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in Different Institutional Contexts (CC2C)

Drought, Kinship, and Conflict in West Africa

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Chiara Livorno† Luca Tiberti‡

Abstract

Weather shocks are frequently associated with heightened violence in agro-pastoral regions, yet the social processes linking weather-induced livelihood pressure to conflict remain insufficiently understood. This study examines whether spatial configurations of community lineages are associated with variation in community-level conflict responses to localized drought shocks. Across West Africa (1997–2022), we combine spatial panel data on drought exposure, conflict events, and the ancestral geography of lineage ties. We find that, conditional on ancestrally connected locations remaining climatically unaffected, drought exposure is associated with a 20-percentage-point lower predicted conflict incidence in clusters embedded in extended lineage networks relative to otherwise comparable clusters with more localized lineage structures. These patterns are consistent with a mechanism whereby social and institutional linkages formed across space condition access to nonlocal support and mobility-based adaptive capacity when climatic conditions deteriorate locally but not covariately. Complementary household panel data from Mali (2018–2021) show that households linked to spatially extended lineage networks experience smaller contractions in annual food expenditures and family remittance inflows following drought shocks. Overall, the findings highlight how historically constituted institutions connecting households across space are associated with differential responses to localized weather shocks in contexts where formal protection remains limited.

Keywords: Extended kinship, informal risk-sharing, conflict, weather shocks, Western Africa.

JEL codes: Q54; Z13; D74; N47; O13.

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1 Introduction

In fragile settings where institutions are weak and contested, and rural livelihoods rely heavily on rainfed agriculture, increasingly frequent extreme weather events are widely viewed as heightening vulnerability to violent conflict (Koubi, 2019). Although climatic stress rarely produces violence on its own, it can interact with existing tensions and patterns of political marginalization. Yet we know comparatively little about how locally embedded institutions, shaped by long-run spatial and historical settlement patterns, are associated with differences in this relationship. In this paper, we study whether drought is differentially associated with local instability across areas characterized by varying degrees of spatial dispersion in extended-family networks and by differences in whether geographically connected locations are simultaneously exposed to the same shock. Building on the conceptualization of long-distance relationships by Pisor and Ross (2022), we hypothesize that spatially dispersed kin ties may create opportunities for risk management and access to non-local resources when drought shocks compress local incomes but do not simultaneously affect geographically connected locations, which may be associated with lower levels of local instability as mobility and resource flows across connected areas are linked to reduced resource pressures in the drought-affected location. Our empirical setting is West Africa, a region where climatic variability intersects with weak formal institutions and overlapping farming and herding livelihoods, and where historically fragile forms of coexistence have been shaped by long-standing political-economy and resource-governance dynamics (Allouche et al., 2024; Bassett, 1988; Benjaminsen and Ba, 2018, 2021; Eboreime et al., 2025; Ejiofor, 2022; Nwankwo and Okafor, 2022). These features make the region an ideal context in which to test the proposed mechanism.

To study this relationship empirically, we combine geocoded information on drought, conflict, and the ancestral spatial extent of kinship systems into a two-level empirical strategy. At the aggregate level, we conduct a cell-based analysis that matches conflict events and growing-season drought episodes with indicators of ancestral kinship systems across West Africa between 1997 and 2022. Local drought captures severe to extremely dry events during the main crop agricultural season, while conflict refers to violence measured within the same agricultural year of the cell's main crop. Each cell inherits its lineage classification based on the dominant population historically associated with that territory, ensuring that this assignment is not itself affected by temporary conflict. An ancestral territory consists of multiple cells, each experiencing its own drought conditions, depending on the main crop being cultivated. This structure allows us to construct three cell-level measures anchored in the same ancestral territory: (i) whether the focal cell experiences a growing-season drought; (ii) whether the corresponding kinship system is traditionally organized through lineages that span multiple communities (extended kinship) or localized to the single community; and (iii) the share of ancestral cells not affected by the same drought episode. Together, these components generate the cross-locality variation underlying our empirical interaction between local drought, the spatial reach of kinship systems, and the availability of climatically unaffected connected territories within the same ancestral domain.[1]

Figure 1 illustrates the core intuition behind our empirical strategy, using a given ancestral territory as an example and displaying weather conditions across all grid cells within that territory in a given year. Within an ancestral homeland, drought exposure can vary substantially across space: a focal location may experience a localized drought shock (red cell), while other locations are either affected (orange cells) or unaffected (green cells). Homelands also differ in whether they are embedded in ancestrally extended kinship configurations, i.e., lineage-based institutional linkages that connect multiple settlements across space. The figure shows how uneven drought exposure across cells and differences in the spatial reach of kinship systems jointly generate the identifying variation in our empirical design. By interacting localized drought shocks with the spatial organization of lineage systems and the share of locations within the same homeland that are not simultaneously affected, we examine whether conflict risk under drought conditions varies systematically with spatially extended kinship.

[1] Although we define extended kinship at the territorial level, ancestrally inhabited by a specific population, we do not treat it as a cultural trait. Rather, we conceptualize extended kinship as a particular spatial configuration that, under certain conditions, may be associated with risk-sharing across geographically dispersed communities.

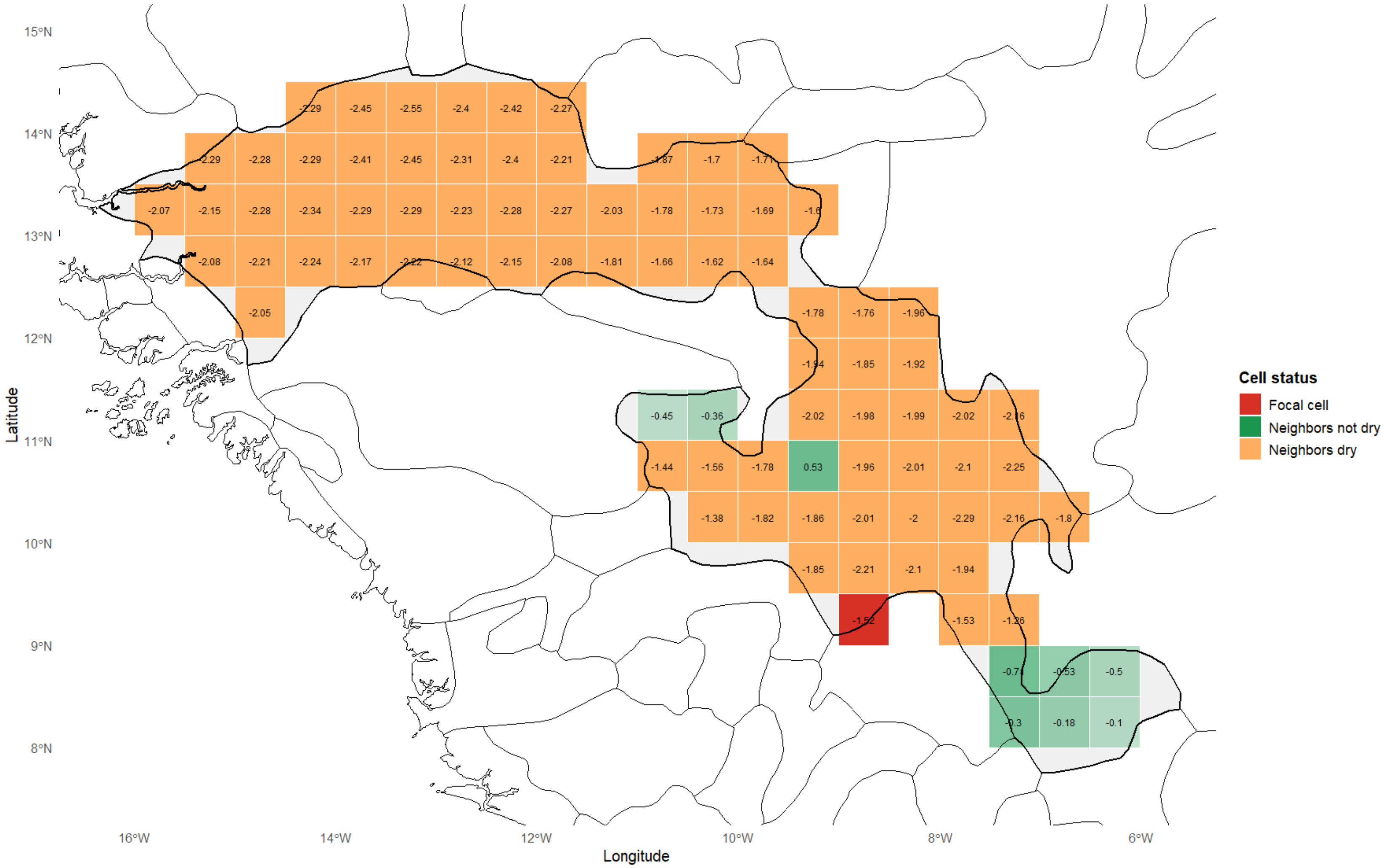

Figure 1: *Illustration of the Mechanism*

Notes: This figure illustrates the construction of the *No Neighbor Dry* variable for a focal grid cell (shown in red) that experiences severe drought in year 2002 and belongs to a given ancestral territory (delineated by the thicker black boundary). Each grid cell is labeled with the value of the Standardized Precipitation-Evapotranspiration Index (SPEI) measured over its main crop growing season. Orange cells denote other locations in the same ancestral territory experiencing at least moderate drought (SPEI < -1.0), while green cells indicate locations that are not in drought. Drought for the focal cell is defined using a stricter threshold (SPEI < -1.5). The *No Neighbor Dry* measure for the focal cell is computed as a weighted share of neighboring cells within the same ancestral territory that are not in drought. Weights are based on geographic proximity and are visually reflected in the transparency of green cells: darker shades indicate greater spatial weight (i.e., closer proximity) to the focal cell.

Sources: Ancestral map (Murdock, 1959) over SPEI grid and values (Vicente-Serrano et al., 2023), computed over cell-specific main crop growing seasons as defined in Tollefsen et al. (2012).

At the aggregate level, we document that when growing-season drought affects a locality while other ancestrally connected locations remain unaffected, the probability of conflict is approximately 20 percentage points lower in clusters embedded in spatially extended lineage-based network configurations, relative to clusters characterized by more spatially localized configurations. We interpret this finding as reflecting access to nonlocal resources or temporary migration facilitated by lineage ties across different localities to unaffected areas, which reduces resource-use pressure in the affected cell. A series of complementary tests supports this interpretation. First, timing matters: the association emerges for growing-season drought, when agricultural incomes are directly affected, but disappears when using pre-season drought as a placebo. Second, replacing the share of ancestrally connected locations unaffected by drought with a measure of geographic proximity alone, constructed without conditioning on shared ancestry, yields no comparable pattern, suggesting that the results are not driven by generic spatial spillovers. Third, because transhumant pastoral populations are fully embedded within spatially extended kinship systems in our data, we extend the main specification to account explicitly for pastoral mobility. Both the coefficient associated with spatially extended lineage networks and the measure of transhumant pastoralism remain statistically significant. This indicates that the documented relationship is compatible with mobile livelihoods, while not being fully accounted for by pastoral mobility alone. At the same time, this pattern raises the concern that the observed decline in conflict in the drought-affected cell may reflect displacement rather than an overall reduction in conflict risk, with violence potentially shifting to surrounding areas, as documented in other research. However, we find no evidence of such spatial spillovers. Instead, when localized drought occurs while other ancestrally connected locations remain unaffected, conflict declines both in the affected cell and in surrounding areas, consistent with localized de-escalation rather than displacement.

At the micro level, we complement the aggregate analysis with household survey data from Mali. We draw on the 2018–2019 and 2021–2022 rounds of the nationally representative *Enquête Harmonisée sur les Conditions de Vie des Ménages* (EHCVM) (Institut National de la Statistique, 2022a,b), which includes retrospective modules on transfers received from former co-resident family members located within the same country or abroad. We focus on households exposed to the 2017 growing-season drought, which severely affected southern provinces of Mali, including Kayes, Koulikoro, and Sikasso. The household-level evidence is consistent with the aggregate results. Descriptively, households embedded in spatially extended kinship networks are more likely to receive transfers and to receive them from more geographically distant locations. Regression estimates indicate that although drought exposure is associated with overall declines in remittance inflows and food expenditures, consistent with strains in informal insurance arrangements, households linked to spatially extended kinship networks experience significantly smaller contractions in both annual food expenditures and informal transfer inflows.

Our paper speaks to two main strands of work. First, it contributes to the literature examining the links between climate variability, resource pressure, and conflict in vulnerable settings. A growing body of research highlights distinct yet complementary channels through which weather shocks are associated with heightened violence. Eberle et al. (2025) show that localized increases in temperature intensify competition over land use in areas where farmers and herders coexist, thereby increasing the likelihood of conflict. McGuirk and Nunn (2025) document that rainfall scarcity in the homelands of transhumant pastoralists prompts earlier migration toward agricultural areas, disrupting seasonal cooperation with farmers and giving rise to tensions related to crop damage. Importantly, they also show that these effects are attenuated in settings where pastoralist actors are embedded in stronger political institutions, underscoring the role of institutional constraints in shaping the climate–violence relationship. Other recent work emphasizes that, in fully pastoral contexts, weather shocks may operate through different mechanisms linked to mobility and changing incentives. In particular, negative shocks that lead to pasture scarcity increase conflict during dry seasons,[2] while positive shocks that generate pasture abundance fuel conflict in subsequent rainy seasons (Jensen et al., 2025).

Second, we build on a large body of work in development economics and anthropology on informal risk-sharing and institutions. This literature shows that extended-family arrangements and local networks provide crucial insurance in settings where formal mechanisms are limited (Cashdan, 1990; Cochrane, 1991; Townsend, 1994). Such arrangements are sustained by norms of reciprocity and repeated interactions (Cox and Fafchamps, 2008; Fafchamps, 1992), which transform short-term transfers into intertemporal insurance mechanisms, whereby individuals provide support today in anticipation of future assistance under adverse conditions. Support may take multiple forms, including agricultural labour exchanges, cash and food transfers, herd restocking, and the provision of productive inputs. Empirical studies further document that informal contracts adjust to shocks through different margins, such as changes in repayment amounts (Udry, 1994) or repayment delays following borrower shocks (Fafchamps and Gubert, 2007). Yet, informal networks insure idiosyncratic shocks more effectively than covariate ones (Fafchamps and Shrinivas, 2024; Paumgarten et al., 2020; Trærup, 2012), highlighting the importance of spatially dispersed intrafamily transfers (Rosenzweig, 1988). Spatial dispersion, however, increases association and extraction costs (Munshi and Rosenzweig, 2009), underscoring the central role of trust (Murgai et al., 2002) and helping explain why informal risk-sharing networks may endogenously form along kinship and close friendship ties (Weerdt, 2002; Fafchamps and Lund, 2003).

At the same time, anthropological research at a very local scale shows that cooperation within networks is often selective and shaped by internal preferences. Kinship ties do not uniformly sustain solidarity: close consanguines may compete over land, inheritance, and marriage payments, limiting support within lineages and sometimes generating open conflict, frequently resolved through local courts (Borgerhoff Mulder, 2007). In such settings, individuals may strategically redirect cooperation toward affinal ties, which can provide support while avoiding the intensified competition characteristic of close kin relations (Kasper and Borgerhoff Mulder,

[2]In this context, conflict refers to the probability that a pastoral household reports experiencing livestock raiding. This form of violence differs from farmer–herder land encroachment and related conflicts studied in settings characterized by mixed agricultural and pastoral land use, such as those examined by Eberle et al. (2025) and McGuirk and Nunn (2025).

2015). Strategic transfers are also documented by studies showing that resource flows often serve coalition-building purposes rather than purely insurance motives. In ecologically abundant settings such as Conambo, Patton (2005) documents that transfers are less oriented toward insurance against scarcity and instead function strategically to sustain political alliances and social influence.

In particular, we draw on the concept of long-distance relationships (LDRs) developed by Pisor and Ross (2022). They distinguish LDRs, which connect geographically separated members of the same social group, from intergroup relationships (IGRs) that cross ethnic or religious boundaries. LDRs are particularly valuable for accessing nonlocal resources (Pisor and Jones, 2020). Among the Tsimane' in Bolivia, historical marginalization and dispersed settlement patterns combined with low population density have meant that long-distance relationships primarily connect co-ethnics through visitation, migration, and marriage. By contrast, in Mosetén and Interculturales communities, both LDRs and IGRs are prevalent and jointly facilitate seasonal labor migration and resource sharing (Pisor and Ross, 2022). Among Tanzania fishers, Pisor et al. (2023) show that LDRs can facilitate coordination over water use, though they may sometimes undermine local cooperation when leveraged for private benefit. Consistent with this perspective, earlier evidence shows that long-distance ties often form along within-group lines: Rosenzweig and Stark (1989) document that long-distance kinship created through marriage facilitates consumption smoothing in South India, while Grimard (1997) finds suggestive evidence that risk-sharing networks may operate along shared ethnic ties, particularly in regions with limited access to formal financial markets.

Within this broader literature, we also engage with work on institutionalized lineage-based arrangements intrinsically connected to resource use. Segmentary lineage (SL) systems are a prominent example. Although their historical emergence is likely multi-causal, early scholarship argues that environmental risk and the need to secure access nonlocal resources contributed shape their function by generating incentives for cooperation and reciprocity across kin-based units (Evans-Pritchard, 1940; Gluckman, 1955, 1963). SL systems can segment or unify depending on context, coordinating internal mediation while enabling collective action against external threats, particularly when access to spatially dispersed resources, such as seasonally flooded areas, creates risks of encroachment and confrontation with unfamiliar groups. This dual capacity helps explain why SL institutions, which are not exclusive to pastoralist societies, have been found to exhibit stronger conflict responses following adverse rainfall shocks (Moscona et al., 2020). This association does not imply that such social structures are inherently conflict-prone; rather, it reflects the historically embedded mobilization mechanisms that can be activated under ecological stress. Similar patterns of historical co-adaptation between social institutions and ecological constraints emerge in other pastoralist contexts. In Ethiopia, for instance, cattle-sharing partnerships have been shown to operate along clan lines, which may reflect both social affinity and efforts to maintain collective strength in contexts of competition over water resources (Santos and Barrett, 2011).

Building on these foundations, we ask whether spatially extended kinship structures are associated with systematic differences in conflict incidence under localized drought exposure when combined with heterogeneous shock exposure within the same homeland. Areas embedded in ancestrally dispersed lineage configurations may be better positioned to cope with localized shocks by drawing on kin-based resources located in less-affected areas, potentially reducing the likelihood of local conflict.

The remainder of the paper is organized as follows. Section 2 describes the data sources and the construction of our dataset, including the definitions of key variables. Section 3 presents the main results and a series of robustness checks. Section 4 turns to household-level evidence from Mali to provide suggestive support for the proposed mechanism. Section 5 concludes with a discussion of the findings and their limitations.

2 Data and Methods

2.1 Grid Level

2.1.1 Data Sources

Climate and Agricultural Data Our core unit of analysis is a 0.5° × 0.5° grid cell, reconstructed from the Standardized Precipitation-Evapotranspiration Index (SPEI) (Beguería et al., 2014) dataset to ensure spatial consistency and full replicability. The SPEIbase dataset is derived from gridded climate variables interpolated from global weather stations (CRU TS 4.08) and relies on the FAO-56 Penman–Monteith method for PET calculation (Beguería et al., 2014). For each cell–year, we extract the SPEI over the main crop growing season. We take main crop per cell and related growing season from PRIO-GRID (Tollefsen et al., 2012), which defines the main crop using Monfreda et al. (2008) and identifies the crop-specific growing periods from MIRCA2000 (Portmann et al., 2010).[3] Local drought events are identified when the growing-season SPEI falls below –1.5, corresponding to severe or extreme drought conditions. To characterize exposure within the broader ancestral territory, we classify neighboring ancestrally connected cells as "climatically safe" when their growing-season SPEI does not fall below –1.0 (i.e., no meaningful drought stress) and does not exceed +2, a value associated with high flood probability.

To validate the underlying mechanism linking drought exposure to vegetation stress, we complement climate data with satellite-based measures of vegetation conditions. Specifically, we use the Normalized Difference Vegetation Index (NDVI) derived from the MODIS MOD13Q1 product, a NASA-produced, atmospherically corrected vegetation index available at 250 m spatial resolution and 16-day temporal frequency from

[3]The SPEI grid is already aligned to the PRIO-GRID grid in terms of spatial resolution and cell boundaries.

February 2000 until today (Didan, 2015). We aggregate these data at the cell level and compute growing-season averages for each cell, aligning the measure temporally with the localized drought exposure.

Conflict Data Conflict data are drawn from the Armed Conflict Location & Event Data (ACLED) over the period 1997–2022 (Raleigh et al., 2010). We retain battles, riots and violence against civilians, and then disaggregate between state and non-state actors. We rely on binary indicators of event occurrence rather than counts or fatalities, as this approach minimizes the risk of double-counting events that may be reported multiple times. We choose to rely on the ACLED dataset because it offers high external validity, does not restrict its scope to predefined conflict types or fatality thresholds, and adopts a dynamic and inclusive approach that captures a broader range of political violence, including low-intensity and non-lethal events that are often underreported (Raleigh et al., 2023). ACLED also integrates diverse sources in multiple languages and prioritizes local media and in-country networks, ensuring better coverage in contexts where traditional or international media are limited or biased. This approach allows us to more accurately measure localized conflicts.

Ethnographic Map and Data Grid cells are assigned to ancestral territories using the Ethnographic Map of Africa (Murdock, 1959), which delineates non-overlapping ethnographic homelands. Unlike more recent sources such as Geo-Referencing Ethnic Groups (GREG) Weidmann et al. (2010), Murdock's map does not split territories across distant locations or allow for overlapping boundaries, making it particularly well suited for constructing ancestry-based spatial lags. Although the map predates recent demographic shifts, prior validations suggest moderate spatial stability in settlement patterns (e.g., Nunn and Wantchekon 2011 report a 0.55 correlation between Murdock-based assignments and self-reported ethnicities from the 2005 Afrobarometer for selected countries). Moreover, because the map reflects pre-colonial territorial structures, it is less likely to be endogenous to contemporary conflict dynamics (Eberle et al., 2025) or recent climatic conditions.

Through the concordance developed by Kincaide et al. (2020), we match each homeland to societies in the Ethnographic Atlas (EA) (Murdock, 1967) and classify lineage organization at the territorial level. Variables v17 and v19 from the EA describe, respectively, the largest patrilineal and matrilineal kin groups recorded for each society. These variables indicate whether kinship organization takes the form of lineage groups confined to a single local community or of larger groups, such as clans or phratries, that extend across multiple settlements. Our interest lies exclusively in the spatial extent of kinship organization, rather than in kinship reliance per se. Accordingly, we classify territories as having extended kinship only when the EA provides explicit evidence that either patrilineal or matrilineal kin groups span multiple communities. Cells are classified as having localized kinship only when both variables indicate that lineage groups are confined to a single community. Crucially, societies for which the EA reports either no organized kin groups ("none") or missing information for both patrilineal and matrilineal kin are coded as missing rather than as having localized kinship. In these cases, the absence of information does not allow us to determine whether kinship ties are spatially localized or extended across communities. Coding these as missing avoids conflating the absence of beyond-community lineage organization with the absence of historical information. The spatial distribution of ancestral extended kinship is illustrated in Figure 4.

Other Data First, we use annual gridded maps of global land cover at 300m resolution from Copernicus Climate Change Service (2019). For each grid cell, we construct time-invariant measures of agricultural and pastoral land use based on the share of land covered by relevant land-cover classes. Agricultural use is defined using rainfed cropland, irrigated cropland, mosaic cropland, and mosaic natural vegetation classes, while pastoral use is defined using mosaic herbaceous cover, shrubland, grassland, and sparse vegetation classes. Grid cells are classified into mutually exclusive land-use categories based on their position in the cross-sectional distribution of agricultural and pastoral cover. Crop-farming cells are those with agricultural cover above the sample median and pastoral cover below the sample median. Pastoral cells are defined analogously. Mixed cells are those for which both agricultural and pastoral cover exceed the 25th percentile of their respective distributions. In our West African sample, using the 25th percentile rather than the median avoids excluding large areas characterized by substantial pastoral land cover.[4]

We also incorporate an indicator of segmentary lineage organization obtained from the replication package of McGuirk and Nunn (2025). Finally, cell-level Köppen–Geiger climate classifications (e.g., semi-arid, savannah, humid) from high-resolution maps by Beck et al. (2018) are shown in the descriptive statistics.

2.1.2 The Dataset

Table A1 reports how the final sample is constructed. We begin from the 0.5° × 0.5° spatial grid underlying the Standardized Precipitation–Evapotranspiration Index (SPEI) and restrict it to cells with an observed main crop growing season, which forms the backbone of our analysis (Figure 2). For each grid cell, we identify the main crop and its corresponding growing season using MIRCA2000-based crop calendars, thereby constructing a cell-specific agricultural calendar that remains fixed over time. Drought exposure is measured annually by computing the SPEI over the growing-season months relevant for each cell, while conflict outcomes are aligned to the same agricultural calendar rather than to the calendar year (Figure 3). As growing seasons differ markedly across space (Table A2), aligning both drought exposure and conflict outcomes to a cell-specific agricultural year ensures that timing is defined relative to local livelihood cycles. This alignment is central to our empirical strategy, as the mechanism of interest operates once agricultural output has materialized, or failed to do so, during the harvest and post-harvest period. Alternative approaches based on calendar-year conflict measures and lagged drought exposure would impose strong assumptions about delayed responses

[4]Related work adopts different strategies to address potential endogeneity to conflict. For example, McGuirk and Nunn (2025) rely on maps of exogenous agricultural suitability, while Eberle et al. (2025) fix land use to a pre-determined year (2009). In contrast, our land-use classification is based on observed land cover and is therefore potentially endogenous to conflict dynamics. However, land-use variables are used exclusively for heterogeneity analysis rather than as primary explanatory variables in the main specification, mitigating concerns about bias in our core estimates.

and may obscure effects operating during or shortly after the growing season. Finally, we do not rely on monthly data in the main specification because our drought measure captures cumulative climatic conditions over the entire growing season, which typically spans several months.

To ensure conceptual consistency with the climate measure, for each grid cell and agricultural year we compute growing-season NDVI as the average of monthly NDVI values observed within the cell during its corresponding growing-season window. This procedure ensures that NDVI captures vegetation conditions over the same agricultural period used to measure drought exposure.

Each grid cell is assigned to a single country and a single ancestral territory based on the largest area of spatial overlap. This predominance rule is a common compromise when artificial spatial units must be linked to overlapping political or ethnographic boundaries. Unlike approaches that assign cells based on their centroid, using the largest area of overlap provides a closer alignment with the territorial extent of interest, particularly in fragmented regions. As a result, interpretations should be understood as referring to areas predominantly affiliated with a given territory, rather than to exclusive population presence. In robustness checks, we exclude cells intersecting multiple borders.

Other factors also make border cells problematic. For example, border cells may contain events originating in one country (e.g., a conflict event coded as occurring in Mauritania) but be assigned to a neighboring country (e.g., Mali) based on the predominance rule. To gauge the extent of potential misclassification, we compare, for each event, the country implied by its ACLED event ID prefix (e.g., "MAA" for Mauritania) with the country assigned to the grid cell in which the event falls. We identify 2,258 events (3.40 percent of the sample) where the two do not match and flag all grid cells in which such mismatches occur. In addition, we construct a more restrictive flag for grid cells containing at least one event whose combination of disorder type, event type, sub-event type, and actor interaction is unique within the cell-year and yet appears in a different country according to the event ID. This narrower criterion captures 719 events, or 1.08 percent of the sample. One clear coding error, an event from Mauritania assigned to Niger due to an incorrect longitude, was corrected manually. The remaining mismatches mostly occur in cells intersecting national borders. Rather than attempting to reassign all such events based on locality names, an approach that risks introducing additional errors, we adopt a conservative strategy and remove these from robustness checks.

An alternative approach would be to rely on administrative boundaries (e.g., ADM1 or ADM2) to avoid mismatches between conflict events and political units. However, administrative borders may have changed over the 1997-–2022 period, making it difficult to construct a consistent panel over time. More importantly, administrative units do not resolve a key limitation: when climatic variables are averaged over large and heterogeneous areas, they tend to smooth localized shocks. Such aggregation may attenuate the observed variation in weather shocks and potentially bias estimates downward, particularly in larger units. In contrast, a grid-based approach spatial resolution of the climatic data and allows for a more precise identification of localized shocks across space, albeit with some unavoidable degree of misclassification, which we address in robustness checks.

2.1.3 Descriptive Statistics at the Grid Level

Given the structure of the dataset described above, our analysis combines variables measured at three distinct levels. First, we observe time-invariant cell-level characteristics, including the main-crop growing season, land-use, and the assignment of cells to countries and ancestral territories. Second, we observe cell–year–level variables that vary over time within grid cells, such as drought exposure and conflict incidence. Third, we observe characteristics defined at the ancestral-territory level (i.e., polygons comprising multiple grid cells), such as the presence of extended kinship structures.

Table A4 summarizes descriptive statistics across these levels. Panel A reports balance tests at the homeland level across groups classified by extended kinship. Homelands exhibiting extended kinship are broadly comparable to other homelands along some observable historical characteristics drawn from the EA. Indicators of jurisdictional hierarchy beyond the local community and reliance on agriculture as the dominant livelihood do not differ systematically across the two sets of territories. At the same time, homelands associated with extended kinship display a significantly higher prevalence of segmentary lineage organization and are the only territories in which transhumant pastoralism is observed in our data. These patterns are consistent with pastoral mobile systems being organized around clan-based ties that extend across communities and space.

Panel B reports static cell-level characteristics. Grid cells associated with ancestral territories classified as exhibiting extended kinship are less likely to border another homeland. This pattern reflects differences in the spatial scale of ancestral territories. Because extended-kinship territories tend to be larger on average, they contain a higher share of interior grid cells that are less likely to border neighboring territories. These cells are also more frequently located in tropical savannah zones and less frequently in arid steppe or rainforest climates. This climatic distribution should not be overinterpreted, as it largely reflects sample selection. The analytical sample includes only grid cells in which a main crop is observed. As a result, large portions of the northern Sahel, falling in the Arid Desert Hot Köppen-Geiger classification of Beck et al. (2018), where extended kinship arrangements are historically prevalent, as shown in Figure 4, are excluded from the analysis. Consequently, areas associated with extended kinship appear more concentrated in savannah environments within the sample, even though their broader ecological range extends into more arid regions. Finally, cells associated with extended kinship are more likely to be located in areas primarily characterized by pastoral land use and less likely to be situated in areas dominated by crop cultivation or mixed farming systems.

Finally, Panel C summarizes cell–year–level characteristics over the period 1997–2022. Grid cells associated with ancestral territories classified as exhibiting extended kinship experience very similar average SPEI values compared to other cells, indicating no systematic differences in underlying climatic conditions. These cells exhibit a slightly higher probability of experiencing a local drought episode. However, conditional on drought occurrence, they are characterized by a significantly higher share of neighboring ancestrally connected cells that remain climatically unaffected. This spatial configuration generates the cross-locality variation exploited by our empirical strategy. Finally, conflict incidence is lower in cells associated with extended kinship across both categories of events, including those involving state actors and those involving non-state actors.

2.2 Household Level

Grid-level data do not allow for the direct observation of informal transfers, risk-sharing arrangements, or household-level coping responses. To provide more direct evidence on the mechanisms suggested by the aggregate analysis, we therefore complement the grid-based results with household panel data from the *Enquête Harmonisée sur les Conditions de Vie des Ménages* (EHCVM) for Mali. Mali constitutes a particularly suitable empirical setting because, over the period covered by the EHCVM, it exhibits substantial spatial heterogeneity in exposure to agricultural drought, measured using the SPEI over the main June–October rainy season, as well as meaningful variation in the ancestral spatial extent of community ties. The latter is reconstructed using household heads' and spouses' self-reported ethnicity, mapped to variables v17 and v19 of the EA, as described in Section 2.[5]

The Dataset We use the two waves (2018–2019 and 2021–2022) of the nationally representative EHCVM, which collect detailed information on demographics, livelihoods, assets, and retrospective informal assistance received from relatives within and outside Mali. These data offer three key advantages for our purposes. First, they allow us to observe the frequency and geographic origin of informal transfers. We focus on two forms of assistance, *soutien courant* (routine help) and *appui travaux champs* (support for farm labor), which capture general and seasonal economic support rather than ceremonial or other events. For each recorded transfer, the survey identifies the sender's relationship to the receiver, whether the sender previously lived in the household, and the sender's current location, which corresponds to the geographic origin of the transfer. The questionnaire classifies this location at several levels, including the household's village, the same administrative region, another location within Mali, West African countries, other African countries, and France. We restrict attention to transfers from close relatives, including spouses, children, parents, siblings, and extended family members, excluding non-kin contacts, which are comparatively rare. This restriction allows us to fo-

[5]This combination of variation is not present in all countries covered by the EHCVM. For instance, in Burkina Faso, self-reported ethnicities in the survey are overwhelmingly associated with ancestrally extended kinship configurations, limiting within-country variation along this dimension.

cus on kin-based ties, consistent with the concept of long-distance relationships as defined by Pisor and Ross (2022). Second, the survey is georeferenced, enabling us to measure household exposure to the 2017 growing-season drought using the SPEI and to relate this exposure to subsequent patterns of informal support. Third, the EHCVM records the self-reported ethnicity of both the household head and spouse(s), which we map to variables v17 and v19 from the EA using the Linked Ethnographic Data Architecture (LEDA) (Müller-Crepon et al., 2022) and the concordance of Kincaide et al. (2020).[6]

Descriptives Households ancestrally associated with extended kinship, hereafter EK households, differ from other households along several observable characteristics, as shown in Table A5. On average, EK households are larger in size, display higher employment ratios, cultivate larger land areas with greater crop diversity, own fewer livestock, and exhibit higher values on an asset-based wealth index.[7] EK households also display substantially higher rates of interethnic unions, consistent with the broader erosion of strict ethnic endogamy documented by Crespin-Boucaud (2020). Two descriptive regularities are particularly relevant for the mechanism. First, EK households exhibit a higher incidence of exposure to the 2017 drought, 13 percent versus 3 percent, reflecting the spatial distribution of the shock across southern Mali rather than an endogenous relationship between social organization and climatic conditions. Second, EK households display a markedly broader remittance structure. To quantify the spatial reach of kin-based assistance, we construct an ordinal distance measure assigning increasing values to transfers originating from the village, the same region, elsewhere in Mali, West African countries, other African countries, and France. Both the maximum and the mean of this distance measure are significantly higher for EK households, as is the total number of transfers received. While the incidence of local assistance is similar across households, EK households are somewhat more likely to receive support from relatives residing elsewhere in the country, although the difference is only marginally statistically significant. These differences indicate that EK households maintain more spatially dispersed support networks. They also exhibit comparatively higher levels of annual total, food, and non-food expenditures. Finally, simple mean comparisons show that non-EK households are more likely to receive formal social protection, including in-kind transfers and participation in public works programs, consistent with their comparatively lower socioeconomic profile.

[6] The mapping is summarized in Table A6. A household is classified as ancestrally associated with extended kinship if either the head or a spouse is linked to a lineage system that historically spanned multiple communities. This approach reflects the fact that informal transfers may flow through both the head's and the spouse's networks.

[7] The difference in livelihood specialization likely reflects survey composition. The EHCVM under-represents mobile populations and transhumant households, so contemporary livestock holdings are not directly comparable to those observed in the broader West African grid-level sample, where areas associated with extended kinship include nomadic populations. The EHCVM follows a standard cluster-based household survey design. In the 2021–2022 wave, enumerators revisited the same enumeration areas surveyed in 2018–2019. Within each cluster, previously interviewed households were re-contacted when found, and households that could not be located were replaced by other households residing in the same enumeration area. While this design ensures representativeness of the settled population over time, it necessarily limits the likelihood of including highly mobile households. As a result, mobile pastoralist and transhumant populations are likely to be under-represented, a limitation common to most large-scale household surveys and population censuses. For this reason, contemporary livelihood indicators in the survey should not be interpreted as contradicting ancestral livelihood classifications. To assess the contemporary relevance of livelihood specializations recorded in the EA, we validate these ancestral categories using the EHCVM in Mali. Results reported in Table A7 point to strong persistence. Households associated with ancestrally pastoral livelihoods today hold significantly larger livestock stocks, cultivate substantially less land, and exhibit lower crop diversification. Conversely, households associated with ancestrally agricultural livelihoods display higher crop diversification and lower livestock holdings. These patterns suggest that EA livelihood classifications capture persistent economic orientations.

2.3 Empirical Strategy

We construct an empirical specification designed to assess whether conflict incidence varies across specific institutional and spatial configurations defined by three jointly interacting elements: local drought exposure, the presence of extended kinship structures at the homeland level, and the availability of neighboring cells belonging to the same homeland not exposed to a drought shock. This specification is motivated by the idea that, in territories characterized by lineage systems spanning multiple communities, spatially heterogeneous exposure to weather shocks across connected areas may, all else equal, constitute a structural condition under which access to nonlocal support is faciliated. The model is specified as follows:

$$\begin{aligned} CONFLICT_{gect} = {} & \phi\, CONFLICT_{gect-1} + \beta_1\, Drought_{gt} \\ & + \beta_2\, W \cdot NoNeighborDry_{gt} + \theta_1\, Drought_{gt} \times W \cdot NoNeighborDry_{gt} \\ & + \gamma_1\, Drought_{gt} \times EK_e + \gamma_2\, W \cdot NoNeighborDry_{gt} \times EK_e \\ & + \boldsymbol{\theta_2\, Drought_{gt} \times W \cdot NoNeighborDry_{gt} \times EK_e} \\ & + \alpha_g + \delta_t + \varepsilon_{gect} \end{aligned}$$

Where $CONFLICT_{gect}$ is the conflict occurrence in grid cell g, homeland e, country c, and year t, with $CONFLICT_{gt-1}$ temporal lag. $Drought_{gt}$ is identified as SPEI ≤ -1.5 for the main crop's growing season in year t. $W \cdot NoNeighborDry_{gt}$ captures the share of neighboring grid cells within the same e that do not experience drought in t, row-standardized ($\sum W = 1$) and excluding self-weighting. Distance-decay weighting is applied: closer cells have more influence, based on the maximum observed distance between any pair of cells within the same e. EK_e is an indicator for extended kinship in homeland e. α_g, δ_t are grid cell and year fixed effects. ε_{gect} is the error term.

The coefficient of primary interest is θ_2, which captures the triple interaction between local drought exposure, the share of ancestrally connected grid cells not simultaneously affected by drought, and the presence of extended kinship structures at the ancestral-territory level. A negative and statistically significant estimate of θ_2 indicates that, conditional on experiencing a local drought, conflict incidence is lower in grid cells belonging to ancestral territories characterized by lineage systems spanning multiple communities as the share of ancestrally connected locations that are climatically unaffected increases. This interaction reflects a structural configuration rather than a behavioral response, since the realization of resource flows or temporary mobility between affected and unaffected areas is not directly observable at the grid-cell level. The triple interaction should therefore be interpreted as capturing the structural condition under which access to nonlocal support is more likely to be feasible. Accordingly, the coefficient is best interpreted as consistent with, rather than as direct evidence of, the proposed mechanism.

To operationalize one component of the triple interaction, namely, the availability of climatically unaffected connected cells, denoted by $NoNeighborDry_{gt}$, we proceed as follows. For each grid cell i, we identify the set of all other grid cells $j \neq i$ that belong to the same ancestral territory e. This ancestral connection is encoded in a binary adjacency matrix E, defined as:

$$E_{ij} = \begin{cases} 1 & \text{if grid cells } i \text{ and } j \text{ share the same ancestral territory } e \text{ and } i \neq j \\ 0 & \text{otherwise} \end{cases}$$

For each cell with $E_{ij} = 1$, within each e, we compute pairwise geographic distances between the centroids of these cells using the Haversine formula which we use to define inverse-distance weights, such that geographically closer cells within the same e receive more weight. Specifically, for each pair (i, j), the raw (unnormalized) weight is defined as:

$$w_{ij}^{\text{raw}} = \frac{1}{1 + \frac{d_{ij}}{D_{\max}}}$$

where d_{ij} is the great-circle distance between cells i and j, and $D_{\max}$ is the maximum observed distance between any pair of ancestrally connected grid cells across all ancestral territories e. These weights are then row-normalized to ensure that, for each cell i, the weights assigned to its e-linked neighbors sum to one:

$$w_{ij} = \frac{w_{ij}^{\text{raw}}}{\sum_{j \neq i} w_{ij}^{\text{raw}}}$$

where $\sum_{j \neq i} w_{ij} = 1$ and $w_{ij} > 0$ only if cells i and j belong to same e.

This procedure yields a row-standardized spatial weight matrix based on e relatedness and geographic proximity. Using these weights, we first construct a spatially lagged drought variable, $LagDrought_{it}$, defined as the weighted share of drought exposure among cell i's neighbors in year t:

$$LagDrought_i^t = \sum_{j \neq i} w_{ij} \cdot drought_j^t$$

where $drought_j^t = 1$ if cell j experienced at least moderate drought during its main agricultural season in year t, defined as the standardized precipitation–evapotranspiration index (SPEI) falling below -1.0, and 0 otherwise.[8] Following Anselin (2002), a spatially lagged variable corresponds to a *potential variable*, a term designed to formally express the importance of "other spaces" in shaping outcomes at a given location. Such spatial cross-regressive terms summarize the influence of neighboring units through weighted values of explanatory variables. Importantly, such variables can be consistently estimated via ordinary least squares (OLS).[9]

We then define our main variable of interest, $\textit{No Neighbor Dry}_{it}$, as the complement of the spatial drought lag:

$$\textit{No Neighbor Dry}_i^t = 1 - \textit{LagDrought}_i^t$$

This variable ranges from 0, when all ancestrally connected neighboring cells are simultaneously affected by drought, to 1, when none of the connected neighboring cells experience drought, and captures the degree of concurrent climatic exposure within the same ancestral territory. It represents the weighted share of ancestrally connected neighboring grid cells that are not experiencing drought in year t. Therefore, higher values indicate a spatial configuration in which a larger fraction of ancestrally connected areas remains climatically unaffected, reflecting conditions under which access to nonlocal support through kinship-linked connections is more likely to be feasible.

3 Results

3.1 Main Results

Extended kinship and exposure to spatially heterogeneous shocks We begin by examining how conflict incidence varies across spatial configurations that combine local drought exposure, extended kinship structures, and heterogeneous climatic conditions within ancestral territories. Table 1 reports estimates from the main specification, where the dependent variable is an indicator equal to one if at least one conflict event occurs during the growing season or the subsequent post-harvest period of the cell's main crop. Throughout the analysis, we refer to this period as a year, with the understanding that it corresponds to a cell-specific agricultural year rather than the calendar year. The key explanatory variable is a triple interaction between

[8]This definition also excludes cells likely experiencing flood conditions (SPEI ≥ 2), thereby capturing the share of neighboring areas that are climatically safe.

[9]Our approach differs from spatial spillover designs that examine how shocks propagate across neighboring areas, such as Harari and La Ferrara (2018). Rather than testing whether shocks transmit differently across types of neighbors, our specification focuses on a three-way interaction that captures a specific configuration, namely localized climatic conditions combined with extended kinship structures and the parallel availability of non-affected, ancestrally connected areas.

an indicator for severe or extreme drought affecting the cell during the growing season, the share of ancestrally connected neighboring cells that are not simultaneously exposed to adverse climatic conditions, and an indicator for whether the ancestral territory to which the cell belongs is characterized by extended kinship structures, defined as lineage systems spanning multiple communities rather than being confined to a single settlement. The coefficient on this triple interaction is negative and statistically significant. This result indicates that, conditional on grid-cell and year fixed effects, local drought exposure is associated with a lower probability of conflict in cells belonging to ancestrally extended lineage systems when a larger share of ancestrally connected locations within the same ancestral territory remain climatically unaffected in the same year. Because the theoretical focus is on this composite spatial configuration, we do not attach independent substantive meaning to the lower-order interaction terms. The finding is consistent with an alleviation of local resource pressure facilitated by the presence of non-affected, ancestrally connected areas. In particular, when part of the ancestral territory remains climatically unaffected, spatially extended lineage networks may enable access to alternative lands, agricultural output, transfers, or temporary migration opportunities, thereby reducing competition over resources within the drought-affected cell. In the last two columns, we report results separately for events involving state and non-state actors and find that the effect is present for both state and non-state events, with somewhat larger magnitudes for non-state actors.

In Table 2, using the post-estimation sample of the main model, we regress growing-season NDVI on our drought measures computed over the main crop's growing-season months. This exercise validates the drought measure: higher (wetter) values of the continuous SPEI are associated with higher NDVI, while severe drought conditions during the growing season significantly reduce NDVI. Overall, growing-season drought is associated with a contemporaneous decline in vegetation intensity, confirming that the shock captures a deterioration in natural vegetation conditions during the relevant season.

We next examine whether the association between drought, extended kinship structures, and conflict incidence differs across areas characterized by distinct dominant livelihood systems, proxied by land use. Using contemporary land-cover data, we classify each grid cell into one of three categories, predominantly crop-farming, predominantly pastoral, and mixed-use. We then re-estimate the main specification separately within each subsample. Results reported in Table 3 show that the coefficient on the triple interaction remains negative across all three livelihood categories and is statistically significant in each case. The estimates are more precise in predominantly crop-farming areas, consistent with the fact that growing-season drought more directly affects agricultural production and income in these settings.

Timing within the agricultural year To assess whether the estimated relationship depends on the timing of drought shocks relative to the agricultural production cycle, we implement a placebo specification that replaces growing-season drought with pre-season drought. Specifically, Table 4 re-estimates the same model as in Table 1, but measures SPEI over the months immediately preceding the main crop growing season, both for the focal cell and for ancestrally connected neighboring cells. The construction of the agricultural calendar, the definition of placebo growing seasons, and the alignment of drought exposure and conflict outcomes are illustrated in Figure 3. In Column (1) of Table 4, conflict incidence continues to be measured over the true growing-season and post-season window, as in the baseline specification, and only drought exposure is shifted to the placebo pre-season window. Across this placebo specification, the coefficient on the triple interaction between pre-season drought at the cell level, extended kinship structures, and exposure of ancestrally connected neighboring cells to pre-season climatic conditions is not statistically different from zero. This result holds under an alternative definition of the conflict outcome. In Column (2), both drought exposure and conflict outcomes are re-aligned to the placebo agricultural calendar, such that conflicts are measured during the placebo growing season and the corresponding post-placebo period, completing a consistent 12-month window. The absence of any statistically significant association in both cases contrasts sharply with the negative triple interaction obtained for growing-season drought. This pattern supports a timing-based interpretation, namely that the associations documented in the main analysis arise only when drought coincides with the period in which agricultural output is realized or fails to materialize, rather than when similar climatic conditions occur earlier in the year. In settings where livelihoods rely heavily on rain-fed agriculture, these results are consistent with the view that shocks affecting agricultural production and income constitute the relevant source of stress linking climate variability to conflict incidence. By contrast, similar climatic conditions occurring prior to the growing season do not generate comparable associations.

Alternative definitions of neighboring areas not exposed to drought To assess whether the baseline results reflect generic geographic proximity rather than linkages embedded in ancestral networks, we replace the baseline measure of *No Neighbor Dry* with alternative indicators capturing the share of neighboring grid cells that are not exposed to drought, irrespective of ancestral affiliation. Specifically, we construct concentric and cumulative spatial rings around each focal cell. Given the 0.5° grid resolution, the first ring includes cells within approximately 55 km, the second within 110 km, and the third within 165 km. Because these rings are cumulative, one would expect specifications based on closer rings to yield larger and more precisely estimated coefficients if geographic proximity alone were driving the results. This is not the case. As shown in Table 5, across all ring-based definitions the coefficient on the triple interaction is statistically indistinguishable from zero. This contrasts with the baseline specification, in which the interaction is negative and statistically significant only when neighboring cells are defined based on ancestral connections and remain climatically unaffected. Overall, this comparison indicates that the estimated association is unlikely to be driven by geographic proximity alone, but instead arises in spatial configurations that combine lineage-based connections with heterogeneous exposure to drought shocks within the same ancestral network.

Ancestral institutional correlates As the descriptive statistics in Table A4 show, ancestral territories classified as exhibiting extended kinship are more likely to have been associated with transhumant pastoralism and segmentary lineage organization. Transhumant pastoralism, in this context, refers to livelihood systems characterized by seasonal mobility of people and herds, combining a high reliance on herding suitable livestock, such as cattle, camels, sheep, and goats, with mobility patterns compatible with nomadic or semi sedentary life. These features may be related to the capacity to structure cooperation in environments with spatially and temporally variable access to pasture and water, to coordinate collective action, or to segment and recompose in response to external pressures. From an identification perspective, this raises the concern that extended kinship may capture a broader ecological and institutional portfolio associated with correlated characteristics such as pastoralism, mobility, aridity, or lineage segmentation. In technical terms, these characteristics may act as confounders. To examine this possibility, we augment the baseline specification with additional ancestral covariates that Panel A of Table A4 identifies as significantly different between territories with extended and non extended kinship configurations, namely lineage segmentation and transhumant pastoralism. Table 6 reports the resulting estimates. In column (5), when we extend the baseline specification to account for these two features, the coefficient associated with spatially extended kinship remains negative and statistically significant. The triple interaction involving transhumant pastoralism is also negative and statistically significant, whereas the corresponding interaction for segmentary lineage organization is not statistically different from zero. This pattern is informative. Segmentary lineage systems do not appear to operate robustly through the specific spatial mechanism examined here. By contrast, transhumant pastoralism directly entails seasonal and spatial mobility across multiple locations, plausibly facilitating coping strategies and access to resources beyond the locally affected area. The fact that both extended kinship and transhumant pastoralism are associated with lower conflict incidence in spatial configurations combining local drought exposure with heterogeneous exposure across connected areas suggests that mobility plays an important, though not exclusive, role in shaping the relationship between drought and conflict through long distance relationships. At the same time, the persistence of the extended kinship association indicates that the results cannot be reduced to mobility alone.

Spatial displacement of violence The finding that transhumant pastoralism enters significantly in the augmented specification highlights the potential role of mobility in shaping responses to livelihood stress. While this result reinforces the interpretation that spatial connections matter for coping, it also raises a natural concern, namely whether the reduction in conflict observed in drought affected cells reflects a genuine decline in violence, or instead a relocation of conflict to nearby areas facilitated by mobility. To examine this possibility, we re-estimate the baseline specification using conflict incidence in neighboring grid cells as the outcome, while keeping the remainder of the model unchanged. We construct concentric and cumulative distance bands around each focal cell, within 55 km, 110 km, and 165 km, and distinguish between neighboring cells belonging to the same ancestral territory, those belonging to other ancestral territories, and purely spatial neighbors irrespective of ancestry. Throughout this analysis, conflict refers to the prevalence of conflict events occurring within different ancestral territories, rather than to the identities of the actors involved.

Results are reported in Table 7. Within ancestrally connected territories, the negative association between the triple interaction and conflict extends across all distance bands, indicating that the decline in conflict is shared within the broader ancestral territory. For neighboring cells belonging to other ancestral territories, we find no evidence of either increased or decreased conflict. Finally, when conflict is aggregated purely by geographic proximity without conditioning on ancestry, a negative association emerges only in the first distance band. This pattern can be explained by the spatial structure of ancestral territories. Because the ethnographic map is composed of contiguous and homogeneous polygons that do not split ancestral territories across space, nearby cells, particularly at short distances, are more likely to belong to the same ancestral territory when that territory spans multiple grid cells. As a result, purely spatial proximity at short distances partially overlaps with ancestral proximity, explaining the negative association observed in the first ring. Beyond this range, no systematic association is detected. While this test does not directly model mobility or land encroachment, the absence of offsetting increases in adjacent territories provides no evidence consistent with a displacement interpretation.

3.2 Sensitivity

We perform a range of sensitivity checks.

Standardized No Neighbor Dry We first assess the robustness of the results to a re-scaling of *No Neighbor Dry*. We standardize *No Neighbor Dry* within each country using the full 1997-2022 sample[10]:

$$\textit{No Neighbor Dry\_std}_{it} = \frac{\textit{No Neighbor Dry}_{it} - \overline{\textit{No Neighbor Dry}_c}}{\sigma(\textit{No Neighbor Dry}_c)}, \tag{1}$$

where $\overline{\textit{No Neighbor Dry}_c}$ and $\sigma(\textit{No Neighbor Dry}_c)$ denote the mean and standard deviation of *No Neighbor Dry* for country c, respectively. This transformation preserves the structure of the interaction but expresses it in units of country-specific standard deviations. Results based on the standardized variable are reported in Table 8. The triple interaction between drought, extended kinship, and *No Neighbor Dry* remains negative and statistically significant, with a magnitude similar to the baseline specification when evaluated over a one-standard-deviation change in exposure among ancestrally connected neighboring areas.

Alternative fixed effects The baseline specification includes grid-cell fixed effects and year fixed effects, which absorb time-invariant local characteristics and common shocks across the sample. While country–year fixed effects are standard in related work using continent-wide samples with substantial cross-country variation, their inclusion in our setting is more demanding. Because the analysis is restricted to West African grid cells with an identified main crop, the baseline specification omits country–year fixed effects in order to preserve meaningful within-country variation. As a robustness check, we nonetheless re-estimate the main

[10] See, for example, Dessy et al. (2025) for a discussion of standardized interaction terms in related settings.

specification replacing year fixed effects with country–year fixed effects. Results are reported in Table 9. The coefficient on the triple interaction remains negative, although its magnitude declines of approximately 9 percentage points and its statistical significance declines from the 1 percent level in the baseline model to the 5 percent level under the more restrictive fixed-effects structure. The persistence of the effect under country–year fixed effects indicates that the results are not solely driven by shocks common to all grid cells within a given country–year.

Excluding border cells and truncated ancestral territories We assess the robustness of the main results to alternative sample restrictions related to border locations and truncated ancestral territories. Specifically, we consider four exclusions: grid cells located along contemporary national borders, grid cells located in areas where multiple ancestral homelands overlap, entire ancestral territories that extend beyond the geographic coverage of the West African sample, and entire ancestral territories that are truncated by the MIRCA2000 grid. These restrictions differ in scope. The first and second operate at the grid-cell level, while the third and fourth operates at the ancestral-territory level by excluding entire homelands. Importantly, in all specifications, the measure of *No Neighbor Dry* continues to be defined over the full set of locations belonging to the same ancestral territory.

There are three primary reasons for concern regarding border cells. First, border areas may exhibit conflict dynamics that differ systematically from interior regions. Second, grid cells located along national borders are more prone to misclassification when linking ACLED events to grid cells and countries. Third, border-related truncation of ancestral territories implies that these territories are not fully observed, which may lead to measurement error in the construction of *No Neighbor Dry*. Column (1) of Table 10 reports results excluding all cells intersecting national borders. The coefficient on the triple interaction remains negative and statistically significant, with a magnitude very similar to the baseline estimate, indicating that the main results are not driven by border-specific dynamics or by misassigned events along national boundaries. Column (2) excludes grid cells located in areas where multiple ancestral homelands overlap. This restriction substantially reduces the estimation sample, reflecting the prevalence of shared territories in the region, and yields a larger negative estimate of the triple interaction, which remains statistically significant despite the substantial reduction in sample size. Next, because some ancestral homelands extend beyond the spatial coverage of our West African grid, truncation of these territories could introduce measurement error in the construction of *No Neighbor Dry*. To address this concern, Column (3) excludes ancestral territories whose spatial extent lies partly outside the study region. The estimated coefficient on the triple interaction remains negative and statistically significant, with a magnitude comparable to the baseline. Finally, Column (4) addresses a related source of measurement error arising from the MIRCA2000 grid. Some ancestral homelands are only partially observed because the main crop is not present in all grid cells, mechanically truncating their observed territorial extent. Excluding these homelands again yields a negative and statistically significant triple interaction, with an estimated magnitude very similar to the baseline, further reinforcing the robustness of the results to potential measurement error in the construction of neighboring capacity.

Accounting for spatial correlation Given the spatial nature of both climate and conflict, residuals are unlikely to be independent across neighboring cells. To address this concern, we re-estimate the main specification with spatially clustered standard errors, allowing for spatial correlation within a 500 km radius of a cell's centroid and infinite serial correlation (Conley, 1999). Table 11 reports the resulting estimates. The standard error of the triple interaction increases, as expected, but the point estimate is unchanged and remains negative and statistically significant. Adjusting for spatial correlation therefore does not alter the substantive interpretation of the main result.

Additional land-use controls Finally, we include additional controls for contemporary land use to ensure that the observed association is not driven by changes in cropping patterns or rangeland characteristics. Using ESA Land Cover data, we compute, for each cell-year, the shares of land in agricultural classes (e.g., cropland, cropland mosaics), pastoral-suitable classes (e.g., grassland, shrubland, sparse vegetation), and other classes (e.g., urban). We add these shares to the main regression. Table 12 shows that the inclusion of these land-use variables leaves the triple interaction negative and statistically significant, with a magnitude very close to the baseline estimate.

4 Potential Mechanisms at Household Level

Our interpretation of the grid-level results rests on the idea that extended kinship systems may buffer households against localized drought shocks by facilitating access to nonlocal support, most plausibly through transfers or temporary migration. At the grid-cell level, however, we can only proxy the potential for such support to exist, as actual transfers and coping responses are not directly observable.

To assess the plausibility of this mechanism more directly, we turn to household-level evidence from Mali. Using data from the EHCVM, Table 13 examines how drought exposure relates to informal assistance received from former co-resident relatives, distinguishing between transfers originating locally, within the same village or region, and those coming from elsewhere in the country. This distinction allows us to separate assistance likely to be exposed to the same local shock from support potentially originating in unaffected areas. Across the first four columns, drought exposure is associated with a clear reduction in transfers in non-extended kinship families, both from local relatives and from relatives elsewhere in the country, with the decline substantially larger for country-level transfers. One possible interpretation is that assistance networks face coordination stress or competing demands when multiple connected households are affected simultaneously, weakening their overall capacity to respond. A complementary interpretation is that severe shocks undermine expected reciprocity. When a household experiences a large income loss, potential donors may anticipate a reduced ability to reciprocate in the future, making assistance less sustainable within informal insurance arrangements. Both mechanisms are consistent with the observed contraction in transfers following drought. Extended kinship is not associated with systematically higher levels of assistance in non-drought years, as indicated by small and statistically insignificant main effects. The interaction terms, however, reveal a distinct pattern in response to drought. For local transfers, the interaction between drought exposure and extended kinship is small and not statistically significant, consistent with the expectation that local relatives face similar covariate shocks and thus have limited scope to provide support. By contrast, for transfers originating elsewhere in the country, the interaction is positive and statistically significant. Quantitatively, this implies that while drought reduces country-level assistance overall, households ancestrally associated with extended kinship experience a substantially smaller contraction relative to other households. Although the net effect of drought remains negative, the attenuation is sizeable and consistent with the idea that spatially dispersed kin networks help sustain nonlocal support when local conditions deteriorate.

Columns (5) and (6) extend the specification to include the triple interaction, mirroring the grid-level analysis. *No Neighbor Dry* follows the same definition adopted in the grid analysis and measures the share of ancestral homeland cells located within Mali that are not simultaneously affected by drought or flood conditions, ensuring consistency with the definition of country-level transfers. The triple interaction is positive and statistically significant, indicating that the attenuation of drought-induced reductions in country-level transfers is stronger when a larger share of ancestrally connected areas within Mali remain climatically unaffected. This pattern is consistent with the proposed mechanism and carries an interpretation analogous to that in the grid-level analysis.

Furthermore, consistent with this interpretation, Table 14 shows that households ancestrally linked to extended kinship groups experience a significantly smaller contraction in consumption during drought episodes, with the effect driven primarily by food expenditures. While drought exposure is associated with sizeable declines in total and food consumption among households not linked to extended kinship, the positive interaction term indicates that these declines are substantially attenuated for extended-kin households. The effect is concentrated in food expenditures, whereas non-food consumption does not exhibit a statistically significant differential response. This pattern is consistent with improved consumption smoothing among households embedded in spatially extended kinship networks. To the extent that livelihood shocks affect incentives through changes in economic conditions, these results suggest a plausible micro-level channel linking extended kinship to the attenuation of drought-related conflict observed at the grid level.

Taken together, these household-level patterns do not constitute direct evidence for the mechanism operating in the 1997 to 2022 West African grid-level analysis. They are, however, consistent with its central premise. Extended kinship structures appear to matter primarily by shaping how households respond to localized income shocks, rather than by mechanically offsetting the shock or generating positive gains in assistance. A useful parallel emerges when comparing these transfer patterns with evidence from rural Mali on a different household arrangement. Dessy et al. (2025) document that villages with higher polygyny prevalence experience a smaller post-drought contraction in remittances than low-polygyny settings, and interpret this as consistent with geographically dispersed family ties facilitating support during shocks. Our results point to an analogous logic through a different institutional marker: in our data, transfer inflows from relatives outside the locality contract less in extended-lineage settings following localized drought. Taken together, both pieces of evidence support the interpretation that the spatial reach of kin connections conditions access to nonlocal support when local conditions deteriorate.

5 Conclusions

This study examined whether the spatial configuration of lineage systems helps account for why localized drought shocks are associated with differing conflict risks across West African communities. The central idea is that weather shocks interact with long-standing social institutions regulating access to resources before translating into conflict risk. We conceptualize these ties formed between settlements as long-distance relationships that may facilitate risk sharing and access to nonlocal resources across dispersed communities heterogeneously affected by drought conditions. From this perspective, spatially extended networks may help attenuate the effects of localized shocks through cross-community support, sustaining flows of assistance during drought and potentially reducing the likelihood that environmental stress coincides with escalations in violence.

Our main contribution is to document that conflict incidence is comparatively lower in spatial clusters embedded in extended kinship systems when localized drought shocks occur while other ancestrally connected areas are not simultaneously exposed to the same shock. This joint spatial and institutional heterogeneity, namely variation in the spatial incidence of drought within the same ancestral territory and in the presence of lineage-based ties linking multiple communities, is central to our empirical strategy. Complementary household-level evidence from Mali, where households associated with extended kinship experience a smaller contraction in family transfers and food expenditures following drought, is consistent with this interpretation.

Several limitations should be considered when evaluating these findings. First, the analysis cannot observe direct support flows across ancestrally connected territories at the grid level. Our measures rely on ancestral territories reconstructed from ethnographic sources, which may not fully capture contemporary variation in how lineage relations are organized. Second, our classification of kinship systems is based on historical and highly aggregated ethnographic categories. As a result, we cannot identify the heterogeneity that may exist within ancestral territories. Nor can we identify which specific ties are activated during periods of climatic stress. Third, our drought indicators rely on MIRCA2000 crop calendars and therefore exclude northern dryland pastoral zones that lack an assigned growing season. These areas are predominantly inhabited by pastoral populations characterized by relatively homogeneous clan-based extended family structures and by forms of conflict, such as cattle raiding, that are often weakly captured by ACLED and similar datasets due to limited reporting. More generally, available conflict data do not capture informal disputes or other non-violent forms of tension over resources that may also respond to climatic variation. With the ethnographic and conflict data available at this spatial scale, however, the exclusion of these areas is unlikely to materially affect our conclusions, which rest on aggregate variation within the agro-pastoral belt where drought exposure, kinship heterogeneity, and recorded conflict incidence are jointly observed.[11] Fourth, household survey data such as the EHCVM underrepresent mobile pastoralist populations, limiting our ability to study mechanisms related to mobility, herd redistribution, or seasonal relocation. Finally, it is important to recognize that this study is aggregate in nature and cannot capture how individuals experience and negotiate long-distance relationships in practice. Such ties may involve power asymmetries, contested belonging, and selective access to resources, dimensions that are not observable in our data but are central to how support is organized and perceived.

Beyond these limitations, the findings speak to broader questions about how social connections across space shape responses to livelihood stress in settings characterized by limited state capacity and exposure to weather shocks. Our results highlight the relevance of long-distance social ties for understanding why localized shocks may generate heterogeneous conflict outcomes across locations. While we document one specific mechanism, namely, informal transfers and consumption smoothing, we remain agnostic about the full set of pathways consistent with our findings. Other mechanisms, such as migration, in-kind support or forms of community-level governance, may likewise operate alongside or independently of remittances.

At the same time, we point to several avenues for future research. First, while our analysis treats lineage-based configurations as historically rooted and measured at an aggregate level, an open question concerns how exposure to conflict reshapes social relationships over time. Examining whether violence weakens, reinforces, or reorients social ties would contribute to a more nuanced understanding of how cooperation and support are sustained, or disrupted, across space in fragile settings, consistent with evidence that conflict can erode trust toward out-groups while strengthening parochial forms of trust (Werner and Skali, 2025).

Second, our results motivate further work on the role of formal social protection in contexts exposed to climatic risk. Recent research on index-based insurance for pastoralists highlights its potential relevance for coping with drought-related losses and for reducing incentives for distress migration into other territories, a dynamic often linked to local tensions (Gehring and Schaudt, 2026; Sakketa et al., 2025). At the same time,

[11] Understanding the links between social ties, access to resources, and conflict dynamics in predominantly pastoral settings likely requires alternative research designs and scales of analysis, including fine-grained ethnographic work, qualitative field studies, or conflict data tailored to capture low-intensity forms of violence.

others emphasize that such interventions may generate heterogeneous effects depending on ecological conditions and timing. In particular, Jensen et al. (2025) shows that while *ex-post* indemnity payments mitigate conflict during droughts by alleviating resource scarcity, *ex-ante* insurance coverage can exacerbate conflict when pasture is abundant in rainy seasons, plausibly by altering risk-taking incentives and encouraging more aggressive or expansive livelihood strategies. Understanding how such formal instruments interact with existing social arrangements, and whether there is scope or not for collective approaches to risk management in fragile settings, remains an open empirical question.

References

Allouche, J., Yao Yao, C., and Soumahoro Amédée, K. (2024). Rethinking Farmer–Herder conflicts in the Ivorian internal frontier. *African Affairs*, 123(493):449–467.

Anselin, L. (2002). Under the hood: Issues in the specification and interpretation of spatial regression models. *Agricultural Economics*, 27(3):247–267.

Bassett, T. J. (1988). The political ecology of peasant-herder conflicts in the northern ivory coast. *Annals of the Association of American Geographers*, 78(3):453–472.

Beck, H. E., Zimmermann, N. E., McVicar, T. R., Vergopolan, N., Berg, A., and Wood, E. F. (2018). Present and future köppen-geiger climate classification maps at 1-km resolution. *Scientific Data*, 5(1):180214.

Beguería, S., Vicente-Serrano, S. M., Reig, F., and Latorre, B. (2014). Standardized precipitation evapotranspiration index (spei) revisited: parameter fitting, evapotranspiration models, tools, datasets and drought monitoring. *International Journal of Climatology*, 34(10):3001–3023.

Benjaminsen, T. A. and Ba, B. (2018). Why do pastoralists in mali join jihadist groups? a political ecological explanation. *The Journal of Peasant Studies*.

Benjaminsen, T. A. and Ba, B. (2021). Fulani-dogon killings in mali: farmer-herder conflicts as insurgency and counterinsurgency. *African Security*, 14(1):4–26.

Borgerhoff Mulder, M. (2007). Hamilton's rule and kin competition: the kipsigis case. *Evolution and Human Behavior*, 28:299–312.

Cashdan, E., editor (1990). *Risk and Uncertainty in Tribal and Peasant Economies*. Routledge, New York.

Cochrane, J. H. (1991). A simple test of consumption insurance. *Journal of Political Economy*, 99:957–976.

Conley, T. G. (1999). Gmm estimation with cross sectional dependence. *Journal of Econometrics*, 92(1):1–45.

Copernicus Climate Change Service (2019). Land cover classification gridded maps from 1992 to present derived from satellite observation. Accessed 01-04-2025.

Cox, D. and Fafchamps, M. (2008). Extended family and kinship networks: Economic insights and evolutionary directions. In Schultz, T. P. and Strauss, J., editors, *Handbook of Development Economics*, volume 4, pages 3711–3784. Elsevier.

Crespin-Boucaud, J. (2020). Interethnic and interfaith marriages in sub-saharan africa. *World Development*, 125:104668.

Dessy, S., Tiberti, L., Tiberti, M., and Zoundi, D. (2025). Polygyny and drought resilience in village economies: Evidence from rural mali. *The World Bank Economic Review*, 00(0):1–23.

Didan, K. (2015). Mod13q1 modis/terra vegetation indices 16-day l3 global 250 m sin grid. *NASA EOSDIS Land Processes DAAC*.

Eberle, U. J., Rohner, D., and Thoenig, M. (2025). Heat and hate: Climate security and farmer–herder conflicts in africa. *The Review of Economics and Statistics*.

Eboreime, E., Anjorin, O., Obi-Jeff, C., Ojo, T. M., and Hertelendy, A. (2025). From drought to displacement: Assessing the impacts of climate change on conflict and forced migration in west africa's sahel region. *The Journal of Climate Change and Health*, 23:100448.

Ejiofor, P. F. (2022). 'we don't have anything': understanding the interaction between pastoralism and terrorism in nigeria. *Conflict, Security & Development*, 22(4):345–385.

Evans-Pritchard, E. E. (1940). *The Nuer: A Description of the Modes of Livelihood and Political Institutions of a Nilotic People*. Clarendon Press, Oxford.

Fafchamps, M. (1992). Solidarity networks in preindustrial societies: Rational peasants with a moral economy. *Economic Development and Cultural Change*, 41(1):147–174.

Fafchamps, M. and Gubert, F. (2007). Contingent loan repayment in the philippines. *Economic Development and Cultural Change*, 55(4):633–667.

Fafchamps, M. and Lund, S. (2003). Risk-sharing networks in rural philippines. *Journal of Development Economics*, 71(2):261–287.

Fafchamps, M. and Shrinivas, A. (2024). Risk pooling and precautionary saving in village economies. NBER Working Paper 30128, National Bureau of Economic Research.

Gehring, K. and Schaudt, P. (2026). Insuring peace: Index-based livestock insurance, droughts, and conflict. *The Quarterly Journal of Economics*.

Gluckman, M. (1955). The peace in the feud. *Past & Present*, 8:1–14.

Gluckman, M. (1963). *Custom and Conflict in Africa*. Basil Blackwell, Oxford.

Grimard, F. (1997). Household consumption smoothing through ethnic ties: Evidence from côte d'ivoire. *Journal of Development Economics*, 53:391–422.

Harari, M. and La Ferrara, E. (2018). Conflict, climate, and cells: A disaggregated analysis. *The Review of Economics and Statistics*, 100(4):594–608.

Institut National de la Statistique (2022a). Enquête harmonisée sur le conditions de vie des ménages 2018–2019. Data set.

Institut National de la Statistique (2022b). Enquête harmonisée sur le conditions de vie des ménages 2021–2022. Data set.

Jensen, N. D., Miguel, E., and Posner, D. N. (2025). Pasture, conflict, and cooperation: Resource shocks and livestock raiding in pastoralist societies. Working paper.

Kasper, C. and Borgerhoff Mulder, M. (2015). Who helps and why? cooperative networks in mpimbwe. *Current Anthropology*, 56:701–732.

Kincaide, L., McGuirk, E., and Nunn, N. (2020). A comprehensive concordance between murdock's map of ethnic groups and the ethnographic atlas. Working Paper, Harvard University.

Koubi, V. (2019). Climate change and conflict. *Annual Review of Political Science*, 22:343–360.

McGuirk, E. F. and Nunn, N. (2025). Transhumant pastoralism, climate change, and conflict in africa. *Review of Economic Studies*, 92(1):404–441.

Monfreda, C., Ramankutty, N., and Foley, J. A. (2008). Farming the planet: Geographic distribution of crop areas, yields, physiological types, and net primary production in the year 2000. *Global Biogeochemical Cycles*, 22:1–19.

Moscona, J., Nunn, N., and Robinson, J. A. (2020). Segmentary lineage organization and conflict in sub-saharan africa. *Econometrica*, 88(5):1999–2036.

Müller-Crepon, C., Pengl, Y., and Bormann, N.-C. (2022). Linking Ethnic Data from Africa (LEDA). *Journal of Peace Research*, 59(3).

Munshi, K. and Rosenzweig, M. (2009). Why is mobility in india so low? social insurance, inequality, and growth. NBER Working Paper 14850, National Bureau of Economic Research, Cambridge, MA. JEL No. J12, J61, O11.

Murdock, G. P. (1959). *Africa: Its Peoples and Their Cultural History*. McGraw-Hill, New York.

Murdock, G. P. (1967). Ethnographic atlas: A summary. *Ethnology*, 6(2):109–236.

Murgai, R., Winters, P., Sadoulet, E., and de Janvry, A. (2002). Localized and incomplete mutual insurance. *Journal of Development Economics*, 67:245–274.

Nunn, N. and Wantchekon, L. (2011). The slave trade and the origins of mistrust in africa. *American Economic Review*, 101(7):3221–3252.

Nwankwo, C. F. and Okafor, U. P. (2022). Ethnic faultline in the farmer–pastoralist conflict (fpc) – when does ethnicity matter to the fpcs? a case study of adani-nimbo area in south-eastern nigeria. *Journal of Global Faultlines*, 9(1):44–56.

Patton, J. Q. (2005). Meat sharing for coalitional support. *Evolution and Human Behavior*, 26(2):137–157.

Paumgarten, F., Locatelli, B., Witkowski, E. T. F., and Vogel, C. (2020). Prepare for the unanticipated: Portfolios of coping strategies of rural households facing diverse shocks. *Journal of Rural Studies*, 80:91–100.

Pisor, A. C., Borgerhoff Mulder, M., and Smith, K. M. (2023). Long-distance social relationships can both undercut and promote local natural resource management. *Philosophical Transactions of the Royal Society B*, 379:20220269.

Pisor, A. C. and Jones, J. H. (2020). Do people manage climate risk through long-distance relationships? *American Journal of Human Biology*, 32(4):e23525.

Pisor, A. C. and Ross, C. T. (2022). Distinguishing intergroup and long-distance relationships. *Human Nature*, 33(3):280–303.

Portmann, F. T., Siebert, S., and Döll, P. (2010). Mirca2000 - global monthly irrigated and rainfed crop areas around the year 2000: A new high-resolution data set for agricultural and hydrological modeling. *Global Biogeochemical Cycles*, 24:1–19.

Raleigh, C., Kishi, R., and Linke, A. (2023). Political instability patterns are obscured by conflict dataset scope conditions, sources, and coding choices. *Humanities and Social Sciences Communications*, 10(1):74.

Raleigh, C., Linke, A., Hegre, H., and Karlsen, J. (2010). Introducing acled: An armed conflict location and event dataset. *Journal of Peace Research*, 47(5):651–660.

Rosenzweig, M. R. (1988). Risk, implicit contracts and the family in rural areas of low-income countries. *The Economic Journal*, 98(393):1148–1170.

Rosenzweig, M. R. and Stark, O. (1989). Consumption smoothing, migration, and marriage: Evidence from rural india. *Journal of Political Economy*, 97(4):905–926.

Sakketa, T. G., Maggio, D., and McPeak, J. (2025). The protective role of index insurance in the experience of violent conflict: Evidence from ethiopia. *Journal of Development Economics*, 174:103445.

Santos, P. and Barrett, C. B. (2011). Persistent poverty and informal credit. *Journal of Development Economics*, 96(2):337–347.

Tollefsen, A. F., Strand, H., and Buhaug, H. (2012). PRIO-GRID: A unified spatial data structure. *Journal of Peace Research*, 49(2):363–374.

Townsend, R. M. (1994). Risk and insurance in village india. *Econometrica*, 62(3):539–591.

Trærup, S. L. M. (2012). Informal networks and resilience to climate change impacts: A collective approach to index insurance. *Global Environmental Change*, 22:255–267.

Udry, C. (1994). Risk and insurance in a rural credit market: an empirical investigation in northern nigeria. *Review of Economic Studies*, 61:495–526.

Vicente-Serrano, S. M., Domínguez-Castro, F., Reig, F., Tomas-Burguera, M., Peña-Angulo, D., Latorre, B., Beguería, S., Rabanuea, I., Noguera, I., Lorenzo-Lacruz, J., and Kenawy, A. E. (2023). A global drought monitoring system and dataset based on era5 reanalysis: A focus on crop-growing regions. *Geoscience Data Journal*, 10(4):427–537.

Weerdt, J. D. (2002). Risk-sharing and endogenous network formation. Technical Report DP2002-57, World Institute for Development Economic Research (UNU-WIDER).

Weidmann, N. B., Rød, J. K., and Cederman, L.-E. (2010). Representing ethnic groups in space: A new dataset. *Journal of Peace Research*, 47(4):491–499.

Werner, K. and Skali, A. (2025). Violent conflict and parochial trust: Lab-in-the-field and survey evidence. *Journal of Development Economics*, 177:103550.

Appendix

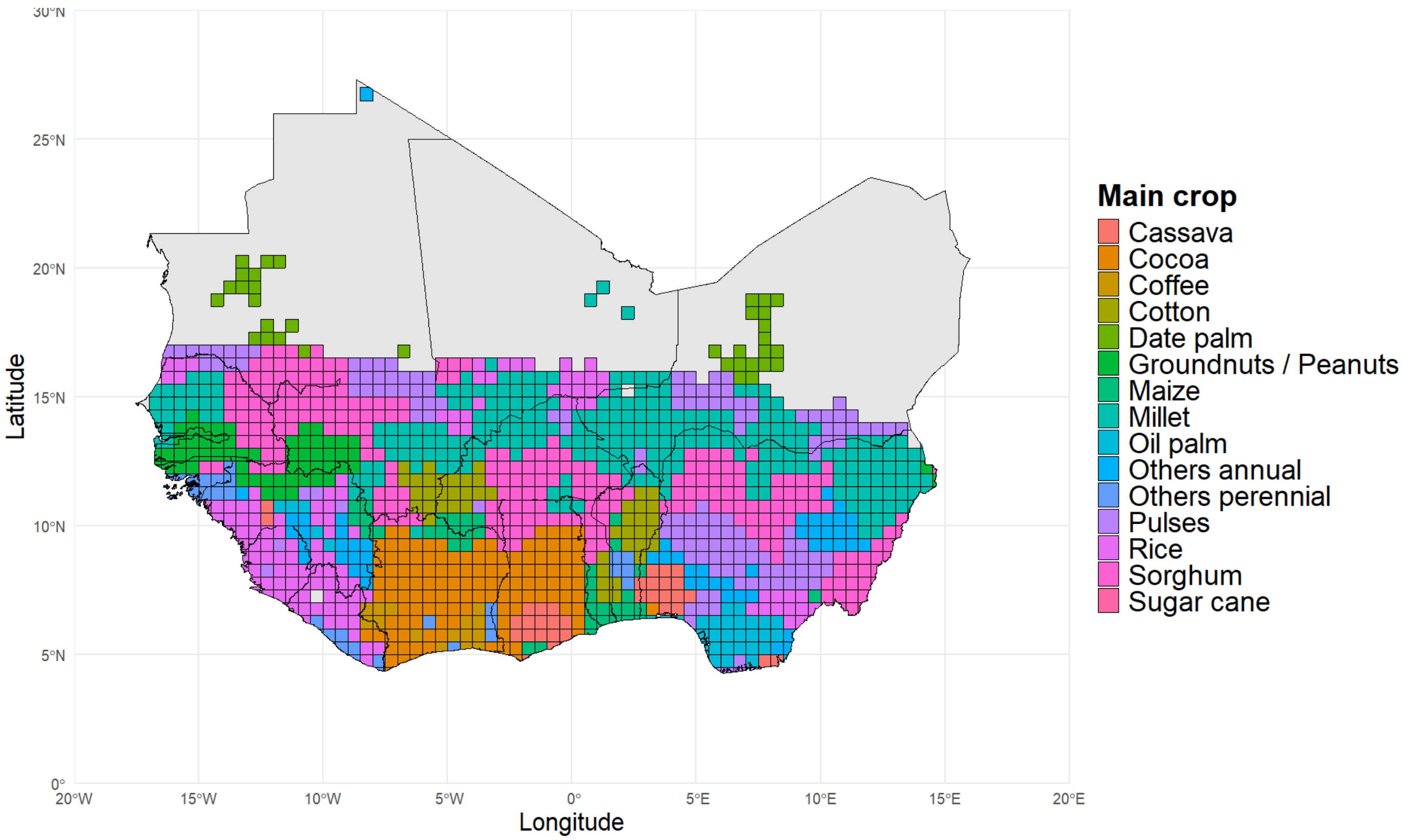

Figure 2: *Main Crop by Grid Cell in West Africa (Year Around 2000)*
Note: Grid cells have a size of 0.5°×0.5°, equivalent to approximately 55 km × 55 km at the equator. The unit of observation of our analysis is this cell-year pair.
Sources: SPEI grid (Vicente-Serrano et al., 2023) and main crop from PRIO-GRID (Tollefsen et al., 2012).

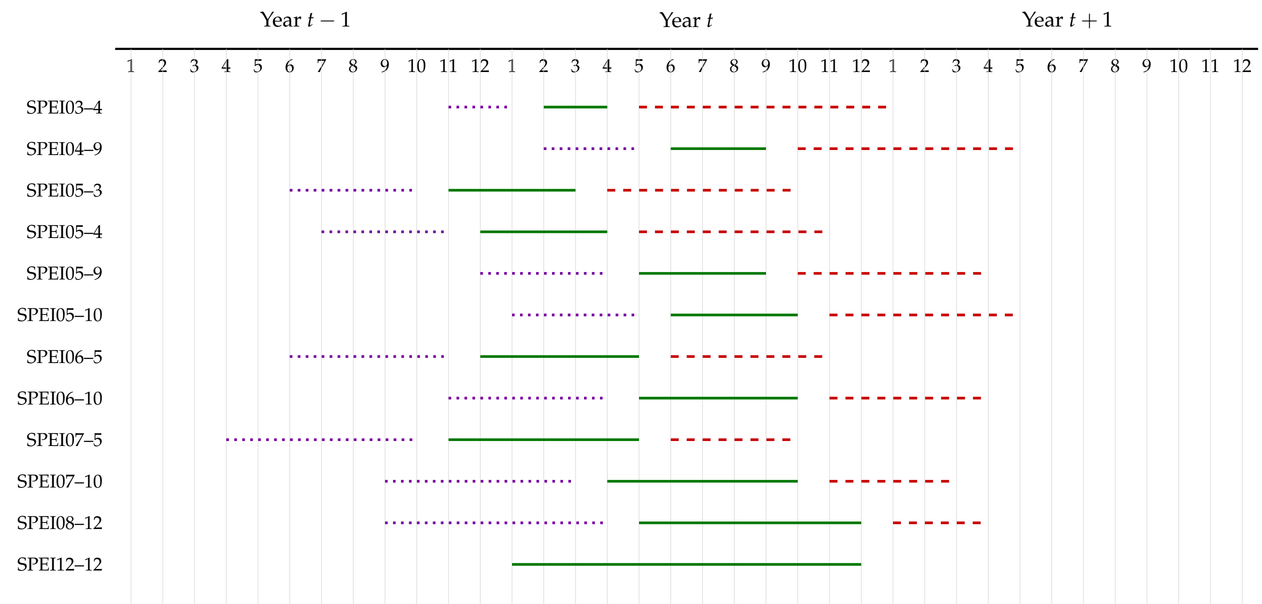

Figure 3: *Timing of Conflict Associated with Main Crop Growing Season*

Notes: Solid green bars indicate the main agricultural growing season of the dominant crop in each grid cell. Cell-level drought exposure (defined as SPEI falling below the -1.5 threshold) is measured over the growing season specific to the cell. Red dashed bars denote the post–growing-season period, which extends forward in time to complete a 12-month agricultural calendar. For example, for a cell with a growing season defined as SPEI03-4, the agricultural season in year 2000 spans from February to April (three months). The post-season window therefore covers the remaining nine months, from May 2000 to January 2001. In the analysis, the outcome variable, defined at the cell–year level, equals one if at least one conflict occurs either during the growing season or in the corresponding post-season period (i.e., from February 2000 to January 2001 in this example). Purple dotted bars indicate placebo growing seasons, defined as periods of equal length to the true growing season but shifted backward in time. In the SPEI03-4 example, the placebo growing season for year 2000 corresponds to spei03-1, spanning from November 1999 to January 2000. Drought shocks are measured during these placebo windows for falsification purposes. Conflict outcomes are measured in two ways for robustness: (i) using the true growing-season and post-season window, and (ii) reclassified to reflect conflicts occurring during the placebo growing season or the corresponding post–placebo-season window, ensuring a consistent 12-month observation period (November 1999 to October 2000 in the example). For SPEI12-12, the growing season coincides with the full calendar year; consequently, all conflict events are classified as occurring during the growing season. No post-season or placebo window is defined, since shifting the window backward would mechanically capture persistence in climatic conditions rather than provide a meaningful falsification test. Because ACLED conflict data begin in January 1997, conflict outcomes occurring before this date cannot be observed; as a result, some information is lost for the earliest observation year when season windows extend into 1996.

For mechanism validation, the NDVI is aligned to the SPEI-defined growing season.

Sources: Main crop growing season from Tollefsen et al. (2012).

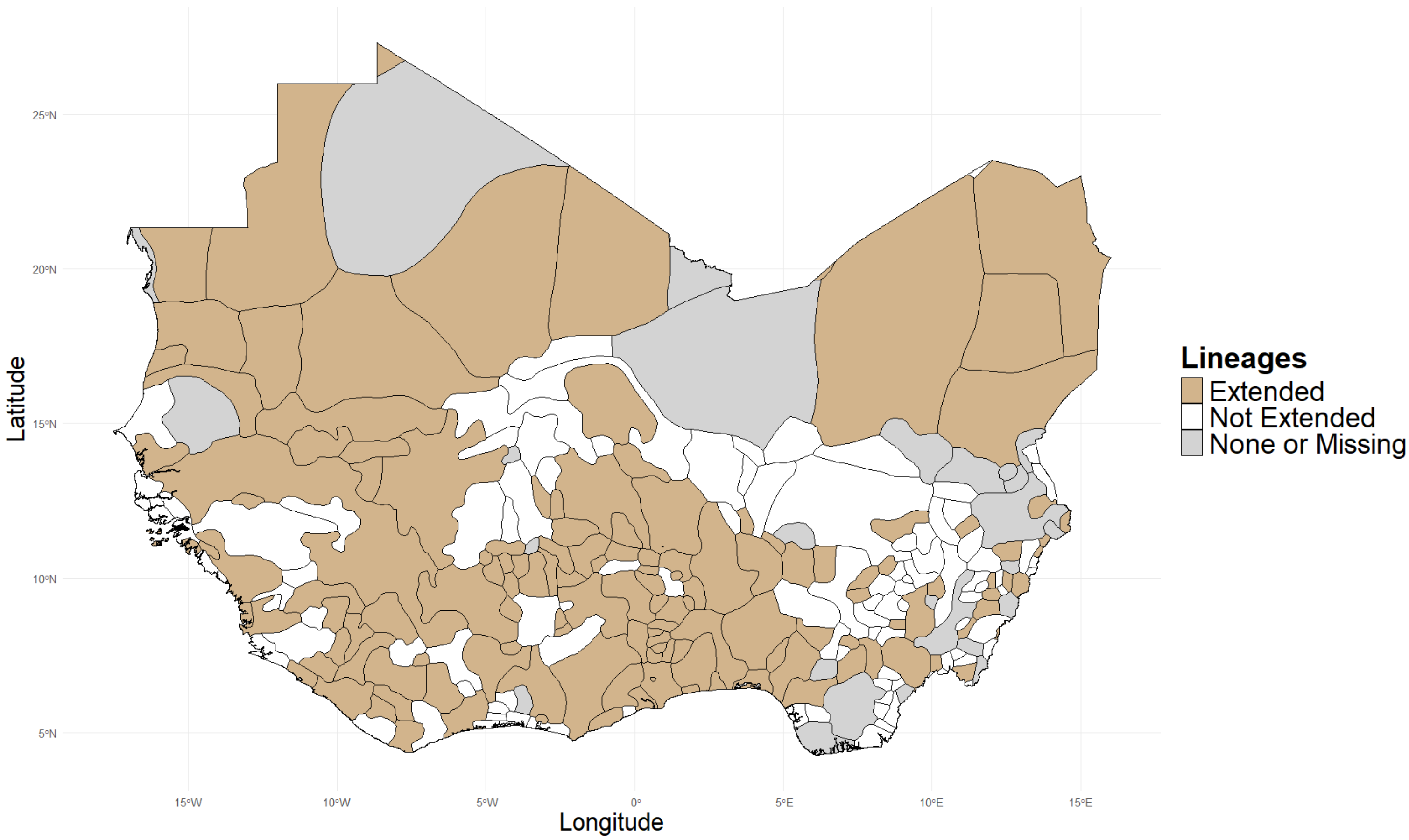

Figure 4: *Ancestral Extent of Lineages in West Africa*
Notes: This map classifies ancestral homelands in West Africa according to the spatial extent of lineage organization. Groups whose lineage systems, whether patrilineal or matrilineal, extend across multiple communities are shown in brown and labeled as having extended kinship. Homelands whose lineage structures are confined to the single local community are shown in white.
Sources: Ancestral map (Murdock, 1959) and extended kinship (Murdock, 1967).

Table 1: *Main Model*

	(1) Any Conflict Event	(2) State Actor	(3) Non-State Actor
Drought	-0.059***	-0.052***	-0.059***
	(0.019)	(0.017)	(0.019)
Drought × Extended Kin	0.030	0.028	0.029
	(0.023)	(0.020)	(0.023)
No Neighbor Dry	-0.059***	-0.039***	-0.059***
	(0.014)	(0.013)	(0.014)
Drought × No Neighbor Dry	0.171***	0.099**	0.161***
	(0.049)	(0.042)	(0.049)
No Neighbor Dry × Extended Kin	0.041**	0.030**	0.038**
	(0.016)	(0.014)	(0.016)
Drought × Extended Kin × No Neighbor Dry	-0.203***	-0.139***	-0.189***
	(0.057)	(0.048)	(0.057)
Dep. Var. Mean	0.194	0.125	0.201
Cell FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
R^2	0.418	0.467	0.435
Adj. R^2	0.393	0.441	0.411
Cell Clusters	1,067	1,067	1,067
Observations	26,675	23,191	26,376

Notes: The dependent variable is conflict incidence at the cell–agricultural-year level. See Figure 3 for details on the timing of shocks and conflict. Column (1) reports estimates for the full sample, while columns (2) and (3) divide the outcome into events involving state and non-state actors, respectively. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2: *Main Crop Agricultural Season Drought and Vegetation Stress*

	(1) Growing Season-NDVI	(2) Growing Season-NDVI
Growing Season-SPEI (cont.)	0.007***	
	(0.000)	
Growing Season-Drought (0/1)		-0.008***
		(0.001)
Dep. Var. Mean	0.466	0.466
Cell FE	Yes	Yes
Year FE	Yes	Yes
R^2	0.977	0.976
Adj. R^2	0.976	0.975
Cell Clusters	1,067	1,067
Observations	24,541	24,541

Notes: The dependent variable is the Normalized Difference Vegetation Index (NDVI), derived from MODIS MOD13Q1, which provides 16-day composite NDVI at 250-meter spatial resolution. Mean growing-season NDVI is computed as the average of monthly NDVI observations falling within the growing-season window for each grid cell and agricultural year. The regression is estimated on the sample used in Table 1. The 2,134 missing observations arise because the NDVI data series begins in February 2000; consequently, NDVI is unavailable for agricultural years prior to that date (1997–1999). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3: *Land-Use Heterogeneity*

	(1) Crop Farming	(2) Pastoral	(3) Mixed
Drought	-0.080***	-0.079**	-0.054*
	(0.030)	(0.031)	(0.028)
Drought × Extended Kin	0.056	0.050	0.037
	(0.037)	(0.035)	(0.033)
No Neighbor Dry	-0.084***	-0.010	-0.073***
	(0.020)	(0.031)	(0.020)
Drought × No Neighbor Dry	0.259***	0.148**	0.152**
	(0.076)	(0.062)	(0.066)
No Neighbor Dry × Extended Kin	0.071***	-0.009	0.036
	(0.024)	(0.032)	(0.023)
Drought × Extended Kin × No Neighbor Dry	-0.364***	-0.145**	-0.189**
	(0.094)	(0.074)	(0.080)
Dep. Var. Mean	0.244	0.129	0.202
Cell FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
R^2	0.413	0.455	0.443
Adj. R^2	0.386	0.427	0.417
Cell Clusters	535	376	615
Observations	12,848	8,364	14,397

Notes: Columns report estimates for subsamples defined by exclusive categories of land cover. Crop Farming refers to grid cells with agricultural cover above the full-sample median and pastoral cover below the full-sample median. Pastoral refers to grid cells with pastoral cover above the full-sample median and agricultural cover below the full-sample median. Mixed includes grid cells where both agricultural and pastoral cover are above the 25th percentile of their full-sample distributions. In the West African sample, using the 25th percentile (rather than the median) avoids excluding large areas suitable for pastoralism. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: *Falsification Test: Pre–growing Season Drought*

	(1) Any Conflict Event	(2) Any Conflict Event (Placebo)
Drought (pre-gs)	-0.019	-0.016
	(0.016)	(0.015)
Drought (pre-gs) × Extended Kin	0.029	0.012
	(0.021)	(0.020)
No Neighbor Dry (pre-gs)	-0.049***	-0.052***
	(0.013)	(0.013)
Drought (pre-gs) × No Neighbor Dry (pre-gs)	0.044	0.054
	(0.050)	(0.045)
No Neighbor Dry (pre-gs) × Extended Kin	0.044***	0.040***
	(0.016)	(0.015)
Drought (pre-gs) × Extended Kin × No Neighbor Dry (pre-gs)	-0.093	-0.093
	(0.062)	(0.058)
Dep. Var. Mean	0.206	0.199
Cell FE	Yes	Yes
Year FE	Yes	Yes
R^2	0.436	0.437
Adj. R^2	0.412	0.412
Cell Clusters	845	845
Observations	21,125	21,125

Notes: This table reports a falsification test based on drought shocks occurring in the pre–growing-season (pre-gs). In Column (1), *Drought (pre-gs)* and *No Neighbor Dry (pre-gs)* are defined over the placebo growing-season window, while conflict outcomes continue to be measured over the true growing-season and post-season windows, as in the main specification. The dependent variable in Column (1) is identical to that in Table 1. Column (2) maintains the same placebo definition for drought exposure but redefines the outcome to capture conflicts occurring during the placebo growing-season and the subsequent post–placebo period, completing a 12-month window. See Figure 3 for more details on timing of placebo shocks and conflict outcomes. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: *Alternative Neighbor Definitions: Pure Geographic Proximity*

	(1) Any Conflict Event	(2) Any Conflict Event	(3) Any Conflict Event
Drought	0.029	0.066	0.155*
	(0.023)	(0.064)	(0.093)
Drought × Extended Kin	-0.047*	-0.124*	-0.214*
	(0.027)	(0.073)	(0.111)
No Neighbor Dry (≤ 55 km)	-0.029*		
	(0.017)		
Drought × No Neighbor Dry (≤ 55 km)	-0.035		
	(0.032)		
Extended Kin × No Neighbor Dry (≤ 55 km)	0.028		
	(0.019)		
Drought × Extended Kin × No Neighbor Dry (≤ 55 km)	0.016		
	(0.038)		
No Neighbor Dry (≤ 110 km)		-0.052*	
		(0.027)	
Drought × No Neighbor Dry (≤ 110 km)		-0.076	
		(0.081)	
Extended Kin × No Neighbor Dry (≤ 110 km)		0.053	
		(0.033)	
Drought × Extended Kin × No Neighbor Dry (≤ 110 km)		0.119	
		(0.095)	
No Neighbor Dry (≤ 165 km)			-0.050
			(0.044)
Drought × No Neighbor Dry (≤ 165 km)			-0.185
			(0.115)
Extended Kin × No Neighbor Dry (≤ 165 km)			0.082
			(0.053)
Drought × Extended Kin × No Neighbor Dry (≤ 165 km)			0.228
			(0.140)
Dep. Var. Mean	0.194	0.194	0.194
Cell FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
R^2	0.418	0.418	0.418
Adj. R^2	0.393	0.393	0.393
Cell Clusters	1,067	1,067	1,067
Observations	26,675	26,675	26,675

Notes: For falsification purposes, climatic conditions in ancestrally connected neighboring areas are replaced by climatic conditions in geographically proximate locations. In these specifications, ancestral geography plays no role and neighbor relationships are defined solely by physical distance. Each column defines neighbors as all grid cells located within a given distance threshold from the focal cell, using cumulative distance bands of approximately 55 km, 110 km, and 165 km, respectively. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: *Additional Ancestral Institutional Controls*

	(1) Any Conflict Event	(2) Any Conflict Event	(3) Any Conflict Event	(4) Any Conflict Event	(5) Any Conflict Event
Drought × Transhumant Pastoral × No Neighbor Dry	-0.253***	-0.146			-0.235**
	(0.094)	(0.098)			(0.111)
Drought × Segmentary Lineage × No Neighbor Dry			-0.326*	-0.163	-0.301
			(0.179)	(0.167)	(0.191)
Drought × Extended Kin × No Neighbor Dry		-0.209***		-0.184***	-0.146**
		(0.064)		(0.063)	(0.067)
Dep. Var. Mean	0.193	0.193	0.190	0.190	0.189
Cell FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
R^2	0.390	0.391	0.389	0.390	0.388
Adj. R^2	0.364	0.365	0.363	0.364	0.362
Cell Clusters	1,057	1,057	1,006	1,006	996
Observations	26,425	26,425	25,150	25,150	24,900

Notes: Segmentary lineage (SL) is taken from the replication package of McGuirk and Nunn (2025). Following McGuirk and Nunn (2025), we also construct an indicator for transhumant pastoralism (THP) using information from the EA. THP is defined as the interaction between pastoral intensity and a broad nomadism indicator. Pastoral intensity is measured as the interaction between (i) the suitability of livestock for herding and transhumance, constructed from variable v40, and (ii) the share of subsistence derived from animal husbandry, based on variable v4. Livestock is classified as herding-suitable if it consists of bovines, camels, equines, or sheep and goats; observations relying exclusively on pigs or with no large animals are classified as not herding-suitable. The subsistence share from animal husbandry is obtained by mapping the categorical measure of v4 into a continuous variable using category midpoints. Broad nomadism, drawn from variable v30, equals one for nomadic, semi-nomadic, and semi-sedentary populations, and zero for sedentary and urban populations; observations with missing nomadism information are coded as missing. This definition captures mobility-based pastoral practices compatible with seasonal transhumance. Columns are organized as follows. Column (1) reports estimates where the triple interaction replaces extended kinship with THP. Column (2) includes both THP and extended kinship jointly. Columns (3) and (4) follow the same structure for SL. Column (5) includes THP, SL, and extended kinship jointly. Relative to column (1) of Table 1, some specifications include fewer observations because SL and THP are available only for a subset of ancestral territories in the EA. Specifically, 1,525 cell-year observations are dropped due to missing values in SL, and an additional 300 observations are dropped due to missing values in THP. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 7: *Conflict Spillovers Across Ancestrally Connected and Geographically Proximate Cells*

	(1) All own homeland	(2) Own homeland $\leq 55km$	(3) Own homeland $\leq 110km$	(4) Own homeland $\leq 165km$	(5) Other homeland $\leq 55km$	(6) Other homeland $\leq 110km$	(7) Other homeland $\leq 165km$	(8) Spatial $\leq 55km$	(9) Spatial $\leq 110km$	(10) Spatial $\leq 165km$
Drought	-0.020	-0.030	-0.034**	-0.027**	-0.001	-0.039***	-0.021***	-0.030**	-0.002	-0.000
	(0.013)	(0.025)	(0.015)	(0.013)	(0.024)	(0.011)	(0.007)	(0.012)	(0.007)	(0.004)
Drought × Extended Kin	0.000	0.023	0.019	0.011	-0.037	0.001	0.000	0.038**	-0.006	-0.001
	(0.014)	(0.028)	(0.017)	(0.015)	(0.030)	(0.013)	(0.008)	(0.015)	(0.009)	(0.005)
No Neighbor Dry	-0.031***	-0.059***	-0.039***	-0.035***	-0.038**	-0.016*	-0.002	-0.027***	-0.006	0.003
	(0.010)	(0.017)	(0.012)	(0.011)	(0.018)	(0.009)	(0.005)	(0.010)	(0.005)	(0.003)
Drought × No Neighbor Dry	0.118***	0.118**	0.127***	0.114***	-0.005	0.067**	0.048**	0.053	-0.001	-0.005
	(0.026)	(0.051)	(0.034)	(0.025)	(0.051)	(0.027)	(0.019)	(0.037)	(0.014)	(0.008)
No Neighbor Dry × Extended Kin	0.022**	0.035*	0.029**	0.025**	0.013	0.004	-0.004	0.017	-0.001	-0.006
	(0.011)	(0.019)	(0.013)	(0.012)	(0.021)	(0.010)	(0.006)	(0.011)	(0.006)	(0.003)
Drought × Extended Kin × No Neighbor Dry	-0.111***	-0.143**	-0.146***	-0.122***	0.019	-0.039	-0.021	-0.082**	0.013	0.006
	(0.029)	(0.062)	(0.038)	(0.029)	(0.064)	(0.035)	(0.021)	(0.041)	(0.018)	(0.010)
Dep. Var. Mean	0.194	0.168	0.195	0.196	0.187	0.204	0.199	0.131	0.191	0.195
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.639	0.488	0.574	0.620	0.467	0.640	0.806	0.538	0.752	0.847
Adj. R^2	0.624	0.466	0.556	0.603	0.443	0.625	0.797	0.518	0.741	0.841
Cell Clusters	1,067	650	1,066	1,066	445	984	1,050	1,067	1,067	1,067
Observations	26,675	16,250	26,650	26,650	11,125	24,600	26,250	26,675	26,675	26,675

Notes: The dependent variable is conflict incidence aggregated over different sets of grid cells, depending on the specification. Columns (1)–(4) measure conflict incidence within the ancestral homeland of the reference cell, using alternative definitions of spatial proximity: all ancestrally connected cells in column (1), and connected neighbors located within cumulative distance bands of approximately 55 km, 110 km, and 165 km in columns (2)–(4), respectively. Columns (5)–(7) measure conflict incidence among neighboring cells belonging to other ancestral homelands only, using the same cumulative distance thresholds. Columns (8)–(10) report purely geographic spatial lags, where conflict incidence is aggregated over all neighboring cells within the same distance bands, irrespective of ancestral affiliation. Importantly, outcomes labeled as "own" or "other" homeland conflict refer to the prevalence of conflict events occurring within territories historically associated with a given ancestral population, rather than to the identities of the actors involved in the violence. Results should therefore be interpreted as spatial patterns of conflict incidence across territories, not as statements about who fights whom. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 8: *Standardized No-Neighbor Dry*

	(1) Any Conflict Event
Drought	0.067**
	(0.032)
Drought × Extended Kin	-0.114***
	(0.036)
No Neighbor Dry (std.)	-0.018***
	(0.004)
Drought × No Neighbor Dry (std.)	0.046***
	(0.014)
No Neighbor Dry (std.) × Extended Kin	0.011**
	(0.005)
Drought × Extended Kin × No Neighbor Dry (std.)	-0.051***
	(0.016)
Dep. Var. Mean	0.194
Cell FE	Yes
Year FE	Yes
R^2	0.418
Adj. R^2	0.393
Cell Clusters	1,067
Observations	26,675

Notes: The *No Neighbor Dry* variable is standardized within each country using the full 1997-2022 sample. For each country, we compute the mean and standard deviation of *No Neighbor Dry* over the entire period and transform the variable into a standardized score by subtracting the country-specific mean and dividing by the country-specific standard deviation. Coefficient estimates should therefore be interpreted as the effect of a one–standard-deviation increase in *No Neighbor Dry* relative to the country-specific historical distribution. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 9: *Country-Year Fixed Effects*

	(1) Any Conflict Event
Drought	-0.030
	(0.020)
Drought × Extended Kin	0.021
	(0.023)
No Neighbor Dry	-0.033**
	(0.015)
Drought × No Neighbor Dry	0.086*
	(0.049)
No Neighbor Dry × Extended Kin	0.020
	(0.017)
Drought × Extended Kin × No Neighbor Dry	-0.118**
	(0.058)
Dep. Var. Mean	0.194
Grid FE	Yes
Country × Year FE	Yes
Cell Clusters	1,067
R^2	0.465
Adj. R^2	0.435
Observations	26,675

Notes: Grid-cell fixed effects are replaced by country–year fixed effects. Country–year fixed effects are standard in the related literature, which typically relies on continental-scale samples with substantial cross-country and time variation. Because our analysis is restricted to West African grid cells with an identified main crop, we report this specification as a robustness check. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 10: *Excluding Shared Cells*

	(1) No shared (national)	(2) No shared (other homeland)	(3) No shared (outside WA)	(4) No extent outside MIRCA2000
Drought	-0.067***	-0.143***	-0.062***	-0.047**
	(0.022)	(0.051)	(0.020)	(0.020)
Drought × Extended Kin	0.037	0.154***	0.033	0.010
	(0.026)	(0.056)	(0.024)	(0.024)
No Neighbor Dry	-0.062***	-0.110***	-0.058***	-0.055***
	(0.017)	(0.039)	(0.015)	(0.015)
Drought × No Neighbor Dry	0.208***	0.250***	0.176***	0.170***
	(0.055)	(0.079)	(0.049)	(0.062)
No Neighbor Dry × Extended Kin	0.043**	0.086**	0.041**	0.025
	(0.019)	(0.040)	(0.017)	(0.017)
Drought × Extended Kin × No Neighbor Dry	-0.213***	-0.360***	-0.208***	-0.203***
	(0.067)	(0.093)	(0.057)	(0.071)
Dep. Var. Mean	0.200	0.179	0.195	0.205
Cell FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	0.441	0.428	0.419	0.419
Adj. R^2	0.417	0.402	0.394	0.394
Cell Clusters	797	299	1,050	885
Observations	19,925	7,475	26,250	22,125

Notes: The dependent variable is conflict incidence at the cell-agricultural year level. Column (1) excludes grid cells located along national borders. Border status is a cell-specific, time-invariant characteristic. Column (2) excludes grid cells located in overlapping ancestral homelands, which is likewise a cell-specific and time-invariant feature. Column (3) excludes ancestral territories whose spatial extent goes beyond the West African study region, such as territories extending into neighboring regions (e.g., Cameroon), where the construction of *No Neighbor Dry*, which relies on the spatial extent of ancestral territories, could be biased by the omission of ancestrally connected locations outside West African political boundaries. Column (4), instead, removes homelands for which the MIRCA2000 grid mechanically reduces the observed territorial extent, potentially biasing *No Neighbor Dry* by understating the true size of ancestral territories. Because ancestral territories are defined using a historical map, the exclusions in columns (3) and (4) are territory-specific. The exclusions in columns (1) and (2) restrict the conflict analysis to more interior portions of ancestral territories, while columns (3) and (4) restrict the neighboring measure to territories that are fully observed. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 11: *Conley Spatial Standard Errors*

	(1) Clustered SEs	(2) Conley SEs
Drought	-0.059***	-0.059***
	(0.019)	(0.022)
Drought × Extended Kin	0.030	0.030
	(0.023)	(0.024)
No Neighbor Dry	-0.059***	-0.059***
	(0.014)	(0.018)
Drought × No Neighbor Dry	0.171***	0.171***
	(0.049)	(0.060)
Extended Kin × No Neighbor Dry	0.041**	0.041**
	(0.016)	(0.020)
Drought × Extended Kin × No Neighbor Dry	-0.203***	-0.203***
	(0.057)	(0.068)
Dep. Var. Mean	0.194	0.194
Cell FE	Yes	Yes
Year FE	Yes	Yes
Observations	26,675	26,675

Notes: The dependent variable is conflict incidence at the cell-agricultural year level. Column (1) reports the baseline specification. Column (2) re-estimates the same model using Conley (1999)'s spatial standard errors, which allow for spatial correlation within a 500 km radius of each grid cell's centroid and unrestricted serial correlation over time within each cell. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 12: *Land-Use Controls*

	(1) Any Conflict Event
Drought	-0.059***
	(0.019)
Drought × Extended Kin	0.031
	(0.023)
No Neighbor Dry	-0.057***
	(0.014)
Drought × No Neighbor Dry	0.166***
	(0.048)
Extended Kin × No Neighbor Dry	0.040**
	(0.016)
Drought × Extended Kin × No Neighbor Dry	-0.192***
	(0.056)
Dep. Var. Mean	0.194
Cell FE	Yes
Year FE	Yes
R^2	0.422
Adj. R^2	0.396
Cell Clusters	1,067
Observations	26,675

Notes: The specification augments the baseline model by adding a comprehensive set of continuous land-use controls for cropland, forest, grassland, wetland, settlement, and other land cover categories. See Section 2 for information on data sources and variable construction. All controls are included in the regression but omitted from the table for readability. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 13: *Drought, Kinship and Assistance: Local vs Country Transfers from Former Co-Resident Members*

	(1) Local	(2) Local	(3) Country	(4) Country	(5) Country	(6) Country
Drought	-0.045***	-0.064***	-0.224***	-0.240***	-0.411*	-0.371
	(0.015)	(0.017)	(0.071)	(0.071)	(0.234)	(0.241)
Extended Kin	-0.004	-0.008	0.010	0.003	0.016	0.001
	(0.013)	(0.013)	(0.028)	(0.027)	(0.045)	(0.044)
Drought × Extended Kin	0.009	0.021	0.158**	0.171**	1.499**	1.488**
	(0.020)	(0.021)	(0.078)	(0.076)	(0.693)	(0.697)
Drought × EK × No Neigh. Dry					0.462**	0.439**
					(0.218)	(0.221)
Y (mean)	0.038	0.038	0.150	0.150	0.153	0.153
Observations	1,679	1,679	1,901	1,901	1,496	1,496
R^2	0.105	0.121	0.107	0.133	0.122	0.148
Grid FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes

Notes: The analysis is restricted to a sub-panel of households observed in 2018–2021 and engaged in agriculture (non-missing land or animal holdings). Local indicates assistance received from former co-resident member living in the same village or region. Country includes transfers from elsewhere in the same country. The only types of assistance considered here are those declared as routine support (*"soutien courant"*) or agricultural labor assistance (*"appui travaux champs"*). Drought is defined as SPEI ≤ -1.5 during the main growing season (June–October 2017). Extended kin (EK) denotes whether the household head or their spouse(s), who are also receivers of remittances, have ancestral extended kinship ties. *No Neighbor Dry* follows the definition adopted in the grid analysis: it measures the share of ancestral homeland cells not simultaneously affected by drought (-1.0) or flood ($+2.0$), and located within Mali (ensuring comparability with the definition of country remittances). All specifications include grid fixed effects and survey-year dummies. Controls include productive and demographic household characteristics: total livestock (TLU), crop diversification (Shannon index weighted by parcels' area), total land, head's education above primary, gender and age of the head, household size, share of adults employed, wealth index, and rural residence. We additionally control for prior exposure to formal assistance through indicators of receipt of cereals, semolina, school feeding, food-for-work, child nutrition supplements, cash-for-work, cash transfers, maternal care, child health services, and mosquito nets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 14: *Drought, Kinship and Household Expenditures*

	(1) Total	(2) Total	(3) Food	(4) Food	(5) Non-Food	(6) Non-Food
Drought	-0.843**	-0.760**	-0.797***	-0.760***	-0.047	-0.000
	(0.347)	(0.298)	(0.224)	(0.207)	(0.173)	(0.147)
Extended Kin	0.002	0.031	0.013	0.049	-0.012	-0.018
	(0.118)	(0.096)	(0.067)	(0.056)	(0.067)	(0.057)
Drought × Extended Kin	0.805**	0.703**	0.546**	0.549**	0.259	0.154
	(0.397)	(0.337)	(0.249)	(0.227)	(0.202)	(0.168)
Y (mean)	2.569	2.569	1.483	1.483	1.087	1.087
Observations	2,620	2,620	2,620	2,620	2,620	2,620
R^2	0.260	0.513	0.231	0.433	0.246	0.480
Grid FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes

Notes: The analysis is restricted to a sub-panel of households observed in 2018–2021 and engaged in agriculture (non-missing land or animal holdings). Outcome variables include total annual real household expenditure, food expenditure, and non-food expenditure, expressed in millions of CFA francs and deflated using survey- and CPI-based deflators to account for spatial and price differences. Drought is defined as SPEI ≤ -1.5 during the main growing season (June–October 2017). Extended kin (EK) denotes whether the household head or their spouse(s) have ancestral extended kinship ties. All specifications include grid fixed effects and survey-year dummies. Controls include productive and demographic household characteristics: total livestock (TLU), crop diversification (Shannon index weighted by parcels' area), total land, head's education above primary, gender and age of the head, household size, share of adults employed, wealth index, and rural residence. We additionally control for prior exposure to formal assistance through indicators of receipt of cereals, semolina, school feeding, food-for-work, child nutrition supplements, cash-for-work, cash transfers, maternal care, child health services, and mosquito nets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

A Online Appendix

Table A1: *Sample Selection Criteria*

Sample selection criterion	Cells per year	Total cells (1997–2022)	Number of homelands
0.5° grid cells in West Africa[a]	2,206	55,150	242
Removing cells with no main crop[b]	1,264	31,600	232
Removing uninhabited homelands[c]	1,260	31,500	231
Removing homelands with missing extended kinship[d]	1,129	28,225	209
Removing single-cell homelands[e]	1,067	26,675	147

Notes: The panel spans the period 1997–2022.

[a] Grid cells are restricted to West Africa using contemporary political boundaries.

[b] Cells are restricted to those with an identified main crop and crop-specific growing season from PRIO-GRID (Tollefsen et al., 2012), which defines the main crop using Monfreda et al. (2008) and growing periods from MIRCA2000 (Portmann et al., 2010).

[c] One homeland classified as uninhabited according to the Murdock ethnographic map is excluded (Murdock, 1959).

[d] Extended kinship is constructed using the Ethnographic Atlas (Murdock, 1967) via the concordance by Kincaide et al. (2020). Variables v17 and v19 describe the largest patrilineal and matrilineal kin groups recorded for each society. Homelands are excluded when both variables are missing or coded as "none".

[e] The *No Neighbor Dry* variable is defined as the weighted share of non-drought-affected cells within the same homeland, excluding the own cell. This measure cannot be computed for single-cell homelands, which are therefore excluded.

Table A2: *SPEI Time Scale by Final Month (Final Sample)*

	Final Month Growing Season						**Total**
SPEI Time Scale	3	4	5	9	10	12	
spei03	0	50	0	0	0	0	50
spei04	0	0	0	600	0	0	600
spei05	925	50	0	0	15,600	0	16,575
spei06	0	0	500	0	1,750	0	2,250
spei07	0	0	575	0	525	0	1,100
spei08	0	0	0	0	0	775	775
spei12	0	0	0	0	0	5,325	5,325
Total	925	100	1,075	600	17,875	6,100	26,675

Notes: Cross-tabulation of SPEI time scales by month of index extraction. For example, spei03-4 refers to an agricultural growing season spanning from February to April. Agricultural growing-season windows are invariant across time within each grid cell. Each observation corresponds to one 0.5° × 0.5° grid cell. In each year, these cell-specific growing-season windows are used to extract the corresponding drought index, which therefore varies over time within cells.

Sources: Main crop growing season from Tollefsen et al. (2012).

Table A4: *Balance Test, Sub-Samples by EK Classification (Grid Data)*

Panel A: Homeland Level (Static)

Variable	(1) Extended Kin = 1	(2) Extended Kin = 0	(3) Difference
Low Jurisdictional Hierarchy Beyond Local Community	0.624	0.552	0.072
	(0.487)	(0.502)	(0.084)
Segmentary Lineage (0–1)	0.518	0.364	0.153***
	(0.215)	(0.137)	(0.032)
Transhumant Pastoralism (0-1)	0.052	0.000	0.052**
	(0.171)	(0.000)	(0.022)
Agriculture > 50% of Income	0.770	0.700	0.070
	(0.423)	(0.462)	(0.074)
Homeland Extends Outside West Africa	0.034	0.067	-0.032
	(0.184)	(0.252)	(0.036)
Homeland Extends Outside MIRCA2000	0.161	0.100	0.061
	(0.370)	(0.303)	(0.058)
Homeland Size (cells)	7.989	6.200	1.789
	(10.960)	(7.357)	(1.621)
Observations	87	60	147

Panel B: Cell-Level (Static)

Variable	(1) Extended Kin = 1	(2) Extended Kin = 0	(3) Difference
Shared National Border	0.268	0.226	0.042
	(0.443)	(0.419)	(0.028)
Shared Homeland Border	0.682	0.790	-0.108***
	(0.466)	(0.408)	(0.029)
Tropical Rainforest (kg 1)	0.003	0.013	-0.011**
	(0.054)	(0.115)	(0.005)
Tropical Monsoon (kg 2)	0.072	0.070	0.002
	(0.259)	(0.255)	(0.017)
Tropical Savannah (kg 3)	0.578	0.511	0.068**
	(0.494)	(0.501)	(0.032)
Arid Desert Hot (kg 4)	0.167	0.153	0.014
	(0.373)	(0.361)	(0.024)
Arid Steppe Hot (kg 6)	0.180	0.253	-0.073***
	(0.384)	(0.435)	(0.026)
Agricultural Land Use Above Median	0.436	0.519	-0.083***
	(0.496)	(0.500)	(0.032)
Pastoral Land Use Above Median	0.387	0.293	0.094***
	(0.487)	(0.456)	(0.031)
Mixed Agro–Pastoral (both >25th pct)	0.506	0.640	-0.133***
	(0.500)	(0.481)	(0.032)
Observations	695	372	1,067

Panel C: Cell-Agricultural Year Level (1997-2022)

Variable	(1) Extended Kin = 1	(2) Extended Kin = 0	(3) Difference
SPEI Growing Season	-0.147	-0.126	-0.021*
	(0.897)	(0.888)	(0.011)
Drought (SPEI ≤ -1.5)	0.067	0.058	0.008***
	(0.250)	(0.234)	(0.003)
Neighbors Not in Drought (0–1)	0.815	0.835	-0.020***
	(0.308)	(0.308)	(0.004)
Neighbors Not in Drought (conditional on drought)	0.252	0.186	0.067***
	(0.286)	(0.294)	(0.015)
NDVI Growing Season	0.474	0.449	0.025***
	(0.155)	(0.152)	(0.002)
Any Conflict Event	0.178	0.224	-0.045***
	(0.383)	(0.417)	(0.005)
State Actors Involved	0.126	0.166	-0.040***
	(0.332)	(0.372)	(0.005)
Non–State Actors Involved	0.185	0.234	-0.048***
	(0.388)	(0.423)	(0.005)
Observations	17,375	9,300	26,675

Notes: Differences computed using two-sided t-tests. See Section 2 for information on data sources and variables construction.

Table A5: *Summary Statistics by Extended Kinship (Household Survey Data)*

Variable	(1) EK[a] = 1	(2) EK[a] = 0	(3) Difference
Total Expenditure (Million CFA)	2.651	2.458	0.193***
	(1.622)	(1.662)	(0.065)
Food Expenditure (Million CFA)	1.524	1.426	0.097***
	(0.928)	(0.956)	(0.037)
Non-Food Expenditure (Million CFA)	1.127	1.031	0.096***
	(0.903)	(0.915)	(0.036)
Local Kin Assistance (Binary)	0.040	0.035	0.005
	(0.197)	(0.185)	(0.009)
Country Kin Assistance (Binary)	0.164	0.132	0.032*
	(0.370)	(0.339)	(0.017)
Max Distance of Kin Assistance	2.787	2.401	0.386***
	(1.349)	(1.020)	(0.081)
Mean Distance of Kin Assistance	2.646	2.284	0.361***
	(1.290)	(0.917)	(0.076)
Number of Distinct Locations of Assistance	0.470	0.425	0.045*
	(0.637)	(0.634)	(0.025)
Number of Total Transfers Received	0.400	0.362	0.038**
	(0.490)	(0.481)	(0.019)
Drought (SPEI[b] ≤ -1.5, Growing Season 2017)	0.113	0.028	0.085***
	(0.316)	(0.165)	(0.010)
Rural Residence	0.799	0.645	0.155***
	(0.401)	(0.479)	(0.017)
Livestock Holdings (TLU units)	3.778	4.318	-0.541**
	(5.834)	(7.092)	(0.253)
Crop Diversification (Shannon Index, Area-Weighted)	0.519	0.260	0.260***
	(0.473)	(0.428)	(0.018)
Total Land Area (ha)	5.808	3.082	2.727***
	(18.114)	(5.472)	(0.562)
Wealth Index (Asset-Based) 0-1	0.315	0.254	0.061***
	(0.188)	(0.193)	(0.008)
Household is Interethnic	0.265	0.038	0.228***
	(0.442)	(0.191)	(0.014)
Head lives in Homeland[c]	0.494	0.526	-0.032
	(0.500)	(0.500)	(0.020)
Head is Polygamous	0.421	0.301	0.120***
	(0.494)	(0.459)	(0.020)
Head Educated Above Primary	0.050	0.058	-0.008
	(0.217)	(0.233)	(0.009)
Age of Household Head	54.637	53.335	1.303**
	(14.718)	(14.251)	(0.574)
Female Household Head	0.047	0.086	-0.039***
	(0.212)	(0.280)	(0.010)
Share of Literate Adults	0.312	0.336	-0.025**
	(0.311)	(0.324)	(0.013)
Household Size	8.804	7.591	1.213***
	(4.674)	(3.973)	(0.174)
Share of Adults Employed	0.609	0.582	0.027**
	(0.290)	(0.300)	(0.012)
Employment Ratio	0.855	0.777	0.077***
	(0.538)	(0.540)	(0.021)
Received Government Cash Transfer	0.136	0.163	-0.027*
	(0.343)	(0.370)	(0.014)
Received Cereal Aid	0.359	0.484	-0.126***
	(0.480)	(0.500)	(0.019)
Received Child Malnutrition Aid	0.116	0.124	-0.009
	(0.320)	(0.330)	(0.013)
Received Maternal Care Aid	0.060	0.099	-0.040***
	(0.237)	(0.299)	(0.010)
Received Mosquito Net Aid	0.474	0.362	0.111***
	(0.499)	(0.481)	(0.019)
Received School Feeding	0.031	0.044	-0.013*
	(0.174)	(0.206)	(0.007)
Food-for-Work Assistance	0.007	0.015	-0.009**
	(0.081)	(0.123)	(0.004)
Received Semolina Aid	0.036	0.063	-0.027***
	(0.187)	(0.243)	(0.008)
Child Health Service Aid	0.259	0.233	0.026
	(0.438)	(0.423)	(0.017)
Public Works Assistance	0.004	0.032	-0.028***
	(0.063)	(0.175)	(0.005)
Observations	1,511	1,109	2,620

Notes: Mean differences between households with and without ancestral extended kinship (EK).
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: Enquête Harmonisée sur les Conditions de Vie des Ménages (EHCVM), 2018–2021, Mali. [a] Drawn from the Ethnographic Atlas Murdock (1967) via self-reported ethnicities; [b] from Beguería et al. (2014); [c] from a spatial merge with the Murdock Map Murdock (1959).

Table A6: *Concordance Between Ethnographic Atlas (EA) and Enquête Harmonisée sur les Conditions de Vie des Ménages (EHCVM) in Mali*

Self-reported Ethnicity in EHCVM (*b_group*)	Match for EA (*a_group*)	Direct Match	Match via Kincaide et al. (2020)	Match via LEDA	LEDA Index (ei_frac_b)	LEDA Source
Arabe	Kunta	No	No	Yes	1.000	Afrobarometer
Bamanan/Bambara	Bambara	Yes	No	No		
Bo/Bwa/Bobo	Bobo	Yes	No	No		
Bozo	Bozo	Yes	No	No		
Dafing	Soninke	No	Yes	Yes		
Dogon	Dogon	Yes	No	No		
Haoussa	Zazzagawa	No	Yes	Yes		
Kakolo	Bambara	No	Yes	Yes		
Khassonke/Khassonké	Kasonke	Yes	No	No		
Malinke/Malinké	Malinke	Yes	No	No		
Mamala/Minianka	Minianka	Yes	No	No		
Mossi	Mossi	Yes	No	No		
Peulh	Futajalonke	No	Yes	Yes		
Samogo	Samo	No	No	Yes	1.000	Afrobarometer
Senoufo	Senufo	Yes	No	No		
Somono	Bozo	No	No	Yes	1.000	IPUMS
Songhay/Sonrhai/Zarma	Songhai	Yes	No	No		
Soninké/Sarakolé	Soninke	Yes	No	No		
Souraka/Maure	Berabish	No	No	Yes	1.000	Afrobarometer
Tamasheq/Touareg	Antessar	No	No	Yes	1.000	Afrobarometer

Notes: The variable ei_frac_b measures the share of linguistic nodes associated with a survey self-reported ethnicity (*b_group*, from the EHCVM) that are covered by the corresponding EA group (*a_group*), using the LEDA linguistic concordance. Because the EHCVM (and LSMS–ISA surveys more generally) are not directly included in LEDA, self-reported ethnic categories are linked to the Ethnologue language tree through intermediary datasets such as Afrobarometer and IPUMS. The variable ei_frac_b measures the share of linguistic nodes associated with a survey self-reported ethnicity (*b_group*) that are covered by the corresponding EA group (*a_group*), based on the LEDA linguistic concordance. A value of $ei\_frac\_b = 1$ indicates that all linguistic nodes associated with the survey category are contained within the matched EA group. For matches reported as via Kincaide et al. (2020), the mapping from the survey category was first established using the LEDA concordance and subsequently reconciled with the EA classification provided in Kincaide et al. (2020).

Table A7: *Validation of Ethnographic Atlas (EA) Livelihood Categories in Mali Survey Data*

Panel A: High vs. Low Reliance on Agriculture (EA)

Variable	(1) Low EA Value	(2) High EA Value	(3) Difference
Pastoral Household	0.224	0.077	-0.147***
	(0.417)	(0.267)	(0.011)
Agricultural Household	0.105	0.100	-0.005
	(0.307)	(0.300)	(0.008)
Livestock Holdings (TLU Index)	4.234	3.035	-1.199***
	(9.675)	(5.413)	(0.254)
Landholdings (ha)	2.715	3.236	0.521
	(14.268)	(5.035)	(0.368)
Crop Diversification (Simpson Index, Area-Weighted)	0.137	0.202	0.065***
	(0.237)	(0.264)	(0.007)
Crop Diversification (Shannon Index, Area-Weighted)	0.225	0.334	0.109***
	(0.401)	(0.449)	(0.011)
Agricultural Assets Index (PCA, 0–1)	0.400	0.501	0.102***
	(0.194)	(0.167)	(0.006)
Observations	8,458	1,538	9,996

Panel B: High vs. Low Reliance on Animal Husbandry (EA)

Variable	(1) Low EA Value	(2) High EA Value	(3) Difference
Pastoral Household	0.163	0.674	0.510***
	(0.370)	(0.469)	(0.014)
Agricultural Household	0.111	0.019	-0.092***
	(0.314)	(0.136)	(0.012)
Livestock Holdings (TLU Index)	3.418	11.864	8.446***
	(7.523)	(18.863)	(0.338)
Landholdings (ha)	3.007	0.176	-2.831***
	(13.773)	(1.272)	(0.504)
Crop Diversification (Simpson Index, Area-Weighted)	0.158	0.007	-0.151***
	(0.248)	(0.060)	(0.009)
Crop Diversification (Shannon Index, Area-Weighted)	0.260	0.012	-0.248***
	(0.420)	(0.102)	(0.015)
Agricultural Assets Index (PCA, 0–1)	0.426	0.182	-0.244***
	(0.190)	(0.130)	(0.013)
Observations	9,248	748	9,996

Notes: This table compares livelihood classifications from the EA with contemporary household-level data from the EHCVM 2018–2022 in Mali (panel households observed in at least two waves, given that self-reported ethnicities are only present in the second wave). Household classifications (Pastoral HH and Agricultural HH) are mutually exclusive: a household is Pastoral if it owns non-zero TLU and zero land; Agricultural if it owns non-zero land and zero TLU. The TLU Index is constructed using FAO weights (e.g., 0.5 for cattle, 1 for camels), trimmed using an interquartile range (IQR) rule by animal species and region. Land represents total household landholdings in hectares, based on GPS plots measures complemented by self-reported values when missing, winsorized at the 99th percentile by region. Households are classified as High EA Value if the self-reported ethnicity of the household head corresponds to an EA cluster showing more than 50 percent reliance on agriculture (Panel A) or animal husbandry (Panel B). All differences are computed using two-sided t-tests. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.