Climate Change, Conservation, and Conflict: Evidence from Nigeria *

Donald Grasse† Melissa Pavlik‡

September 25, 2024

Word Count: 9004

Abstract

Climate change is driving rapid shifts in human behavior, some of which have spurred violent conflict over resources. Environmental degradation prompts conservation efforts, which attempt to preserve resources to avoid over-exploitation. How do conservation efforts impact climate conflict dynamics? We develop a theoretical model built on the insight that land use restrictions intended to conserve resources can discourage productive effort, creating an incentive for some actors to increase their use of coercion to capture resources. We find evidence in Nigeria, exploiting the staggered adoption of laws that restricted open cattle grazing using a difference-in-differences design. We show farmer-herder conflicts become more fatal after the laws are passed. The effect of the laws is moderated by favorable rainfall, but exacerbated by negative shocks. Survey data suggests ethnic and religious tensions increased after the laws, consistent with increased violent competition for land. Our results illustrate the negative unintended consequences of conservation, while highlighting how institutions and climate shocks interact to produce political violence.

*The authors would like to thank Kate Baldwin, David Cerero, Christopher Grady, Eoin McGuirck, Gerard Padro i Miquel, Ryan Pike, Steven Rosenzweig, and participants of the Boston Area Working Group in African Political Economy 2023 (BWGAPE), the Midwestern Political Science Association 2023 (MPSA), and the Empirical Studies of Conflict (ESOC) for their generous feedback. All remaining errors are our own.

†Visiting Assistant Professor, Cornell University dgrasse@cornell.edu

‡Yale University, Political Science melissa.pavlik@yale.edu

1 Introduction

Climate change is rapidly changing patterns of human behavior and posing security challenges across the globe, both directly and as a risk multiplier (Busby, 2022; Burke et al., 2010; Koubi, 2019). A particular flash point of climate-related conflict is clashes between farmers and pastoralists in sub-Saharan Africa, caused in part by the latter changing their migratory patterns due to fluctuations in weather patterns and scarcity of available land (McGuirk and Nunn, 2020; Eberle, Rohner and Thoenig, 2020). Farmers and herders tend to be drawn from distinct ethnic and religious groups, generating larger communal conflicts from clashes (Fearon and Laitin, 1996).

In reaction, states craft policies designed to regulate the environment to manage common pool resources. In the context of farmer and pastoralist conflict, policy responses often take the form of *conservation laws* governing land use by either group. How do conservation policies impact violent conflict between competing social groups?

We argue policies that seek land conservation by restricting land use to either favor open grazing or enclosed pastures economically disadvantage farmers or herders respectively, based on the insight that "[g]iven the still deeply political nature of land tenure in Africa, these [land tenure] policies easily become zero-sum" (Brottem, 2020*b*). Semi-nomadic pastoralists benefit most from common property rights regimes, whereas farmers tend to prefer private property rights. We develop a theoretical model drawing from Butler and Gates (2012) that assumes conflict is produced through two channels: rapacity, or the incentive to use force to capture resources, and opportunity cost, the lost income which comes from diverting resources from productive labor towards appropriation(Dal Bó and Dal Bó, 2011; Dube and Vargas, 2013; Hirshleifer, 1989). We show that protecting the property rights of one group (who we call the advantaged group) reduces the opportunity for the disadvantaged group to access income, increasing the relative benefit of using coercion to capture land resources.

Our model provides three core insights: (a) a group disadvantaged by conservation laws will produce violence at a higher level to attempt to capture control of resources (b) as property rights protections grow stronger in favor of the advantaged group, the disadvantaged group will increase their investment in violence faster than the advantaged group decreases their violent behavior, producing a net increase in

aggregate conflict and (c) the effects of a-b are moderated by increasing labor productivity, which reduces conflict through an opportunity cost effect, and grows stronger with increased bias. Our theory predicts that policies which attempt conservation by limiting the grazing rights of pastoralists may backfire and create more conflict, but that the effect of such policies may become more mutated if weather conditions are particularly favorable for productivity. Yet, due to climate change, favorable weather conditions are more variable, meaning these conservation policies may produce the conditions for more violent flare-ups if sudden droughts or heat waves reduce labor productivity after policies are enacted.

We test our argument in Nigeria, the sixth most populous country in the world and one where farmer-herder conflict has been expanding in scope and scale in recent years. Nigeria has historically had a rural-based economy where farmers and headers largely existed in symbiosis: herders would openly graze in cropland during the planting season, providing free fertilization, and migrate to other shrubland during the harvest season (McGuirk and Nunn, 2020; Eberle, Rohner and Thoenig, 2020; Brottem and McDonnell, 2020). However, Nigeria is one example of a country where climate change has created land scarcity through desertification, limiting available grazing options for headers.

Given its federalist system, Nigerian states have individually responded to land scarcity by enacting strict bans on open grazing by pastoralists, which we collectively call anti-grazing laws (AGL). The laws began to be introduced in 2016, and have proliferated since then. AGL include fines or impounding of cattle that is grazing openly without a permit, under the assumption that by restricting open grazing herders will switch from nomadism to sedentary practices, choosing to keep their cattle in enclosed ranches.

Using a difference-in-differences design, we find evidence that anti-open grazing laws increase violent conflicts over grazing and land use. Conflicts increase by nearly 1 additional fatality per 100,000 residents for each category, which represents nearly a half standard deviation increase in conflict intensity. Our results are not driven by particular states, preexisting conflict trends, aberrations in news reporting, or downstream effects of Boko Haram violence.

Next, we study how fluctuations in rainfall impact violent conflict before and after AGL. Given conservation policies are intended to be necessary in times of environmental stress, we explore how conservation policies may actually fuel conflict when they are needed the most: times of drought. We find higher levels of rainfall reduce conflict more strongly after AGL are passed. The result is consistent with the idea that during

droughts, when returns to labor are lower, the incentive to engage in conflict intensifies. The takeaway from our results is that (1) after AGL, years with lower rainfall make conflict more intense and (2) overall, conflict levels become more sensitive to weather after AGL.

Our paper makes several contributions. First, we show how the connection between climate change and conflict is shaped by political institutions. Our paper links political and ecological drivers of conflict by studying how state policy in the face of environmental change shapes conflict dynamics. Debates regarding environmental security have questioned the degree to which scarcity shapes conflict relative to governance (Goldstone, 2018; Soysa, 2002; Peluso and Watts, 2001). In the context of climate change, while Burke et al. (2009) have argued that climate drive drives political violence in Africa, others have argued that "[t]he primary causes of civil war are political, not environmental" (Buhaug, 2010). We reconcile these perspectives by illustrating how a political response to an environmental condition – scarcity of land and changing migratory patters due to shifting weather patterns – fuels violent conflict. We respond to the call of Koubi (2019), who argues "scholars should continue to investigate how climatic changes interact with and/or are conditioned by socioeconomic, political, and demographic settings to cause conflict." By focusing on the consequences of policies made in response to climate change, rather than variability in temperature or precipitation, we center politics and the policy-making process. In doing so, we illustrate an unintended pathway to conflict through environmental conservation (Gilmore and Buhaug, 2021). In contrast to neo-Malthusian perspectives (Homer-Dixon, 2010, 1994), our results highlight the mediating impact of government policy.

Second, we show how policy responses to scarcity impact resource conflict, beyond a resource's intrinsic value. Conflict over scarce resources is shaped by two factors: (1) contestability, or the conflict actor's ability to potentially capture the resource if they decide to fight for it; and (2) the value of the resource (Fetzer and Marden, 2017). Research on resource conflict largely studies how commodity shocks to resource value impact conflict outcomes (Blair, Christensen and Rudkin, 2021; Dube and Vargas, 2013). By studying how changes in resource value shape conflict incentives, the commodity shocks literature illustrates how shifts in the "size of the prize" influence conflict intensity. While critically important, the focus on resource value is only half the equation. We emphasize how institutional responses to scarce resources can impact violent conflict – namely, how changes that reduce the *contestability* of the prize influence incentives for violence

(Couttenier, Grosjean and Sangnier, 2017; Fetzer and Marden, 2017).

Finally, our study highlights the challenges of state-building by showing how strengthening private property rights may backfire. State failure can occur if there is no production, or if there is a surplus of production with no protection (Dal Bó, Hernández-Lagos and Mazzuca, 2022). Conventional wisdom suggests that when property rights are protected – that is, made legible (Scott, 2020) and enforceable with a monopoly on violence (Weber, 1978) – states build strength and achieve better economic outcomes. However, as we see in the case of AGL in Nigeria, land rights for farmers (at the expense of nomadic herders) can prompt increased destruction and extrajudicial violence. Our study speaks to the tightrope states must walk to develop: strengthening land claims under the wrong conditions may in fact exacerbate state fragility by increasing political violence between non-state actors.

2 Theory

2.1 Scarcity, Conflict, and Climate Change in Sub-Saharan Africa

Tensions between farmers and herders emerge due to ecological constraints, which are shaped by governance. The Sahel is characterized by arid and semi-arid conditions, making fertile land and water sources scarce. Both farmers and pastoralists rely on these limited resources for their livelihoods – farmers need land for crops, while pastoralists need grazing land and water for their livestock. Pastoralist production activity tends to be nomadic or semi-nomadic, since grazing herds may otherwise exhaust the same patch of land if they remained sedentary. Pastoralist groups therefore move seasonally based on changes in where available grazing land can be accessed. Customary land rights tend to govern land use across Sub-Saharan Africa, which both groups having some legitimate claim to traditional use (Brottem and McDonnell, 2020; Homewood, 2008; Lane, 2014).

Pastoralists' migratory patterns can spur tensions with farmers. Livestock can accidentally trample crops, destroying farmers' source of income. To deter pastoralists from coming near farmers, farming groups may use violence against them as punishment for destroying crops. However, these actions can trigger reprisal attacks, escalating into larger intergroup conflict (Butler and Gates, 2012; Eberle, Rohner and Thoenig, 2020; McGuirk and Nunn, 2020). For example, in Nigeria's Middle Belt region, violent clashes between

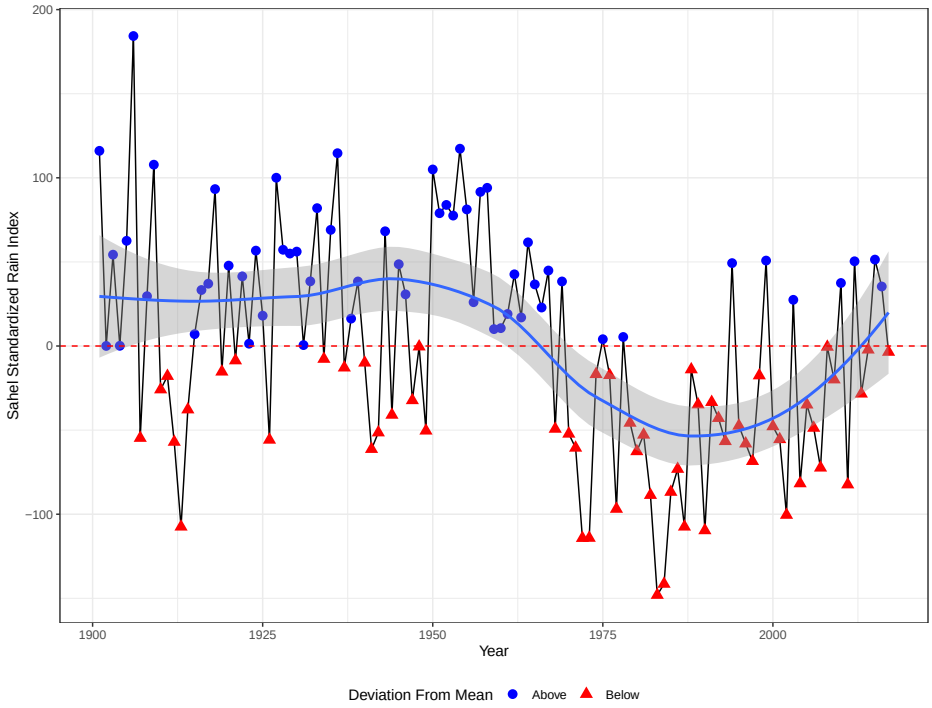
herders and farmers have resulted in significant casualties and displacement. In 2018, it was reported that these conflicts resulted in more deaths than those caused by the terrorist group Boko Haram. The clashes, exacerbated by the proliferation of small arms, have led to a cycle of retaliatory violence, with over 1,300 people killed and approximately 300,000 displaced since January 2018. Meanwhile, a clash in northeast Ivory Coast killed at least 27 and displaced thousands in 2016 (Nnoko, 2018).

Historically, farmers and herders had developed informal institutions to sustain peaceful cooperation through repeated interactions (Blattman, Hartman and Blair, 2014; Hartman, Blair and Blattman, 2021; Jha, 2013; Tajima, 2014; Skaperdas, 1992). In Northwest Cameroon, during growing seasons, herders would allow their cattle to graze around farm land, but would not do so during harvest seasons. By allowing grazing during the planting season, herders could feed their livestock while farmers received free fertilizer. By avoiding grazing around farms during harvest seasons, pastoralists avoided conflicts with farmers my minimizing the possibility of crop damage.[1] Cooperative relations between Mbororo and Gbaya groups – herders and farmers respectively – are maintained through reciprocal gift giving, which builds trust and friendship (Burnham et al., 1980; Bukari, Sow and Scheffran, 2018). These cooperative norms can allow groups to bargain and negotiate to smooth over tensions should conflict begin to arise.

Climate change has disrupted the informal institutions that have typically supported cooperation by both forcing pastoralists onto new lands and by reducing the overall share of usable land. Eberle, Rohner and Thoenig (2020) find heat stress from climate change pushes nomadic groups into new territory, where there have not been repeated interactions or reputations built by either party. As such, there are no cooperative norms to facilitate peaceful dialogue, leading to more conflict in areas where land is suitable to both farming and grazing. Further, droughts may push herders into new grazing routes following irregular seasonal patterns, generating conflicts with farmers (McGuirk and Nunn, 2020). Figure 1 illustrates the decline in average rainfall in the Sahel region of Africa. Climate change has generated scarcity and new migratory pressures, which have overwhelmed informal means of peaceful cooperation between both groups (Eberle, Rohner and Thoenig, 2020; McGuirk and Nunn, 2020). We show the result of this rainfall shortage - land degradation - in Figure 2, which shows the loss of usable soil across the continent.

[1]Thin Lei Win, 9-22-2018. Reuters. "Africa's nomadic herders help, not harm, land and planet - U.N." Accessed 4-1-2023.`https://reut.rs/2zort7z`

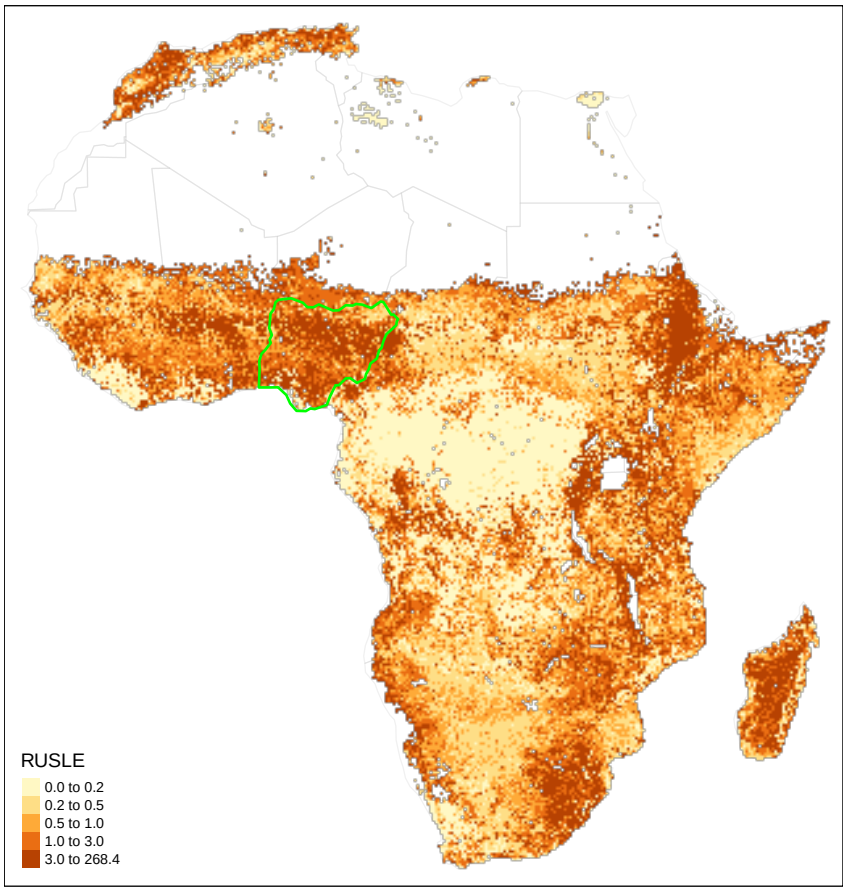
Figure 1: Rainfall Decline in the Sahel Overtime



Note: Sahel Standardized Rainfall Index against time (1900-2017) normalized by the long run mean. Deviations below the mean have become more common in the last 50 years.

States confront the challenges of competition by pastoralists and farmers over land use with various legal strategies, with the most prevailing being laws regulating the commons by defining land use rights for either farming or herding. For instance, Niger law establishes "terroirs d'attache", where "land uses other than pastoralism are prohibited." Similarly, Burkina Faso, Mali, and Mauritania have created national pastoral charters which promote pastoral land rights. In contrast, Ethiopian policy explicitly promotes agricultural development in pastoralist lands. Somaliland has historically sought to promote exclusive land rights, favoring ranching and sedentary agriculture over pastoralism (Dyer, Omondi and Wantsusi, 2008). Indeed, "[l]egislative instruments have been used by most independent African states to legitimise alienation of pastoral land" (Lane, 2014). A common view of pastoralism is that it makes less productive uses of land than agricultural activities, and since sedentary and nomadic uses of land trade off with one another, many states decide to promote the former (Lane, 2014; Dyer, Omondi and Wantsusi, 2008).

Figure 2: Land Degradation in Africa



Note: Data is from Revised Universal Soil Loss Equation (RUSLE), a measure of soil erosion across Africa. Higher values indicate more soil loss. Green outline is Nigeria, the country that is the subject of our empirical analysis.

Creating exclusive land rights could be one pathway to reduce conflict by making resources - namely land - less contestable. In the context of secure land rights in the Amazon, Fetzer and Marden (2017) find property rights protections reduce land-related conflict in Brazil, consistent with the idea that making common pool resources less contestable reduces the effort agents are willing to invest in conflict since they can expect to not capture much even after they use force. In the context of farmer-herder conflicts driven by climate change in Sub-Saharan Africa, Eberle, Rohner and Thoenig (2020) argue that "sound property

rights protection and land dispute resolution strongly reduces the scope for harmful conflict effects."

However, creating more exclusive land rights may further marginalize economically disadvantaged groups, generating stronger incentives to use violence to push (relatively) advantaged groups off of their land. In the context of farmer-herder conflicts, Brottem and McDonnell (2020) remark that "interventions that work through public institutions in places where certain groups have been marginalized or have low levels of trust in the institutions can risk reinforcing the same drivers of conflict that these interventions are trying to transform." Creating stronger land rights for farmers may reduce the amount of land that herders can legally claim to have a customary right to, but it also may reduce their overall expected earnings from herding by crowding them out of productive uses of land, while also making what land they may be able to claim through force all the more valuable. Therefore, we expect exclusive land reforms which strengthen the property holdings of one group to generate more conflict. We provide a brief model to elucidate our theoretical framework and formally provide testable predictions.

2.2 Model

We develop a model that builds upon the insights of the qualitative literature that expanding property rights for farmers limits the productive land available for headers (Brottem and McDonnell, 2020; Brottem, 2020*a*, 2014). We expand a model from Butler and Gates (2012) of range wars over resources between pastoralists and farmers by decomposing income into (1) earnings from captured land and (2) production from labor, which allows us to make predictions about how changes in property rights protection interact with shifts in outside options from climate shocks. Our model is focused on the level of conflict (intensive margin) rather than its onset (extensive margin).[2]

Consider $N = 2$ groups indexed by i and j where $i \neq j$. We assume groups to be unitary and homogeneous. Each group has a fixed finite amount of resources $E_i \in \mathbb{Z}^+$ that can be divided into working W_i or fighting F_i. One can think of working as tending to crops or investing in care for livestock. Alternatively, fighting may include spending money on weapons, or organizing communal militias. For example, farmers may form

[2]Two critical differences between our set up and that of Butler and Gates (2012) are of note. First, we model the opportunity cost of conflict by including labor scaled by productivity as the outside option rather than the share of resources left after committing fighting resources. Second, we do not combine η_i and η_j to construct an aggregate measure of total property rights in the system.

'livestock guards' or vigilante militias at the community level; while herders may invest in weapons such as guns and machetes with which to defend their cattle. At the extreme, investing in fighting may take the form studied by Thurston (2020), where pastoralists join insurgent groups and include open grazing land as one of their demands (Brottem and McDonnell, 2020). An example of this tradeoff of resource allocations can be found in Mali, where pastoralist insurgent groups have "introduced the Zakat in some localities, an Islamic custom that requires families to give up a proportion of one's wealth to the poor, but which also partly go towards feeding and funding combatants" (Rupesinghe and Bøås, 2019).

Allocating resources to F_i allows groups to contest access to an exogenous resources $V > 0$. We consider V to be fixed assets, such as mixed-use land that is suitable for either grazing or farming (Eberle, Rohner and Thoenig, 2020; McGuirk and Nunn, 2020). Contesting or capturing the resource in the context of farmer-herder conflicts may be driving farmers off of land, or alternatively intimidating herders from crossing into certain places through force, such as slaughtering cattle.

The proportion of V that group i accesses is p_i, a ratio contest success function (CSF) of four parameters: the fighting effort of both groups F_i and F_j, and how well the state protects either group's claims to property $\eta_i > 0, \eta_j > 0$ (Neary, 1997; Butler and Gates, 2012).[3]

When group i has support of the state over claims to property, we assume they are able to capture some proportion of V without needing to invest in fighting, since the state can leverage its coercive apparatus to support the property right of group i. η_i therefore "protects" a share of V for player i (Butler and Gates, 2012). The modified CSF has the following form.

$$p_i = \begin{cases} \frac{F_i+\eta_i}{F_i+\eta_i+F_j+\eta_j}, & \text{if } F_i, F_j > 0 \\ \frac{\eta_i}{\eta_i+\eta_j}, & \text{otherwise} \end{cases} \tag{1}$$

When neither actor invests in fighting, $p_i = \frac{\eta_i}{\eta_i+\eta_j}$, meaning V is allocated according to the share of total property rights protection $(\eta_i + \eta_j)$ held by group i η_i. Since our focus is on inequality of property rights,

[3]The functional form of the CSF is open to some debate in the context of conflict, with some arguing for a logistic rather than a ratio form (Hirshleifer, 1989). The ratio form in our setting, however, captures the feature that any investment in arms has a relatively sizeable impact on probability of victory, considering we are focused on conflicts between communal groups rather than armies where battle success is more stochastic. Further, the inclusion of constants η guard against the possibility that any minuscule investment from 0 increases the share of resources taken to 1.

we assume (without loss of generality) $\eta_1 > \eta_2$. The total benefit of fighting then is:

$$Vp_i \tag{2}$$

Any effort not diverted towards fighting is placed into labor ($W_i = E_i - F_i$). Devoting resources to working is multiplied by a productivity parameter $\alpha > 1$. A higher α means one unit of labor is converted into to more production: for example, if rainfall was plentiful during growing season, spending time on crop production provides higher returns than normal. The parameter captures the the opportunity cost of conflict (Dal Bó and Dal Bó, 2011; Dube and Vargas, 2013).

However, productive output is weighted by the protection of the other player's property rights η_j. This discounts the returns to labor in proportion to the strength of one's opponent's property rights. The more property rights protection the other player has, the less productive output group i can secure. This reflects the fact that strong property rights protection for group j creates an environment where player i's returns to labor are reduced. Strong property rights protection for group j reflects the fact that group i may be at a competitive disadvantage in the productive sector when group j has stronger property protection.

Our parameterization captures the insight that "[g]iven the still deeply political nature of land tenure in Africa, these [land tenure] policies easily become zero-sum" (Brottem, 2020*b*). Stronger protections for one group often come at an economic cost for the other group by shaping where they can produce. Hendrickson, Mearns and Armon (1996) argue "[r]estrictions placed on pastoral mobility by conflict in the region have joined with those imposed by colonial and post-independence administrations severely to curtail the pursuit of normal productive activities" (Hendrickson, Mearns and Armon, 1996). Exclusion around land use has been a central theme in farmer-herder conflicts in both Mali and Tanzania (Benjaminsen and Ba, 2009; Benjaminsen, Maganga and Abdallah, 2009), due to the economic costs of such exclusion.

For instance, migration corridors for pastoralists are state-led initiatives that protect certain areas of land for herders to engage in transhumance. Farmers criticize these policies since they are concerned that this protection for herders diminishes productive land that they could use for farming (Brottem, 2014). Meanwhile, laws that limit grazing area protect areas of land for farmers. State restrictions on land use have historically limited pastoralist productivity, because "exclusionary land tenure regimes... ensured that many

members of pastoralist communities were forced to operate on the margins of the law" (Brottem, 2020*a*). The total benefit to working then is:[4]

$$\frac{\alpha(E_i - F_i)}{\eta_j} \tag{3}$$

Plugging equation (1) into equation (2), the total utility for player i is given in equation (4). Each player i seeks to maximize Equation 4 by making an optimal investment in F_i. The first half of the equation represents the incentive to predate (the rapacity effect) whereas the second captures the loss of potential income from investing in fighting rather than labor (opportunity cost). When the rapacity incentive is larger, groups invest more in conflict, and when the outside option to conflict is larger, predating incentives are lower (Dal Bó and Dal Bó, 2011; Dube and Vargas, 2013).[5]

$$\pi_i = \underbrace{V\frac{F_i + \eta_i}{F_i + \eta_i + F_j + \eta_j}}_{\text{Rapacity}} + \underbrace{\frac{\alpha(E_i - F_i)}{\eta_j}}_{\text{Opportunity Cost}} \tag{4}$$

2.3 Equilibrium Conflict Levels

We solve for Cournot Nash equilibrium (Neary, 1997; Hirshleifer, 1991; Butler and Gates, 2012). We adopt the following assumption, without loss of generality, to focus our discussion on inequality in property rights protection.

Assumption 1. *Property rights inequality:* $\eta_1 > \eta_2$

Throughout, we assume $\eta_1 > \eta_2$ because our theoretical focus is on how property rights protection of one group shapes overall conflict. If we assumed equality, our solution would not reflect the case we theorize about, where the state provides uneven protection of land rights to different groups based on their policy. We refer to group 1 as the advantaged group, and group 2 as the disadvantaged group, to reflect the difference in the relative size of their respective η.

[4]The nature of how the other sides property rights discounts the returns to labor has been unmodeled in previous versions of this game. In Appendix A, we show that allowing the ratio of property rights as a factor scaling productivity yields the same insights as our model, albeit with more complicated parameters. Due to the simplicity of allowing property rights entering labor solely in the denominator, we prefer the version in the main text.

[5]We summarize the parameters of the model with examples in Table A.1.

The best response for group i is found by taking the first order condition for F_i. These functions are given in equation (5).

$$\begin{aligned} RC_1 &= \frac{\sqrt{\alpha V \eta_2 (F_2 + \eta_2)}}{\alpha} - F_2 - \eta_2 - \eta_1 \\ RC_2 &= \frac{\sqrt{\alpha V \eta_1 (F_1 + \eta_1)}}{\alpha} - F_1 - \eta_2 - \eta_1 \end{aligned} \tag{5}$$

Substituting the reaction curves from equation 5 into each other, we solve for the equilibrium response from both groups.

$$\begin{aligned} F_1^* &= \frac{\eta_2^2 \eta_1 V}{\alpha(\eta_2 + \eta_1)^2} - \eta_1 \\ F_2^* &= \frac{\eta_2 \eta_1^2 V}{\alpha(\eta_1 + \eta_2)^2} - \eta_2 \end{aligned} \tag{6}$$

The equilibrium is an interior solution where $F_i \in (0, E_i) \forall\ i, j \ \ i \neq j$. Each group selects a level of F based on the ratio of fixed resources V to labor productivity α scaled by the property rights protection of both sides η_1, η_2, and shift the intercept of that ratio according to their level of property rights protection (η_i). The denominators are equivalent, but the numerators reveal that $F_2^* > F_1^*$ since $\eta_1 > \eta_2$ by assumption, meaning the disadvantaged groups produce a higher volume of violence. We graph the equilibrium in Appendix A.

2.4 Empirical Implications

We turn now to analyzing the results of the model to derive empirical predictions. We assume that resources are sufficiently rich such that resource conflict is worthwhile: given the setting of our argument and our substantive focus on conservation policy in areas with contentious politics over land, our assumption is fitting. Specifically, we assume $V > \frac{\alpha(\eta_1+\eta_2)^2}{\eta_1 \eta_2}$. When this inequality does not hold, the ratio of labor productivity to resources is sufficiently high that investing in conflict over resources is dominated by productive labor. Under this assumption, our model predicts two results.

Proposition 1. ***Increased Protection of One Group's Property Rights Increases Aggregate Conflict***

We consider aggregate conflict (AC) as the sum of both groups conflict production $AC = \sum_{i=1}^{N} F_i$. Taking the first derivative of the advantaged group's property rights protection η_1 with respect to AC, we

observe.

$$\frac{\partial AC}{\partial \eta_1} = \frac{V\eta_2^2}{\alpha(\eta_1+\eta_2)^2} - 1 > 0$$

Therefore, aggregate conflict increases as η_1 increases. From the perspective of the disadvantaged group, the incentive to increase conflict production in the face of rising property rights for the advantaged group is driven by the fact that a larger η_1 affords a larger share of V to the advantaged group, meaning the disadvantaged group must increase F to offset the advantage. Furthermore, as η_1 increases, the returns to productive labor are decreasing since the land left for grazing is of lower quality, creating even more pressure for land conflict. From the perspective of the advantaged group, investment in conflict decreases since less conflict production is needed to capture a share of V as η_1 rises, however, the decrease does not occur at the same rate as the disadvantaged group's increase in conflict effort. The advantaged group cannot commit reducing their conflict effort symmetrically, since doing so would surrender a larger share of V. Overall, higher η_1 boosts conflict effort from the disadvantaged group substantially, while it prompts the advantaged group to draw down effort at a slower rate. We visualize this effect in Figure 3, which illustrates a total increase in conflict, primarily driven by the disadvantaged group.

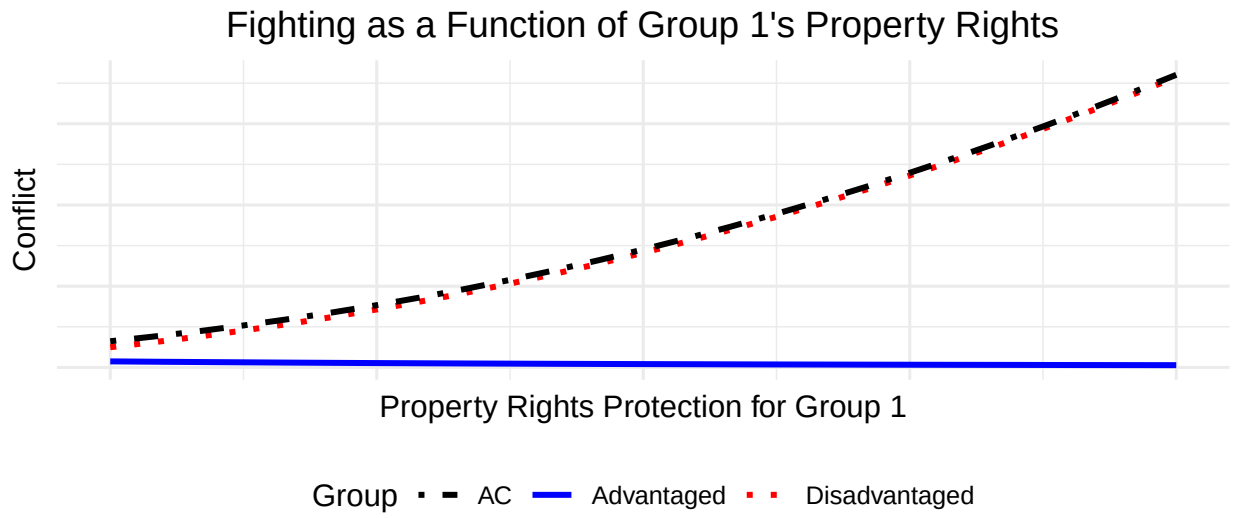
Proposition 2. ***Labor productivity (α) reduces conflict, and faster as bias (η_1) increases***

As labor productivity increases (higher α), the opportunity cost of conflict increases, reducing the level of effort devoted to conflict $\frac{\partial AC}{\partial \alpha} = -\frac{V\eta_1\eta_2}{\alpha^2(\eta_2+\eta_1)} < 0$. The prediction is in line with the theory that the as the size of the outside option increases, groups allocate less to appropriation (Blair, Christensen and Rudkin, 2021; Dal Bó and Dal Bó, 2011; Dube and Vargas, 2013).

Next, we seek to understand the interactive effect of increasing labor productivity (α) while property rights become more biased (increasing η_1). Taking the mixed partial derivative, we see that partial of α after taking the partial of AC with respect to η_1 is $-\frac{V\eta_2^2}{(\eta_2+\eta_1)^2\alpha^2} < 0$. This means labor productivity has an even larger conflict-reducing effect as biased protection for property rights rises.

For intuition, consider a herder who is already disadvantaged in a conflict because their claim to property rights is weaker (η_1 growing larger relative to η_2). A smaller change in α is required for them to see greater returns on investing one unit in $W = E - F$ rather than F. Of course, the downside of this moderating effect is that climate change makes weather patterns more variable and extreme, meaning that areas with large

Figure 3: Aggregate Conflict (AC) as η_1 Increases



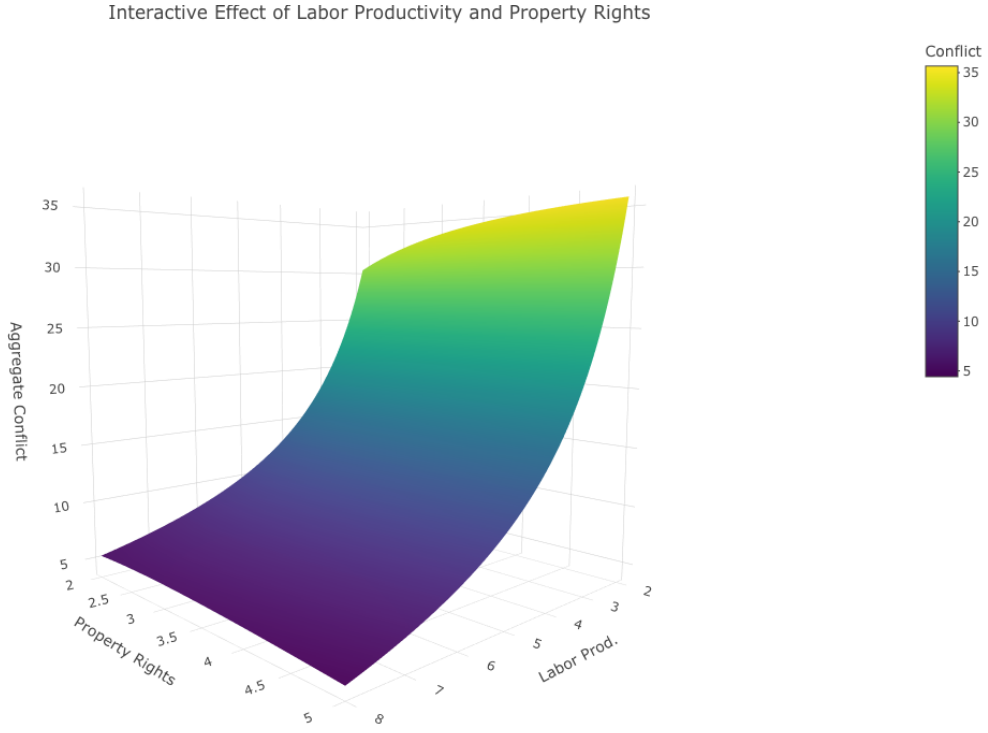
Note: Conflict production as a function of increasing η_1.

η_1 relative to η_2 may see reductions from favorable labor productivity shocks due to climate, but may also see surges in violence generated from unfavorable shocks. Substantively, this means conservation through restricting access to the commons will be *most* effective when it is generally not needed (weather shocks are favorable for production) and *least effective* when it is needed the most (drought conditions which create more scarcity). We visualize this relationship in Figure 4.

3 Anti-Grazing Laws in Nigeria

We test our argument that property rights protection that favors one group (an increasing η_1 relative to η_2) corresponds with more farmer-herder conflict, and that changes in labor productivity moderate the effect, in the context of anti-grazing laws in Nigeria. Since 2016, Nigerian states have enacted bans on open grazing in a staggered fashion (meaning sudden increases in η_1 if group 1 is farmers). Since Nigerian agriculture is primarily rainfed, we measure labor productivity (α) with rainfall, which has empirically been linked to productivity and economic well-being in rural Nigeria (Amare et al., 2018).

Figure 4: Effect of α as η_1 increases



Note: Simulation of aggregate conflict equilibrium varying α (Labor productivity) and η_1 (property rights protection for advantaged group). Note the steeper increasing slope as η_1 increases when α is low (top right of graph).

3.1 Farmer-herder conflict in Nigeria

Nigerian pastoralists – particularly cattle herders – are primarily based in the North and are largely nomadic or semi-nomadic. These herders, while migratory, have traditionally followed fairly regular land-use patterns. Herders typically migrate between the North and the South of Nigeria to access pastures across the country at different times of year (ACAPS, 2017). In the past, this southwards movement took place in the drier first half of the year, as pastoralists and their cattle gravitated away from the Sahara and towards less arid coastal areas in the south. During rainy season from roughly June through October – overlapping with farmer harvesting season – herders headed back north, away from southern flood plains (ACAPS, 2017).

However, increasing degradation of pastureland in the North has pushed many herders southwards more frequently and in greater volume. Moreover, herders have traveled to (or remained in) the south and the Middle Belt well later than previously. Herders have begun to graze cattle across the south even in the latter half of the year, while farmers attempt to grow and harvest their crops. The result has been crop destruction, loss of livelihood, and violence.

This farmer-herder violence in Nigeria has reached unprecedented levels in recent years. Its growing severity stems from a complex intersection of environmental, economic, ethnic, and political issues. In particular, differences in ethnic group, region, language, and religion between farmers and herders regularly lead the violence to take on communal dimensions. Many herders in Nigeria are from the majority-Muslim North, often of the Fulani ethnic group. On the other hand, populations – and farmers – in southern Nigeria tend to be predominately Christian and identify across a wide variety of ethnic groups (Bamidele, 2020). News reports on the conflict tend to be tinged with inter-ethnic suspicion, often conflating herder banditry with jihadist violence by Boko Haram, also concentrated in the North.

Importantly, climate-related displacement of Fulani pastoralists has ignited political conflict over land-use rights between farmers and herders. In many cases, farmers and herders have resorted to violence over land which has been settled and turned to farmland, but which overlaps with traditional migration routes or areas previously reserved for grazing migrating cattle. As a result, both groups have claimed the right to access the land. Farmer-herder violence has increased in complexity even as it has escalated in scope and severity. This includes the introduction and involvement of more professionalized communal and ethnic militias, as well as outbursts of widespread, organized, and brutal banditry.

3.2 Anti-open grazing laws in Nigeria

'Anti-open grazing laws' (AGL) is the term we use to collectively refer to a series of land-use policies passed over the past decade by individual states of Nigeria restricting open grazing of cattle in order to combat the destruction of farmlands and stem farmer-herder conflict. 'Open grazing' as defined in one such law is "the act of pasturing livestock to feed on dry grass, growing grass, shrubs, herbage, farm crops etc. in open fields without any form of restriction" (Aondofa Aligba and Gbakighir, 2019/2020). These laws often require that cattle only graze in ranches, which require permits. Legal penalties are associated with grazing cattle in the

open, especially if one has a firearm or other weapon while doing so. Fines and penalties may include the impounding of animals, as well as being responsible for damages (Agwu and Wilson-Okereke, 2019).

The first wave of AGL in 2016 and 2017 was preceded by Nigeria's 2015 general election, among the most important in the young democracyâs history. An upstart coalition the All Progressives Congress (APC) allying Southwest, Middle Belt and Northern politicians unseated the Peoples' Democratic Party (PDP), which had been in power since the end of the period of military rule. It represents the first time in the Republic's history a ruling president was unseated and peacefully stepped down, transferring power to an opposition party. As part of the compromise, the (victorious) APC Presidential nominee was Muhammadu Buhari, a retired Fulani general and former military ruler who had run as the Northern candidate during the past three elections under different parties. During the election, Middle Belt states had mixed results for gubernatorial and presidential elections, with the Southwest and the Middle Belt being the most contested areas.

The implementation of AGL in Nigeria began in 2016 in the South West state of Ekiti, with Middle Belt states Taraba and Benue passing similar laws in 2017. These laws varied slightly in their details and stated objectives, but had similar implications. For example, the first law passed in Ekiti (The Prohibition of Cattle and other Ruminants Grazing in Ekiti State Law No. 4 of 2016) restricts all grazing of cattle on any land "the Governor has not designated as ranches" (*(The Prohibition of Cattle and other Ruminants Grazing in Ekiti State Law No. 4 of 2016*, 2016). The law explicitly limits any grazing from 6pm - 7am. Under Ekiti's policy, herders in possession of firearms are to be charged with terrorism, have their cattle confiscated, face a mandatory 6 month prison sentence (at minimum), and be forced to compensate for any property destruction. Benue state's anti-grazing law restricts grazing even more broadly, imposing an absolute ban on grazing without possession of a ranch permit obtained by the government. Abia's 2018 policy explicitly lays out its objectives to include (as reported by BBC (2021)):

1. Prevention of destruction of crops, community land, and property by grazing livestock
2. To prevent clashes between farmers and herders
3. To protect environmental degradation and pollution from open grazing and rearing of livestock

Most recently, on May 11, 2021, 17 governors in the Southern States announced their collective intention

to ban open grazing in their states, despite opposition from the federal government (Kabir, 2021; Day, 2021). At the governors' meeting, they resolved (as reported by the Premium Times):

> "... that open grazing of cattle be banned across Southern Nigeria; noted that development and population growth has put pressure on available land and increased the prospects of conflict between migrating herders and local populations in the South. Given this scenario, it becomes imperative to enforce the ban on open grazing in the South (including cattle movement to the South by foot)" (Kabir, 2021).

A follow-up meeting in Lagos in July confirmed this agenda, giving a deadline of September 1 for region-wide implementation. Despite a declared commitment on the part of southern states, the resolution was unevenly enacted. Not all involved states successfully passed anti-open grazing laws, and less than half were immediately compliant. Only five met the September 1 deadline. The staggered passage of these land-use laws gives us leverage in assessing their effect on the conflict and violence they were designed to prevent.

4 Data and Design

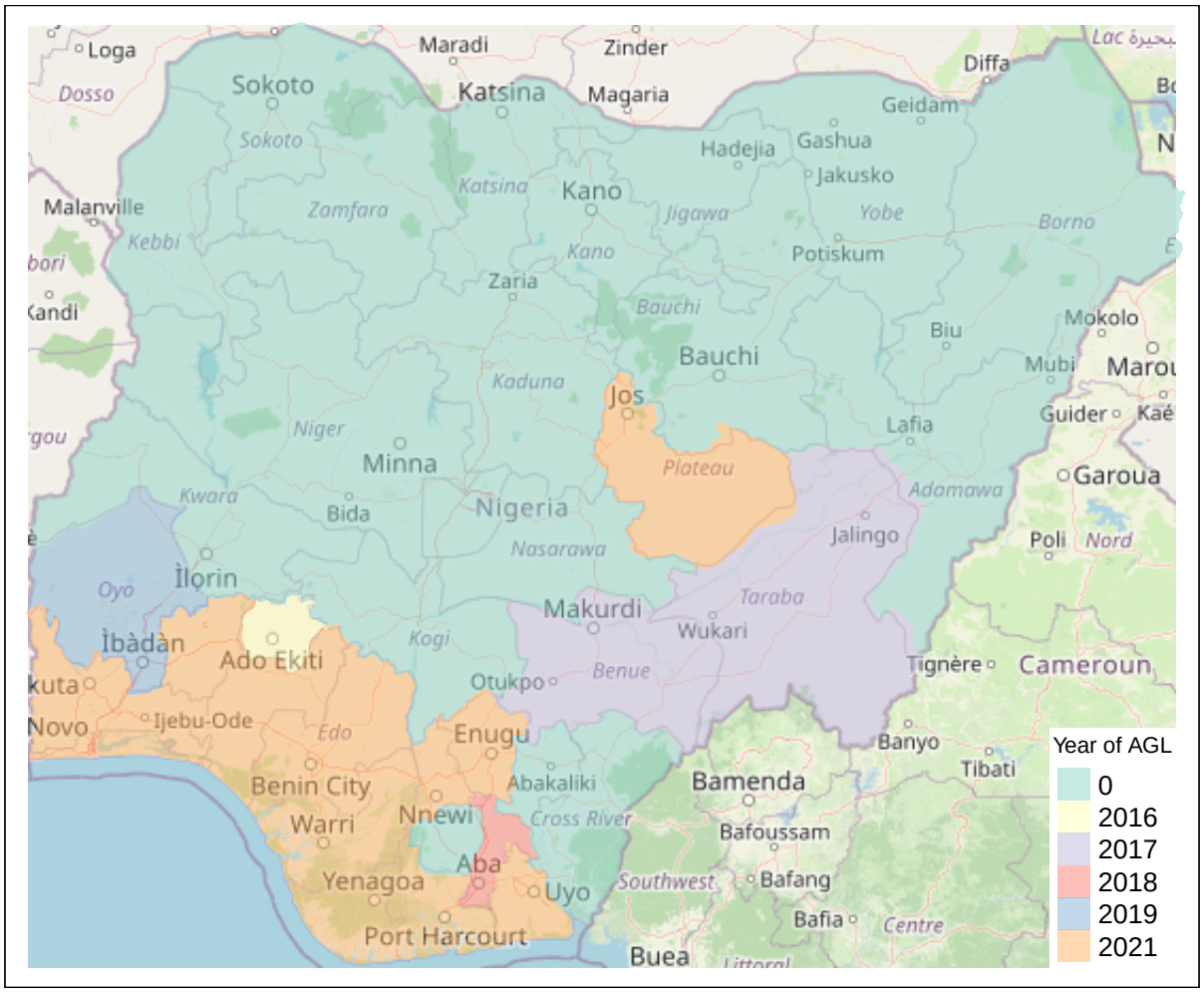
4.1 Data

Our conflict data covers years $t \in \{2007, 2008, ...2022\}$ and states $i \in \{1, 2, ...37\}$. AGL first passed in 2016, and continued to be passed up to 2021. Therefore, we focus on the period of 2007 to present for our main analysis. Since states are the unit where the laws are enacted, we construct a panel of all states from the 2007-2022 period.

AGL in Nigerian States

We construct a dataset of AGL in Nigeria from newspaper and official state sources which announce the passage and year of implementation of anti-open grazing laws at the state level. These laws began in 2016 and reached their zenith in 2021 when 17 southern states agreed to implement policies which prohibited open grazing, with 7 immediately complying. Our data include c treatment cohorts with $c \in \{2016, 2017, 2018, 2019, 2021, \infty(\text{never})\}$. We map the spatial distribution of laws and their timing in Figure 5.

Figure 5: Map of States that Passed Anti-Grazing Laws and the Year of Passage



We consider states as treated after states pass AGL. We focus on passage over implementation because the signal that the law will come into force is salient for conflict dynamics. We expect herders and farmers to to begin to adjust their behavior in light of these policies once hearing news of them, since the adjustments required are major.[6] Further, the implementation of laws have a known start date, meaning agents could anticipate their treatment status, threatening inference by making the AGL group non-comparable to the non-AGL group in the lead up to enforcement. As such, passage is our key intervention of interest, for both theoretical and identification-based reasons.

Conflict Data: Nigeria Watch

We use fatality data from violent events gathered by Nigeria Watch. Nigeria Watch is a research project hosted by French Institute for Research in Africa. The group collects information on fatal events from 10 daily and weekly newspapers as well as human rights organizations to measure violent conflict fatalities across the country. Unlike other conflict event databases, Nigeria Watch focuses on violent events that are smaller in scale, especially land related conflict and small-scale violence over cattle grazing, which are two key categories of conflict for our study. The coverage from Nigeria Watch is therefore more extensive: whereas ACLED records 22,483 conflict events from 1998-2022, Nigeria Watch records nearly 40,000 from 2006-2022.

We evaluate the veracity of Nigeria Watch relative to other popular conflict databases. In Figure C.1, we show Nigeria Watch counts more fatalities in every year versus ACLED and UDCP GED dataset, the two most commonly used subnational conflict databases. Importantly, the correlation between ACLED, GED, and Nigeria Watch is quite high. The positive (and statistically significant) relationship between the time series in Nigeria Watch and other databases strongly suggests all sources detect the same signals, and that the greater count of fatalities from one source is not merely driven by random noise. However, Nigeria Watch picks up more low-scale fatality events than the other two data sources. In appendix Figure C.2, we show the density of event coverage converges across databases as the number of fatalities grows larger, but that at low levels of fatalities, the density of observations is higher in Nigeria Watch.[7] We reject the null that

[6] As mentioned, some states agreed in principle to consider passage such laws, but failed to do so in the stated timeframe. Despite the widespread announcement of this intention, plausible uncertainty as to whether a given state would follow through with the agreement means that a law's *passage*, not *announcement*, is the relevant date of interest.

[7] Our argument is not an indictment of ACLED as a data source in general, nor a criticism of its accuracy

the density of distributions is the same, providing credence to our claim that Nigeria Watch includes more converge of the kind of low level conflict events we study.

Rainfall

We use rainfall data from the Climate Research Unit (CRU) processed by Aid Data (Tierney et al., 2011). We use the natural logarithm of annual rainfall totals, which as been shown to impact labor productivity in Nigeria (Amare et al., 2018), and is the same functional form used in Gehring and Schaudt (2024), who studies the effect of rain shocks on farmer-herder conflicts in Kenya. We analyze this data at the administrative level below the state, the Local Government Area (LGA), to capture more fine-grained weather variation. We report the time series of rainfall for all LGAs in Appendix Figure C.3.

Survey Data: Afrobarometer

Finally, we use four waves of the Afrobarometer in Nigeria, spanning from 2015 to 2022. Waves were collected in 2015, 2017, 2020, and 2022. The survey is a nationally representative sample across states, with about $1,600$ respondents per wave, and asks a series of questions about general perceptions of governance, democracy, and economic conditions; as well as some more specific questions about country-specific issues.[8] Although conflict between farmers and herders is primarily economic, the fact that each group is typically drawn from a distinct religious and ethnic group animates communal conflict. We use survey data to test the degree to which individuals in AGL states become more hostile to out-groups.

4.2 Empirical Strategy

We use a difference-in-differences strategy to identify the effect of AGL passage on farmer-herder conflict, taking advantage of the differential timing of the passage of these laws in some states relative to others. We estimate the interaction-weighted difference-in-differences estimator to account for the staggered introduction of AGL over time (Sun and Abraham, 2021).[9]

or veracity. Instead, it is an illustration that motivates our choice of dataset given the purpose of answering our particular research question.

[8]Data can be accessed at Afrobarometer's website, `https://www.afrobarometer.org/`

[9]We plot the regression weights from a two-way fixed effects model using the decomposition in Goodman-Bacon (2021), which shows forbidden comparisons receiving non-zero weight with opposite signed effects.

$$y_{it} = \alpha_i + \lambda_t + \sum_{c \neq 0} \sum_{\ell \neq -1} \beta_{c\ell}(\mathbf{1}\{\text{AGL}_i = c\} \cdot D_{it}^{\ell}) + \varepsilon_{it} \tag{7}$$

The outcome y_{it} is the count of fatalities per capita in a state i during year t. Our measure captures the intensive margin of violent conflict; since we measure violence at a highly aggregate level (the state) the extensive margin of violence shows considerably less variability. Theoretically, our argument is concerned with intensity, which makes the measure appropriate.

$D_{it}^{\ell} := \mathbf{1}\{t - c_i = \ell\}$ where $\ell \in \{-14, -13, ...6\}$ captures the time after laws are passed; positive values indicate laws have passed state legislatures, negative values represent years until laws are passed. D_{it}^{ℓ} is equal to 1 when state i is ℓ periods from passing AGL. We follow convention and exclude the year prior to AGL $\ell = -1$ as a reference. $\mathbf{1}\{\text{AGL}_i = c\}$ is a binary indicator for which treatment cohort $c \in \{2016, 2017, 2018, 2019, 2021, 0(\text{never})\}$ state i belongs to, with 0 set as the reference.

The parameter(s) of interest are $\beta_{c\ell}$, which capture the effect of AGL post-implementation among states in cohort c at event time ℓ relative to states that never implemented AGL. $\beta_{c\ell}$ is a difference-in-differences estimator between states that implemented AGL in time ℓ relative to time $\ell = -1$. We report our main results by plotting $\beta_{c\ell}$ to show dynamic effects and tests for pre-trends in conflict, but also report the average effect of AGL. The average effect of AGL is a weighted average of cohort average treatment effects, where the weights are the share of all treated states that are in each cohort (Sun and Abraham, 2021). Throughout, we cluster standard errors on the state, as that is the level where the treatment is assigned.[10]

We adjust for different levels in conflict driven by common shocks and state-specific factors. α_i are state fixed effects which account or time-invariant confounders. These include attributes of the state that change little or not at all from year to year, such as geography or historical institutions. λ_t are year fixed effects which account for common shocks across states in a given year, such as the COVID-19 pandemic and national elections.

We include time-invariant covariates interacted with year fixed effects to account for different conflict cycles that may be experienced by states with distinct baseline traits. We spatially merge tribal boundaries

[10]Since there are over 30 states in our panel (37), there are a sufficient number of groups for standard clustering of errors to account for serial correlation (Cameron, Gelbach and Miller, 2008).

from Murdock (1967) to compute the fractionalization of states by different tribes.[11] Next, we use satellite data to compute the area of the state that is cropland,[12] the volume of land that is desertified, as well as total area. Throughout, we use fixed effects for the terciles of these covariates to account for non-linearlity.

Our core identification assumption is parallel trends, that is, the potential outcomes of states that passed AGL would have evolved along a path that is comparable to the states that never passed AGL. This requires those states that passed AGL to have similar conflict trends to those which never passed AGL.

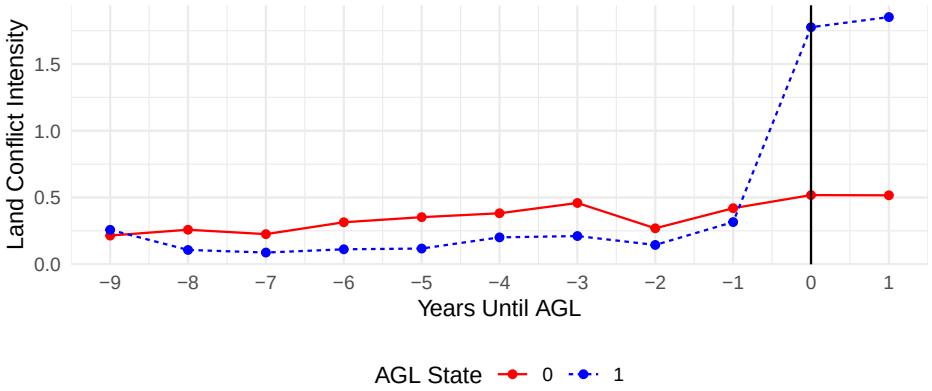
Our theory implies a parallel trend between two locations prior to a change in any of the underlying parameters because conflict reaches a steady state as per equation 6. Parallel trends are an untestable assumption, but an observable implication of the assumption holding is a similar conflict trend in states that adopted AGL and those that did not prior to AGL adoption. We visually inspect preexisting trends by constructing a group of "never exposed" states that did not adopt AGL, normalizing years as time until AGL are passed for each cohort, and then stacking each treated cohort against control to create separate time series charts for AGL and clean control states. Figure 6 shows states are relatively similar before AGL, but spike in the years after they pass.

Our theoretical model and visual tests suggest that conflict trends are similar prior to AGL passage. We supplement these facts with a qualitative accounting of how AGL became law by comparing two states: Benue and Nasarawa. While we include a more detailed accounting in appendix, we briefly summarize the key point in the main text. In the case of Benue, the govenor faced political pressure to placate farmers interests due to the 2015 election and the a budget crisis which had eroded the civil service, making agriculture a glowingly salient occupation as an alternative. In the case of a neighboring state, Nasarawa, an AGL was considered but never passed due to lack of political will. As the case studies illustrate, the process of passing AGL is not a mechanical response to conflict trends, it is instead a messy and negotiated processes, which lends itself to idiosyncratic timing of passage with respect to conflict trends (Appendix B).

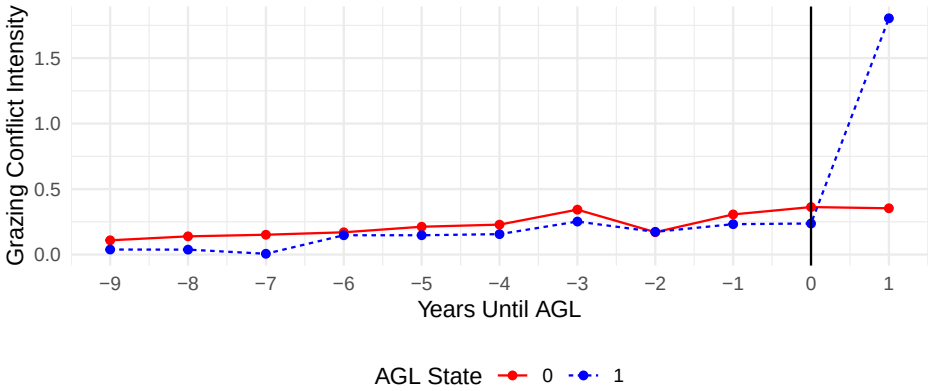
[11] Specifically we compute the Herfindahl index: the sum of squared shares.
[12] Data obtained from Goodman et al. (2019).

Figure 6: Common Trends Between States Prior to AGL

(a) Land Conflicts



(b) Grazing Conflicts



Conflict trends of states that passed AGL (AGL State = 1) versus states without AGL (AGL State=0) for years until AGL are passed (negative for years before, 0 for the year of, positive for the year after). Vertical axis in both graphs are fatalities per capita from the conflict event category.

5 Main Results

We report our baseline results in two ways. First, we present the event study estimates, which show the dynamic effects of AGL. Dynamic effects include placebo treatment times, which measure the difference-in-differences at a sequence of years prior to AGL being implemented versus the year prior to the laws. If the parallel trends assumption holds, it would unlikely that we find sizeable jumps prior to the laws being

implemented. Likewise, if parallel trends are violated, it would be unsurprising to find diverging trends between states prior to the laws. After we report our event study estimates, we report the average dynamic effects by cohort in a tabular format with covariates.

Figure 7 shows our event study results. We fail to detect a strong pre-trend in conflict, with coefficients tightly estimated closed to zero. However, right of the vertical dashed line, we report a sharp increase in conflicts in both panels.

Table 1: AGL Increased FH Conflicts

Dependent Variables:	Grazing Conflict		Land Conflict	
Model:	(1)	(2)	(3)	(4)
Variables				
Post AGL	0.4830***	0.5185***	0.8611***	0.8878***
	(0.0653)	(0.1565)	(0.1774)	(0.2585)
Fixed-effects				
State	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Crop Tercile x Year		Yes		Yes
Area Tercile x Year		Yes		Yes
Desertification Tercile x Year		Yes		Yes
Ethnic Fractionalization Tercile x Year		Yes		Yes
Fit statistics				
Observations	592	592	592	592
N State	37	37	37	37
N Year	16	16	16	16

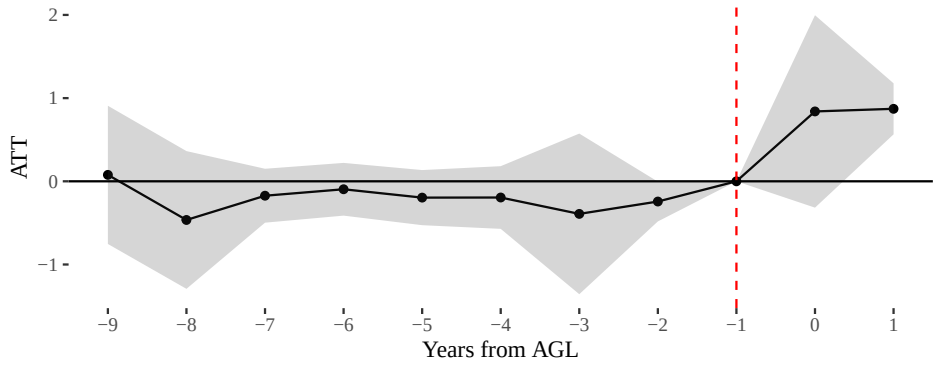
Clustered (state) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table 1 shows average effects of AGL. Columns 1 and 2 refer to grazing conflicts, and 3-4 refer to land conflicts. Odd numbered columns report models with state and year fixed effects, whereas even columns include the fixed effects for terciles (share of crop land area, total area, desertification, ethnic fractionalization) interacted with year fixed effects.

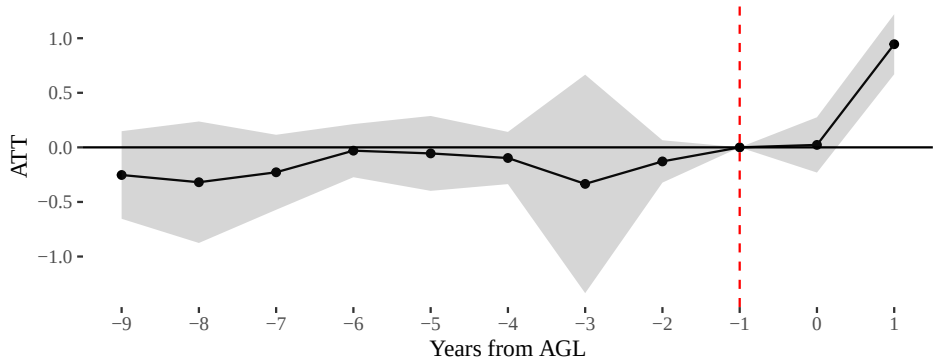
Our results show that the average effect of AGL on grazing conflict is 0.53σ (standard deviation of grazing conflict = .90) and 0.58σ for land conflict (standard deviation of land conflict = 1.48). In terms of the mean of the states that do not impact AGL, the effects are roughly double (144% and 256%) of the

Figure 7: Conflicts Per Capita

(a) Land



(b) Grazing



Note: Outcome is fatalities per capita. Each point estimate represents the difference-in-differences relative to the year before AGL are implemented. Estimates to the left of the vertical dashed line are placebo pre-trend estimates, estimates to the right are treatment effects. Panel A is grazing conflicts, Panel B is land conflicts. Shaded regions are confidence intervals, constructed from standard errors clustered by state. Note that not all cohorts have five periods past treatment

control average. Our point estimates are largely unimpacted by the inclusion of flexible covariates, meaning that the shift in trends is not driven by ethnic composition, crop dependency, the size of the state, or the degree of desertification. The effect corresponds to roughly .5 additional deaths per 100,000 residents. The results suggest that AGL had a sizeable positive impact on violent conflict.

5.1 Robustness

We test for several plausible alternative accounts of the pattern we uncover.

Idiosyncratic shocks to treated states One may be concerned our results are driven by a trend shock that is correlated with the adoption of AGL by certain states.To probe for this possibility, we systematically drop treated states and re-estimate equation (1). We find effects are not driven by any particular state (Figure D.2).

Strength of Reporting Our outcome data is from a newspaper database. Although we illustrate the validity and reliability of Nigeria Watch, one may still raise the concern that reporting has nonrandom variation across states, and that this measurement error may drive our findings. First, we note that any measurement error would need to be correlated with both the state and the timing of treatment: any cross-state differences in measurement, which likely accounts for most of the error, is absorbed by state fixed effects. Second, we count only fatal events, which are less likely to be missed by newspaper reports or falsified do to their lethal nature.

Nonetheless, we use several strategies to probe the robustness of our estimates to measurement error from newspaper reporting. First, we assume that even if the exact count of fatalities is subject to error, the count of fatal events is not mismeasured: that is, reporters may not know the total number of fatalities, but they do effectively observe when fatalities occur. Using an event count measure, we find consistent results (Appendix D.3).

Second, we weight states based on covariates that may predict accurate reporting. First, we use Afrobarometer data on mobile phone usage, since information communication technology penetration is associated with more accurate conflict reporting (Weidmann, 2016). Second, we use survey data on newspaper readership per state to capture the strength of media in each state. Using both of these reweighing schemes to provide more weight to states with more accurate conflict coverage, we find consistent results (Appendix D.3).

Unrelated Conflict Trends? Falsification Tests

Communal conflicts in Nigeria have escalated for reasons beyond farmer herder conflicts: cultist activity, banditry, and the rise of Boko Haram all constitute alternate security threats. One interpretation of our

results is that the jump we detect is the byproduct of a generic conflict cycle among AGL states. We test for this possibility by using conflict fatalities resulting from banditry, Boko Haram, and cultist activity as outcome variables. We find no divergence in trends between AGL and control states, which suggests the surge in violence we find is specific to farmer-herder conflict (Appendix D.4).

Boko Haram Confounder?

One source of confounding may be a correspondence between the timing of AGL with pressures that spur conflicts between herders and farmers. The primary mechanism by which this has occurred in the Nigerian context is movement of herders further south due to insecurity created by Boko Haram, which primarily operates in the North of the country. One may argue that our results are an artifact of these population pressures coinciding with the timing of grazing restrictions, meaning the relationship we uncover is driven by other exogenous forces. We address this possibility by allowing total Boko Haram conflict to have a state-specific effect on farmer-herder conflict. We interact the total number of annual Boko Haram conflict events (BH_t) with state fixed effects to adjust for the aggregate effects the insurgency may have had on specific states (Appendix D.5).

Time Varying Confounders? TD Strategy

A key confounding concern is that some shock co-occurs within AGL states that creates a time-varying difference between states the pass the laws and those which do not. For instance, our case studies highlight that Benue state enacted a ban in part because of the growing salience of farmers political interests due to funding shortfalls for civil servants, which pushed the Governor to act in ways that protected farmers interests. One may argue the time-varying state-specific conditions in Benue - the economic situation - explains both the passage of AGL and a rise in farmer-herder conflict. We address this possibility with a triple differences (TD) design which uses Afrobarometer survey data on Farmer-Herder conflict frequency and takes advantage of the fact that the laws impact the perceptions of those employed in the agricultural sector. Our approach nets out state specific and sector specific trends, and finds the laws increase the perception of farmer-herder conflicts (Appendix D.6).

6 Moderating Effect of Weather Shocks

Next, we examine if shifts in labor productivity (α in the model) moderate the effect of AGL. Since rainfall is a crucial input into agricultural production in both the herding and farming sector (Amare et al., 2018; McGuirk and Nunn, 2020), we use (the logarithm) of annual rainfall totals to capture the returns to productive labor as in Gehring and Schaudt (2024). To exploit more fine-grained variation in weather patterns, we shift our unit of analysis down to the local government area (LGA), which captures more localized impacts of weather changes than a state-level analysis.

To study the moderating effect AGL on of rainfall shocks, we must model the interaction of post-AGL policy with rainfall. Since the Sun and Abraham (2021) estimator has yet to be extended to model heterogeneous effects per cohort, we use a stacked DID approach. We construct $k = c - 1$ dataframes, where each dataframe is a single treated treated cohort $k = c_{treat} \in \{2016, 2017, 2018, 2019, 2021\}$ and the "clean control" cohort of never treated units ($c_{control} \in \{0\}\}$). We "stack" these dataframes together, and include unit-stack and time-stack fixed effects. The approach allows us to cleanly estimate the average interaction effect by group across cohorts without the use of forbidden controls (Goodman-Bacon, 2021). We estimate the following specification.

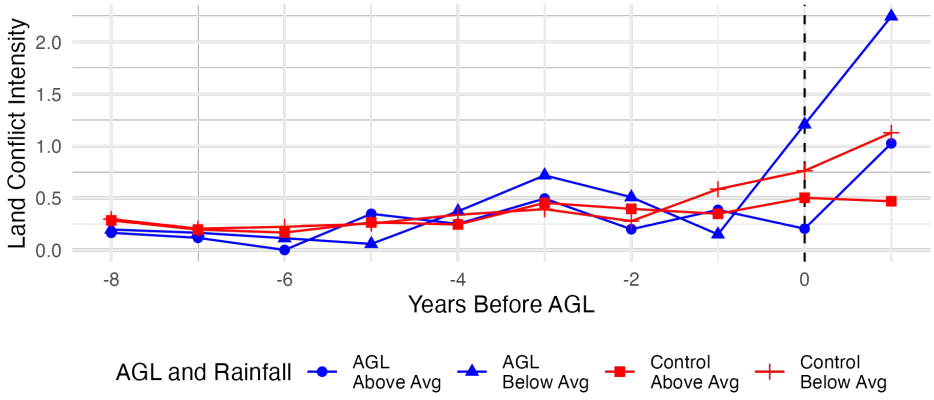
$$\text{Conflict}_{lstk} = \delta_1 \text{Post AGL}_{stk} + \delta_2 \text{Rainfall}_{lstk} + \delta_3 \big(\text{Post AGL}_{stc} \times \text{Rainfall}_{lstk}\big) + \mu_{lk} + \lambda_{tk} + \varepsilon_{lstk} \tag{8}$$

The parameter of interest is δ_3, which captures the differential effect or rainfall in states that passed AGL after the laws are in effect. The ratio of $\frac{\delta_3}{\delta_1}$ captures the percentage difference of the effect of droughts after the implementation of AGL, which can be interpreted as the difference in intensity of droughts on conflict post-AGL. To account for spatial autocorrelation due to the dependence of rainfall values across states and LGAs, we use Conely standard errors.

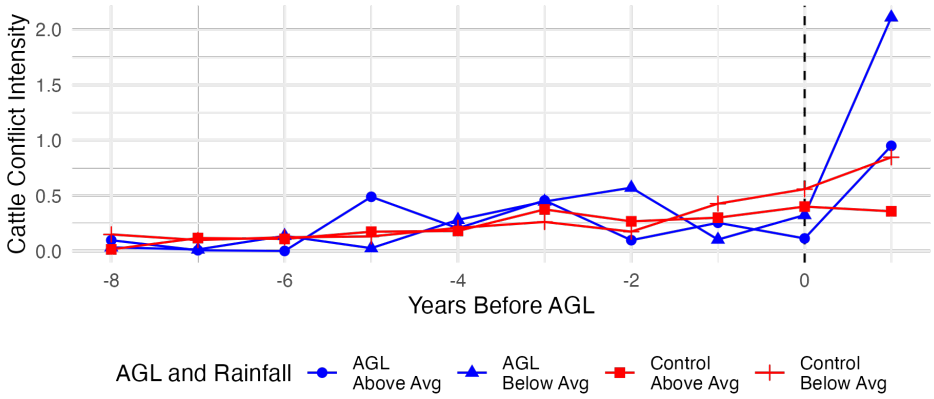
First, as a visual test, we recreate Figure 6 by placing LGAs annual rainfall total into below average and above average buckets (for the LGA) and plot the average level of conflict in event time by the categories of AGL state with above average rainfall, AGL state with below average rainfall, control with above average rainfall, and control with below average rainfall. Figure 8 shows areas with below average rainfall differentially spike after AGL is implemented.

Figure 8: Common Trends Between States Prior to AGL Stratified by Rainfall Levels (Above or Below LGA Average)

(a) Land Conflicts



(b) Grazing Conflicts



Conflict trends of states that passed AGL (AGL State = 1) versus states without AGL (AGL State=0) for years until AGL are passed (negative for years before, 0 for the year of, positive for the year after). Vertical axis in both graphs are fatalities per capita from the conflict event category.

Results from estimating equation 8 confirm the visual test. First, consistent with several studies of rainfall and conflict (Burke, Hsiang and Miguel, 2015), we find more rainfall to be negatively correlated with violence. The result is consistent with the predictions from the model that as α increases, the returns to violence decline. Turning to heterogenous effects, the effect of AGL are more mutated as rainfall totals grow.

The result implies that AGL will be most effective when they are needed the least: when weather

Table 2: AGL Amplifies the Effect of Rainfall on Conflict

Dependent Variable:	Land Conflict		
Model:	(1)	(2)	(3)
Variables			
Post AGL	0.6825*		10.41**
	(0.4073)		(4.471)
Ln Rain		-0.6716*	-0.6442*
		(0.3762)	(0.3787)
Post AGL × Ln Rain			-1.982**
			(0.7997)
Dependent Variable:	Grazing Conflict		
Model:	(1)	(2)	(3)
Variables			
Post AGL	0.6150**		10.12**
	(0.3132)		(4.535)
Ln Rain		-0.7734**	-0.7479**
		(0.3650)	(0.3646)
Post AGL × Ln Rain			-1.936**
			(0.8438)
Fixed-effects			
LGA-Stack FE	Yes	Yes	Yes
Year-Stack FE	Yes	Yes	Yes
Fit statistics			
Observations	39,408	39,408	39,408

Conley (500km) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

conditions are such that violence is generally unfavorable, due to the higher returns to labor. Conversely, when conservation is critical, such as conditions when rainfall is scarce, AGL will be less effective. Overall, our results suggest that AGL could help to reinforce peace when labor conditions are already generally supportive of less conflict, but are not as strong when needed most.

7 Mechanism: Ethnic Tension

We test the microfoundations of our argument using survey data. If AGL increased tensions between herders and farmers, who are predominately from different ethnic and religious groups, we may expect individuals

Table 3: AGL Intensified Ethnic and Religious Tensions

Dependent Variables:	Ethnicity		Religion	
Model:	(1)	(2)	(3)	(4)
Variables				
Post AGL	-0.3530***	-0.3385***	-0.4688**	-0.4534**
	(0.1214)	(0.1204)	(0.1738)	(0.1716)
Fixed-effects				
State	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
sex-Year		Yes		Yes
Urban-Year		Yes		Yes
Fit statistics				
Observations	7,148	7,148	7,085	7,085
R^2	0.09938	0.10262	0.53250	0.53554
Within R^2	0.00573	0.00507	0.00955	0.00863

Clustered (State)) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

to be more hostile towards outgroups after AGL within AGL states. Afrobarometer includes useful survey questions for probing this idea, namely questions about whether an individual would like or dislike someone from a distinct religious or ethnic group from their own as a neighbor. We use this question to estimate the DD, adjusting for covariates that predict sampling (gender and urban/rural residence) interacted with wave fixed effects.

Our results show a sizeable decrease in willingness to live next to a person from a distinct ethnic group and a distinct religious group. The result is consistent with inflamed ethnic conflict in states that adopted AGL.

8 Conclusion

Do conservation policies dampen or inflame violent conflicts over resources? We develop a theoretical model taking a high profile flash-point - farmer and herder conflicts in the Sahel - as the setting. We argue conservation policies that restrict access to resources shapes actors' incentives to invest in tools for coercion over economic production by reducing the size of the outside option. When states make it more difficult for

herders to operate economically through their conservation laws, the net benefit of peace relative to violence is lower for herders, encouraging them to use force to attempt to take land. However labor productivity, which is determined in part by the weather, is a critical moderator of this effect.

We find empirical support for our argument in the Nigerian case, exploiting the staggered roll out of conservation laws across states overtime. Our results are not explained by other conflict trends, specific states, Boko Haram, and are unlikely to be the byproduct of measurement error. Further, we find that increased rainfall reduces the effect of conservation laws, but the converse is also true that shortfalls trigger more violence. Due to the fact that climate change increases the variance of weather shocks, our results suggest that extreme events that occur after such conservation laws are passed may amplify conflict more than they would have in the absence of such policies.

Our study takes a broader look at the conflict climate nexus beyond the reduced form relationship between weather shocks and violence. While we consider the role of weather, our theoretical model and empirical approach considers how climate change shapes incentives for combat while centering the state's response to the conservation challenges which conflict is attributed to. In doing so, we follow the call of Koubi (2019), who stresses the importance of researching how climate interacts with politics to understand how conflict is produced. Our approach navigates between Burke et al. (2009) who argues climate change spurs social conflict and (Buhaug, 2010) who argues environmental explanations are subordinate to political causes of conflict. We provide a theoretical framework that considers the interaction between climate effects and the policy environment to explain how communal violence may emerge.

Our results highlight the unintended consequence of conservation. As climate change threatens to drive more scarcity, the need to preserve environmental resources is more pressing. At the same time, restrictions on access may have distributional consequences across ethnic, religious, or other sociopolitical divides, fueling social conflict. The findings underscore an important point regarding conservation and climate mitigation: if the losses from regulations are not offset somehow, restrictions on resource use may have negative externalities in the form of political violence. One implication of our work is that policies that bundle regulations with some forms of compensation for "losers" may not trigger the same effect. For instance, Gehring and Schaudt (2024) find that livestock insurance schemes in Kenya reduced herder conflicts, a consistent finding with other literature on social insurance as a mitigating factor in conflict (Fetzer, 2020). Under our framework,

one may consider a bundle of conservation relations along with programs that boost labor productivity as being especially effective at reducing conflict.

Future scholarship may consider the role of other environmental policies on conflict in developing countries, such as REDD+, which may have similar impacts on local stability changing the distribution of land for economic production. As Gilmore and Buhaug (2021) describe, modeling trade offs between climate actions requires a full accounting of costs and benefits of different policy packages, but doing so requires an understanding of how climate policies may trigger (or alternatively dampen) conflict dynamics. Empirical studies with careful attention to theoretical mechanics and causal pathways will be crucial to push such an agenda forward. Our study serves as a template for such investigations.

As the climate continues to change, fragile and already strained populations will become more vulnerable, creating conditions ripe for conflict. At the same time, states may be hard pressed to make changes to mitigate or adapt to environmental stressors. Overall, our findings suggest states must consider unintended consequence for conservation restrictions on conflict when developing their responses, or bear the consequences.

References

ACAPS. 2017. Nigeria: Farmer-Fulani Herder Violence in Benue, Kaduna and Plateau States. Technical report ACAPS.

Agwu, Sunday Kenechukwu and Clinton Elochukwu Wilson-Okereke. 2019. "Human Rights Considerations to Anti-Grazing Laws in Nigeria: The Way Forward." *Available at SSRN 3619127* .

Amare, Mulubrhan, Nathaniel D Jensen, Bekele Shiferaw and Jennifer Denno Cissé. 2018. "Rainfall shocks and agricultural productivity: Implication for rural household consumption." *Agricultural systems* 166:79–89.

Aondofa Aligba, Mary Omanchi and Terzungwe Gbakighir. 2019/2020. "The Open Grazing Prohibition and Ranches Establishment Law, Benue State 2017 and Ruga Settlement Policy of the Federal Government: Constitutional Implications." *Benue State University Law Journal* 9(8). `https://bsum.edu.ng/journals/files/law/vol9/article8.pdf`.

Bamidele, Seun. 2020. "Ethnic Conflict and the Politics of Spoils in Nigeria." *Social Change* 50(4):569–583.

BBC. 2021. "Anti-Open Grazing law: Cattle herders/farmers law for southern Nigeria - Key facts." *BBC News Pidgin* August 25. `https://www.bbc.com/pidgin/world-58326035`.

Benjaminsen, Tor A and Boubacar Ba. 2009. "Farmer–herder conflicts, pastoral marginalisation and corruption: a case study from the inland Niger delta of Mali." *Geographical Journal* 175(1):71–81.

Benjaminsen, Tor A, Faustin P Maganga and Jumanne Moshi Abdallah. 2009. "The Kilosa killings: Political ecology of a farmer–herder conflict in Tanzania." *Development and change* 40(3):423–445.

Blair, Graeme, Darin Christensen and Aaron Rudkin. 2021. "Do commodity price shocks cause armed conflict? A meta-analysis of natural experiments." *American Political Science Review* 115(2):709–716.

Blattman, Christopher, Alexandra C Hartman and Robert A Blair. 2014. "How to promote order and property rights under weak rule of law? An experiment in changing dispute resolution behavior through community education." *American Political Science Review* 108(1):100–120.

Brottem, Leif. 2014. "Hosts, strangers and the tenure politics of livestock corridors in Mali." *Africa* 84(4):638–657.

Brottem, Leif and Andrew McDonnell. 2020. "Pastoralism and conflict in the Sudano-Sahel: A review of the literature." *Search for common ground* pp. 1–46.

Brottem, Leif V. 2020*a*. "Pastoral resource conflict in the context of Sudano–Sahelian security crises: A critical review of research." *African Security* 13(4):380–402.

Brottem, Lief. 2020*b*. "Climate War in the Sahel? Pastoral Insecurity in West Africa Is Not What It Seems." *New Security Beat* .
URL: *https://www.newsecuritybeat.org/2020/11/climate-war-sahel-pastoral-insecurity-west-africa/*

Buhaug, Halvard. 2010. "Climate not to blame for African civil wars." *Proceedings of the National Academy of Sciences* 107(38):16477–16482.

Bukari, Kaderi Noagah, Papa Sow and JÃ¼rgen Scheffran. 2018. "Cooperation and Co-Existence Between Farmers and Herders in the Midst of Violent Farmer-Herder Conflicts in Ghana." *African Studies Review* 61(2):78â102.

Burke, Marshall B, Edward Miguel, Shanker Satyanath, John A Dykema and David B Lobell. 2009. "Warming increases the risk of civil war in Africa." *Proceedings of the national Academy of sciences* 106(49):20670–20674.

Burke, Marshall B, Edward Miguel, Shanker Satyanath, John A Dykema and David B Lobell. 2010. "Climate robustly linked to African civil war." *Proceedings of the National Academy of Sciences* 107(51):E185–E185.

Burke, Marshall, Solomon M Hsiang and Edward Miguel. 2015. "Climate and conflict." *Annu. Rev. Econ.* 7(1):577–617.

Burnham, Philip et al. 1980. *Opportunity and constraint in a savanna society: the Gbaya of Meiganga, Cameroon.* Academic Press.

Busby, Joshua. 2022. *States and nature: The effects of climate change on security.* Cambridge University Press.

Butler, Christopher K and Scott Gates. 2012. "African range wars: Climate, conflict, and property rights." *Journal of Peace Research* 49(1):23–34.

Cameron, A Colin, Jonah B Gelbach and Douglas L Miller. 2008. "Bootstrap-based improvements for inference with clustered errors." *The review of economics and statistics* 90(3):414–427.

Couttenier, Mathieu, Pauline Grosjean and Marc Sangnier. 2017. "The wild west is wild: The homicide resource curse." *Journal of the European Economic Association* 15(3):558–585.

Dal Bó, Ernesto, Pablo Hernández-Lagos and Sebastián Mazzuca. 2022. "The paradox of civilization: Preinstitutional sources of security and prosperity." *American Political Science Review* 116(1):213–230.

Dal Bó, Ernesto and Pedro Dal Bó. 2011. "Workers, warriors, and criminals: social conflict in general equilibrium." *Journal of the European Economic Association* 9(4):646–677.

Day, This. 2021. "The Existence of Grazing Routes in Nigeria: Fact or Fiction (Part 2)." *This Day* Aug 31. `https://www.thisdaylive.com/index.php/2021/08/31/the-existence-of-grazing-routes-in-nigeria-fact-or-fiction-part-2/`.

Dube, Oeindrila and Juan F Vargas. 2013. "Commodity price shocks and civil conflict: Evidence from Colombia." *The review of economic studies* 80(4):1384–1421.

Dyer, Nat, Shadrack Omondi and Michael Wantsusi. 2008. "Securing pastoralism in East and West Africa: Protecting and promoting livestock mobility." *Review of the legislative and institutional environment governing livestock mobility in East and West Africa. London: International Institute for Environment and Development (IIED)* .

Eberle, Ulrich J, Dominic Rohner and Mathias Thoenig. 2020. "Heat and Hate: Climate security and farmer-herder conflicts in Africa.".

Fearon, James D and David D Laitin. 1996. "Explaining interethnic cooperation." *American political science review* 90(4):715–735.

Fetzer, Thiemo. 2020. "Can workfare programs moderate conflict? Evidence from India." *Journal of the European Economic Association* 18(6):3337–3375.

Fetzer, Thiemo and Samuel Marden. 2017. "Take what you can: property rights, contestability and conflict." *The Economic Journal* 127(601):757–783.

Gehring, Kai and Paul Schaudt. 2024. "Insuring peace: index-based livestock insurance, droughts, and conflict." *Droughts, and Conflict (January 22, 2024)* .

Gilmore, Elisabeth A and Halvard Buhaug. 2021. "Climate mitigation policies and the potential pathways to conflict: Outlining a research agenda." *Wiley Interdisciplinary Reviews: Climate Change* 12(5):e722.

Goldstone, Jack A. 2018. Demography, environment, and security. In *Environmental conflict*. Routledge pp. 84–108.

Goodman-Bacon, Andrew. 2021. "Difference-in-differences with variation in treatment timing." *Journal of econometrics* 225(2):254–277.

Goodman, Seth, Ariel BenYishay, Zhonghui Lv and Daniel Runfola. 2019. "GeoQuery: Integrating HPC systems and public web-based geospatial data tools." *Computers & geosciences* 122:103–112.

Hartman, Alexandra C, Robert A Blair and Christopher Blattman. 2021. "Engineering informal institutions: Long-run impacts of alternative dispute resolution on violence and property rights in Liberia." *The Journal of Politics* 83(1):381–389.

Hendrickson, Dylan, Robin Mearns and Jeremy Armon. 1996. "Livestock raiding among the pastoral Turkana of Kenya: Redistribution, predation and the links to famine." *IDS Bulletin* 27(3):17–30.

Hirshleifer, Jack. 1989. "Conflict and rent-seeking success functions: Ratio vs. difference models of relative success." *Public choice* 63(2):101–112.

Hirshleifer, Jack. 1991. "The paradox of power." *Economics & Politics* 3(3):177–200.

Homer-Dixon, Thomas F. 1994. "Environmental scarcities and violent conflict: evidence from cases." *International security* 19(1):5–40.

Homer-Dixon, Thomas F. 2010. *Environment, scarcity, and violence*. Princeton University Press.

Homewood, Katherine. 2008. *Ecology of African pastoralist societies*. Ohio University Press.

Jha, Saumitra. 2013. "Trade, institutions, and ethnic tolerance: Evidence from South Asia." *American political Science review* 107(4):806–832.

Kabir, Adejumo. 2021. "17 Southern governors resolve to ban open grazing of cattle." *Premium Times Nigeria* May 11. `https://www.premiumtimesng.com/news/headlines/460960-updated-17-southern-governors-resolve-to-ban-open-grazing-of-cattle.html?tztc=1`.

Koubi, Vally. 2019. "Climate Change and Conflict." *Annual Review of Political Science* 22(1):343–360.

Lane, Charles. 2014. *Custodians of the Commons: Pastoral Land Tenure in Africa*. Routledge.

McGuirk, Eoin F and Nathan Nunn. 2020. Transhumant Pastoralism, Climate Change, and Conflict in Africa. Technical report National Bureau of Economic Research.

Murdock, George Peter. 1967. "Ethnographic atlas: a summary." *Ethnology* 6(2):109–236.

Neary, Hugh M. 1997. "Equilibrium structure in an economic model of conflict." *Economic Inquiry* 35(3):480–494.

Nnoko, Juliana. 2018. "Farmer-Herder Conflicts on the Rise in Africa." *Human Rights Watch* . **URL:** *https://www.hrw.org/news/2018/08/06/farmer-herder-conflicts-rise-africa*

Peluso, Nancy Lee and Michael Watts. 2001. *Violent environments*. Cornell University Press.

Rupesinghe, Natasja and Morten Bøås. 2019. "Local drivers of violent extremism in Central Mali.".

Scott, James C. 2020. *Seeing like a state: How certain schemes to improve the human condition have failed*. yale university Press.

Skaperdas, Stergios. 1992. "Cooperation, conflict, and power in the absence of property rights." *The American Economic Review* pp. 720–739.

Soysa, Indra de. 2002. "Ecoviolence: shrinking pie, or honey pot?" *Global environmental politics* 2(4):1–34.

Sun, Liyang and Sarah Abraham. 2021. "Estimating dynamic treatment effects in event studies with heterogeneous treatment effects." *Journal of Econometrics* 225(2):175–199.

Tajima, Yuhki. 2014. *The institutional origins of communal violence: Indonesia's transition from authoritarian rule*. Cambridge University Press.

(The Prohibition of Cattle and other Ruminants Grazing in Ekiti State Law No. 4 of 2016. 2016. Vol. 2016.

Thurston, Alexander. 2020. *Jihadists of North Africa and the Sahel: Local politics and rebel groups*. Cambridge University Press.

Tierney, Michael J, Daniel L Nielson, Darren G Hawkins, J Timmons Roberts, Michael G Findley, Ryan M Powers, Bradley Parks, Sven E Wilson and Robert L Hicks. 2011. "More dollars than sense: Refining our knowledge of development finance using AidData." *World Development* 39(11):1891–1906.

Weber, Max. 1978. *Economy and society: An outline of interpretive sociology*. Vol. 2 University of California press.

Weidmann, Nils B. 2016. "A closer look at reporting bias in conflict event data." *American Journal of Political Science* 60(1):206–218.

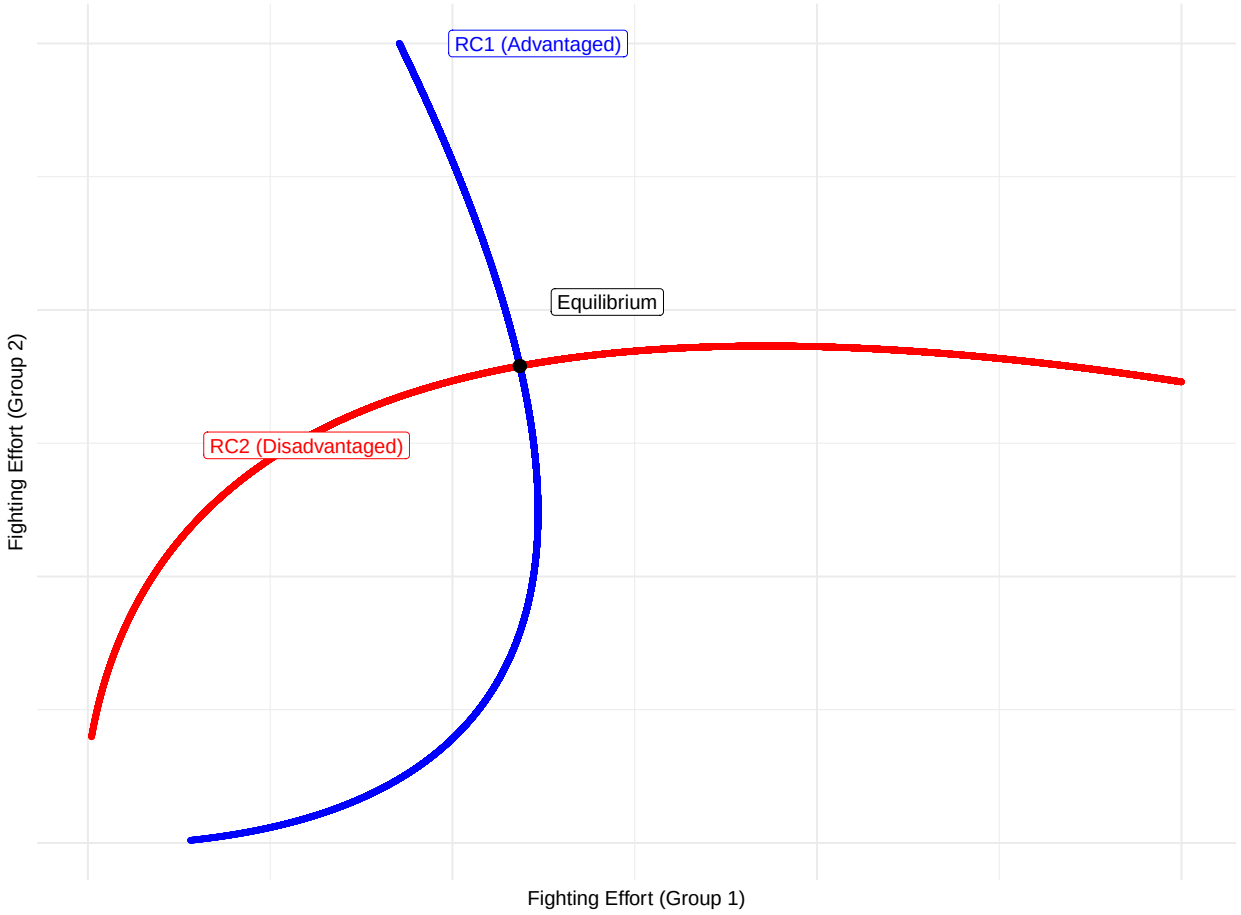
Online Appendix

Contents

A Model Appendix

A.1 Equilibrium Graph

Figure A.1: Cournot Equilibrium of Conflict Effort



A.2 Alternative Production Function

An alternative way to conceptualize the trade off of property rights is that productive output is scaled by the ratio of ones own property rights (η_i) to the property rights of the other group η_j. We show this produces the same results as our baseline model but with more nonlinearity.

The utility function is given as:

$$\pi_i = V\frac{F_i + \eta_i}{F_i + \eta_i + F_j + \eta_j} + \frac{\eta_i \alpha(E_i - F_i)}{\eta_j} \tag{9}$$

with the first derivative respect to F_i as:

$$\frac{V}{F_i + \eta_j + \eta_i + F_j} - \frac{V\left(F_i + \eta_i\right)}{\left(F_i + \eta_j + \eta_i + F_j\right)^2} - \frac{\alpha\eta_i}{\eta_j} \tag{10}$$

and the reaction curve:

$$F_i = \frac{\sqrt{\alpha F_j \eta_j \eta_i V + \alpha\eta_j^2 \eta_i V}}{\alpha\eta_i} - F_j - \eta_i - \eta_j \tag{11}$$

Plugging F_i into F_j revleals the equilibrium response.

$$F_i^* = \frac{\eta_j^3 \eta_i V}{\alpha(\eta_j^2 + \eta_i^2)^2} - \eta_i \tag{12}$$

Of course, this is very similar to the equation in the main text.

A.3 Summary of Parameters

Table A.1: Parameters and Descriptions in the Context of Farmer-Herder Conflicts in the Sahel

Parameter	**Description**	**Example in the Context of Farmer-Herder Conflicts in the Sahel**
F_i, F_j (endogenous)	Fighting effort	Effort farmers (F_i) and herders (F_j) put into conflict. E.g., farmers create and join communal militias, herders arm themselves.
$(E_i - F_i)$ (endogenous)	Working effort	Remaining effort for productive work after fighting. E.g., farmers tend to crops, herders use money for investments in livestock health and maintenance.
V	Contestable resources	Resources available for capture through conflict. E.g., fertile land, water sources.
η_i, η_j	State protected property rights	State protection for property rights of farmers (η_i) and herders (η_j). E.g., enforced land ownership laws for farmers, restrictions on where grazing occurs, or corridors set aside for pastoralists.
α	Labor productivity	Efficiency of labor in productive activities. E.g., crop yield, livestock management.

B Case Appendix

To provide further context typical of the legislative debates surrounding AGL at the state-level, we use original news reports to describe the lead-up and aftermath of a rise in violence in 2017 for two neighboring North-Central states: Benue, and Nasarawa. The states share a border along the Benue River; Benue passed an AGL in 2017, and Nasarawa never did. In documenting the legislative and popular debate surrounding AGL proposal and passage (or lack thereof) in these two states, we show that AGL passage was not caused by some unobserved third factor simultaneously catalyzing violence and legislation. Instead, legislative progress across states varies idiosyncratically, even across similar contexts facing similar threats and considering similar solutions.

B.1 Benue

Benue's AGL was first proposed by Governor Samuel Ortom of the APC, who was was elected in 2015. Benue state was one of those which voted, on margin, for the APC in both the gubernatorial and the presidential elections of 2015.[13] After Ortom took office, his predecessor was promptly arrested. In Benue, sometimes nicknamed the Food Basket of Nigeria, agriculture is critical as both a primary industry and a survival mechanism, and the government encourages individuals to rely on subsistence farming when times are hard.

The decision to follow Ekiti in passing a ban on open grazing was made in the context of a few overlapping factors. For one, Benue state was unable to pay salaries, leading to strikes and protests by civil servants in the lead-up to the ban's announcement. In fact, during the time of the law's passage, bureaucrats in Benue were being withheld paychecks due to lack of funds, and being actively encouraged by the governor to go back to the farm: "Because what is important is food is on the table." This mass movement back to the farms was, for the governor, a major constraint on the availability of land in the state at that moment: "everybody is going back to agriculture and they all know about the economy of the state that it is driven by civil service... internally generated revenue is not enough to pay salaries."[14]

Moreover, ongoing insecurity in the state targeted majority-Christian, predominately-farming indigenous

[13] Benue' neighbors Nasarawa and Taraba, the latter of which also passed an AGL in 2017, remained PDP.

[14] "Benue Grazing Law: We don't have lands to accommodate both farmers, herders." *Sunday Trust.* June 11, 2017.

Tiv, Idoma, and Igede groups, who (especially the Tiv) successfully mobilized in the lead-up to the ban's enactment with appeals to the APC, who they had crucially supported in the 2015 elections both at the federal and the state level. When, after a largely peaceful 2017 rainy season, suspected herders killed ten in communities across Benue State[15] a group called the Vanguard Against Tiv Massacre stormed the National Assembly in protest. One sign allegedly read: "We voted you to protect us, not watch us killed-take action." Local governments such as Buruku Federal Constituency also called directly on the federal government to provide increased security[16] – though President Buhari, himself Fulani, was viewed with suspicion. Pressure from both sub-state and non-state actors continued to mount on the Federal Government to intervene in Benue and in farmer-herder conflict more generally.

In May 2017, Governor Ortom took things into his own hands and signed his own AGL into law. In an address to State House correspondents, he said "we will do everything to protect lives and property of the state...[and] in Benue State, almost all the land is for cultivation."[17] He signed the "Anti-Open Grazing and Anti-Kidnapping, Abduction, Cultism and Terrorism" bill on May 22, 2017, which required all livestock to be ranched, and included fines and jail terms for open grazing. [18] The law was scheduled to go into effect as the next season began in November.

Between the law's passage in May and its planned enforcement in November, both indigenous Tiv and Fulani socio-cultural groups reacted strongly. Fulani group and cattle breeders association Miyetti Allah Kautal Hore (MAKH) President Alhaji Abdullahi Bello promised to mobilize herdsmen to resist the law.[19] MAKH also promised to file a lawsuit in the federal courts, saying the law was unconstitutional for not allowing freedom of movement of Nigerian citizens, especially given the Fulani's long history in the area. On the other hand, Christian and indigenous socio-cultural groups continued their own campaign, protesting equally vehemently in support of the AGL. They continued to publicly highlight the atrocities committed during farmer-herder violence, as well as seizing upon MAKH's legal challenge as a direct, existential threat to their homeland. In the days following MAKH's press release, Tiv youths protested in Benue over the lack

[15] Reports differ on the total number of casualties, as well as the specific origin of the fight - although the police noted there was a filed report of youths attacking cows with machetes: "Suspected herdsmen kill 10 in Nigeria's Benue State." March 12, 2017.

[16] House Reps to FG, Disarm All Herdsmen." *Daily Independent.* March 14, 2017.

[17] "Ortom meets Osinbajo, vows to outlaw grazing." *Weekly Trust.* May 20, 2017.

[18] State approves anti-open grazing, kidnapping bills into law," *PM News.* May 22, 2017.

[19] "Herdsmen in Nigeria to fight grazing law." The Mercury. 5 June 2017.

of prosecution over killings of farmers since 2012, and specifically voiced alarm that MAKH claimed a right to occupy what they considered their ancestral land[20] Christian groups such as the Christian Association of Nigeria (CAN) joined protests against MAKH's legal challenge. The governor's office, which called an emergency state security council meeting, claimed MAKH's leaders had gone "beyond grazing to talk about struggle for natural resources; that they were here before we came... we will not accept that kind of threat."[22]

Within a month of the law's passage, the threatened court case from MAKH had turned, in the public imagination, to an outright and imminent Fulani invasion. Various groups – including the state government itself – warned of thousands of cows and herders amassing at the border, including of neighboring countries, prepared to invade at the behest of MAKH's leader. About two weeks before the AGL was set to be enforced, on October 18, Governor Ortom officially called for the arrest of the leadership of MAKH after meeting with President Buhari.[23]

MAKH's president rejected (with confusion) claims that he was planning to invade Benue. He blamed the violence in Benue state on militias, who had been disguising as herders, and maintained that herders were indeed consistently victims of the violence. He accused Governor Ortom of using "threat and blackmail tactics," and of attempting to force Fulani out of Benue: "How can a Nigerian ask other Nigerians to leave a place they are constitutionally entitled to be?" President Bodejo asked.[24] Forty-eight hours before the law was set to be enforced, in a last ditch effort, another Fulani group the Miyeti Allah Cattle Breeders Association of Nigeria (MACBAN) – which had been in dialogues with the state government to extend the law's implementation date to no avail – called on President Buhari to intervene on behalf of herders.[25] They were met with radio silence.[26]

Despite herder protests, Governor Ostrom held firm. The Benue AGL was officially enacted on November 1. Initially, conditions remained much the same. Small outbursts of violence continued throughout the rest of the calendar year in Benue, with occasional killings of two to three during clashes. However, late on New

[20]Reports of the protest describe signs bearing messages such as 'Our land, our ancestors, our possession' and 'Call Miyetti Allah to order.'[21]

[22]"Gov. Ortom Warns Against Breach of Anti-Open Grazing Law." *PM News.* June 19, 2017.

[23]"Ortom seeks arrest of Miyetti Allah leaders." *The Nation.* October 18, 2017

[24]"Miyetti Allah to Ortom: You have no right to chase us out of Benue." *The Nation.* October 20, 2017.

[25]"Open Grazing law: Herders appeal for FG's intervention." *Sun Times.* October 29, 2017.

[26]MAKH President Bodejo also later expressed dismay at President Buhari's reluctance in to intervene in the displacement of Fulani from Benue: 'Ani-Grazing law: Miyetti Allah blames Buhari for silence over eviction of pastoralists." *The Nation.* November 9, 2017.

Year's night and into the next day, fighting broke out which killed nearly scores in attacks across six LGAs in Benue.[27] The first week of the new year had more than 70, and possibly up to 80 deaths, already surpassing total deaths from the conflict from the year before.

The reactions were swift from all sides. During a requiem church service for the 73 dead after the New Years attack, Makurdi Ancestral leader of the Tiv Nation Wantaregh Paul Unongo said that President Buhari's failure to protect his people may mean they have to train their own army,[28] and voiced his people's support for Gov. Ortom and the AGL. At the same church service, Benue State House of Assembly representative expressed regret "that president Buhari came to Benue during electioneering campaign to beg for votes and was overwhelmingly [supported]... and after he was voted into power, his brothers began to kill Benue people with reckless abandon," while Governor Ortom himself lamented the killings, and said he was "'ready to pay the supreme price' for the implementation of the anti open grazing [law]."[29] Governor Ortom also told Benue citizens to use all legal means of defense against future attackers.[30]

On the other hand, the MACBAN State coordinator condemned the passage of the law, expressly blaming the attacks on its passage. The MACBAN President, in reporting the many herders and cattle lost during the conflict, said "The anti-grazing law has caused a lot of crises... we had to rush to court because you cannot just sleep, wake up and implement the law like that...The Fulani who are the traditional herders do not know the law you are talking about and you need to take time to explain it to them... All the crises that we are seeing now, it is the anti-open grazing law that is causing them." He complained that the politicization in the media of Fulani stemmed in part from fears of President Buhari being in office[31] Representatives of MACBAN also said the attacks were prompted by upwards of 1,000 cattle rustled by local youths in Benue border villages, leading to a Fulani man's suicide – though his claims were refuted by the government.[32]

In the coming months, many political rifts deepened, even as killing continued unabated: rifts between Governor Ortom and neighboring governors; between Benue state and the federal government (and President

[27] "Scores Killed in Fresh Attack in Benue." Daily Trust. January 2, 2018.

[28] In fact, former military governor and Idoma from Benue General Lawrence Onoja supported Unongo's call, and offered "to command that army, despite my age.": "Benue killings: We may raise our own Army if..., says Unongo." *The Sun.* January 11, 2018.

[29] "Benue killings: We may raise our own Army if..., says Unongo." *The Sun.* January 11, 2018.

[30] "A police spokesman and his unbridled tongue." *Business Day.* February 11, 2018.

[31] "Politicians Buy Arms for Herdsmen â Bodejo, Miyetti Allah President." *The Sun.* February 3, 2018.

[32] "Benue Commissioner Denies Claims By Herdsmen of Cattle Killing." *This Day.* January 9, 2018.

Buhari in particular); between Tiv and Fulani groups within Benue, and betwen the Benue state chapter and national APC party branches. Many of these rifts, tinged with long-standing suspicion of the Fulani government from indigenous and Tiv communities, stemmed from placing blame on Benue's AGL for the violence. While President Buhari condemned the killings shortly after they occurred, he also pled with Governor Ortom: "I ask you in the name of God to accommodate your countrymen."[33]

The idea that the recent violence in Benue had been prompted by the AGL was widespread by both Fulani representatives[34] and members of the FG – including the Inspector General of Police[35] and the Defense Minister Muhammad Dan Ali. In response to the latter's comments, the Benue State chapter of the APC called Dan Ali a "disgrace," stating: "As a state that gave President Muhammadu Buhari an edge in the 2015 general elections, we demand [Dan Ali] resigns his positon [immediately]". The federal government's proposed policy solution to the crisis – so-called 'cattle colonies' – were portrayed as, at best, impositions by the federal government onto states, and at worst, as active colonialist territorial expansion by the Fulani ethnic group.[36] Two days after more than a dozen were killed at a Catholic mass and again at a burial, and nearly fifty killed across both Benue and Nasarawa villages, CAN was publicly accusing President Buhari, together with security agencies, of protecting Fulani militias.[37]

As our model suggests, Governor Ortom's passage of the AGL not only increased Fulani herder willingness to fight over land they felt unlawfully banned from, but was followed by a undiminished tendency for indigenous Benue and Christian groups to frame the conflict in ethnic terms and encourage the taking up of arms by indigenous populations.

B.2 Nasarawa

Nasarawa, to the North, followed a different path from its neighbor. While Benue (along with another Nasarawa neighbor, Taraba) passed its AGL in 2017, at the time of writing, Nasarawa has never passed an AGL. Like Benue, Nasarawa is a Middle Belt state which was a key 'swing state' in the 2015 elections.

[33] "Accommodate Your Fellow Country Men, Buhari Appeals to Ortom." This Day. January 16, 2018.

[34] Including JIBWIS ("JIBWIS knocks Ortom, Isiyaku over anti-open grazing ban." *Sunday Trust*, February 4 2018); and GAFDAN ("Benue should dump law, says Fulani group." *The Nation*. January 12, 2018)

[35] "IG apologises to Benue over 'communal clash' comment." *Weekly Trust* January 13, 2018.

[36] "Opposition To Proposed Cattle Colony Heightens." *Daily Independent*. January 27, 2018.

[37] "Outrage as gunmen kill 13 more in Benue village." *The Nation*. April 26, 2018; "Killings: CAN accuses Buhari, security chiefs, of gang up against Christians." *The Sun*. April 28, 2018.

In the Presidential race, Nasarawa narrowly voted to re-elect President Goodluck Jonathan of the PDP (ultimately defeated by President Buhari). However, in the gubernatorial races, Nasarawa elected Governor Umaru Tanko Al-Makura – the incumbent, who had joined the APC at its founding. Governor Al-Makura was a native of Benue state, and after his governorship ended in 2019, became one of the state's senators. Governor Al-Makura also had as a major tenant of his administration land management reform efforts in the state, including by banning land titling without surveys.[38] Nasarawa is diverse; it features at least 25 different ethnic groups that speak at least as many different languages, and local government areas vary widely in their ethnic makeup.

Before the ban, there were not significant differences between the two states in terms of their conflict levels.[39] In Nasarawa too, violence attributed to herders (in particular MAKH, Nasarawa branch) was frequent, as was MACBAN's insistence that these were the work of political or otherwise unaffiliated militias in the guise of Fulani herders. In one case in August 2016, such alleged herders kidnapped four accused cattle rustlers, stole livestock from them, and macheted them to death in the bush. In Nasarawa, the target of violence was often Fulanis themselves, as in the attack in August 2016[40] as well as indigenous communities, including (increasingly, in 2017 and 2018) Tivs settled just over the border from Benue.

In the lead-up to Benue's ban, indigenous communities (especially Tiv and Christian groups) in Benue were actively campaigning against Fulani herders. In Nasarawa, indigenous communities often responded differently to impending threats. At the beginning of the year, there was a tense period during which thousands of herders and cattle amassed along the Nasarawan side of the River, waiting to cross into Benue. After meetings between the state and relevant local governments and traditional leaders, Agatu community

[38] "Nasarawa Bans Land Titling Without Survey Plan." *Daily Trust.* January 9, 2013.

[39] There is one exception: In 2013, Nasarawa saw a significant spike of violence related to this conflict. While Fulani herders were engaged in some of these events, 2013 was also a time of multiple other organized militias operating throughout the state. In particular, *Ombaste* was a militia group active in 2013 and 2014 in Nasarawa Eggon local government area, which carried out large-scale attacks (including allegedly killing nearly 100 security officers). Much of the communal violence in 2013 were between indigenous Eggon and Fulani groups ("Eggon, Fulani Fight Enters Al-Makura's Home Town, Spills Into Lafia." Daily Trust. February 7, 2013.; Abel, Daniel"30 Killed, Scores Injured in Fulani Herdsmen, Eggon Farmers Clash." Vanguard. February 8 2013), as well as Eggon and Alago or Jenkwe groups ("Communal Clashes Tear Nasarawa Apart". *Vanguard.* January 13, 2013). Fulani interest groups, including the Nasarawa Chapter of MACBAN, as well as Eggon socio-cultural groups pointed fingers at each other when it came to the question of who was to blame for the clahses ("Faceless Militiamen take Fight to Al-Makuraâs Village." *Daily Trust.* February 10, 2013).

[40] "Family of Four Slain Fulani Herders Cry Out, Petition IG Over Threat." *Africa News.* January 30, 2017

in Nasarawa agreed to host the Fulani herders after the harvest season, alleviating the crisis. The Agatu local council boss warned herdsmen not to allow their cattle into farmland; but also stated that "our people received them with joy."[41]

In general, Nasarawa's response to the crisis featured more community-based, situation-dependent mediation by local leaders from both sides of the conflict; including work from NGOs and spearheaded by the state government. One example played out in the immediate leadup to Benue's implementation of its AGL at the end of September 2017. Tensions in Nasarawa continued to ocasionally flare, especially between Fulani and Tiv communities along the border with Benue. However, after one such clash, the state government facilitated peace meetings between the leaders of the Tiv Development Association (TIVDA) and the Fulani community in Nasarawa. This meeting resulted in an agreement to lay down their arms and send displaced farmers back home. Both sides expressed satisfaction with the arrangement.[42] Just a couple of weeks later in October, two weeks before Benue's AGL was set to come into effect, an NGO held a peace meeting and cultural festival in Nasarawa State, attended by representatives from Fulani, Eggon, Tiv, Migili, Alago, and other ethnic groups, as well as traditional rulers.[43]

This is not to say that an AGL was not considered in Nasarawa. Indeed, a bill was introduced in Nasarawa around the same time as Benue's (not by the governor as in Benue, but by the State Assembly). In May, shortly after neighboring Benue governor signed Benue's AGL, the chairman of the state chapter of MACBAN Muhammed Husseni protested vehemently against Nasarawa's proposed bill, which was similar – if more limited – than Benue's. Husseni accused the assembly of attempting to dislodge Fulani from Nasarawa entirely, and urged Governor Al-Makura to decline to sponsor the bill, which had been passed into second reading the week before: "if Nasarawa follow[s suit with Benue], we have nowhere to go and that will have adverse effect on farmers, what we want in Nasarawa State is peace and not crisis and the bill will cause crisis." He also claimed farmers had already encroached upon existing grazing reserves and on a majority of cattle routes, severely limiting herders options.[44] Nasarawa's bill got no further.

[41] "Over 50,000 cows now graze in Agatu communities-LG boss." *Nigerian Tribune*. February 26, 2017. However, the crisis did not end with this peace pact; a year and a half later, six months after Benue's AGL was implemented, spiraling violence claimed the lives of at least a dozen in this community ("Nasarawa: Herdsmen brutally murder 3 police officers, 8 farmers." *The Sun*. June 5, 2018.)

[42] "1 injured, dozens displaced as Tiv, Fulani clash in Nasarawa." *Sunday Trust*. September 24, 2017.

[43] "NGO organizes herders, farmers unity festival in Nasarawa." *Weekly Trust*. October 14, 2017.

[44] Adio, Segun. "Miyyetti Allah fumes over Nasarawa Grazing Bill." *The Sun*. May 23, 2017.

However, after Benue state enacted its own ban in November 2017, Nasarawara farmers braced themselves for a massive influx of herders and their cattle into their communities. Farmers who had yet to harvest their crop, such as rice farmers, were concerned – some so much so that they harvested early. Al-Makura visited the affected areas and urged calm.[45] Days after his statements, multiple fatalities were reported in connection with Fulani herder invasion of some farmlands on the Nasarawa side of the Benue River.[46] Representatives of local indigenous communities raised alarm.[47] However, even in the aftermath of these brutal episodes, Governor Al-Makura actively called on Tiv leaders to spearhead reconciliation and peace with herders.[48]

The New Years attacks in Benue provoked open agitation between Governor Al-Makura of Nasarawa state and Governor Ortom of Benue. Ortom began by accusing Nasarawa of being the location from which alleged herders launched the New Yearâs attack. Al-Makura responded by saying the attack was because of Ortomâs AGL. [49] Over much of the following year, the bulk of the reported violence in Nasarawa took place in the south near the border with that state; and where indigenous Tivs habitually populated.[50] Violence continued between the two groups as the dry season wore on. On January 29, alleged Tiv militias attacked a Nasarawa community, resulting in at least two missing or killed and 73 cows slaughtered.[51] In April 2018, fresh clashes between Fulani herders and Tiv ethnic militias resulted in seven Tiv farmers reportedly killed in Nasarawa, and at least 37 in Benue.[52] As the season came to a close in April, Nasarawa and its neighbors continued to face attacks, though Nasarawa featured fewer reported fatalities per attack on average than in Benue and Taraba TK.[53]

Despite the fact that an AGL bill was proposed in Nasarawa around the same time as in Benue, Governor

[45] Hassan Ibrahim, Lafia. "Exodus of Herders, Cattle Sparks Fears in Nasarawa." *Daily Trust.* November 5, 2017. `https://t.ly/CZ08T`

[46] Though the death toll was reported by police as being much lower, others claimed 'scores' were killed ("Herdsmen Kill 11 In Plateau, Scores in Nasarawa." *Daily Independent.* November 9, 2017.)

[47] "Benue Grazing Law: Herdsmen's Influx Into Nasarawa Alarming - Youth President Cries Out." *Daily Independent.* November 12, 2017.

[48] "Pursue peace between herders, farmers, Al-Makura tells Tiv leaders." *Weekly Trust.* November 25, 2017.

[49] "Three herdsmen jailed for open grazing in Benue." The Nation. February 23, 2018.

[50] "Farmers, Herders Clashes - Lasting Solution Underway - Al-Makura." *Daily Trust.* January 11, 2018. Nasarawa was also one of several states to which the Nigerian Army deployed to confront the violence in the aftermath of the New Years attacks in Benue ("Herdsmen killings: FG deploys special troops to Benue, Nasarawa." *Business Day.* January 9, 2018.)

[51] "2 Missing, 73 Cows Killed As Militia Attacks Nasarawa Community." *Daily Trust.* January 29, 2018.

[52] "4 killed in fresh Benue, Nasarawa attacks." *The Sun.* April 26, 2018.

[53] "Suspected Nomads Kill 26 Persons in Taraba, Nasarawa." The Guardian. April 13, 2018.

Al-Makura consistently rejected calls to sign it, deciding instead to prioritize other policy solutions. While Nasarawa state did contribute resources to its security apparatus in the wake of attacks, it also promoted programs such as Community Based Conflict Resolution Committees across the state.[54] This program's intention was to establish local solutions to manage the crisis through local stakeholders who understand the root of the conflict in this area. It was put in place during his first administration in 2013, and Governor Al-Makura explicitly mentions its effectiveness when he confirmed that he had no plans to pass an AGL.[55] Even during the height of militia-herder violence in the state in 2013, Governor Tank Al-Makura pursued a variety of multi-dimensional policies, including set up a committee to recover cows that had gone missing during the violence.[56]

This reluctance to embrace AGLs as a solution for the conflict was not for lack of interested parties trying to gather support for such a law. In April 2018 Tiv IDPs in Nasarawa, who had fled their homes due to alleged herder attacks, stoned the Governor's convoy when he came to visit their camps.[57] By April, the Benue-based Tiv sociocultural group Mdzough U Tiv (MUT) was actively accusing Governor Al-Makura of not protecting the Tiv people.[58] Tiv communities also complained about being detained or displaced by officials in allegiance with herdsmen, especially after Governor Al-Makura supported the FG's ranching plan and offered seven grazing reserves for usage in the program.[59] And despite not ultimately passing an AGL like its neighbors, 2018 was Nasarawa's most violent year for farmer herder conflict, especially in zones bordering Benue. But after this period of tension, it would remain relatively peaceful, maintaining a low rate of grazing conflict per capita in the years since. Signs of cooperation also continue, although conflict has not disappeared entirely: The relative peace in the following years was jealously protected by stakeholders. Indeed, in the years since, MACBAN has continued to warn its members against illegal encroachment on farmlands, set up self-monitoring systems, and promised active cooperation with security forces to maintain the peace.[60]

[54] "Nasarawa State Govt. to donate 50 vehicles to aid security agencies." *PM News.* February 6, 2018.
[55] "Al-Makura rejects call to enact anti-grazing law." *The Nation.* April 4, 2018.
[56] "Communal Crisis â Al-Makura Sets Up Committee to Recover Missing Cows." Leadership. January 27. 2013.
[57] "IDPs stone Gov. Al-Makura of Nasarawa State." *PM News.* April 17, 2018.
[58] And of ignoring their calls: "Herdsmen kill one, set 40 houses ablaze in ex-Gov Suswam's hometown." *The Nation.* April 21, 2018.
[59] "Nasarwa monarch cedes Tiv farmland to herdsmen." *The Sun.* June 25, 2018.
[60] "Miyetti Allah warns members in Nasarawa against encroachment on farmlands." *The Sun.* October 19,

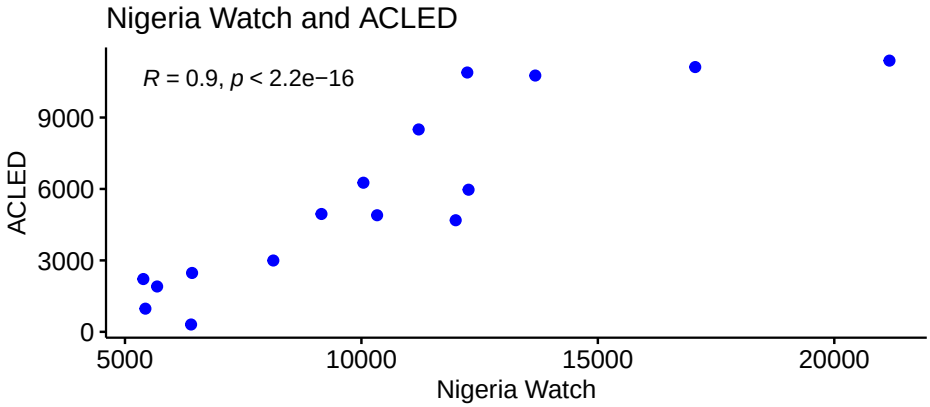
2019.

C Data Appendix

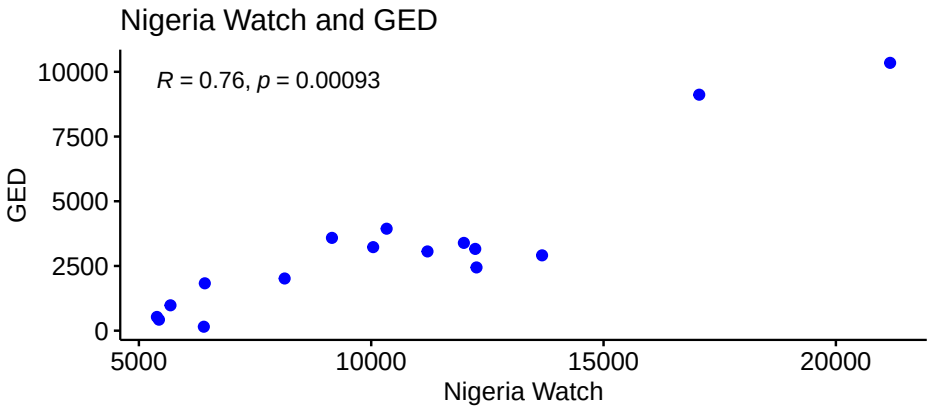
C.1 Correlation Between Annual Fatality Counts in Nigeria Watch with ACLED and GED

Figure C.1: Correlation Between Nigeria Watch and Other Databases

(a)



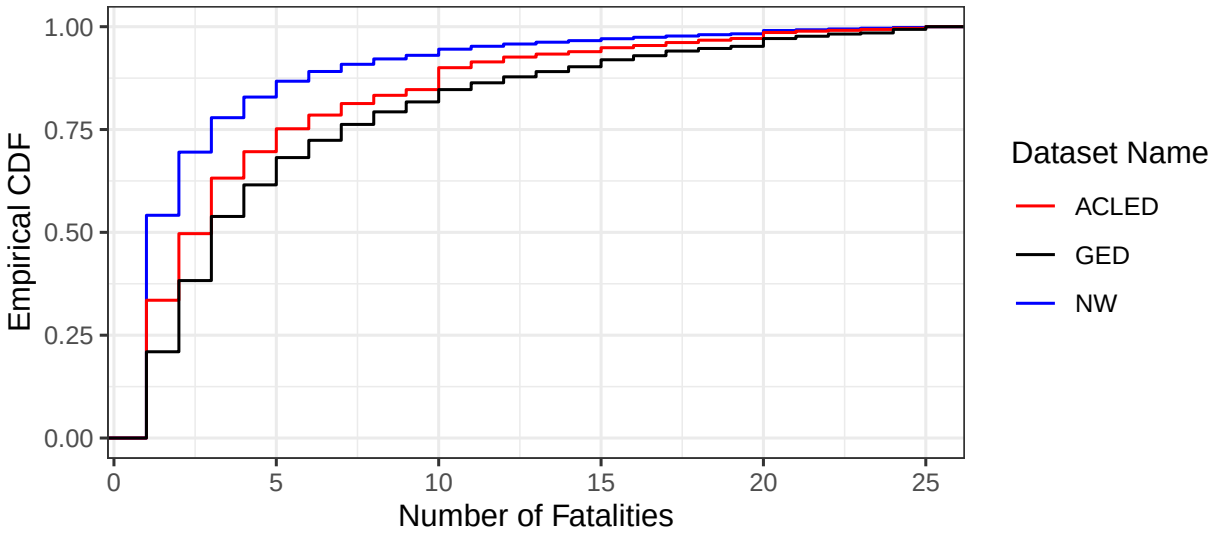
(b)



.

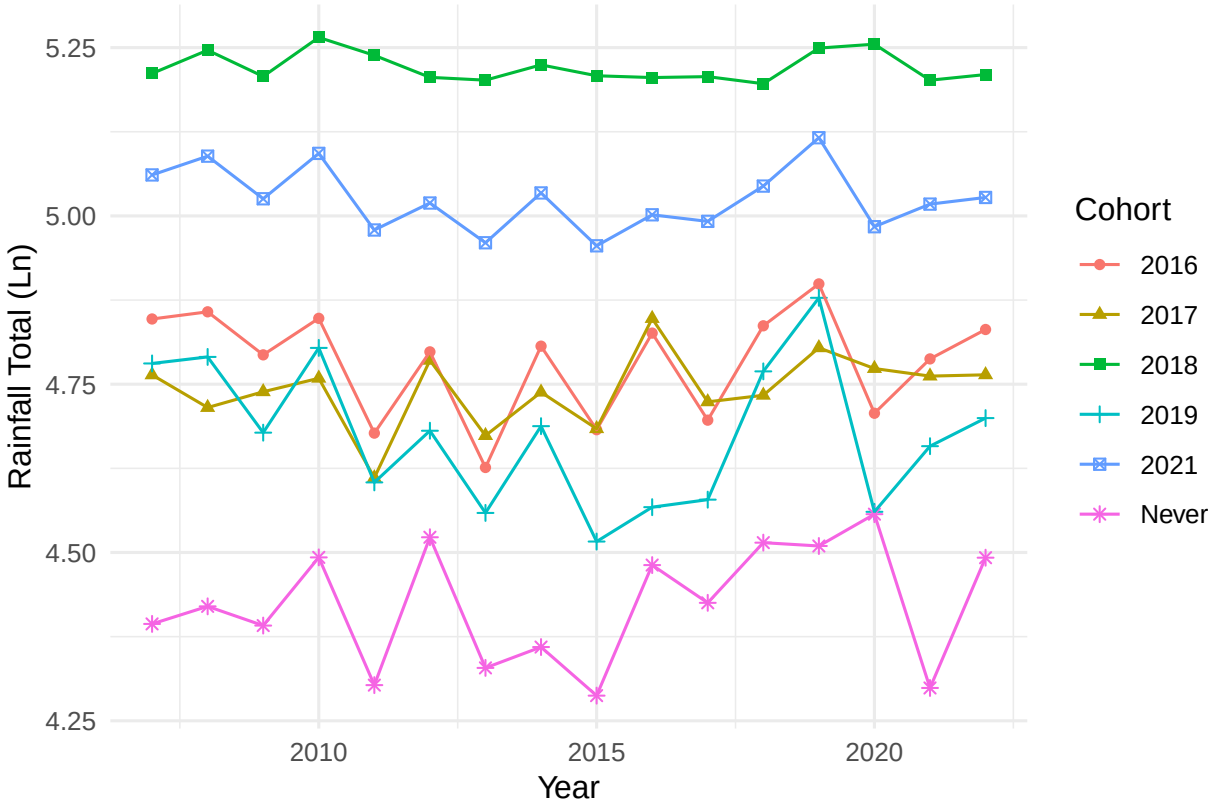
C.2 Density of Nigeria Watch Fatalities Compared to GED and ACLED

Figure C.2: Empirical CDF of Nigeria Watch, ACLED, and GED



C.3 Rainfall by LGA Overtime

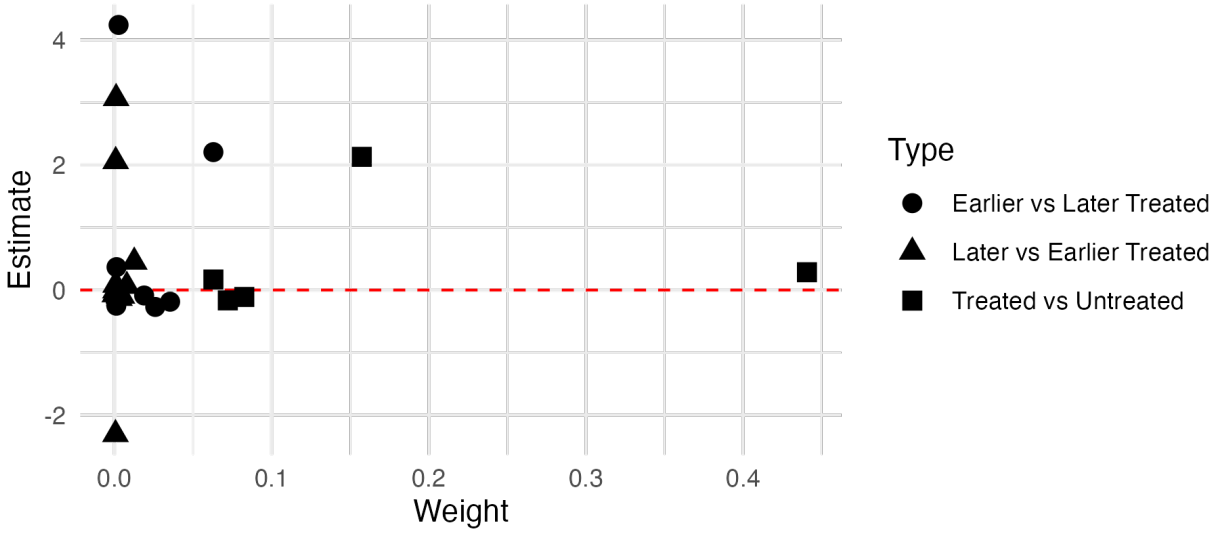
Figure C.3: Average Logged Rainfall Overtime By Cohort



D Empirical Appendix

D.1 Bacon Decomposition

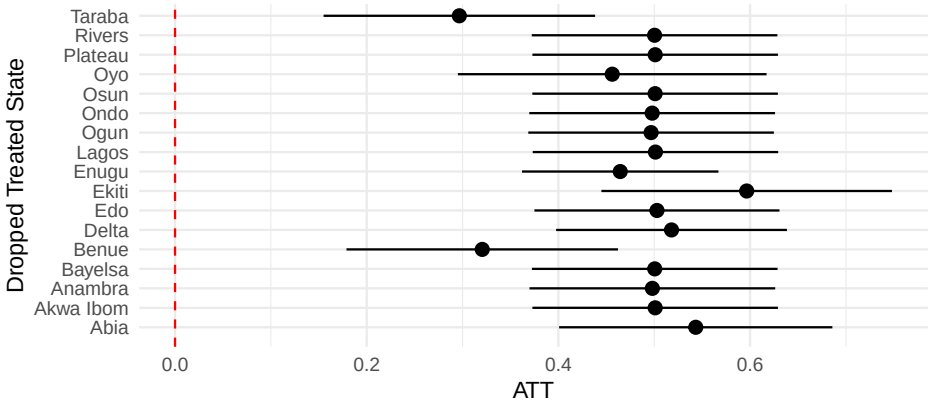
Figure D.1: Bacon Decomposition



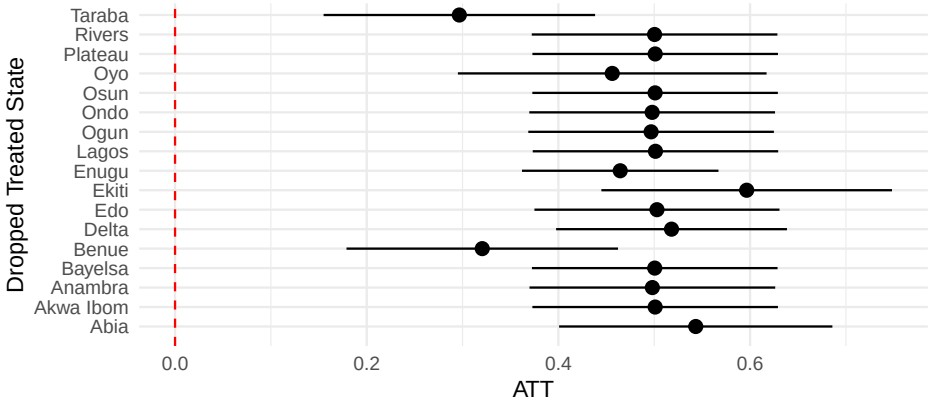
D.2 Dropping States

Figure D.2: Correlation Between Nigeria Watch and Other Databases

(a)



(b)



.

D.3 Measurement Error

Event Counts

Table D.1: Count of Fatal Events

Dependent Variables:	Land Conflict	Grazing Conflict
Model:	(1)	(2)
Variables		
ATT	4.093*	3.414*
	(2.085)	(1.838)
Fixed-effects		
State	Yes	Yes
Year	Yes	Yes
Fit statistics		
Observations	592	592
R^2	0.66787	0.65198
Within R^2	0.39687	0.45551

Clustered (state)) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Reweighting

We assume measurement error is decreasing in one of two features of states: (1) in places where individuals report more news consumption, the quality of news is higher, leading to more accurate reporting due to civically engaged readers or (2) when mobile phone coverage is greater, the penetration of information communication technology results in more reliable reporting.

Table D.2: Weighted Regressions using Media and ICT Penetration

Dependent Variables:	Land	Grazing	Land	Grazing
Model:	(1)	(2)	(3)	(4)
Variables				
ATT	0.7478***	0.4517***	0.8866***	0.5187***
	(0.2047)	(0.1267)	(0.1924)	(0.0817)
Fixed-effects				
Weights	News	News	Mobile	Mobile
State	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Fit statistics				
Observations	528	528	560	560
R^2	0.64722	0.68002	0.54772	0.56977
Within R^2	0.45706	0.54388	0.33789	0.34000

Clustered (State) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

D.4 Falsification Tests

Table D.3: Falsification Tests: Irrelevant Conflict Outcomes

Dependent Variables:	Banditry	Boko Haram	Cult Violence
Model:	(1)	(2)	(3)
Variables			
ATT	1.308	-0.9068	-0.0149
	(1.200)	(0.7570)	(0.0509)
Fixed-effects			
State	Yes	Yes	Yes
Year	Yes	Yes	Yes
Fit statistics			
Observations	592	592	592
R^2	0.47182	0.42129	0.57478
Within R^2	0.03930	0.07630	0.12236

Clustered (state)) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

D.5 Boko Haram Confounder

Table D.4: Adjusting for Boko Haram Shocks

Dependent Variables:	Grazing	Land
Model:	(1)	(2)
Variables		
ATT	0.3888***	1.095***
	(0.1241)	(0.3554)
Fixed-effects		
State	Yes	Yes
Year	Yes	Yes
Varying Slopes		
Aggregate BH Violence $\times$*State*	Yes	Yes
Fit statistics		
Observations	592	592
R^2	0.65730	0.55609
Within R^2	0.48002	0.33138

Clustered (State)) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

D.6 TD

To address the possibility of time-varying within-state confounders, we adopt a triple differences (TD) strategy using Afrobarometer survey data. Afrobarometer asked questions in two rounds of the survey (7 in 2017 and 8 in 2020) about farmer-herder conflicts, particularly if a respondent had heard about them, and if they were worried about them, two questions we use for our analysis. Since the data only includes two years, there is no staggering in introduction. Our TD estimator is as follows.

$$\begin{aligned} y_{ist} = \gamma_0 + \gamma_1 \text{AGL}_s + \gamma_2 \text{Post AGL}_t + \gamma_3 \text{Farmer}_i + \gamma_4 (\text{AGL}_s \times \text{Post AGL}_t) \\ + \gamma_5 (\text{Farmer}_i \times \text{Post AGL}_t) + \gamma_6 (\text{Farmer}_i \times \text{AGL}_s) + \\ \gamma_7 (\text{Post AGL}_t \times \text{Farmer}_i \times \text{AGL}_s) + \varepsilon_{ist} \end{aligned} \tag{13}$$

The parameter of interest is γ_7, the difference between two difference-in-differences: the DD between the before and after among states that adopted AGL, and the DD between farmers and non-farmers before and after AGL. The DD between farmers and non-farmers nets out time-varying state confounders (state-specific shocks to AGL states that covary with laws), and the DD between states nets out employment specific confounders (that farmers and non-farmers follow different trends in concern about herder conflict).

Table D.5: Triple Difference (TD) Results

Dependent Variables:	Index	Heard of Conflict	Concerned About Conflict
Model:	(1)	(2)	(3)
Variables			
1(Agriculture)	-0.4309***	-0.2970***	-0.1339
	(0.1380)	(0.0723)	(0.1003)
1(AGl State) × 1(Post AGL)	0.3480*	-0.0620	0.4100***
	(0.1920)	(0.1240)	(0.1212)
1(AGl State) × 1(Agriculture)	0.4664*	0.2961**	0.1704
	(0.2690)	(0.1422)	(0.1635)
1(Post) × 1(Agriculture)	0.3725**	0.2790***	0.0935
	(0.1542)	(0.0791)	(0.1153)
1(AGl State) × 1(Post AGL) × 1(Agriculture)	-0.7025**	-0.3382*	-0.3642*
	(0.3372)	(0.1875)	(0.1901)
Fixed-effects			
State	Yes	Yes	Yes
Year	Yes	Yes	Yes
Gender-Year	Yes	Yes	Yes
Rural-Year	Yes	Yes	Yes
Fit statistics			
Observations	2,585	2,585	2,585
R^2	0.10451	0.12927	0.06211
Within R^2	0.00844	0.00751	0.01501

Clustered (state) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*