involving *State Forces*, *Internal Forces* not including the state, and *External Forces* involving state and non-state forces acting outside of their main country of operation, including mercenaries. *Own Group* refers to the ethnic society that contains cell i. *Nearest Neighbor* refers to the nearest neighboring ethnic society to cell i. *Nomad* indicates that an ethnic society is nomadic. *Precipitation* is annual ground precipitation measured in centimeters. 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 A10: Effect of Neighbor's Rainfall when Neighbor is a Herder: Using ACLED Conflict Data

	ACLED 1(Conflict)		*Event: Battle*		*Event: Attack*		*State Forces*		*Internal Forces*		*External Forces*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Nearest Neighbor												
Precipitation	0.0003	0.0006*	0.0000	0.0002	0.0002	0.0005*	0.0002	0.0004	0.0002	0.0003	0.0002**	0.0003***
	(0.0004)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0001)	(0.0001)
Precipitation × Herder	-0.0028**	-0.0034	-0.0019*	-0.0031	-0.0020*	-0.0010	-0.0013	-0.0009	-0.0002	-0.0009	-0.0010	0.0001
	(0.0012)	(0.0022)	(0.0011)	(0.0019)	(0.0011)	(0.0018)	(0.0011)	(0.0019)	(0.0014)	(0.0020)	(0.0007)	(0.0012)
Own Group												
Precipitation	0.0005	0.0005	0.0008**	0.0007**	0.0004	0.0004	0.0002	0.0001	0.0005	0.0005	0.0004*	0.0005**
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0002)	(0.0002)
Precipitation × Herder	0.0025		0.0000		0.0027		0.0018		0.0031*		0.0003	
	(0.0017)		(0.0014)		(0.0017)		(0.0016)		(0.0017)		(0.0009)	
Own Cell												
Precipitation	-0.0002	-0.0004	-0.0002	-0.0003	-0.0001	-0.0003	-0.0002	-0.0003	0.0000	-0.0001	-0.0001	-0.0002
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0001)	(0.0002)
Precipitation × Herder	-0.0014		0.0001		-0.0016		-0.0007		-0.0035**		0.0001	
	(0.0016)		(0.0016)		(0.0014)		(0.0012)		(0.0016)		(0.0007)	
Nearest Neighbor												
Precipitation + Precipitation × Herder	-0.0025	-0.0028	-0.0019	-0.0029	-0.0018	-0.0005	-0.0011	-0.0005	-0.0001	-0.0006	-0.0008	0.0004
p-value	0.032	0.195	0.089	0.138	0.087	0.763	0.318	0.778	0.953	0.779	0.253	0.708
Impact (%):												
Neighbor Precipitation (SD)	1.4	2.9	0.0	1.2	1.4	3.6	1.3	2.1	1.2	2.5	7.9	9.6
× Herder	-13.3	-16.2	-14.2	-22.5	-14.1	-7.3	-7.7	-5.3	-1.8	-6.7	-33.3	4.8
Mean dep. var.	0.064	0.080	0.042	0.051	0.041	0.053	0.049	0.063	0.042	0.049	0.009	0.011
Sample: Herder = 0	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate Zone × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Time Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	129642	81651	129642	81651	129642	81651	129642	81651	129642	81651	129642	81651

Note: All outcome variables measure conflict incidence at the level of a cell-year. ACLED 1(Conflict) indicates at least one violent conflict event in a cell-year. The two *Event* outcomes are mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. The following three outcomes are not mutually exclusive. They indicate respectively conflict incidence involving *State Forces*, *Internal Forces* not including the state, and *External Forces* involving state and non-state forces acting outside of their main country of operation, including mercenaries. *Own Group* refers to the ethnic society that contains cell i. *Nearest Neighbor* refers to the nearest neighboring ethnic society to cell i. *Herder* measures the intensity of nomadic pastoralism in an ethnic group from 0-1. *Precipitation* is annual ground precipitation measured in centimeters. 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 A11: Effect of Neighbor's Rainfall when Neighbor is a Herder: With Country-Year FE and Using ACLED Conflict Data

	ACLED 1(Conflict)		*Event: Battle*		*Event: Attack*		*State Forces*		*Internal Forces*		*External Forces*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Nearest Neighbor												
Precipitation	0.0004	0.0006*	0.0003	0.0003	0.0000	0.0003	0.0005*	0.0006**	0.0005	0.0005*	0.0002	0.0002*
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0001)	(0.0001)
Precipitation × Herder	-0.0037***	-0.0040**	-0.0030**	-0.0052***	-0.0025**	-0.0010	-0.0031**	-0.0023	-0.0019	-0.0035	-0.0021***	-0.0020**
	(0.0010)	(0.0019)	(0.0012)	(0.0019)	(0.0010)	(0.0016)	(0.0012)	(0.0019)	(0.0012)	(0.0022)	(0.0007)	(0.0010)
Own Group												
Precipitation	0.0006	0.0005	0.0010***	0.0008**	0.0002	0.0003	0.0005	0.0004	0.0007*	0.0006	0.0002	0.0002
	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0004)	(0.0004)	(0.0002)	(0.0002)
Precipitation × Herder	0.0014		-0.0013		0.0026		-0.0012		0.0017		-0.0013	
	(0.0018)		(0.0016)		(0.0017)		(0.0018)		(0.0018)		(0.0011)	
Own Cell												
Precipitation	-0.0005	-0.0006	-0.0004	-0.0005	-0.0002	-0.0004	-0.0004	-0.0005	-0.0002	-0.0003	-0.0000	-0.0001
	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0004)	(0.0003)	(0.0003)	(0.0001)	(0.0001)
Precipitation × Herder	-0.0010		0.0007		-0.0016		0.0006		-0.0031*		0.0005	
	(0.0015)		(0.0016)		(0.0014)		(0.0012)		(0.0016)		(0.0008)	
Nearest Neighbor												
Precipitation + Precipitation × Herder	-0.0033	-0.0034	-0.0028	-0.0049	-0.0025	-0.0007	-0.0025	-0.0017	-0.0014	-0.0030	-0.0019	-0.0018
p-value	0.002	0.080	0.019	0.011	0.024	0.657	0.040	0.371	0.237	0.172	0.009	0.066
Impact (%):												
Neighbor Precipitation (SD)	1.8	2.9	1.9	2.3	0.3	2.2	3.2	3.6	3.6	4.1	5.0	5.4
× Herder	-17.7	-19.0	-22.2	-38.1	-17.4	-7.1	-18.1	-13.5	-14.4	-26.4	-65.5	-62.8
Mean dep. var.	0.064	0.080	0.042	0.051	0.041	0.053	0.049	0.063	0.042	0.049	0.009	0.011
Sample: Herder = 0	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
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	129642	81651	129642	81651	129642	81651	129642	81651	129642	81651	129642	81651

Note: All outcome variables measure conflict incidence at the level of a cell-year. ACLED 1(Conflict) indicates at least one violent conflict event in a cell-year. The two *Event* outcomes are mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. The following three outcomes are not mutually exclusive. They indicate respectively conflict incidence involving *State Forces*, *Internal Forces* not including the state, and *External Forces* involving state and non-state forces acting outside of their main country of operation, including mercenaries. *Own Group* refers to the ethnic society that contains cell i. *Nearest Neighbor* refers to the nearest neighboring ethnic society to cell i. *Herder* measures the intensity of nomadic pastoralism in an ethnic group from 0-1. *Precipitation* is annual ground precipitation measured in centimeters. 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 A12: Effect of Neighbor's Rainfall when Nomadic or Herder With Country-Year FE: Estimates for Nomadic Pastoral Cells Only

	ACLED 1(Conflict)		*Event: Battle*		*Event: Attack*		*State Forces*		*Internal Forces*		*External Forces*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Nearest Neighbor												
Precipitation	-0.0026**	-0.0013*	-0.0016	-0.0001	-0.0026***	-0.0017***	-0.0011	-0.0003	-0.0015	-0.0004	-0.0002	-0.0000
	(0.0011)	(0.0007)	(0.0012)	(0.0007)	(0.0009)	(0.0006)	(0.0010)	(0.0006)	(0.0011)	(0.0007)	(0.0004)	(0.0003)
Precipitation × Nomad	0.0001		0.0001		-0.0001		-0.0007		0.0011		-0.0005	
	(0.0013)		(0.0012)		(0.0009)		(0.0012)		(0.0013)		(0.0005)	
Precipitation × Herder		0.0006		-0.0003		0.0000		-0.0000		0.0018		0.0001
		(0.0015)		(0.0017)		(0.0011)		(0.0017)		(0.0018)		(0.0011)
Own Group												
Precipitation	0.0022*	-0.0002	0.0015	-0.0006	0.0018	0.0006	0.0024**	0.0000	0.0028**	0.0001	0.0004	-0.0002
	(0.0012)	(0.0008)	(0.0009)	(0.0008)	(0.0011)	(0.0008)	(0.0011)	(0.0008)	(0.0014)	(0.0009)	(0.0006)	(0.0004)
Own Cell												
Precipitation	0.0008	0.0009	0.0008	0.0007	0.0009	0.0007	0.0003	0.0006	-0.0011	-0.0003	0.0003	0.0002
	(0.0011)	(0.0008)	(0.0012)	(0.0007)	(0.0011)	(0.0007)	(0.0010)	(0.0008)	(0.0014)	(0.0007)	(0.0006)	(0.0004)
Nearest Neighbor												
Precipitation + Precipitation × Pastoral	-0.0026	-0.0008	-0.0015	-0.0004	-0.0027	-0.0016	-0.0019	-0.0003	-0.0004	0.0014	-0.0007	0.0001
p-value	0.049	0.633	0.184	0.824	0.005	0.142	0.120	0.866	0.784	0.435	0.248	0.961
Impact (%):												
Neighbor Precipitation (SD)	-12.6	-6.4	-11.9	-0.9	-18.0	-11.6	-6.7	-1.7	-10.9	-3.0	-6.7	-0.2
× Pastoral	0.4	2.7	0.6	-2.0	-0.9	0.1	-4.4	-0.0	8.1	13.6	-14.6	2.0
Mean dep. var.	0.036	0.041	0.027	0.029	0.021	0.025	0.025	0.029	0.028	0.029	0.006	0.007
Sample: Pastoral variable > 0	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate-Zone × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Time Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	50592	61370	50592	61370	50592	61370	50592	61370	50592	61370	50592	61370

Note: All outcome variables measure conflict incidence at the level of a cell-year. ACLED 1(Conflict) indicates at least one violent conflict event in a cell-year. The two *Event* outcomes are mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. The following three outcomes are not mutually exclusive. They indicate respectively conflict incidence involving *State Forces*, *Internal Forces* not including the state, and *External Forces* involving state and non-state forces acting outside of their main country of operation, including mercenaries. *Own Group* refers to the ethnic society that contains cell i. *Nearest Neighbor* refers to the nearest neighboring ethnic society to cell i. *Nomad* indicates that an ethnic society is nomadic. *Precipitation* is annual ground precipitation measured in centimeters. 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 A13: Effect of Neighbor's Rainfall when Nomadic or Herder With Country-Year FE and Using ACLED Conflict Data: Estimates for Nomadic Pastoral Cells Only

	ACLED 1(Conflict)		*Event: Battle*		*Event: Attack*		*State Forces*		*Internal Forces*		*External Forces*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Nearest Neighbor												
Precipitation	-0.0030***	-0.0015**	-0.0018*	-0.0000	-0.0030***	-0.0018***	-0.0011	0.0000	-0.0015	0.0001	-0.0003	-0.0001
	(0.0011)	(0.0007)	(0.0010)	(0.0007)	(0.0009)	(0.0005)	(0.0010)	(0.0006)	(0.0009)	(0.0006)	(0.0004)	(0.0003)
Precipitation × Nomad	-0.0004		0.0001		-0.0006		-0.0017		0.0006		-0.0008	
	(0.0011)		(0.0011)		(0.0010)		(0.0011)		(0.0011)		(0.0006)	
Precipitation × Herder		0.0001		-0.0003		-0.0006		-0.0013		0.0013		-0.0004
		(0.0017)		(0.0019)		(0.0012)		(0.0020)		(0.0016)		(0.0011)
Own Group												
Precipitation	0.0015	-0.0008	0.0015	-0.0008	0.0009	-0.0000	0.0012	-0.0007	0.0026**	0.0001	-0.0006	-0.0008
	(0.0012)	(0.0009)	(0.0010)	(0.0009)	(0.0011)	(0.0008)	(0.0013)	(0.0009)	(0.0011)	(0.0009)	(0.0009)	(0.0005)
Own Cell												
Precipitation	0.0008	0.0010	0.0008	0.0008	0.0007	0.0009	0.0009	0.0010	-0.0012	-0.0003	0.0005	0.0004
	(0.0010)	(0.0007)	(0.0011)	(0.0007)	(0.0009)	(0.0006)	(0.0009)	(0.0007)	(0.0011)	(0.0007)	(0.0006)	(0.0003)
Nearest Neighbor												
Precipitation + Precipitation × Pastoral	-0.0034	-0.0014	-0.0018	-0.0003	-0.0036	-0.0024	-0.0028	-0.0013	-0.0008	0.0013	-0.0012	-0.0005
p-value	0.008	0.461	0.149	0.864	0.002	0.065	0.019	0.514	0.425	0.393	0.080	0.679
Impact (%):												
Neighbor Precipitation (SD)	-14.6	-7.2	-13.5	-0.4	-20.8	-12.7	-6.4	0.0	-10.9	0.6	-11.0	-4.1
× Pastoral	-1.7	0.6	0.6	-2.1	-4.4	-4.3	-10.1	-7.8	4.8	9.4	-26.5	-12.2
Mean dep. var.	0.036	0.041	0.027	0.029	0.021	0.025	0.025	0.029	0.028	0.029	0.006	0.007
Sample: Pastoral variable > 0	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
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	50609	61370	50609	61370	50609	61370	50609	61370	50609	61370	50609	61370

Note: All outcome variables measure conflict incidence at the level of a cell-year. ACLED 1(Conflict) indicates at least one violent conflict event in a cell-year. The two *Event* outcomes are mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. The following three outcomes are not mutually exclusive. They indicate respectively conflict incidence involving *State Forces*, *Internal Forces* not including the state, and *External Forces* involving state and non-state forces acting outside of their main country of operation, including mercenaries. *Own Group* refers to the ethnic society that contains cell i. *Nearest Neighbor* refers to the nearest neighboring ethnic society to cell i. *Nomad* indicates that an ethnic society is nomadic. *Precipitation* is annual ground precipitation measured in centimeters. 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 A14: Effect of Neighbor's Rainfall when Neighbor is Nomadic: With Country-Year FE, Additional Covariates and Using ACLED Conflict Data

	ACLED 1(Conflict)		*Event: Battle*		*Event: Attack*		*State Forces*		*Internal Forces*		*External Forces*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Nearest Neighbor												
Precipitation	0.0012*	0.0015**	0.0004	0.0006	0.0011**	0.0014**	0.0008	0.0010*	0.0014**	0.0016***	0.0002	0.0002
	(0.0006)	(0.0007)	(0.0005)	(0.0005)	(0.0005)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0002)	(0.0002)
Precipitation × Nomad	-0.0024***	-0.0025*	-0.0020**	-0.0034**	-0.0020**	-0.0010	-0.0017*	-0.0010	-0.0016**	-0.0028**	-0.0014***	-0.0014*
	(0.0008)	(0.0014)	(0.0008)	(0.0013)	(0.0008)	(0.0014)	(0.0009)	(0.0013)	(0.0008)	(0.0014)	(0.0005)	(0.0008)
Own Group												
Precipitation	0.0006	0.0005	0.0009***	0.0007**	0.0004	0.0004	0.0004	0.0003	0.0007*	0.0006	0.0002	0.0002
	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0004)	(0.0004)	(0.0002)	(0.0002)
Precipitation × Nomad	0.0006		-0.0004		0.0006		-0.0005		0.0013		-0.0010	
	(0.0012)		(0.0011)		(0.0010)		(0.0012)		(0.0011)		(0.0008)	
Own Cell												
Precipitation	-0.0005	-0.0006*	-0.0004	-0.0004	-0.0003	-0.0004	-0.0004	-0.0005	-0.0003	-0.0003	-0.0000	-0.0000
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0002)	(0.0002)
Precipitation × Nomad	-0.0000		0.0005		-0.0001		0.0004		-0.0015		0.0004	
	(0.0010)		(0.0010)		(0.0009)		(0.0008)		(0.0010)		(0.0005)	
Additional Controls												
Neighbor Precipitation × Jurisdictional Hierarchy	-0.0004	-0.0004*	-0.0001	-0.0001	-0.0005**	-0.0005**	-0.0001	-0.0002	-0.0004**	-0.0005**	-0.0000	0.0000
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0001)
Year × Neighbor Nomad	0.0003	-0.0001	0.0005	0.0003	-0.0000	-0.0002	0.0001	-0.0013	0.0003	0.0013	-0.0003	0.0001
	(0.0005)	(0.0013)	(0.0004)	(0.0011)	(0.0004)	(0.0009)	(0.0005)	(0.0012)	(0.0005)	(0.0012)	(0.0002)	(0.0005)
Nearest Neighbor												
Precipitation + Precipitation × Nomad	-0.0012	-0.0010	-0.0016	-0.0028	-0.0009	0.0004	-0.0009	-0.0001	-0.0002	-0.0012	-0.0012	-0.0012
p-value	0.147	0.462	0.032	0.028	0.333	0.781	0.295	0.960	0.776	0.429	0.024	0.129
Impact (%):												
Neighbor Precipitation (SD)	5.6	7.0	2.8	4.4	7.9	9.8	4.8	5.7	10.4	12.2	6.8	5.4
× Nomad	-11.3	-11.9	-14.6	-25.1	-13.9	-7.2	-10.0	-6.1	-12.0	-20.9	-45.3	-44.2
Mean dep. var.	0.064	0.081	0.042	0.051	0.042	0.054	0.049	0.063	0.041	0.049	0.009	0.011
Sample: Nomad = 0	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
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	124780	77180	124780	77180	124780	77180	124780	77180	124780	77180	124780	77180

Note: All outcome variables measure conflict incidence at the level of a cell-year. ACLED 1(Conflict) indicates at least one violent conflict event in a cell-year. The two *Event* outcomes are mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. The following three outcomes are not mutually exclusive. They indicate respectively conflict incidence involving *State Forces*, *Internal Forces* not including the state, and *External Forces* involving state and non-state forces acting outside of their main country of operation, including mercenaries. *Own Group* refers to the ethnic society that contains cell i. *Nearest Neighbor* refers to the nearest neighboring ethnic society to cell i. *Nomad* indicates that an ethnic society is nomadic. *Precipitation* is annual ground precipitation measured in centimeters. 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 A15: Effect of Neighbor's Rainfall when Neighbor is a Herder: With Country-Year FE, Additional Covariates and Using ACLED Conflict Data

	ACLED 1(Conflict)		*Event: Battle*		*Event: Attack*		*State Forces*		*Internal Forces*		*External Forces*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Nearest Neighbor												
Precipitation	0.0010	0.0014**	0.0002	0.0005	0.0010*	0.0014**	0.0007	0.0009	0.0012**	0.0015***	0.0001	0.0001
	(0.0006)	(0.0006)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0002)	(0.0002)
Precipitation × Herder	-0.0038***	-0.0042**	-0.0031**	-0.0053***	-0.0029***	-0.0015	-0.0030**	-0.0026	-0.0021*	-0.0037*	-0.0022***	-0.0019*
	(0.0011)	(0.0019)	(0.0012)	(0.0019)	(0.0011)	(0.0016)	(0.0013)	(0.0019)	(0.0012)	(0.0022)	(0.0007)	(0.0010)
Own Group												
Precipitation	0.0006	0.0005	0.0009***	0.0007**	0.0003	0.0004	0.0005	0.0003	0.0007	0.0006	0.0002	0.0002
	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0004)	(0.0004)	(0.0002)	(0.0002)
Precipitation × Herder	0.0016		-0.0011		0.0023		-0.0012		0.0020		-0.0012	
	(0.0018)		(0.0017)		(0.0017)		(0.0019)		(0.0019)		(0.0011)	
Own Cell												
Precipitation	-0.0005	-0.0006*	-0.0004	-0.0004	-0.0002	-0.0004	-0.0004	-0.0004	-0.0002	-0.0003	-0.0000	-0.0001
	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0002)	(0.0001)
Precipitation × Herder	-0.0007		0.0007		-0.0013		0.0008		-0.0030*		0.0005	
	(0.0016)		(0.0017)		(0.0014)		(0.0012)		(0.0017)		(0.0008)	
Additional Controls												
Neighbor Precipitation × Jurisdictional Hierarchy	-0.0003	-0.0004	-0.0000	-0.0001	-0.0004*	-0.0005**	-0.0001	-0.0002	-0.0003*	-0.0004**	0.0000	0.0000
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0001)
Year × Neighbor Herder	0.0006	-0.0007	0.0007	-0.0004	0.0001	-0.0004	0.0006	-0.0019	0.0001	0.0010	-0.0002	0.0005
	(0.0008)	(0.0018)	(0.0007)	(0.0016)	(0.0006)	(0.0012)	(0.0007)	(0.0016)	(0.0007)	(0.0015)	(0.0003)	(0.0007)
Nearest Neighbor												
Precipitation + Precipitation × Herder	-0.0028	-0.0028	-0.0029	-0.0049	-0.0019	-0.0002	-0.0023	-0.0016	-0.0009	-0.0023	-0.0021	-0.0018
p-value	0.017	0.148	0.017	0.010	0.110	0.916	0.085	0.379	0.466	0.313	0.008	0.080
Impact (%):												
Neighbor Precipitation (SD)	4.7	6.7	1.7	3.5	6.7	9.6	4.1	5.5	9.3	11.1	3.2	3.7
× Herder	-18.3	-19.9	-22.9	-39.2	-20.2	-10.8	-17.6	-15.2	-16.0	-28.0	-70.5	-61.6
Mean dep. var.	0.064	0.079	0.042	0.050	0.042	0.053	0.049	0.062	0.041	0.048	0.009	0.011
Sample: Herder = 0	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
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	124763	79781	124763	79781	124763	79781	124763	79781	124763	79781	124763	79781

Note: All outcome variables measure conflict incidence at the level of a cell-year. ACLED 1(Conflict) indicates at least one violent conflict event in a cell-year. The two *Event* outcomes are mutually exclusive subcategories: *Battle* indicates at least one two-sided conflict event; *Attack* indicates at least one one-sided conflict event. The following three outcomes are not mutually exclusive. They indicate respectively conflict incidence involving *State Forces*, *Internal Forces* not including the state, and *External Forces* involving state and non-state forces acting outside of their main country of operation, including mercenaries. *Own Group* refers to the ethnic society that contains cell i. *Nearest Neighbor* refers to the nearest neighboring ethnic society to cell i. *Herder* measures the intensity of nomadic pastoralism in an ethnic group from 0-1. *Precipitation* is annual ground precipitation measured in centimeters. 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.