Development Mismatch? Evidence from Agricultural Projects in Pastoral Africa

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Abstract: We study the consequences of a clash between contemporary development initiatives and traditional economic practices in Africa. Crop agriculture has expanded considerably across the continent in recent years. Much of this expansion has occurred in traditionally pastoral areas, where land is typically managed according to customary arrangements. This is believed to be a major cause of conflict between pastoral and agricultural ethnic groups. We test this hypothesis using geocoded data on agricultural development projects across Africa from 1995–2014. We find that implementing agricultural projects in traditionally pastoral areas leads to an almost two-fold increase in the risk of conflict. We find no equivalent effect for agricultural projects implemented in traditionally agricultural areas, nor for non-agricultural projects implemented in either location. We also find that this mechanism contributes to the spread of extremist-religious conflict in the form of jihadist attacks. The effects are muted when agricultural projects are paired with pastoral projects. This is more likely to occur when pastoral groups have more political power. Despite these effects on conflict, we find that crop agriculture projects increase nighttime luminosity in both agricultural and pastoral areas. Evidence from survey data suggests that the gains in pastoral areas are concentrated in non-pastoral households. Our findings indicate that "development mismatch"—i.e., imposing projects that are misaligned with local populations—can be costly.

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1. Introduction

States and donors typically implement development aid projects to reduce poverty and stimulate economic growth. Many such projects are in the agricultural sector, where investments in crop production are undertaken to increase the supply of food and accelerate structural transformation into the higher-value-added manufacturing and services sectors. In Africa, these agricultural projects often involve preparing marginal lands for commercial crop production since increases in productivity on the intensive margin are difficult to achieve.

We examine how the impact of these projects critically depends on the subsistence mode of local populations. If agricultural projects are situated in territories traditionally inhabited by agricultural ethnic groups, then there is consonance between the new investment and the existing way of life, potentially facilitating the adoption of new technologies. However, if agricultural projects are situated in areas that are traditionally used for grazing by pastoral ethnic groups, then there is dissonance between the new investment and the existing way of life, potentially fueling discord over land-use rights. This "mismatch" has been cited as a major driver of escalating violence in pastoral areas across the African continent in recent decades. In this paper, we empirically test the claim that agricultural development projects aggravate civil conflict in pastoral regions of Africa.

Transhumant pastoralism is a traditional economic practice that emerged around 7,000 years ago in response to rising aridity in northern Africa. In the wet season, herders traverse semi-arid pastoral areas in pursuit of plant biomass (*phytomass*) for grazing. In the dry season, herders migrate to neighboring agricultural areas, where they occupy more fertile farmlands that are left fallow after crops are harvested. The system is understood to be an efficient use of scarce resources in otherwise unproductive regions. It is facilitated by mobility, which permits pastoralists to withstand local weather shocks; flexibility, which allows for customary land use arrangements that update from year to year; and cooperation, which sustains production complementarities with neighboring agricultural ethnic groups who benefit from animals grazing on their farmland in return.

Despite this mutually beneficial arrangement, conflict between herders and farmers—and between herders and the state, which is typically aligned with farmers—is increasingly common in Africa. Figure 1 indicates that both the level and growth rate of conflict is higher in countries

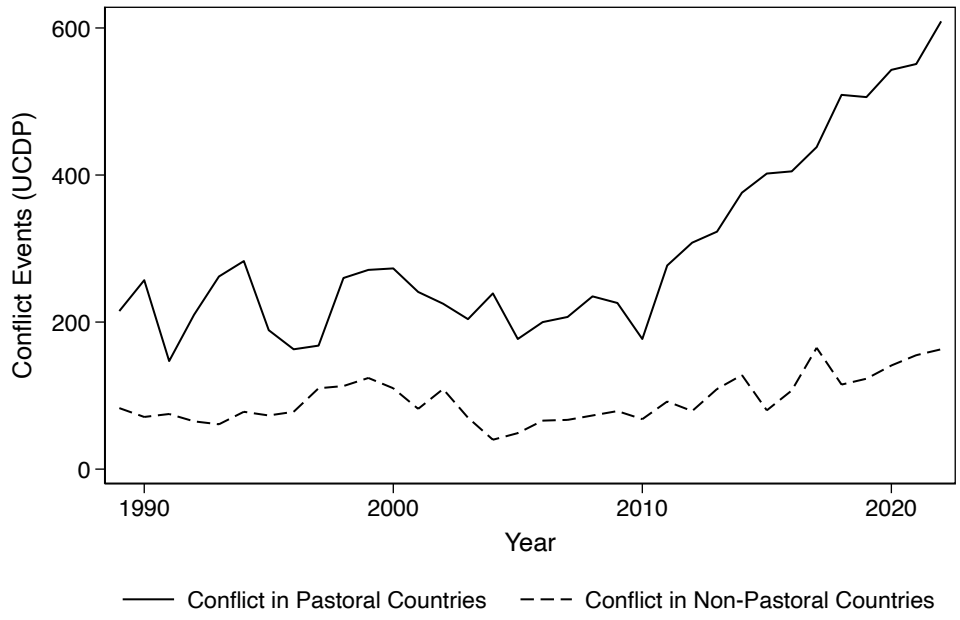


Figure 1: **Conflict Events in African Counties with Pastoral Territories.** Conflict event data is from UCDP (Sundberg and Melander, 2013). Data on the traditional location of pastoral territories is computed by the authors using information from the *Ethnographic Atlas* (Murdock, 1967).

that contain transhumant pastoral territories relative to those that do not. According to some accounts, the 'core' actors (comprising the state and its donors) tend to view pastoralism as "backward" (Catley, Scoones and Lind, 2013), "archaic" (Mattee and Shem, 2006) and "primitive" (Fratkin, Roth and Nathan, 2004). The imperative from their perspective is to sedentarize pastoral communities by expanding commercial crop agriculture into pastoral areas, modernizing production and fostering prosperity and peace.

The counterargument from the perspective of the 'periphery' (pastoralists) is that, in practice, expanding commercial crop agriculture into pastoral areas undermines the livelihoods of pastoral people. Commercial agriculture projects can hinder pastoral systems by blocking access to critical water points and grazing areas. Case study research also suggests that transhumant pastoralism is an efficient use of dryland resources compared to commercial crop agriculture plantations (Campbell, Leslie, Little, Brainard and DeLuca, 1999, Fratkin et al., 2004, Behnke and Kerven, 2013). These projects are thus enacted either because the government overestimates the benefits, underestimates the opportunity costs (i.e., forgone output from transhumant pastoralism), or nevertheless aims to replace pastoralism with crop agriculture because it is less costly to tax sedentary economic activities, even if they are less productive (Catley et al., 2013). From the perspective

of pastoralists, the imperative is to resist the forced settlement—or even displacement—that accompanies such projects.

Whether or not agricultural development projects ultimately lead to violence in pastoral territories is an empirical question. On the one hand, these projects may create a surplus, the benefits of which could compensate affected pastoral groups and thus ensure peace. On the other hand, case study accounts indicate that, due to their informal land management system, pastoralists are easily expropriated "in the national interest" (Zambakari, 2017). Since they are usually on the margins of national political power, they may resort to violence against the state if evicted.

We take this question to the data. We assemble a panel dataset at the level of a 0.5-degree cell (around 55km $\times$ 55km at the equator) covering the African continent. We combine three main sources of data. First, we use geocoded conflict event data from UCDP (covering the period from 1989–2020) and ACLED (1997–2020) to create measures of conflict incidence that are equal to one if there is any conflict observed in a cell-year and zero if there is none.[1] Second, we use geocoded World Bank development project data from Aid Data to create a cell-year level indicator for the presence of at least one development project. This data covers the period from 1995–2014. Third, we use ethnographic information on the traditional territories of transhumant pastoral ethnic groups to create an ethnic-territory-level measure of transhumant pastoralism (THP) (Murdock, 1959, 1967, McGuirk and Nunn, 2024). We take advantage of the sector labels in the World Bank data and ask if agricultural projects have a differential effect on the incidence of conflict in THP territories relative to non-THP territories. We estimate difference-in-differences (DD) style parameters in regressions that control for cell fixed effects and country-by-year fixed effects.

We first find that, in non-THP territories, cells that receive an agricultural project experience a significant reduction in conflict (-1.9 p.p., $p<0.01$) compared to other cells. However, we see a very large and significant increase (+9.7 p.p., $p<0.01$) when we allow the estimates to vary by the THP index. This estimate captures the difference between the DD estimates for THP and non-THP territories. It thus allows for cell-level sources of selection bias that vary over time but are common across both types of territories. The estimate is similar for both UCDP and ACLED outcomes.

We then allow the agricultural development projects to vary by subtype, distinguishing be-

[1] See Sundberg and Melander (2013) and Raleigh, Linke, Hegre and Karlsen (2010)

tween crop agriculture projects, of which there are 3,801, and pastoral projects, which are rare in comparison (592). The hypothesis implies that the THP difference ought to be driven by crop agriculture projects, which are mismatched, and not pastoral projects, which are not. We see precisely this pattern. For crop agriculture projects, the THP difference is +12.8 p.p. ($p<0.01$), while for pastoral projects, it varies between -12.7 p.p. ($p<0.05$) for UCDP and -5.8 p.p. ($p>0.10$) for ACLED. Since pastoral projects tend to be bundled with crop agriculture projects, this estimate effectively implies that the main mismatch effect in THP territories is either partially or entirely offset when the state also includes pastoral development projects.

Finally, we also allow non-agricultural projects to enter the estimating equation as a placebo treatment. These comprise around 74% of all projects and include initiatives on infrastructure, energy, health, education, and many other sectors. We find that these projects have no differential effect on conflict in THP territories. Moreover, we show that the THP difference for crop agriculture is itself significantly different from the equivalent effect for non-agricultural projects. This amounts to a difference in triple difference comparison. It allows for cell-level selection bias that varies over time and is specific to THP areas, but common across crop agriculture and non-agriculture project types.

While the various differencing procedures account for concerns over selection bias that one would typically consider in this type of application, we proceed with two additional exercises to probe the robustness of our main findings. First, using the Callaway and Sant'Anna (2021) estimator, we plot event study estimates that show parallel trends before treatment and a sharp divergence thereafter. Second, we exploit a natural experiment based on a 'supply shock' of agricultural development projects funded by the World Bank: an unusual surfeit of projects launched around the time the Bank produced its *World Development Report* on agriculture in 2008. Using this variation, we find results consistent with our main multi-way differencing estimates.

Having established the connection between agricultural development projects and civil conflict in pastoral areas, we then explore various implications of these findings that are relevant for policy. We begin by examining the growing presence of religious-extremist conflict—specifically jihadist conflict—in Africa. Since there are many more Muslims than Christians in THP groups, and again more Christians then Muslims in agricultural groups, it is plausible that the effects we identify have a religious dimension. For example, jihadist groups may be able to exploit disaffected young pastoral men who are displaced as a result of agricultural expansion in pastoral

areas. In this case, jihadist groups may provide resources (including weapons) in exchange for membership, resulting in conflict events that are categorized as jihadist.[2] We test for this using information reported in the UCDP conflict data that allows us to categorize conflict events into those involving self-styled jihadist groups and those that do not. The (scaled) estimates indicate that jihadist conflict responds to agricultural expansion in a very similar way to non-jihadist conflict, implying that extremism is, in part, a response to government policy (Berman and Laitin, 2008).

Next, in order to better understand the mechanisms at play, we study changes in economic activity. First, using satellite data on land use, we find that agricultural projects lead to an expansion of cropland coverage in traditionally pastoral territories, but not in agricultural territories. This finding suggests that the objective of these projects is to increase production at the extensive margin in pastoral areas and the intensive margin in agricultural areas. Second, we find that agricultural projects also contribute to an increase in nighttime light emissions in both agricultural and pastoral areas. Taken together, these findings indicate that agricultural projects succeed in generating economic activity in pastoral areas by expanding cropland coverage, implying that the increase in conflict we observe is unlikely due to implementation failures.

Instead, it suggests that, in pastoral areas, mismatched projects lead to sharply diverging development outcomes for different population subgroups. We find patterns consistent with this interpretation using survey data from the Demographic and Health Surveys (DHS). Pastoral respondents exposed to mismatched crop agriculture projects—-i.e., crop agriculture projects in traditionally pastoral areas—report significantly lower wealth than non-pastoral respondents in the same cell. In agricultural areas, by contrast, the absence of conflict suggests that the gains from projects there are broadly shared or, at least, that projects do not inflict sufficient harm on subgroups to elicit a violent response. Consistent with this interpretation, we do not see a corresponding divergence between households where projects are not mismatched. Pastoral respondents appear to benefit at least as much as non-pastoral respondents from crop agriculture projects that are located in traditionally agricultural areas.

Finally, we examine the role of political power in moderating our estimated effects. Using data from the *Ethnic Power Relations* dataset, we measure the share of political power that is

[2]For an account on how jihadists exploit farmer-herder tensions, see The Economist, "Fanatics and putschists are creating failed states in west Africa," August 1st, 2023.

held by pastoral groups in the national government of a country in a year. We find that when pastoral groups have more political power, crop agriculture projects are more likely to be paired with animal production projects in pastoral territories. This appears to come at the expense of non-agricultural projects. Since animal production projects offset the effects of crop agriculture projects on conflict, this finding uncovers one channel through which pastoral political power suppresses conflict in pastoral areas. While correlational, these patterns provide evidence more generally of a mechanism linking political power sharing to peace.

This paper contributes to a relatively nascent literature in economics on the importance of local characteristics in shaping the success or otherwise of development projects (Ashraf, Bau, Nunn and Voena, 2020, Lowes and Montero, 2021), which itself follows a rich tradition in anthropology and political science (e.g., Ferguson, 1994, Scott, 1998).

This paper also builds on a multidisciplinary case study literature on land-use tensions and pastoralism in Africa (e.g., see Catley et al., 2013), as well as an established ethnographic literature on the nature of transhumance in Africa (Lewis, 1961, Jacobs, 1965, Konczacki, 1978, Dyson-Hudson and Dyson-Hudson, 1980). In so doing, our paper contributes to a thin but growing literature in economics on animal husbandry in Africa, which tends to focus on poverty and risk management within pastoralist groups (Little, Smith, Cellarius, Coppock and Barrett, 2001, McPeak and Barrett, 2001). We continue in the spirit of McGuirk and Nunn (2024), which focuses on relations between pastoral and other groups. In that paper, the symbiotic relationship between neighboring farmers and herders is undermined by drought in transhumant pastoral territories, which forces herders to migrate to nearby farmland before the harvest, generating conflict over resources. The present paper indicates that conflict between these groups is not only due to environmental changes; it is also a direct consequence of government policies.

Other papers focus on the behavioral consequences of ancestral pastoralism in contemporary populations. Nazarova (2020) and Le Rossignol and Lowes (2022) show respectively that individuals from pastoral backgrounds are today more risk tolerant and are relatively more likely to exhibit altruism towards in-group members than out-group members. Cao, Enke, Falk, Giuliano and Nunn (2021) further show that contemporary linguistic groups that descend from pastoral societies exhibit "culture of honor" traits, such as revenge-taking and violence. These characteristics are understood to complement the traditional pastoral way of life, which can absorb idiosyncratic shocks and reward in-group cohesion and out-group aggression. Relatedly,

Becker (2019) finds that women from pastoral backgrounds face restrictive gender norms, a trait linked to seasonal male absence in traditional pastoral societies.

Rather than focusing on the origins of these fixed characteristics, we instead shed light on political economy decisions that raise the risk of conflict between pastoral and non-pastoral groups, including the state. In this respect, we contribute to a rich literature that aims to understand when and where inter-group divisions become more salient (Posner, 2004, Eifert, Miguel and Posner, 2010, Hjort, 2014, Yanagizawa-Drott, 2014, Depetris-Chauvin, Durante and Campante, 2020, Mousa, 2020, Berge, Bjorvatn, Galle, Miguel, Posner, Tungodden and Zhang, 2020, Lowe, 2021), and eventually spark conflict (Montalvo and Reynal-Querol, 2005, Esteban, Mayoral and Ray, 2012, Rohner, Thoenig and Zilibotti, 2013, Michalopoulos and Papaioannou, 2016, Berman, Couttenier, Rohner and Thoenig, 2017, McGuirk and Burke, 2020, Moscona, Nunn and Robinson, 2020, Arbatli, Ashraf, Galor and Klemp, 2020, Eberle, Rohner and Thoenig, 2020).

2. Background

In this section, we first outline the rationale for converting land use from pastoralism to agriculture from the perspective of the 'core' actors, defined as the state and its donors. We discuss the conditions under which these conversions ought to avoid conflict with pastoral groups. We then contrast this framework with on-the-ground accounts of agricultural development projects in pastoral areas of Africa.

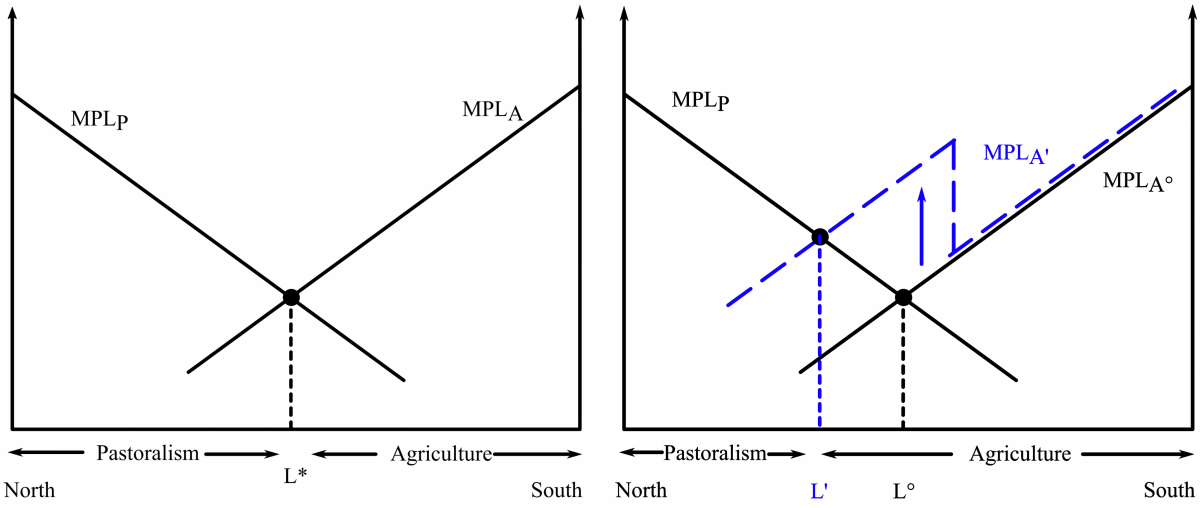
A. The Economic Logic of Land Use Conversions

Consider a state containing a continuum of land from North to South (Figure 2a). In the North, pastoralism is more productive; in the South, agriculture is more productive. The marginal product of labor for each activity along the land continuum is denoted by MPL_P and MPL_A, respectively. The point at which these curves intersect, L^*, defines the efficient border between each land use type. That is, the allocation of land that maximizes aggregate output.

Suppose the state aims to increase crop output by investing in an agricultural capital project. Since raising yields on the intensive margin is costly to achieve in Africa (Babcock, 2015), it is plausible that the returns to agricultural investment are relatively lower in areas closer to

the South. In such scenarios, the most profitable project is one that converts marginal land for commercial crop production via, e.g., a large-scale irrigation project.

We illustrate the comparative statics in Figure 2b. The development project increases the productivity of agriculture in marginal areas, as represented by the shift from the old MPL_{A^o} to the new $\text{MPL}_{A'}$. As a result, the efficient border shifts from L^o to $L^{'}$, implying that the land segment $|L^o - L^{'}|$ is optimally converted from pastoralism to agriculture. This conversion ensures that aggregate output is maximized and is greater than initial output in part (a).



(a) Initial land use distribution

(b) Land use distribution after local investment in agricultural productivity

Figure 2: **Economics of Land Use Conversions.**

B. Transhumant Pastoralism, Land Use Conversions, and Conflict

As the new equilibrium at $L^{'}$ is more efficient, there is no obvious reason why conflict should emerge between pastoralists and the state and/or agriculturalists. The additional surplus could be allocated such that all groups are better off. For example, pastoralists could exit the marginal area in exchange for transfers generated from the additional output. Alternatively, they could remain in the area with a view to adopting new technologies and converting their livelihoods to agriculture. Either of these arrangements could ensure a Pareto improvement, rather than a zero-sum redistribution.

Whether this Coasian solution occurs in reality is the subject of an extensive case study literature. While, in theory, there exist conditions under which conflict is avoided, in practice, there are several examples of violent conflict emerging in the wake of agricultural development projects

in pastoral areas. The typical path is summarized concisely by Zambakari (2017, pp. 200–203), for the case of Sudan. He argues that, first, transhumant pastoralists are especially susceptible to expropriation because they traditionally rely on communal land use without resorting to formal titling. In such customary regimes, common pasture land is "vulnerable to expropriation [...] in the 'national interest."' Second, transhumant pastoral communities are indeed evicted specifically to make way for the preparation of land for commercial crop agriculture projects. Third, as they are typically on the margins of political power, these evicted communities have resorted to violence in dealing with the state: "[t]he displacement caused by mechanized farming remains a major source of grievance and conflict."

This experience is echoed in other parts of the continent, including the Awash Valley project in Ethiopia (Getachew, 2001, Behnke and Kerven, 2013), the Tana River Delta in Kenya (Umar, 1997, Nunow, 2013) and dryland areas of northern Ghana (Soeters, Weesie and Zoomers, 2017, FAO, 2018). Some episodes receive attention in international media outlets, such as in the Omo valley in Ethiopia, where the 30,000-hectare Koka plantation precipitated violence between displaced Suri pastoralists and Dizi agriculturalists, who were perceived by the Suri to be collaborating with the government. The first episode of violence involved the murder of three Dizi police officers, who were marking land for expansions of the plantation. In retaliation, government forces reportedly killed 54 Suri civilians in a marketplace.[3]

Since conflict is extraordinarily costly, these accounts raise the question of why states and their donors persist with such projects. Catley et al. (2013) summarize three potential explanations. The first is that states overestimate the benefits. Agricultural projects require costly maintenance, and new farmers require detailed knowledge of input and output markets. In practice, these conditions may not hold, especially in semi-arid areas. The second is that states underestimate (or underweight) the opportunity costs, i.e., forgone production from displaced pastoral activities. Pastoralists are apparently viewed by the core actors to be "at once baffling, unruly, threatening and backward," and in need of civilizing. This stems from the belief that transhumant pastoralism is unproductive relative to other subsistence modes. For example, in his 2005 inaugural speech to parliament, Tanzanian President Jakaya Kikwete argued that mobile herders should modernize

[3]See "'Nightmare' for Ethiopian pastoralists as foreign investors buy up land," published in The Guardian newspaper on Nov 10th, 2014 and available at the following URL: https://www.theguardian.com/global-development/2014/nov/10/ethiopia-pastoralists-foreign-investors-land; as well as "Ethiopia dam project is devastating the lives of remote indigenous groups," published in The Guardian on Feb 6th, 2013 and available at: https://www.theguardian.com/global-development/2013/feb/07/ethiopian-dam-project-devastating-remote-tribes.

production and become sedentary (Mattee and Shem, 2006). In 2006, he maintained that "we have to do away with archaic ways of livestock farming." Contrasting this perception is ample evidence that transhumant pastoralism is a comparatively efficient use of scarce resources in harsh environments, namely drylands, mountainous areas, and tundra (Schlee, 2013). Behnke and Kerven (2013) compare output from transhumant pastoralism and irrigated agriculture in the Awash valley in Ethiopia, finding that cotton and sugar cane production generally yield less per hectare than leaving the land to the Afar pastoralists who were displaced by the project. Relatedly, Campbell et al. (1999) find that pastoral Turkana are healthier than recently sedentarized Turkana, while Fratkin et al. (2004) observe similar differences amongst pastoral and sedentarized Rendille in northern Kenya. These patterns are consistent with pastoral resistance toward efforts to sedentarize through large-scale agricultural development projects.

The third explanation does not assume an information deficit on the part of the state. Because transhumant pastoralists are mobile, their economic activities are difficult to monitor, and hence, they are rarely taxed. Thus, even if transhumant pastoralism is more productive than irrigated agriculture, its output is less accessible to the state. If we replace the assumption that states maximize aggregate output with the assumption that they instead maximize taxable output, as in Scott (2009), then converting land use from pastoralism to agriculture is potentially desirable, even if it results in a loss of welfare for incumbent pastoral groups.

These explanations provide insight into why states might persist with land use conversions in pastoral areas, even if they carry a risk of violent resistance. However, they do not provide the necessary conditions for conflict. In this sense, it is plausible that agricultural projects do not cause conflict at all. It may be the case that the on-the-ground accounts are not broadly representative. It may be that they reflect spurious correlation—mixed-use areas might be prone to conflict independent of these projects, or states may allocate projects to areas where the risk of conflict increases for other reasons. Thus, due to omitted variables or selection bias, we might observe an association between agricultural development projects and conflict that is not causal.

We proceed to the empirical analysis in this spirit. We aim to test the hypothesis that agricultural development projects lead to an increased risk of conflict when they are assigned to traditionally pastoral areas.

3. Data

Structure We assemble a panel dataset at the level of a 0.5-degree cell and year, covering the continent of Africa. There are 10,229 cells. We overlay the gridded dataset with a map of pre-colonial ethnic societies from Murdock (1959). Excluding uninhabited territories and lakes, we are left with 9,691 cells. We denote cells by i and ethnic territories by e. Cells are nested in ethnic territories according to the location of their centroids.

Conflict Our main outcome variable is a conflict incidence indicator variable that equals one if there is at least one violent conflict event in a cell and year and zero otherwise. An event can be a two-sided battle between armed groups or it can be a one-sided attack on civilians. We use two sources of geocoded conflict event data: the Uppsala Conflict Data Program (UCDP), which began coverage in 1989, and the Armed Conflict Location and Event Data project (ACLED), which began coverage in 1997.

To be included in the UCDP data, events must result in at least one fatality, and they must involve a dyad that generated 25 fatalities in at least one year in the data series. There is no fatality minimum for inclusion in the ACLED data. In this respect, the UCDP data can be considered a measure of larger-scale violent events between major civil conflict actors.

Owing primarily to its longer coverage, we use UCDP conflict incidence as the main outcome variable. We also report estimates using the ACLED outcome in each regression table. In addition to the main conflict incidence variables, we additionally use sub-categories for the incidence of conflict involving the state and conflict not involving the state.

World Bank Development Projects To measure development projects, we rely on richly detailed, geocoded data on projects funded by the World Bank from 1995–2014. The dataset is assembled and organized by the AidData research lab (AidData, 2020). Each observation in the data is for a specific project site. There are 14,879 project sites in Africa in our sample. We define agricultural projects as those for which "agriculture" is listed as one of the sector categories in the AidData dataset. These comprise 26% of project sites. We define non-agricultural projects as the rest (74%).

Within agricultural projects, we further distinguish between two sub-categories: crop agriculture, which comprises 3801 projects (98.9%), and "animal production" (i.e., pastoral), which

comprises 592 projects (15.4%). These sum to more than 100% because most animal production projects are bundled with crop agriculture projects.

To measure the appropriate treatment year for each project, we aim to identify the earliest date possible of the project life cycle. This is to capture incidents such as the one that began the Suri-Dizi conflict mentioned above, where Dizi police officers were killed for marking potential expansions of a plantation. In the World Bank data, this corresponds to what we define as the *initiation* date, which is when a project is assigned a unique ID number internally for record keeping. While the initiation date is not provided in the AidData dataset, we do observe the ID number, which is assigned chronologically, and the *transaction* date, which is later in the project life cycle (Kilby, 2013). To estimate the initiation date for each project, we first identify the projects with the shortest life cycle, i.e., the shortest gap between the initiation date and the transaction date. These are the projects with the highest ID numbers in a given period of transactions, e.g., per month. Using this sample, we estimate the transaction date as a linear function of the ID number. Using estimates from that regression, we predict the initiation date for all projects in the dataset using their ID number. The process yields an estimated initiation year that is 2.04 years earlier on average than the transaction year provided in the dataset. We proceed using this initiation year to measure our treatment timing.[4]

Transhumant Pastoralism We measure transhumant pastoralism at the level of an ethnic group e as in McGuirk and Nunn (2024), building on Becker (2019). It is an index between 0 and 1 measuring an ethnic society's reliance on mobile animal husbandry, as documented in the *Ethnographic Atlas* (Murdock, 1967). There are three components: an indicator for whether the ethnic group is mobile (1) or sedentary (0); a 0-1 index measuring the share of subsistence derived from animal husbandry (as opposed to, e.g., crop agriculture); and an indicator equal to one for ethnic groups relying on herding animals (e.g., bovine, equine, sheep, goats, etc.) rather than sedentary (e.g., poultry, pigs) or no animals (0). The THP index is the interaction between all three components.

Other data We introduce other variables as they appear in the paper. We present summary statistics and difference-in-means estimates between pastoral and non-pastoral territories for all variables in Appendix Tables A1–A4.

[4]We also check our main results using the given transaction date.

4. Estimation

Our main empirical strategy is to estimate the effect of agricultural development projects on conflict incidence using the following specification:

$$\begin{aligned} y_{it} &= \beta_1 THP_{e(i)} \times AgricultureProject_{it} + \beta_2 AgricultureProject_{it} \\ &\quad + \lambda_t THP_{e(i)} + \alpha_i + \alpha_{c(i)t} + \eta_{it}, \end{aligned} \tag{1}$$

where i indexes cells, t years, $e(i)$ the ethnic group that traditionally inhabited the territory in which a cell is located, and $c(i)$ the country in which a cell is located. The dependent variable y_{it} is the conflict incidence indicator for cell i and year t; $THP_{e(i)}$ is the index of transhumant pastoralism for the territory e in which cell i is nested; and $AgricultureProject_{it}$ is an indicator equal to one if an agricultural development project has been initiated in cell i by year t. Since this is an absorbing treatment—i.e., it switches from 0 to 1 but not from 1 to 0—we control for year fixed effects interacted with the transhumant pastoral index, $\lambda_t THP_{e(i)}$. This captures all shocks and trends that are common to THP areas. We additionally control for cell fixed effects α_i and country-by-year fixed effects $\alpha_{c(i)t}$. We cluster standard errors by cell, to allow for serial correlation within cells, and by country-year, to allow for spatial correlation across cells within countries.

The parameter β_2 captures the average difference-in-differences (DD) effect of agricultural projects in non-THP areas, as estimated by two-way fixed effects regression. Our parameter of interest, β_1, captures the additional effect of these projects in THP areas relative to non-THP areas. With the inclusion of cell fixed effects, both parameters allow for time-invariant sources of omitted variable bias, such as a cell's proclivity to observe conflict due to geographical or historical factors. With the inclusion of country-by-year fixed effects, both also allow for time-varying sources of endogeneity at the level of a country, such as changes to national political institutions or other macroeconomic factors. Importantly, β_1 additionally allows for time-varying sources of selection bias at the level of a cell that are common to projects in both THP and non-THP territories. For example, if a state assigns agricultural projects to cells in which they perceive the risk of conflict to be changing. In this respect, it resembles a triple difference in spirit, which requires weaker identifying assumptions than the standard DD estimator.

Our analysis proceeds in five steps. We begin by presenting event-study-style plots using raw data. Our objective is to compare mean conflict incidence by cell in years before and after the

initiation of an agricultural project, in both THP and non-THP territories. Second, we present estimates based on our main fixed effects regression equation above. These are the main findings of the paper. Third, we present event study plots based on those regressions, which allows us to track the evolution of treatment effects over time. We use the procedure in Callaway and Sant'Anna (2021), which corrects for bias due to treatment effect heterogeneity. Fourth, as a robustness check, we exploit variation generated from an unusual surfeit of World Bank agricultural projects that were supplied from 2006–2008 and coincided with the publication of the *World Development Report* on agriculture. This provides an alternative means of estimating our relationship of interest. In the final sub-section, we examine the effect of projects on extremist religious violence, which is plausibly shaped by mismatched projects in pastoral areas.

A. Raw Data Differencing

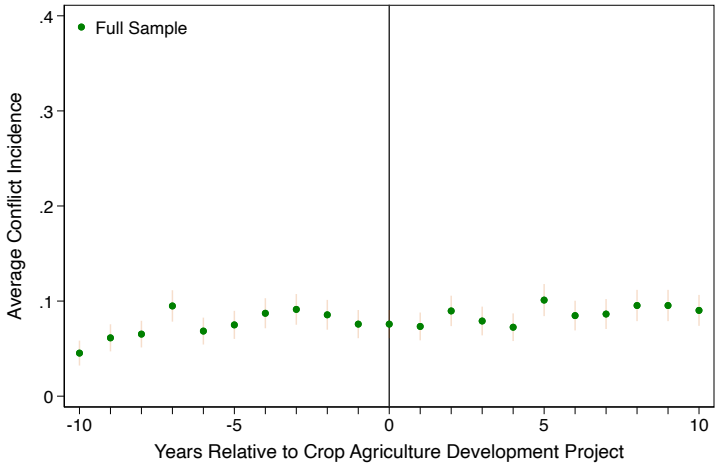
In Figure 3a, we present mean conflict incidence at the level of a cell in the years before and after a crop agriculture project is initiated. This sample contains only cells that ever receive a project. We see no obvious change in conflict after a project is initiated, although there appears to be slightly more variance.

In Figure 3b, we split the sample between THP and non-THP cells. Here, a sharp divergence appears in THP cells once a project is initiated. Conflict after the project is markedly higher. By contrast, no such divergence appears for the non-THP cells.

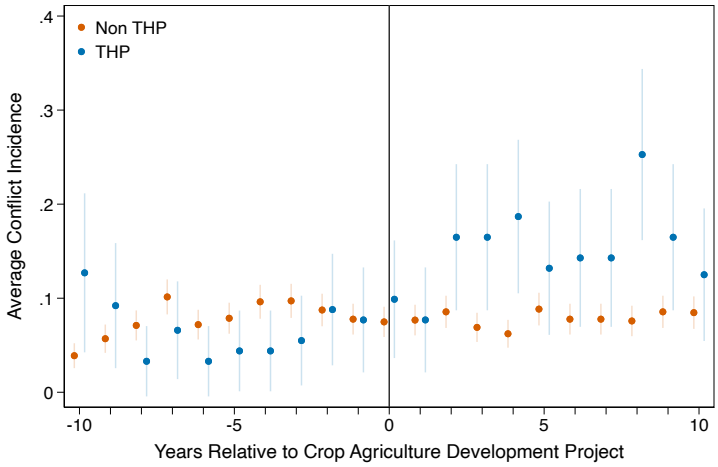
In Figure 3c, we replace the crop agriculture project variable with the non-agricultural project variable. This measures projects on, for example, education, health, energy, infrastructure, and governance. We consider this as a placebo treatment variable since it includes many characteristics of the treatment variable—including contact with the state and other providers of public services—without changes in land use toward agriculture. Here, we see no divergence after a project is initiated.

B. Multi-Way Differencing with Fixed Effects

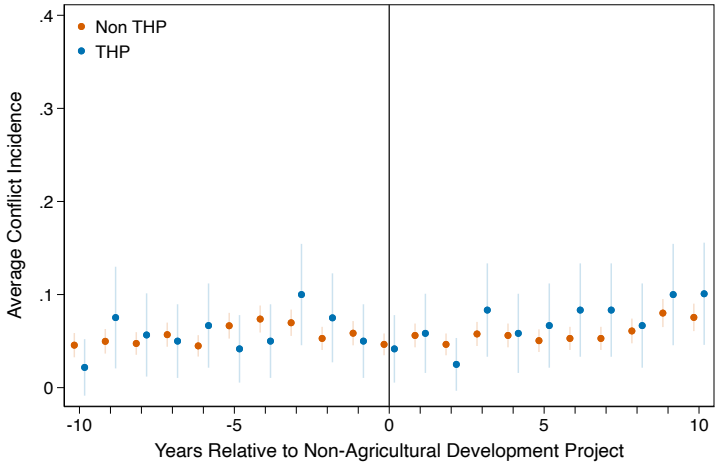
In Table 1, we present estimates from our main specification. Focusing on column 1, where the outcome variable is UCDP conflict incidence, we estimate a coefficient of -0.019 ($p<0.01$) for β_2. This estimate implies that, in non-THP areas, conflict incidence falls by around 48% of the sample mean in cells where an agricultural project is initiated relative to other non-THP cells. This is



(a) Mean UCDP Conflict Incidence and Temporal Proximity to Crop Agriculture Project: Full Sample



(b) Mean UCDP Conflict Incidence and Temporal Proximity to Crop Agriculture Project: THP and Non-THP Territories



(c) Mean UCDP Conflict Incidence and Temporal Proximity to Non-Agricultural Project: THP and Non-THP Territories

Figure 3: **Raw Data Differences**

Table 1: Differential Effect of Agricultural Aid on Conflict in THP vs. Other Territories

	I(UCDP Conflict)			I(ACLED Conflict)		
	(1) Any	(2) State	(3) Non-State	(4) Any	(5) State	(6) Non-State
Transhumant Pastoral × Agricultural Project	0.0968***	0.1073***	0.0114	0.0893**	0.0683*	0.0480
	(0.0369)	(0.0323)	(0.0180)	(0.0376)	(0.0374)	(0.0301)
Agricultural Project	-0.0190***	-0.0197***	-0.0098**	-0.0047	-0.0146**	0.0053
	(0.0065)	(0.0057)	(0.0049)	(0.0079)	(0.0068)	(0.0063)
Additional Calculations						
Total Effect in Median THP Area	0.0396	0.0453	-0.0029	0.0493	0.0267	0.0343
p-value	[0.07]	[0.02]	[0.78]	[0.03]	[0.24]	[0.06]
Dep. Var. Mean	0.0323	0.0235	0.0150	0.0648	0.0384	0.0450
THP × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes
Cells	8,813	8,813	8,813	8,813	8,813	8,813
Country-Years	980	980	980	882	882	882
Observations	176,260	176,260	176,260	158,634	158,634	158,634

Note: All outcome variables measure conflict incidence at the level of a cell-year. "I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year. "I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year. Standard errors, which are reported in parentheses, are adjusted for two-way clustering at the levels of a cell and a country-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

consistent with a large literature documenting how productivity shocks in labor-intensive sectors tend to lower the risk of conflict (Dal Bo and Dal Bo, 2011, Dube and Vargas, 2013, Harari and La Ferrara, 2018, McGuirk and Burke, 2020).

By contrast, the estimate for β_1 is +0.097 (p<0.01), three times the sample mean. This indicates the differential effect in THP areas relative to non-THP areas. It allows for time-varying sources of selection bias that are common between THP and non-THP areas. In the middle panel of the table, we predict the total effect of an agricultural project in the typical THP area, which we define as the median THP index value conditional on being greater than zero. In these cells, a project is predicted to increase the risk of conflict by 4 p.p, or 123% of the sample mean.[5]

In both the UCDP and ACLED data, the THP interaction effect is driven mainly by conflict involving the state rather than conflict not involving the state. The pacifying effect of projects in agricultural areas is significant for both state and non-state conflict in the UCDP data, but only state conflict in the ACLED data.

We next separate the $AgricultureProject_{it}$ variable into the crop agriculture component and the animal production (i.e., pastoral) component. The theoretical expectation is straightforward. If conflict is due to land use conversions from pastoralism to agriculture, then the estimate for β_2

[5]The calculation is: $(0.0968 \times 0.605) - 0.0190 = 0.0396$.

Table 2: Crop Agriculture Vs. Animal Production Projects

	I(UCDP Conflict)			I(ACLED Conflict)		
	(1) Any	(2) State	(3) Non-State	(4) Any	(5) State	(6) Non-State
Transhumant Pastoral × Crop Agriculture Project	0.1275***	0.1346***	0.0192	0.1044***	0.0953**	0.0400
	(0.0386)	(0.0366)	(0.0143)	(0.0404)	(0.0417)	(0.0276)
Crop Agriculture Project	-0.0177**	-0.0199***	-0.0074	-0.0027	-0.0165**	0.0104
	(0.0069)	(0.0061)	(0.0053)	(0.0086)	(0.0075)	(0.0071)
Transhumant Pastoral × Animal Production Project	-0.1269**	-0.1137***	-0.0306	-0.0578	-0.0975**	0.0288
	(0.0573)	(0.0414)	(0.0345)	(0.0512)	(0.0440)	(0.0503)
Animal Production Project	-0.0072	0.0007	-0.0127	-0.0028	0.0110	-0.0211
	(0.0108)	(0.0096)	(0.0089)	(0.0147)	(0.0118)	(0.0145)
Additional Calculations						
(THP × Crop Ag.) + (THP × Animal Prod.)	0.0006	0.0209	-0.0114	0.0465	-0.0022	0.0688
p-value	[0.99]	[0.50]	[0.77]	[0.36]	[0.95]	[0.21]
Total Crop Ag. Effect in Median THP Area	0.0594	0.0616	0.0042	0.0604	0.0411	0.0346
p-value	[0.01]	[0.01]	[0.61]	[0.01]	[0.10]	[0.03]
Dep. Var. Mean	0.0323	0.0235	0.0150	0.0648	0.0384	0.0450
THP × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes
Cells	8,813	8,813	8,813	8,813	8,813	8,813
Country-Years	980	980	980	882	882	882
Observations	176,260	176,260	176,260	158,634	158,634	158,634

Note: All outcome variables measure conflict incidence at the level of a cell-year. "I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year. "I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year. Standard errors, which are reported in parentheses, are adjusted for two-way clustering at the levels of a cell and a country-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 3: Differencing Against Non-Agricultural Projects

	I(UCDP Conflict)			I(ACLED Conflict)		
	(1) Any	(2) State	(3) Non-State	(4) Any	(5) State	(6) Non-State
Transhumant Pastoral × Crop Agriculture Project	0.1271***	0.1341***	0.0190	0.1021**	0.0933**	0.0396
	(0.0382)	(0.0364)	(0.0138)	(0.0407)	(0.0420)	(0.0279)
Crop Agriculture Project	-0.0161**	-0.0188***	-0.0069	-0.0021	-0.0159**	0.0106
	(0.0067)	(0.0059)	(0.0053)	(0.0084)	(0.0073)	(0.0071)
Transhumant Pastoral × Animal Production Project	-0.1271**	-0.1141***	-0.0306	-0.0606	-0.0999**	0.0284
	(0.0566)	(0.0415)	(0.0335)	(0.0516)	(0.0439)	(0.0507)
Animal Production Project	-0.0062	0.0014	-0.0124	-0.0024	0.0114	-0.0209
	(0.0108)	(0.0096)	(0.0089)	(0.0147)	(0.0118)	(0.0145)
Transhumant Pastoral × Non-Agricultural Project	0.0014	0.0034	0.0004	0.0259	0.0225	0.0039
	(0.0190)	(0.0122)	(0.0150)	(0.0255)	(0.0201)	(0.0179)
Non-Agricultural Project	-0.0130**	-0.0085*	-0.0039	-0.0055	-0.0054	-0.0019
	(0.0052)	(0.0046)	(0.0036)	(0.0071)	(0.0064)	(0.0055)
Additional Calculations						
Total Crop Ag. Effect in Median THP Area	0.0609	0.0623	0.0046	0.0597	0.0405	0.0346
p-value	[0.01]	[0.00]	[0.56]	[0.02]	[0.11]	[0.04]
THP × Crop Agriculture = THP × Animal Production (p-value)	0.002	0.001	0.159	0.036	0.012	0.850
THP × Crop Agriculture = THP × Non-Agricultural Aid (p-value)	0.002	0.000	0.303	0.129	0.158	0.334
Dep. Var. Mean	0.0323	0.0235	0.0150	0.0648	0.0384	0.0450
THP × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes
Cells	8,813	8,813	8,813	8,813	8,813	8,813
Country-Years	980	980	980	882	882	882
Observations	176,260	176,260	176,260	158,634	158,634	158,634

Note: All outcome variables measure conflict incidence at the level of a cell-year. "I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year. "I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year. Standard errors, which are reported in parentheses, are adjusted for two-way clustering at the levels of a cell and a country-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

ought to be driven entirely by crop agriculture projects and not animal production projects. As reported in Table 2, this is precisely what we see. Focusing again on column 1, the THP difference for crop agriculture is +12.8 p.p. ($p<0.01$). Notably, the THP difference for animal production is almost symmetrically opposite at -12.7 p.p ($p<0.05$). Since animal production projects are bundled with crop agriculture in pastoral areas, we compute the combined THP difference in the first row of the middle panel. It is not significantly different from zero in any of the six columns. This implies that when crop agriculture projects in pastoral territories are paired with animal production projects, there is no additional effect on conflict relative to non-THP areas. In effect, pastoral development projects entirely offset the deleterious effect of agricultural projects in pastoral territories.

Finally, we report estimates of our most complete specification, which includes an indicator for non-agricultural projects and the corresponding THP interaction. This addition serves three

important purposes. First, these are important control variables since World Bank projects of different types may be correlated across space and time. Second, the THP interaction allows us to check whether THP cells respond differently to aid of any type relative to non-THP cells. It may be the case that contact with the state due to other development project types may also spark conflict in THP areas. Third, the THP interaction serves as a placebo treatment. By comparing the THP interactions for crop agriculture versus non-agriculture projects, we can determine statistically whether or not the specific nature of the project—i.e., crop agriculture—significantly affects conflict, holding constant other characteristics common to aid projects in general. This comparison allows for time-varying selection bias at the level of a cell that is specific to THP areas but common across aid types. Thus, it is a very different identifying assumption to the one we make in estimating β_2 in equation (1) (Tables 1 and 2).

The estimates, which we report in Table 3, reinforce our findings. First, our main estimates of interest remain large and significant. The total effect of a crop agriculture project in the median THP territory ranges from 6.1 p.p. to 6.0 p.p. across the two main specifications (columns 1 and 4). The effect is almost twice the sample average for UCDP all conflict incidence (189%), between two and three times the sample average for UCDP state conflict (265%), and around equal to the mean for ACLED all conflict and state conflict (92% and 105% respectively). Second, we note that none of the THP interactions for non-agricultural projects are statistically significant. This implies that conflict in pastoral communities is not affected by aid in general; it is a function of crop agriculture specifically. Third, we show that the difference between the THP interactions for crop agriculture and non-agriculture projects is itself significant for the UCDP outcomes ($p<0.01$) but not for ACLED outcomes. We also confirm that the THP interactions for crop agriculture and animal production are significantly different across both main specifications.[6]

Taken together, this exercise indicates that crop agriculture projects significantly increase the risk of conflict in traditionally pastoral territories of Africa. The effect is robust to allowing for

[6]We include four additional robustness tests in the Appendix. In Table A5, we allow the Crop Agriculture Project treatment to vary by other ethnicity-level characteristics: pre-colonial jurisdictional hierarchy, religion (both from the *Ethnographic Atlas*), and segmentary lineage (from Moscona et al. (2020)). The main interaction effect is unchanged by the inclusion of these covariates. In Table A6, we control for a triple interaction between ethnicity fixed effects, country fixed effects, and year fixed effects. This is a highly demanding specification since it shuts down much of our available variation. Nevertheless, the UCDP estimates remain unchanged. The ACLED estimates, while no longer significant, are positive and sizable. In Table A7, we control for lagged dependent variables since conflict may beget more conflict over time within cells. Again, all four main estimates are largely unaffected by the inclusion of these controls. Finally, in Table A8, we use the off-the-shelf transaction date rather than our predicted initiation date for project assignment to cells, finding similar estimates across the board.

selection bias that is specific to crop agriculture projects but common across THP and non-THP areas, as well as selection bias that is specific to THP areas but common across project types. It is not due to a more general effect of development projects in THP areas, and it is largely offset by the additional inclusion of animal production (i.e., pastoral) development projects.

C. Event Study Design

In Figure 4, we present event study plots that derive from equation 1, i.e., including leads and lags in order to observe pre- and post-treatment dynamics. We focus on the main UCDP conflict incidence outcome and use the procedure in Callaway and Sant'Anna (2021) to allow for treatment effect heterogeneity.

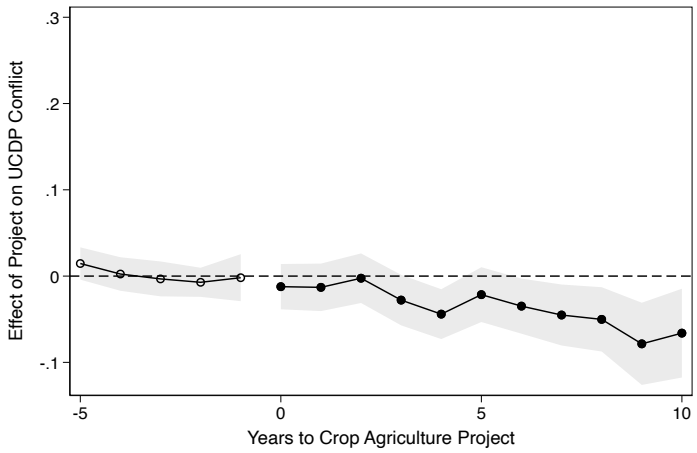
In Figure 4a, we limit the sample to non-THP cells. We see that the negative effect of projects on violence in non-THP areas becomes apparent at around year $t + 3$. In Figure 4b, we limit the sample to THP cells. Here, we see no obvious difference in conflict trends during the pre-treatment period, yet a large and significant increase in conflict soon after the project is initiated. The effects are still large nine years later. In Figure 4c, we pool all cells and estimate the dynamic interaction effects corresponding to our main estimating equation, again finding similar results.

D. Examining a 2006–2008 Supply Shock

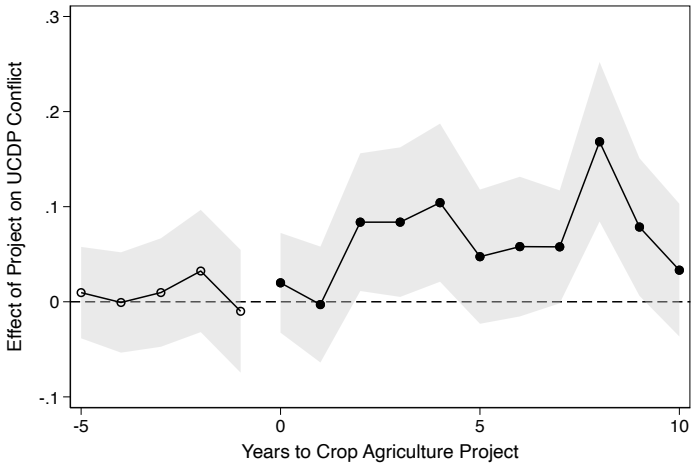
While the evidence presented in the previous sections is consistent and robust to obvious sources of selection bias, we nonetheless avail of an alternative identification approach that is permitted by a "supply shock" of World Bank agricultural projects for which planning was initiated in 2006 and completed in 2008.

In Figure 5, we plot the number of cells receiving new agricultural aid projects each year (darker line). We also express this variable as a share of cells receiving any new aid projects (lighter line). In most years, there are considerably fewer than 200 cells treated with new agricultural projects, but in 2006, there are 344. This spike is not due to an increase in all types of projects during that year. Indeed, 2006 is the only year in which crop agriculture projects constitute more than 50% of all new projects in Africa, implying a shift away from other sectors towards agriculture.

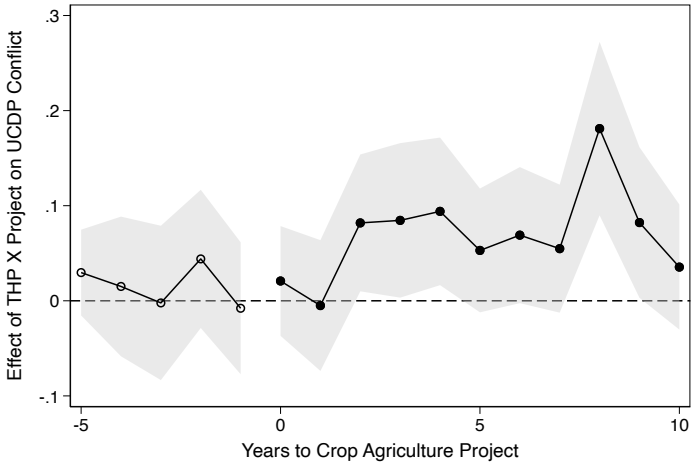
One explanation for this unusual surfeit of projects relates to the annual publication of the World Bank's flagship *World Development Report* (WDR), which provides in-depth analysis and



(a) Non-Pastoral Sample: THP $= 0$



(b) Pastoral Sample: THP > 0



(c) Pooled Sample THP Interaction Effects

Figure 4: **Event Study Figures Using Callaway & Sant'Anna (2021) Estimator**

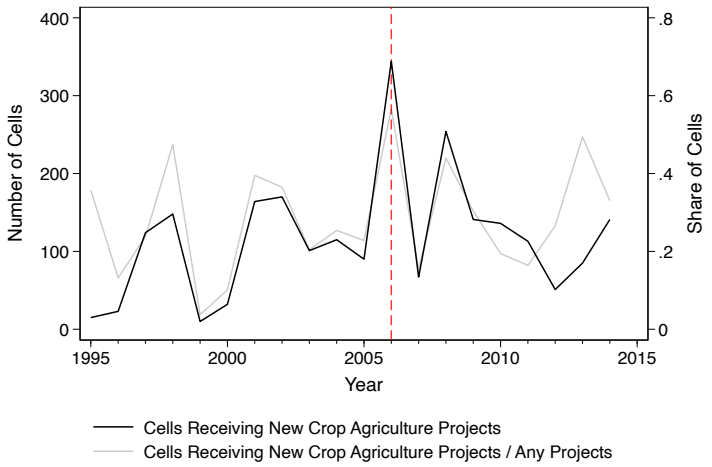


Figure 5: **Cells Receiving New World Bank Agriculture Projects over Time**

commentary on one area of economic development policy each year. The 2008 report on agriculture calls for sharply increased investment in Africa (pp. xiii). It is plausible that the topic of a given WDR provides a window into the organization's priorities and that, importantly, the discrete change in topics from year to year generates some arbitrary variation in the World Bank's development investment portfolio that is independent of short-run demand-side factors.[7]

We harness this variation under the assumption that, whatever decision rule states typically adopt for assigning crop agriculture projects to cells, it is unlikely to resemble the assignment mechanism generated by this supply shock. We proceed by comparing the average effect of the relevant 2006 cohort to the average effect for all cohorts from 1997–2014. If these effects are similar, it suggests that the main findings are not driven by a demand-side selection mechanism whereby the state assigns agricultural projects to pastoral areas with higher potential conflict.

We present this comparison in Figure 6, where we report, for each cohort, the estimated effect of agricultural projects initiated in THP cells using the Callaway and Sant'Anna (2021) estimator that allows for cohort-by-cohort heterogeneity. The full sample average treatment effect is represented by the red line. The treatment effect for the 2006 cohort (labeled "G2006") is almost identical.[8]

This finding implies that the estimates are similar whether we rely on the 2006 supply shock

[7]There is a similar coincidence with respect to environmental development projects for which planning was initiated in 2008 and completed in 2010, the year of the "Development and Climate Change" WDR. As in the case for agriculture, more projects were supplied in this period than in any other period in the dataset.

[8]For completeness, the figure also reports the estimated effects for all other cohorts, with the exception of the 2013 cohort estimate, which exhibits confidence intervals that cannot be contained in the figure as presented. (This estimate is included in the calculation of the mean.)

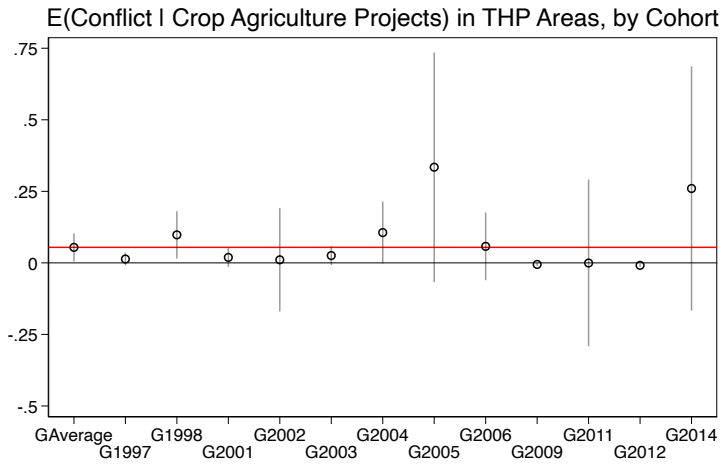


Figure 6: **Effect of 2006 Cohort Relative to Mean Effects**

or not, suggesting that our main result is unlikely to be driven by demand-side selection.

E. Religious Extremist Conflict

The final exercise in this section examines the effect of agricultural development on the incidence of jihadist conflict in Africa. Among THP groups, there are around six times more Muslims as there are Christians (see Appendix Table A4). Similarly, among non-THP groups, there are around twice as many Christians as there are Muslims. It is possible that, in generating conflict between pastoral and non-pastoral groups, the mechanism that we study also generates conflict (mechanically) between Muslims and Christians. Since jihadist groups have proliferated across the continent in recent years—see Figure 7—it is plausible that disaffected young pastoral men are vulnerable to recruitment into these groups in the wake of being dispossessed or displaced by an agricultural land-use conversion (Benjaminsen and Ba, 2019).

In this scenario, we may expect to observe conflict involving jihadist groups as a response to agricultural development projects. The counterpoint is that jihadist conflict has a more complex combination of determinants that are independent of government policies over local land use.

We examine this question empirically. We generate two conflict incidence variables using the UCDP data: one based on events that include well-known jihadist groups and one based on

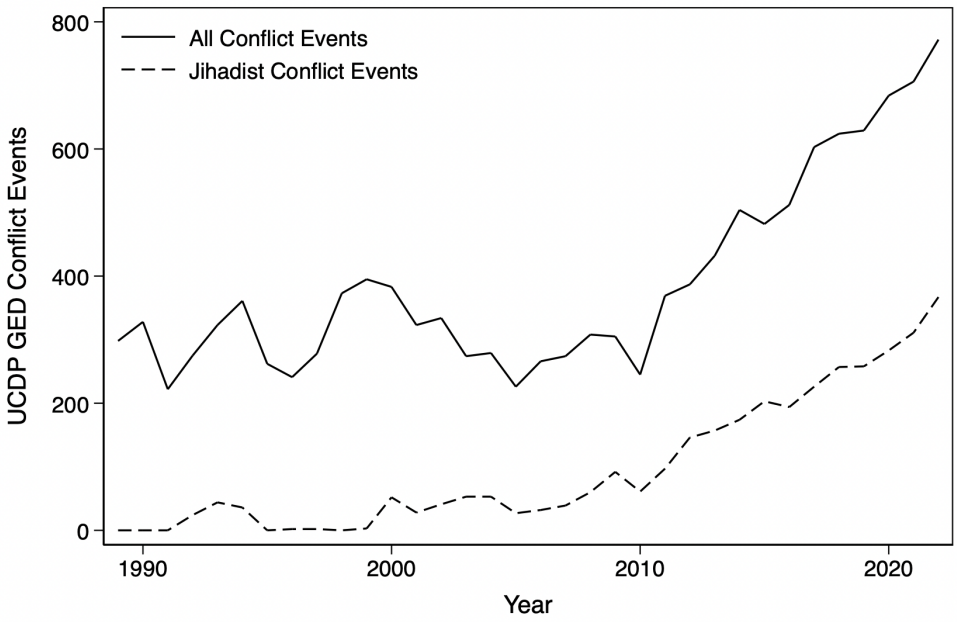


Figure 7: **Total Jihadist and Non-Jihadist Conflicts over Time in Africa** This figure depicts the total number of UCDP conflict events recorded in African for each year from 1989 to 2022 (solid line) and the corresponding number of events involving self-styled jihadist groups (broken line). See text for definition of conflict events involving jihadist groups.

events that do not.[9] We then estimate a version of equation (1) using each type of outcome. The estimates, presented in columns 1 and 2 of Table 4, indicate that both jihadist and non-jihadist conflict are affected in a similar manner (relative to their respective means) when crop agriculture projects are initiated in THP areas.

To ensure that we are not capturing the effect of assigning a project to areas with different religious compositions, we also include control interactions whereby the THP component is replaced by the share of a territory's population that is Muslim and Christian, respectively (columns 3 and 4).[10] The estimates are robust to the inclusion of these interactions, indicating that the effects are not due to mismatched projects in areas where people believe in Islam *per se*; rather, they are due to mismatched projects in areas where people practice pastoralism.

[9]We identify jihadist conflict events as those for which (i) the word "jihad" is present in either the actor's name or source headline or (ii) the word "Islam-" appears in the source headline and one of the actors is known to be jihadist. These groups are: Islamic State, Boko Haram, Al-Qaeda in the Islamic Maghreb (AQIM), Movement for Oneness and Jihad in West Africa (MUJAO), Benghazi Revolutionaries Shura Council, Ansar Dine, Ansaroul Islam, Mujahideen, Signed-in-Blood Battalion, Ansar al-Sharia in Libya (ASL), al-Murabitun, Macina Liberation Front (FLM), Jama'at Nasr al-Islam wal Muslimin (JNIM), Ansar al-Sunnah, Derna Protection Force (DPF), and Al-Shabaab.

[10]The data are constructed using information from the World Religion Database, which reports information on the populations of 18 religions for each language group in the world. The data are reported with Ethnologue identifiers which we match to our Ethnographic Atlas. Since multiple Ethnologue groups often match to one Ethnographic Atlas group, we create Ethnographic Atlas level measures by taking population-weighted averages across all Ethnologue groups that match to an Ethnographic Atlas group. See McGuirk and Nunn (2024).

Table 4: Jihadist Conflict

	(1) I(Jihadist)	(2) I(Non Jihadist)	(3) I(Jihadist)	(4) I(Non Jihadist)
Transhumant Pastoral × Crop Agriculture Project	0.0207***	0.1045***	0.0121*	0.0954**
	(0.0079)	(0.0377)	(0.0063)	(0.0391)
Crop Agriculture Project	-0.0024	-0.0123*	-0.0046*	-0.0155
	(0.0015)	(0.0070)	(0.0025)	(0.0241)
Muslim population % in 2020 × Crop Agriculture Project			0.0074	0.0070
			(0.0049)	(0.0305)
Christian population % in 2020 × Crop Agriculture Project			0.0012	0.0043
			(0.0030)	(0.0329)
Additional Calculations				
Total Crop Ag. Effect in Median THP Area	0.0101	0.0510	0.0027	0.0422
p-value	[0.02]	[0.02]	[0.47]	[0.20]
Dep. Var. Mean	0.0049	0.0281	0.0049	0.0299
All Aid Controls	Yes	Yes	Yes	Yes
THP × Year FE	Yes	Yes	Yes	Yes
Country FE × Year FE	Yes	Yes	Yes	Yes
Cell FE	Yes	Yes	Yes	Yes
Cells	8,813	8,813	8,028	8,028
Country-Years	980	980	980	980
Observations	176,260	176,260	160,560	160,560

Note: All outcome variables measure conflict incidence at the level of a cell-year. "I(Jihadist)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year that involves at least one self-styled jihadist group. "I(Non Jihadist)" is an indicator variable that equals one if at least one conflict event not involving a self-styled jihadist group occurs in a cell and year. Standard errors, which are reported in parentheses, are adjusted for two-way clustering at the levels of a cell and a country-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

These estimates are consistent with McGuirk and Nunn (2024), where jihadist conflict is found to respond to scarcity induced by adverse rainfall shocks in pastoral areas. In both cases, we find evidence of material drivers of extremist-religious violence. However, in this setting, jihadist conflict is a response to government policy; specifically one that potentially undermines livelihoods within a co-religious population subgroup. These conditions are potentially conducive to the emergence of extremist religious violence (Berman and Laitin, 2008, Berman, 2011).

5. Economic Activity

While we have demonstrated that agricultural projects in pastoral territories lead to sharp increases in violent conflict, it is unclear whether they positively or adversely affect economic development outcomes in the longer run.

On the one hand, mismatched projects may undermine development for the reasons stated above: projects may be unsuited to semi-arid conditions and thus more likely to fail. This absence of economic development could be at the root of the conflict that we observe.

On the other hand, these projects may succeed in contributing to agricultural productivity by

facilitating a reallocation of labor from subsistence to commercial crop production. The conflict that we observe might thus be due to the uneven distribution of projects costs and benefits across populations subsets. In the scenario, it is the form of development rather than its absence that generates conflict.

In this section, we distinguish between these mechanisms by considering the effect of projects on economic outcomes, including land-use imagery, nighttime luminosity, and survey measures.

A. Land-Use

We begin by estimating the proximate effect of projects on land use. Much of the case study writing that motivates this research implies that conflict is due to land-use changes toward commercial agriculture, for which pastoralist groups are forcibly cleared. However, it is also plausible that the projects failed to induce any land-use change at all. In this scenario, the conflict may be due to the project's failure, or indeed to successful resistance on the part of pastoralists, or other reasons.

To test this, we require data on land-use changes at a sufficiently granular level across space and over time. Moreover, we require that cropland be observed distinctly from grasslands and other forms of pasture. For this, we turn to the Copernicus Climate Change Service, which provides high-resolution land cover classification derived from satellite imagery on a global scale.[11] This data source contains information on 30 distinct land use types for the period 1992-2020, including three measures of cropland: irrigated, rainfed, and "mosaic," or cropland that is mixed with natural vegetation. We aggregate these measures to the level of a cell and year and regress each on our full project specification, as in Table 3.

The estimates are presented in Table 5. In column 1, we see that crop agriculture projects lead to a large and significant increase in irrigated cropland in pastoral territories. By contrast, the effect is zero in non-pastoral territories. These estimates are consistent with the idea that crop agricultural development in pastoral territories involves increasing production at the extensive margin, while projects in agricultural territories may target the intensive margin. When animal production projects are paired with crop agriculture projects, the effect in pastoral territories is

[11]See Copernicus Climate Change Service (C3S) Climate Data Store (CDS). DOI: 10.24381/cds.006f2c9a (Accessed on 19-Feb-2024.)

Table 5: Agricultural Development Projects and Land-Use

	(1) Cropland: Irrigated	(2) Cropland: Rainfed	(3) Cropland: w/ Nat. Veg.	(4) Cropland: Combined
Transhumant Pastoral × Crop Agriculture Project	0.1444**	0.1554*	0.2869***	0.5867***
	(0.0723)	(0.0898)	(0.1037)	(0.2008)
Crop Agriculture Project	0.0115	-0.0181	-0.0326	-0.0392
	(0.0072)	(0.0558)	(0.0597)	(0.0981)
Transhumant Pastoral × Animal Production Project	-0.0945*	0.1520	-0.1380	-0.0805
	(0.0493)	(0.1384)	(0.1869)	(0.2814)
Animal Production Project	0.0225*	-0.0747	-0.1185	-0.1708
	(0.0136)	(0.0731)	(0.1197)	(0.1589)
Transhumant Pastoral × Non-Agricultural Project	-0.0075	-0.0874	-0.0045	-0.0994
	(0.0199)	(0.0729)	(0.1036)	(0.1555)
Non-Agricultural Project	0.0051	0.0443	0.0279	0.0772
	(0.0051)	(0.0454)	(0.0536)	(0.0828)
Additional Calculations				
Total Crop Ag. Effect in Median THP Area	0.0989	0.0759	0.1409	0.3157
p-value	[0.02]	[0.05]	[0.00]	[0.00]
THP × Crop Agriculture = THP × Animal Production (p-value)	0.039	0.985	0.060	0.088
THP × Crop Agriculture = THP × Non-Agricultural Aid (p-value)	0.069	0.026	0.040	0.005
Dep. Var. Mean	0.8040	8.0320	4.8610	13.6970
THP × Year FE	Yes	Yes	Yes	Yes
Country FE × Year FE	Yes	Yes	Yes	Yes
Cell FE	Yes	Yes	Yes	Yes
Cells	8,813	8,813	8,813	8,813
Country-Years	980	980	980	980
Observations	176,260	176,260	176,260	176,260

Note: All outcome variables measure cropland coverage as a percentage of a cell's total area. "Irrigated" denotes irrigated cropland; "Rainfed" denotes rainfed cropland; "w/ Nat. Veg." denotes cropland coverage that is mixed with natural vegetation; "Combined" is the sum of all three cropland coverage types in a cell. Standard errors, which are reported in parentheses, are adjusted for two-way clustering at the levels of a cell and a country-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

reduced from 0.14% of a cell (or 4.3 square kilometers, assuming 55km × 55km cells) to 0.05% (1.5 square kilometers.)

In columns 2 and 3, we see similarly large and significant effects on rainfed and mixed cropland, although relative to the respective dependent variable means, the effect on irrigated cropland is greatest. In column 4, we aggregate all cropland measures and show that, in the median THP area, a crop agriculture project increases cropland coverage by 0.32%, or 9.7 square kilometers. We see no effect of other project types. This pattern is consistent with agricultural development projects inducing changes in land-use in pastoral territories, but not in other territories.[12]

[12]In Appendix Table A9, we examine the association between land-use and conflict. While these estimates are purely correlational—and likely negatively biased due to reverse causality—we still note that expansions of irrigated cropland are associated with more conflict in pastoral areas. The difference relative to non-pastoral areas are significant for ACLED outcomes only. We see no such pattern for expansions of rainfed or mixed-use cropland.

Table 6: Effect of Development Projects on Nightlight Luminosity

	Nightlights: Any		Nightlights: Mean	
	(1)	(2)	(3)	(4)
Transhumant Pastoral × Crop Agriculture Project	0.0071	0.0250	0.3623**	0.3787*
	(0.0332)	(0.0299)	(0.1737)	(0.1972)
Crop Agriculture Project	0.0250***	0.0167*	0.0839*	0.0623
	(0.0091)	(0.0091)	(0.0476)	(0.0524)
Transhumant Pastoral × Animal Production Project		-0.0950*		-0.1451
		(0.0486)		(0.1384)
Animal Production Project		0.0226		0.1173*
		(0.0164)		(0.0643)
Transhumant Pastoral × Non-Agricultural Project		0.0266		0.0928*
		(0.0366)		(0.0553)
Non-Agricultural Project		0.0301***		0.0088
		(0.0075)		(0.0215)
Additional Calculations				
Total Crop Ag. Effect in Median THP Area	0.0294	0.0319	0.3031	0.2914
p-value	[0.14]	[0.07]	[0.01]	[0.03]
THP × Crop Agriculture = THP × Animal Production (p-value)		0.042		0.092
THP × Crop Agriculture = THP × Non-Agricultural Aid (p-value)		0.970		0.194
Dep. Var. Mean	0.3483	0.3483	0.3500	0.3500
THP × Year FE	Yes	Yes	Yes	Yes
Country FE × Year FE	Yes	Yes	Yes	Yes
Cell FE	Yes	Yes	Yes	Yes
Cells	8,813	8,813	8,813	8,813
Country-Years	931	931	931	931
Observations	167,447	167,447	167,447	167,447

Note: Standard errors (reported in parentheses) are adjusted for two-way clustering at the levels of a cell and a country-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

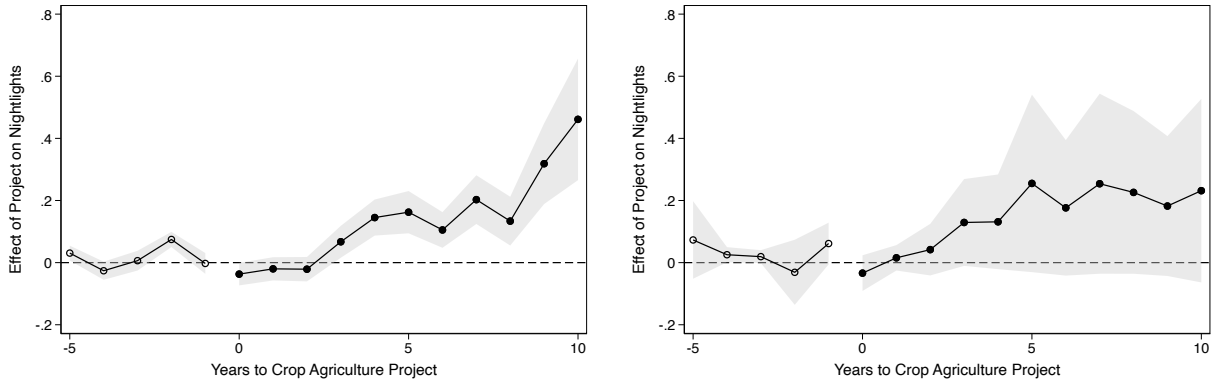
B. Nighttime Luminosity

Next, we examine the effect of agricultural projects on nighttime luminosity at the level of a cell and year. We estimate our main specification only replacing the conflict outcome with outcomes measuring (i) any and (ii) mean nighttime lights emission from the DMSP-OLS Nighttime Lights Time Series Version 4, which is available from 1992–2013.[13]

The estimates, presented in Table 6, indicate that crop agricultural projects increase nighttime luminosity in *both* THP and non-THP areas. We present event study estimates for the mean luminosity measure in Figure 8a (for THP cells) and 8b (for non-THP) cells, using the Callaway and Sant'Anna (2021) estimator.

This pattern indicates that, even though these projects lead to violence in THP areas, they nonetheless contribute to economic development as measured by nightlights. In concert with the

[13]Image and data processing were undertaken by NOAA's National Geophysical Data Center. The DMSP data were collected by the U.S. Air Force Weather Agency. The data were obtained from: PRIO GRID 2 Tollefsen, Strand and Buhaug (2012).



(a) THP Cells (b) Non-THP Cells

Figure 8: **Event Study Estimates: Effect of Crop Agriculture Project on Nightlight Luminosity**

findings on land use, this indicates strongly that the increased conflict we observe is not due to the failure of mismatched project implementation. Rather, it suggests that the gains from agricultural projects are not distributed broadly in pastoral areas relative to non-pastoral areas. To examine this interpretation more closely, we turn to household survey data.

C. DHS Survey Data

To further explore the distributional consequences of mismatched development projects, we use household survey data from the Demographic and Health Surveys Program (DHS). We require survey data that allows us to observe (i) the geographic coordinates of the household's enumeration area, which will determine whether it is assigned to a cell containing a project or not; and (ii) the ethnicity of respondents, which will permit a comparison of pastoral versus non-pastoral households within cells. This is possible using the most recent DHS surveys conducted in each country.[14] We merge the Woman's Questionnaire modules across these rounds and use the (jittered) geocodes to assign households to a cell. We then assign each woman a THP score by matching her self-reported ethnicity to the *Ethnographic Atlas.*

The objective of this exercise is to determine the extent to which pastoral households benefit from mismatched crop agricultural projects relative to non-pastoral households in the same cell. We do this by regressing household level development outcomes on an indicator for mismatched crop agriculture projects, which is equal to one if a cell is in a THP area and received a crop

[14]These are Burkina Faso (2010), Benin (2017), DRC (2013), CAR (1994), Cote d'Ivoire (2012), Cameroon (2018), Ghana (2014), The Gambia (2019), Guinea (2018), Kenya (2014), Mali (2018), Malawi (2015), Mozambique (2011), Nigeria (2018), Sierra Leone (2019), Senegal (2018), Chad (2014), Togo (2013), and Uganda (2016).

agriculture project at any period up to and including the survey year. We allow this to vary by the THP index score of the respondent. We also allow matched crop agriculture projects to enter the specification in the same manner. For each outcome, we estimate one specification without cell fixed effects and one with cell fixed effects. The specifications without cell fixed effects allow us to estimate the level effect for non-THP respondents. The specifications with cell fixed effects allow us to control for unobserved cell characteristics that might influence the assignment of certain projects, as follows:

$$\begin{aligned} y_{jit} &= \gamma_1 \textit{THP (Ethnicity)}_{e(j)} \times \textit{Mismatched Crop}_{it} + \gamma_2 \textit{THP (Ethnicity)}_{e(j)} \times \textit{Matched Crop}_{it} + \\ &\quad \gamma_3 \textit{THP (Ethnicity)}_{e(j)} + \mathbf{X}'_{jt}\zeta + \alpha_i + \alpha_{ct} + u_{jit}, \end{aligned} \tag{2}$$

where j indexes respondents, i cells, $e(j)$ the ethnicity of respondent j, and t survey years; $\textit{THP (Ethnicity)}_{e(j)}$ is the THP index score of the respondent j's self-reported ethnicity e; $\textit{Mismatched Crop}_{it}$ is an indicator equal to one if cell i is in a pastoral territory and contains a crop agriculture project by year t; $\textit{Matched Crop}_{it}$ is an indicator equal to one if cell i is in a non-pastoral territory and contains a crop agriculture project by year t; $\mathbf{X}_{jt}$ is a vector of controls that includes interactions between the THP score of individual j and cell-level indicators for animal production projects (matched and mismatched), non-agricultural projects, and whether the cell is in a pastoral territory; α_i represents cell fixed effects and α_{ct} country-by-year fixed effects.[15]

The parameter γ_1 captures the difference between pastoral and non-pastoral households in the presence of mismatched crop projects relative to no projects. While this is a descriptive analysis using cross-sectional survey data, it is nonetheless an informative parameter in the context of the findings on nighttime luminosity above. Adverse outcomes for pastoral households (i.e., a negative γ_1) would indicate that the gains from mismatched crop projects are mostly captured by non-pastoral households.

The estimates from these specifications are presented in Table 7. We use four outcomes: an off-the-shelf DHS household asset index, labeled "Wealth" and measured in standard deviations; an indicator for whether the household is located in an urban setting; an indicator for whether

[15]In the specification without cell fixed effects, we also control for matched and mismatched animal production project indicators, the non-agricultural project indicator, an indicator for whether the cell is located in a pastoral territory.

Table 7: Effect of Development Projects on DHS Survey Outcomes

	Wealth (SD)		Urban		Working		Child Mort.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
THP (Ethnicity) × Mismatched Crop Project	-0.675	-0.990***	-0.338**	-0.388**	-0.106	-0.203**	-0.061	0.008
	(0.485)	(0.357)	(0.139)	(0.184)	(0.098)	(0.099)	(0.058)	(0.074)
Mismatched Crop Project	0.593		0.192*		0.110		0.003	
	(0.452)		(0.100)		(0.072)		(0.058)	
THP (Ethnicity) × Matched Crop Project	0.998***	0.574	0.341*	0.094	0.104**	-0.163	-0.086***	0.015
	(0.323)	(0.763)	(0.186)	(0.182)	(0.044)	(0.173)	(0.022)	(0.222)
Matched Crop Project	0.319***		0.125***		-0.011		-0.008	
	(0.090)		(0.035)		(0.013)		(0.018)	
THP (Ethnicity)	-1.272***	-0.241	-0.086	-0.078	-0.643***	-0.156	0.042	0.006
	(0.265)	(0.566)	(0.110)	(0.126)	(0.039)	(0.278)	(0.052)	(0.240)
Dep. Var. Mean	0.156	0.157	0.381	0.381	0.678	0.678	0.298	0.298
Cell FE	No	Yes	No	Yes	No	Yes	No	Yes
Country FE × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cells	978	859	1,032	912	1,032	911	1,032	912
Ethnicities	114	114	116	116	116	116	116	116
Observations	109,616	109,497	113,288	113,168	102,916	102,795	113,079	112,959

Note: The four outcome variables are the DHS household asset index, labeled "Wealth" and measured in standard deviations (1-2); an indicator for whether the household is located in an urban setting (3-4); an indicator for whether the respondent is "currently working" (5-6); and a measure of child mortality, defined as number of children born minus number of children alive at the time of the survey (7-8). Standard errors (reported in parentheses) are adjusted for two-way clustering at the level of a cell and an ethnicity. * p < 0.1, ** p < 0.05, *** p < 0.01.

the respondent is "currently working;" and a measure of child mortality, defined as number of children born minus number of children alive at the time of the survey.

Focusing on the specifications that include cell fixed effects, we see that a mismatched crop project is associated with a decline in wealth by one standard deviation for a pastoral household relative to a non-pastoral household in the same cell. The estimate is significant at the 1% level. Pastoral respondents are also significantly less likely to be in urban locations and to report that they are currently working. We see no significant difference in child mortality. Interestingly, we do not see the same pattern for well-matched crop development projects in non-pastoral cells. In this scenario, pastoral households are no worse off than other households.

This pattern of evidence indicates that while the benefits of crop agriculture projects in traditionally agricultural locations are significant and broadly shared, the benefits in traditionally pastoral locations are likely concentrated among non-pastoral households. This is consistent with the case study argument that pastoral people in pastoral locations are adversely affected by mismatched agriculture projects.

6. Political Power and the Allocation of Projects

Finally, we examine how the allocation of projects is shaped by the distribution of political power across ethnic groups. We have established that the deleterious effect of mismatched crop projects in pastoral areas is fully mitigated by the concurrent presence of well-matched animal production projects. A question naturally arises as to when this allocation is more likely to be realized. Following evidence in McGuirk and Nunn (2024) that pastoral political power tends to mute the effect of climate shocks on herder-farmer conflict, we posit that political power-sharing may also influence the allocation of projects in a manner that is conducive to peace.

To test this, we first measure the share of national political power held by transhumant pastoral ethnic groups.[16] This variable equals zero when pastoral groups are not in parliament and one when they have a monopoly on national politics. We then restrict the sample to observations for which the crop agriculture treatment equals one and ask whether new animal production (i.e., pastoral) projects are more likely to be observed in pastoral areas when THP political power increases. Specifically, we estimate the following:

$$\begin{aligned} \textit{New Animal Production Project}_{it} \;=\; & \delta_1 \textit{THP}_{e(i)} \times \textit{THP Power Share}_{c(i)t} \\ & + \delta_2 \textit{THP Power Share}_{c(i)t} + \zeta_t \textit{THP}_{e(i)} + \alpha_i + \alpha_t + \epsilon_{it}, \quad (3) \end{aligned}$$

where i indexes grid cells, $e(i)$ the traditional ethnic territory in which cell i lies, $c(i)$ the country of cell i, and t years. The outcome variable, *New Animal Production Project*$_{it}$ is equal to one when a cell is assigned a new animal production project, and zero otherwise; the explanatory variable *THP Power Share*$_{c(i)t}$ measures the share of total national political power held by transhumant pastoral groups in a country and year, as measured by the *Ethnic Power Relations* project; α_i represents cell fixed effects and α_t year fixed effects. In alternate specifications, we replace α_t with country-by-year fixed effects, which absorbs important confounds but also prohibits us from estimating δ_2. Our parameter of interest is δ_1; a positive estimate indicates that more animal production projects are assigned to pastoral territories when pastoral groups have more political power.

We see evidence that is clearly consistent with this hypothesis in column 1 of *Panel A*. The relevant interaction effect is positive and significant a the 5% level. In column 2, we replace the

[16] This variable is constructed by combining data from the *Ethnic Power Relations* dataset with data from the Murdock map (Murdock, 1959) and the *Ethnographic Atlas* (Murdock, 1967). For details on this process, see McGuirk and Nunn (2024).

Table 8: THP Political Power, Project Allocation, and Conflict

	Animal Production Projects			
	(1)	(2)	(3)	(4)
Panel A	I(New)	I(Incidence)	I(New)	I(Incidence)
Transhumant Pastoral × THP Power Share	0.2271**	1.2730***	0.0695	0.4163
	(0.1084)	(0.4861)	(0.0468)	(0.2663)
THP Power Share	-0.1083	-0.6241*		
	(0.0894)	(0.3665)		
Dep. Var. Mean	0.0241	0.1647	0.0241	0.1645
Cells	1,210	1,210	1,208	1,208
Country-Years	587	587	557	557
Observations	14,800	14,800	14,770	14,770
	Non-Agriculture Projects			
	(1)	(2)	(3)	(4)
Panel B	I(New)	I(Incidence)	I(New)	I(Incidence)
Transhumant Pastoral × THP Power Share	-0.4116	-0.1153	-0.6064**	-0.3830
	(0.3231)	(0.5077)	(0.2847)	(0.4696)
THP Power Share	0.4730	-0.1240		
	(0.3381)	(0.3063)		
Dep. Var. Mean	0.1584	0.6240	0.1582	0.6244
Cells	1,210	1,210	1,208	1,208
Country-Years	587	587	557	557
Observations	14,800	14,800	14,770	14,770
	Conflict: I(Any)			
	(1)	(2)	(3)	(4)
Panel C	UCDP	UCDP	ACLED	ACLED
Transhumant Pastoral × THP Power Share	-0.3440	-0.5386**	-0.5680*	-0.5018*
	(0.2869)	(0.2443)	(0.2932)	(0.2925)
THP Power Share	0.2052		0.5299**	
	(0.2144)		(0.2236)	
Dep. Var. Mean	0.0861	0.0858	0.1829	0.1825
Cells	1,210	1,208	1,210	1,208
Country-Years	587	557	553	527
Observations	14,800	14,770	14,341	14,315
	Sample: Crop Agriculture Project = 1			
Country FE × Year FE	No	Yes	No	Yes
THP × Year FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Cell FE	Yes	Yes	Yes	Yes

Note: This sample is restricted to cell-years for which the Crop Agriculture Project variable is equal to one. In columns 1-4 of *Panel A*, the outcome variables measure animal production projects. In columns 1 and 3, the outcome is equal to one in years when there is a new project initiated in a cell and zero otherwise. In columns 2 and 4, the outcome is equal to one in years when there are projects present in a cell and zero otherwise. In *Panel B* are the equivalent outcomes for non-agriculture projects. In *Panel C*, the outcome variables are the incidence of any violent conflict events in UCDP (1-2) or ACLED (3-4). Standard errors, which are reported in parentheses, are adjusted for two-way clustering at the levels of a cell and a country-year. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

outcome variable with an indicator for project incidence that is equal to one when there is a project present in a cell and equal to zero when there is not. This outcome additionally captures extensive margin variation at the end of a project's life cycle. Again, we obtain a large and significant estimate for δ_2, implying that pastoral political power leads to more animal production projects in THP areas. The estimates remain positive even when conditioning on country $\times$ year fixed effects (columns 3 and 4), although they are marginally outside of 10% significance. We see no similar pattern for non-agricultural projects (*Panel B*); if anything, the effect is reversed, suggesting substitution between project types. Finally, we confirm that pastoral political power is conducive to peace in pastoral areas (*Panel C*).

The exercise indicates that pastoral political power shapes the allocation of development projects across space. As pastoralists gain political power, more pastoral projects and fewer non-agricultural projects are assigned to pastoral territories. This finding provides evidence of one mechanism linking political power sharing to peace (Mueller and Rohner, 2018).

7. Discussion and Conclusion

Civil conflict reverses economic development by undermining physical, human, and social capital. This paper documents how 'mismatched' development projects can exacerbate conflict in traditionally pastoral areas of Africa. We estimate that World Bank crop agriculture projects increase the risk of conflict in the median transhumant pastoral cell by about 6 p.p., almost twice the sample mean.

We estimate consistent findings using raw data plots, fixed effects regressions that allow for different sources of selection bias, event study plots, and a natural experiment. These projects also contribute to the spread of extremist-religious conflict.

Despite increasing conflict, we find that crop agriculture projects in pastoral areas succeed in expanding crop coverage and increasing nighttime luminosity. This suggests that the gains are unevenly distributed across population subgroups. We find support for this interpretation using DHS micro-data: pastoral households in pastoral territories are worse off than non-pastoral households in the presence of mismatched projects.

By contrast, we find that well-matched crop agriculture projects, i.e., in agricultural areas, lead to clear reductions in conflict, increased nighttime luminosity, and improved development

outcomes for both pastoral and non-pastoral households.

Critically, we find that the increased risk of conflict in pastoral areas is fully muted when agricultural projects are paired with animal production projects. This allocation of projects is more likely to occur when pastoral groups hold more political power, suggesting one mechanism through which political power-sharing can lead to peace in the territory of minority groups.

We conclude that more consonance between development aid projects and the populations they purportedly serve are likely conducive to peace in pastoral Africa.

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Online Appendix (Not for Publication)

Appendix Tables

Table A1: Summary Statistics: Cell-Year Variables

	Cell-Year Level Variables					
	Mean	SD	Count	Min	Median	Max
UCDP: I(Any Conflict), 0/1	0.03	0.18	176,260	0.00	0.00	1.00
I(State Conflict), 0/1	0.02	0.15	176,260	0.00	0.00	1.00
I(Nonstate Conflict), 0/1	0.01	0.12	176,260	0.00	0.00	1.00
I(Jihadist Conflict), 0/1	0.00	0.07	176,260	0.00	0.00	1.00
I(Non-Jihadist Conflict), 0/1	0.03	0.17	176,260	0.00	0.00	1.00
ACLED: I(Any Conflict), 0/1	0.06	0.25	158,634	0.00	0.00	1.00
I(State Conflict), 0/1	0.04	0.19	158,634	0.00	0.00	1.00
I(Nonstate Conflict), 0/1	0.05	0.21	158,634	0.00	0.00	1.00
Agricultural Project	0.10	0.29	176,260	0.00	0.00	1.00
Crop Agriculture Project	0.09	0.29	176,260	0.00	0.00	1.00
Animal Production Project	0.02	0.13	176,260	0.00	0.00	1.00
Non-Agricultural Project	0.17	0.37	176,260	0.00	0.00	1.00
Cropland: Irrigated	0.01	0.05	176,260	0.00	0.00	0.94
Cropland: Rainfed	0.08	0.17	176,260	0.00	0.00	0.99
Cropland: w/ Nat. Veg	0.05	0.10	176,260	0.00	0.00	0.82
Nighttime Luminosity	0.35	1.95	167,447	0.00	0.00	61.26

Note: See text for variable definitions.

Table A2: Summary Statistics: Ethnicity-Level Variables

	Ethnic Group Level Variables					
	Mean	SD	Count	Min	Median	Max
Transhumant Pastoralism, 0-1	0.08	0.22	712	0.00	0.00	0.92
EPR: Political Power, 0-5 (Average)	0.42	0.20	413	0.00	0.40	1.00
Muslim population % in 2020	0.29	0.38	663	0.00	0.06	1.00
Christian population % in 2020	0.45	0.35	663	0.00	0.46	1.00
Segmentary Lineage	0.50	0.25	690	0.02	0.48	0.98
EA: Jurisdictional Hierarchy, 0-4	1.29	0.97	685	0.00	1.00	4.00
EA: High Gods, 0/1	0.31	0.46	712	0.00	0.00	1.00

Note: See text for variable definitions.

Table A3: Difference in Means: Cell-Year Variables

Variable	(1) THP > 0	(2) THP = 0	(3) Difference
UCDP: I(Any Conflict), 0/1	0.021	0.039	-0.018***
	(0.143)	(0.194)	(0.002)
I(State Conflict), 0/1	0.015	0.029	-0.014***
	(0.121)	(0.167)	(0.002)
I(Nonstate Conflict), 0/1	0.009	0.019	-0.010***
	(0.092)	(0.136)	(0.001)
I(Jihadist Conflict), 0/1	0.005	0.005	-0.000
	(0.070)	(0.070)	(0.001)
I(Non-Jihadist Conflict), 0/1	0.017	0.035	-0.018***
	(0.128)	(0.184)	(0.002)
ACLED: I(Any Conflict), 0/1	0.037	0.082	-0.045***
	(0.189)	(0.274)	(0.003)
I(State Conflict), 0/1	0.022	0.048	-0.027***
	(0.147)	(0.215)	(0.002)
I(Nonstate Conflict), 0/1	0.025	0.057	-0.032***
	(0.157)	(0.232)	(0.002)
Agricultural Project	0.021	0.141	-0.120***
	(0.143)	(0.348)	(0.004)
Crop Agriculture Project	0.021	0.140	-0.119***
	(0.143)	(0.346)	(0.004)
Animal Production Project	0.004	0.027	-0.023***
	(0.060)	(0.161)	(0.002)
Non-Agricultural Project	0.035	0.251	-0.216***
	(0.185)	(0.434)	(0.006)
Cropland: Irrigated	0.005	0.010	-0.005***
	(0.038)	(0.056)	(0.001)
Cropland: Rainfed	0.027	0.113	-0.086***
	(0.106)	(0.192)	(0.003)
Cropland: w/ Nat. Veg	0.016	0.068	-0.052***
	(0.068)	(0.106)	(0.002)
Nighttime Luminosity	0.133	0.484	-0.351***
	(0.847)	(2.377)	(0.034)
Observations	67,040	109,220	176,260

Note: * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A4: Difference in Means: Ethnicity-Level Variables

Variable	(1) THP > 0	(2) THP = 0	(3) Difference
EPR: Political Power, 0-5 (Average)	0.374	0.433	-0.059**
	(0.263)	(0.190)	(0.027)
Muslim population % in 2020	0.745	0.244	0.501***
	(0.419)	(0.340)	(0.045)
Christian population % in 2020	0.122	0.489	-0.367***
	(0.249)	(0.340)	(0.043)
Segmentary Lineage	0.513	0.502	0.011
	(0.144)	(0.258)	(0.030)
EA: Jurisdictional Hierarchy, 0-4	1.452	1.271	0.181
	(0.817)	(0.982)	(0.120)
EA: High Gods, 0/1	0.862	0.234	0.628***
	(0.347)	(0.423)	(0.047)
Observations	87	625	712

Note: * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A5: Controlling for Other Ethnic Characteristics

	I(UCDP Conflict)			I(ACLED Conflict)		
	(1) Any	(2) State	(3) Non-State	(4) Any	(5) State	(6) Non-State
Transhumant Pastoral × Crop Agriculture Project	0.1410***	0.1495***	0.0213	0.1005**	0.0751*	0.0533*
	(0.0419)	(0.0393)	(0.0164)	(0.0417)	(0.0437)	(0.0277)
Crop Agriculture Project	0.0013	0.0042	0.0047	0.0399**	0.0127	0.0405**
	(0.0164)	(0.0136)	(0.0127)	(0.0203)	(0.0163)	(0.0163)
Jurisdictional Hierarchy × Crop Agriculture Project	-0.0091	-0.0108**	-0.0029	-0.0210***	-0.0181***	-0.0134**
	(0.0061)	(0.0053)	(0.0050)	(0.0077)	(0.0068)	(0.0064)
Segmentary Lineage × Crop Agriculture Project	-0.0164	-0.0235	-0.0185	-0.0296	-0.0161	-0.0256
	(0.0195)	(0.0165)	(0.0162)	(0.0290)	(0.0237)	(0.0231)
High Gods: Active, Not Supportive × Crop Agriculture Project	0.0232	0.0278**	0.0109	-0.0248	0.0085	-0.0123
	(0.0157)	(0.0128)	(0.0161)	(0.0327)	(0.0245)	(0.0257)
High Gods: Active, Supportive × Crop Agriculture Project	0.0104	0.0119	0.0025	0.0160	0.0332**	-0.0022
	(0.0152)	(0.0141)	(0.0106)	(0.0192)	(0.0165)	(0.0156)
Additional Calculations						
Total Crop Ag. Effect in Median THP Area	0.0866	0.0946	0.0176	0.1007	0.0582	0.0727
p-value	[0.01]	[0.00]	[0.30]	[0.00]	[0.06]	[0.00]
Dep. Var. Mean	0.0320	0.0226	0.0156	0.0665	0.0387	0.0469
THP × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes
Cells	7,943	7,943	7,943	7,943	7,943	7,943
Country-Years	960	960	960	864	864	864
Observations	158,860	158,860	158,860	142,974	142,974	142,974

Note: All outcome variables measure conflict incidence at the level of a cell-year. "I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year. "I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year. Standard errors, which are reported in parentheses, are adjusted for two-way clustering at the levels of a cell and a country-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A6: Controlling for Ethnicity FE × Country FE × Year FE

	I(UCDP Conflict)			I(ACLED Conflict)		
	(1) Any	(2) State	(3) Non-State	(4) Any	(5) State	(6) Non-State
Transhumant Pastoral × Crop Agriculture Project	0.0964***	0.1084***	0.0096	0.0551	0.0562	0.0152
	(0.0325)	(0.0303)	(0.0135)	(0.0391)	(0.0367)	(0.0285)
Crop Agriculture Project	0.0002	-0.0052	0.0019	0.0019	-0.0088	0.0119**
	(0.0060)	(0.0049)	(0.0046)	(0.0073)	(0.0062)	(0.0060)
Additional Calculations						
Total Crop Ag. Effect in Median THP Area	0.0586	0.0604	0.0078	0.0352	0.0252	0.0211
p-value	[0.00]	[0.00]	[0.32]	[0.14]	[0.26]	[0.21]
Dep. Var. Mean	0.0315	0.0230	0.0144	0.0633	0.0375	0.0438
All Aid Controls	Yes	Yes	Yes	Yes	Yes	Yes
Ethnic Group FE × Country FE × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes
Cells	8,618	8,618	8,618	8,618	8,618	8,618
Country-Years	980	980	980	882	882	882
Observations	172,360	172,360	172,360	155,124	155,124	155,124

Note: All outcome variables measure conflict incidence at the level of a cell-year. "I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year. "I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year. Standard errors, which are reported in parentheses, are adjusted for two-way clustering at the levels of a cell and a country-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A7: Controlling for Lagged Outcomes

	I(UCDP Conflict)			I(ACLED Conflict)		
	(1) Any	(2) State	(3) Non-State	(4) Any	(5) State	(6) Non-State
Transhumant Pastoral × Crop Agriculture Project	0.1071***	0.1131***	0.0177	0.0900**	0.0747**	0.0453
	(0.0315)	(0.0305)	(0.0123)	(0.0385)	(0.0358)	(0.0299)
Crop Agriculture Project	-0.0134**	-0.0156***	-0.0061	-0.0025	-0.0128*	0.0099
	(0.0058)	(0.0051)	(0.0047)	(0.0080)	(0.0069)	(0.0067)
L. Dep. Var.	0.1685***	0.1598***	0.1499***	0.1034***	0.1084***	0.0934***
	(0.0118)	(0.0133)	(0.0144)	(0.0100)	(0.0107)	(0.0111)
Additional Calculations						
Total Crop Ag. Effect in Median THP Area	0.0514	0.0529	0.0046	0.0519	0.0324	0.0373
p-value	[0.01]	[0.00]	[0.50]	[0.03]	[0.14]	[0.04]
Dep. Var. Mean	0.0323	0.0235	0.0150	0.0658	0.0388	0.0459
THP × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
All Aid Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country FE × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes
Cells	8,813	8,813	8,813	8,813	8,813	8,813
Country-Years	980	980	980	833	833	833
Observations	176,260	176,260	176,260	149,821	149,821	149,821

Note: All outcome variables measure conflict incidence at the level of a cell-year. "I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year. "I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year. Standard errors, which are reported in parentheses, are adjusted for two-way clustering at the levels of a cell and a country-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A8: Using Transaction Dates Rather than Predicted Initiation Dates for Project Assignment

	I(UCDP Conflict)			I(ACLED Conflict)		
	(1) Any	(2) State	(3) Non-State	(4) Any	(5) State	(6) Non-State
Transhumant Pastoral × Crop Agriculture Project	0.1081***	0.1131***	0.0107	0.1069***	0.1036***	0.0364
	(0.0308)	(0.0291)	(0.0119)	(0.0353)	(0.0377)	(0.0244)
Crop Agriculture Project	-0.0221***	-0.0251***	-0.0054	-0.0038	-0.0177**	0.0083
	(0.0072)	(0.0067)	(0.0047)	(0.0082)	(0.0069)	(0.0067)
Transhumant Pastoral × Animal Production Project	-0.1178**	-0.1080***	-0.0157	-0.0969**	-0.1292***	0.0241
	(0.0585)	(0.0401)	(0.0373)	(0.0480)	(0.0478)	(0.0477)
Animal Production Project	-0.0049	-0.0000	-0.0141	0.0121	0.0266**	-0.0099
	(0.0124)	(0.0109)	(0.0099)	(0.0166)	(0.0129)	(0.0153)
Transhumant Pastoral × Non-Agricultural Project	0.0141	0.0207	-0.0110	0.0562**	0.0667***	-0.0032
	(0.0227)	(0.0183)	(0.0133)	(0.0274)	(0.0241)	(0.0165)
Non-Agricultural Project	-0.0113**	-0.0073*	-0.0035	-0.0035	-0.0064	0.0010
	(0.0047)	(0.0040)	(0.0035)	(0.0062)	(0.0057)	(0.0050)
Additional Calculations						
Total Crop Ag. Effect in Median THP Area	0.0433	0.0434	0.0010	0.0608	0.0449	0.0304
p-value	[0.03]	[0.02]	[0.88]	[0.00]	[0.05]	[0.03]
THP × Crop Agriculture = THP × Animal Production (p-value)	0.003	0.000	0.495	0.004	0.002	0.822
THP × Crop Agriculture = THP × Non-Agricultural Aid (p-value)	0.007	0.003	0.213	0.278	0.433	0.226
Dep. Var. Mean	0.0323	0.0235	0.0150	0.0648	0.0384	0.0450
THP × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes
Cells	8,813	8,813	8,813	8,813	8,813	8,813
Country-Years	980	980	980	882	882	882
Observations	176,260	176,260	176,260	158,634	158,634	158,634

Note: All outcome variables measure conflict incidence at the level of a cell-year. "I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year. "I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year. Standard errors, which are reported in parentheses, are adjusted for two-way clustering at the levels of a cell and a country-year. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A9: Land-Use and Conflict

	I(UCDP Conflict)			I(ACLED Conflict)		
	(1) Any	(2) State	(3) Non-State	(4) Any	(5) State	(6) Non-State
Transhumant Pastoral × Cropland: Irrigated	0.0002	0.0101	0.0195	0.0557**	0.0615*	0.0342*
	(0.0227)	(0.0360)	(0.0242)	(0.0259)	(0.0354)	(0.0193)
Cropland: Irrigated	0.0045	0.0089	-0.0005	-0.0242	-0.0239	-0.0127
	(0.0065)	(0.0065)	(0.0043)	(0.0157)	(0.0161)	(0.0112)
Transhumant Pastoral × Cropland: Rainfed	-0.0024	-0.0060	0.0040	0.0061	0.0158*	0.0059
	(0.0078)	(0.0069)	(0.0040)	(0.0118)	(0.0084)	(0.0097)
Cropland: Rainfed	-0.0051***	-0.0039***	-0.0031***	-0.0085***	-0.0102***	-0.0081***
	(0.0013)	(0.0011)	(0.0009)	(0.0023)	(0.0021)	(0.0021)
Transhumant Pastoral × Cropland: w/ Nat. Veg	-0.0026	-0.0033	-0.0012	-0.0175***	-0.0107*	-0.0142***
	(0.0043)	(0.0032)	(0.0031)	(0.0061)	(0.0054)	(0.0050)
Cropland: w/ Nat. Veg	0.0025***	0.0022***	0.0015***	0.0072***	0.0039***	0.0062***
	(0.0008)	(0.0007)	(0.0005)	(0.0015)	(0.0013)	(0.0013)
Additional Calculations						
Total Effect of Irrigated in Median THP Area	0.0046	0.0150	0.0113	0.0095	0.0133	0.0080
p-value	[0.70]	[0.45]	[0.40]	[0.34]	[0.42]	[0.29]
Dep. Var. Mean	0.0373	0.0268	0.0178	0.0846	0.0507	0.0610
THP × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes
Cells	8,813	8,813	8,813	8,813	8,813	8,813
Country-Years	1,421	1,421	1,421	1,176	1,176	1,176
Observations	255,577	255,577	255,577	211,512	211,512	211,512

Note: All outcome variables measure conflict incidence at the level of a cell-year. "I(Any)" is an indicator variable that equals one if at least one violent conflict occurs in a cell and year. "I(State)" is an indicator variable that equals one if at least one conflict event involving the state occurs in a cell and year; "I(Non-State)" is an indicator variable that equals one if at least one conflict event not involving the state occurs in a cell and year. Standard errors, which are reported in parentheses, are adjusted for two-way clustering at the levels of a cell and a country-year. * p < 0.1, ** p < 0.05, *** p < 0.01.