Essays on the Economics of Violent Conflict

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Uzoma Iloanugo

Department of Economics

Contents

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Abstract

This thesis contributes to the literature on conflict in economics with two chapters. Chapter 1 investigates the effect of the 2009 Niger-Delta Amnesty Program on the oil-related conflict in Nigeria. Using a difference-in-differences estimation strategy, we compare conflict in Local Government Areas (LGAs) with and without oil fields in the Niger-Delta region. We find robust evidence that the amnesty policy reduced rebel and militia activities by about 27 percent. However, the reduction in conflict was short-lived. Beyond 2014, we do not find any impact of the amnesty program on conflict. Using broad trends in key social indicators, we explore how the increase in conflict in the long-run is due to the amnesty only paying existing rebel while ignoring the economic causes of violence. Further, we find evidence of a peace dividend in terms of increase in economic activities—as measured through night time luminosity data—in Niger-Delta Local Government Areas with oil fields after the policy.

Chapter 3 is a study of the age-old herder-farmer conflict in North-Central Nigeria which estimates the impact of drought on pastoral conflict. Using an interaction of drought and the availability of pasture, we identify adverse shocks to contested land and estimate its effect on the pastoral conflict. After controlling for cattle production and the spillover effect of drought from herders' homeland into the contested area, we find local drought effect within the agro-pastoral region. Adverse weather shocks to productive land substantially decrease pastoral conflict in the contested area. We attribute this effect to lower agricultural productivity decreasing farmers' incentive to engage herders in violence. Importantly, contrary to existing research, we tend to find a positive relationship between precipitation and conflict—a rapacity effect—in the labour-intensive agricultural sector.

Declaration

I declare that no portion of the work referred to in this thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

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Chapter 1

Introduction

1.1 The Economics of Conflict

Since the end of the cold war, the nature of violent conflict around the world has shifted from wars between countries to internal conflict and insurgencies (Blattman and Miguel (2010) and Watts et al. (2017)). Of the fifty wars recorded in 2015 by the Uppsala Conflict Data Program (UCDP), only one was an interstate conflict between India and Pakistan (Allansson et al. (2017)). The increasing civil conflict and decreasing interstate wars trends continued into 2018 and 2019, where the only occurring interstate wars were Iran-Israel, and India-Pakistan. In response, recent research on violent conflict is focused on understanding the causes and consequences of civil conflict.

In 2016, 12 civil conflicts reached the intensity of war—UCDP classify war as conflict with at least 1,000 battle deaths. Nevertheless, this was a sharp decline from the continuously increasing trend between 2011-2014 (Allansson et al. (2017)). Furthermore, the data from UCDP in 2016 show heterogeneity across the broad categorisation of civil conflict. State-based conflict, wars between the state government and rebel groups, declined, but non-state and one-sided violence (violence against civilians) increased substantially in the same period. The observed trend suggests that finding solutions to modern-day warfare requires understanding the incentives for individuals within a society to form/join groups that engage in violence with other competing actors.

The majority of civil conflict occur in developing countries, mostly in sub-Saharan Africa. The Uppsala Conflict Data Program (UCDP) show that in 2016, fifty percent of the 54 civil wars recorded happened in African countries (Allansson et al. (2017)). The UCDP records also indicate that the incidence of conflict in Africa is still increasing, growing by 50 incidents in 2017 alone.

Nigeria is one of the sub-Saharan African countries most impacted by violent conflict. In 2018, UCDP ranked Nigeria as the 10th most conflict-affected country in the world, recording 50282 conflict fatalities just behind India with 52568 fatalities (Pettersson and Eck (2018)). Some of the central conflicts in Nigeria include: First, the terrorist Boko Haram insurgency in northeast Nigeria. The Boko Haram terrorist group have existed since the 1990s but became more prominent and violence oriented in 2009. The United Nations Development Programme (UNDP) estimate that since 2009, the Boko Haram insurgency has killed 230,000 people in Northern Nigeria (UNDP (2021)). Second, the oil resource conflict in the Niger Delta region. This conflict is the struggle between rebel groups and the federal government over oil rent in the Niger-Delta region. Between 2003 and 2007, oil companies operating in the region reported a total loss of $21.5 billion to rebel activities (Nwozar (2010)). The third central conflict in Nigeria is the herder-farmer conflict around the Niger-Benue river belt. The herder-farmer violence is over productive land resources between Fulani pastoralists and sedentary farmers. In 2016 alone, the pastoral violence in Nigeria resulted in 2500 fatalities (International Crisis Group (2017)).

Nigeria is the most populous and one of the most densely populated countries in Africa, with about 212 million people as of 2020 (Akinyemi and Isiugo-Abanihe (2014) and CIA (2021)). With a GDP per capita of $5900 (PPP), 40 percent of Nigerians (83 million people) live below the poverty line (National Bureau of Statistics (2019) and

CIA (2018)). The Nigerian political institutions are relatively weak, ranking 149/179 in the 2020 Transparency International's Corruption Perception Index. These weak institutions can translate into fragile property right contracts, which is one theoretical determinant of the onset and incidence of conflict (see Garfinkel and Skaperdas (2007) and Dixit (2011)). Also, with 250 ethnic groups, the high ethnic fractionalisation; its abundance and dependence on natural resources, and multiple violent actors make Nigeria specifically relevant for conflict research (Esteban and Ray (2008), Udosen et al. (2009), Esteban et al. (2012), and CIA (2021)).

Using the conflicts in Nigeria as the contexts, this thesis contributes to two broad themes in the conflict literature. The themes include: i.) Natural resource conflict and ii.) Income shocks and violent conflict. A brief discussion on these themes and how the thesis fits into them is as follows:

1.1.1 Natural Resource Abundance, State Capacity and Conflict

It is not clear from existing research how exactly the presence of natural resources directly impacts violent conflict. On the one hand, Ross (2004) shows that natural resource wealth tends to increase the likelihood of conflict. Humphreys (2005), on the other hand, estimate that natural resource presence leads to shorter wars because actors have incentives to end wars when natural resources are threatened. Some of the differences in findings can be attributed to differences in how natural resources and violent conflict are measured in the literature (Watts et al. (2017)).

Natural resources are usually geographically concentrated in regions within a country and can lead to income disparities, giving rise to grievance and conflict (Collier and Sambanis (2002) and Watts et al. (2017)). The negative externalities of natural resource extraction are also localized, causing land degradation and lower incomes in regions with natural resource (Odoemene (2011)). Other research in the literature explain that the presence and over-reliance on natural resources can directly weaken state capacity and increase corruption (See Fearon and Laitin (2003), Collier and Hoeffler (2004), Bates (2008), Pendergast et al. (2011), and Watts et al. (2017)). In addition, the presence of natural resources in weak states serves as a viable source of funding for rebel groups that mount long-term rebellion against the government (Collier and Hoeffler (2004) and Watts et al. (2017)).

Finding lasting solutions to natural resource violence is of importance to international institutions and the government in developing countries. Rebel groups easily capture natural resource to fund their activities in developing countries with weak state capacity and are unable to secure its natural resources (Watts et al. (2017)). The United Nations have some of its branches devoted to resolving conflict related to natural resources. The Peace Building Commission Support Office (PBSO) of the United Nations set out policies and programs to end natural resource conflict. Also, the United Nations Peacemakers provide support and set out guide lines on finding sustainable solutions specifically for mediating natural resource related conflict around the world.

The Niger-Delta conflict in Nigeria is one of the major resource related conflicts around the world. After Nigeria's independence in 1960, crude oil became Nigerian's main export accounting for over 90 percent of export from 1970 (Udosen et al. (2009) and Idemudia and Ite (2006)). Oil rent accounted for 70 percent of government revenue in 2011 and 26.8 percent of GDP in 2012 (Idemudia and Ite (2006) and Akpolat and Bakirtas (2020)). The Nigerian government's excess reliance on crude oil has led to the negligence of the labour-intensive sector and weakened its state capacity (Martin and Subramanian (2013)). The cause of the conflict is attributed to relative deprivation and the high degree of land degradation from oil production. After years of military campaigns against rebel groups, the Nigerian government implemented the Niger-Delta Amnesty Program (NDAP) in August 2009 as a way to resolve the conflict in the region. The policy aimed to demilitarize the Niger Delta by encouraging rebels to surrender their arms and weapons, sever linkages between fighters and the militant groups, and reintegrate former rebels back into society (Okonofua (2016), Ikelegbe and Umukoro (2016), and Okoi (2020)).

Chapter 2 estimates the impact of the amnesty on violence in the Niger-Delta. We analyze the short- and long-run implication of the amnesty program on the resource conflict in Nigeria. To establish the impact of the amnesty, we compare violence in oil and non-oil producing local government areas (LGAs) within the Niger-Delta, before and after the policy was announced. The choice of comparing violence in these LGAs was driven by the fact that the amnesty policy targeted active oil resource rebel actors in the Niger Delta. Furthermore, LGAs in the region share very similar socio-economic and political characteristics, making them fit for comparison. We run various checks that show our model satisfied the parallel trend assumption, and see no evidence of spillover in violence between treated and control LGAs.

Our results in chapter 2 show that the amnesty policy only had a short-lived effect on violence. Violence in the oil-producing region decreased sharply following the amnesty policy; but it tends to have reverted back to previous levels four years later. The result was relevant for violence classed as rebel/militia activities, violence involving government forces, and violence against civilians. In contrast, the amnesty policy had no impact on non-violent protests in all periods since its implementation. The insignificant result on non-violent protest is expected; the amnesty program was intended to solve a violent oil-resource conflict in the Niger-Delta.

By evaluating the amnesty program, the research in chapter 2 questions the effectiveness of making payment to rebels as a long-term strategy for peace and state-capacity building. An important concern about implementing counter-insurgency policies is the associated time inconsistency, where once the conflict reduces, the incentive to follow through with the policy dissipates, making such policies effective only in the short-run (Walter (1997), Walter (2009), and Blattman and Miguel (2010)). The failure of parties in conflict to credible commit to peace agreement can impede amnesty policies. More-over, the Niger Delta Amnesty Policy (NDAP) only paid existing rebel while failing to address the underlining reason why rebels pick up arms in the first place. We observe that unemployment, primary school enrollment, and malaria incidence —some relevant indices of economic outcomes—did not improve in the region after the program was implemented. A more sustainable approach would be to use the cease fire period that followed the amnesty as a window of opportunity to improve the economic outcomes of citizens, thereby reducing rebel's influence within the society (see Crost et al. (2016)). In chapter 2, we provide a detailed analysis of why the amnesty failed to sustain peace.

Chapter 2 also contributes to the literature by exploring the peace dividends from the amnesty program. Reduction in violent conflict is estimated to lead to considerable increase in economic activities (see Besley et al. (2015), Singhal and Nilakantan (2016), and Kaila et al. (2020)). Besley et al. (2015) estimates the welfare gains/losses from piracy in the Somalian region. They find that the increase in pirate attacks around the coast of Somalia in 2008 led to a 8-12 percent increase in the cost of shipping. They also explained how reduction in violence could result in positive peace dividend (by reducing the cost of shipping). In the same vein we establish some peace dividend as a result of the amnesty policy. We find that the amnesty policy improved measures of night light in the treated areas in periods when the policy was effective at reducing violence. Although increase in light may not only imply direct improvement to economic outcome in this case, but night light also reflect increased gas flare from oil production which can translate into increase employment around the region. The estimated result on economic outcomes implies that sustaining peace in the oil producing region would yield economic benefits.

1.1.2 Income Shocks and Violent Conflict

Economic shocks are robustly estimated to impact the onset and incidence of violent conflict (see Collier and Hoeffler (2004), Miguel et al. (2004), Berman et al. (2011b), Dube and Vargas (2013), and Crost et al. (2016)). Income shock is estimated to impact violence in two directions. First, higher income reduce conflict. Collier and Hoeffler (2004) explain that rebel members must be paid, and the amount paid is related to the income forgone by enlisting into rebel groups. When local income is low, the opportunity cost of enlisting in rebel groups become lower. Crost et al. (2016) also show that conditional cash transfers that reduce poverty tend to decrease violence, rebel influence and their ability to recruit soldier. Therefore, conflict resolution strategies that reduce poverty, weaken insurgent's influence, and are likely to have long-term effects on conflict (Crost et al. (2016)).

Second, researchers also find evidence of the opposite effect. Berman et al. (2011a) estimate that unemployment was negatively related to violent incidence in Afghanistan, Iraq and the Philippines. They explain that high unemployment made it cheaper for the government to get information on insurgents from the public. Similarly, when the unemployment rate is high, improved government service provision won the hearts and minds of civilians, who then share vital information on rebels with government forces (Berman et al. (2011b)). Berman et al. (2011b) findings relate to the concept of state capacity discussed previously.

The estimated differences in the impact of income on conflict is shown to depend on the type of sector (Dube and Vargas (2013)). On the one hand, in the labour-intensive sector, an increase in income reduce conflict through the opportunity cost effect. On the other hand, shocks to income in the capital-intensive sector increase conflict through a rapacity effect. Dube and Vargas (2013) provides estimates for the differential impact of income shocks to labour-intensive versus the capital-intensive sector in Columbia.

They find that positive shocks to the international price of coffee (labour-intensive sector) had a differential effect in reducing conflict in Columbia's coffee growing districts. In contrast, positive shocks to the price of oil (capital-intensive sector) differentially increased violence in the oil-producing districts in Columbia. Therefore, any factor that change income levels will impact conflict positively or negatively, depending on the whether the sector is capital- or labour-intensive.

Adverse climatic shocks through its impact on agricultural income, which are highly labour-intensive, should increase conflict. Research has shown that weather condition has a strong inverse relationship with violent conflict through agricultural income (Burke et al. (2009), Moritz (2010), Hsiang et al. (2013), Abbass (2014), Kitchell et al. (2014), SB Morgen (2016), Brottem (2016), Harari and Ferrara (2018), and McGuirk and Nunn (2020)). Chapter 3 contributes to the literature that seeks to understand how climate (through its effect on farm income) impacts pastoral conflict using the herder-farmer violence in North-Central Nigeria as a context. Agriculture accounts for 21 percent of GDP and 70 percent of labour income in Nigeria; 80 percent of all agricultural production is done by smallholder farmers (Varrella, 2020); Kurukulasuriya and Rosenthal, (2013)). However, agricultural households' income is weakened by low land productivity (only about 1 percent of all lands are irrigated (Kurukulasuriya and Rosenthal, (2013))). The sensitivity of Nigeria agricultural production to weather has huge implications on the incidence of conflict caused by climatic shocks.

Nigeria provides a suitable context for studying herder-farmer violence. In Nigeria specifically, a large proportion of conflict incidence is accounted for by agro-pastoral conflict between herders and farmers. Recently, the number of fatalities from pastoral conflict incidence has intensified in Nigeria. Between 2017-18, about 1500 deaths and 300000 people were displaced by herder-farmer related conflict incidence in Nigeria alone (International Crisis Group (2017)). The high dependence of the Nigerian population on agricultural activities and farmers interaction with herders provide a relevant study area to understand the channels through which weather conditions impact pastoral conflict.

In Chapter 3, we explore the possibility that increasing agricultural productivity—by increasing farm output— can in fact increase pastoral conflict. The analysis focuses on conflict incidence that involved the Fulani ethnic group or violence classed as pastoral conflict.[1] We measure adverse shocks to favourable lands for cattle herding around agricultural regions using an interaction of drought and pasture availability measures. We find that drought in areas favourable for herding significantly decreases pastoral conflict. We attribute this weather effect to farmers being less likely to engage in conflict with herders when output is lower on farmlands.

Showing that a decrease in agricultural income tends to reduce violent conflict extends the already established relationship between climate and conflict from previous studies. Evidence in the literature supports the opportunity cost channel as the means through which rainfall affects conflict. In general, lower agricultural productivity reduce the opportunity cost of engaging in conflict (see Miguel et al. (2004), Burke et al. (2009), Moritz (2010), Hsiang et al. (2013), Harari and Ferrara (2018), and McGuirk and Nunn (2020)). In chapter 3, we test the opposing hypothesis that when conflict is between herding and farming population, as is currently predominant in Africa, violence increases in periods when the value of productive lands increases. After addressing several possible threats to identification in chapter 3, we explain how farmers have less output on agricultural land to compete over with herders in drought years—leading to less pastoral conflict.

With two chapters, this thesis has shown how intractable violent conflict can become and presents some challenges to civil conflict resolution. Paris (2004) argues that marketising and democratising post-conflict societies as a strategy for conflict resolution can result in the onset of new conflict.[2] By examining an amnesty that failed to sustain

[1]Fulani are the largest cattle herding ethnic group across Africa, and own 90 percent of livestock in the country Ajibefun (2018)

[2]Paris (2004) explain that the level of competitiveness associated with market democracies can exacerbate social tension

peace in the long run in chapter 2, this thesis shows that even though offering amnesties to rebels can have genuine intentions, such policies are difficult to construct and implement. We also explore the possibility of violent conflict in the labour-intensive sector as a result of a boom to agricultural productivity in chapter 3. A large part of the existing literature has been devoted to showing that violent conflict is inversely related to low economic outcomes; violent conflict is expected to reduce with positive shocks to the labour-intensive sector (see Miguel et al. (2004), Burke et al. (2009), Moritz (2010), Hsiang et al. (2013), Harari and Ferrara (2018), and McGuirk and Nunn (2020)). In chapter 3, we find that increased land productivity tends to increase pastoral conflict. Therefore, to instil long term peace post-conflict, policymakers need to consider findings in these thesis for building a more holistic conflict resolution framework.

The rest of the thesis is as follows: Chapter 2 evaluates the amnesty program in the Niger-Delta oil producing region in Nigeria. Chapter 3 estimates the impact of drought on agro-pastoral conflict in North-central Nigeria. Chapter 4 summarizes the main findings of chapter 2 and 3 and then concludes the thesis.

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and undermine peace when political institutions remain unstable post-conflict.

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Chapter 2

Do Amnesty Policies Reduce Resource Conflict? Evidence from the Niger-Delta Amnesty Program

2.1 Introduction

The purpose of this paper is to estimate the impact of the Niger-Delta Amnesty Programme (NDAP) on conflict and economic activities in the Niger-Delta region. Nigeria is the largest oil producer in Africa, and the Niger-Delta holds the entire bulk of its oil reserve (Akpolat and Bakirtas (2020)). Earnings from oil constitutes a significant part of the federal government's revenue (Udosen et al. (2009) and Fenske and Zurimendi (2017)).[1] The Niger-Delta has been buffeted by increasing conflict between various rebel and militia groups and government forces since the early 1990's, resulting in significant loss of revenue for the government.[2] Nwokolo et al. (2018) shows that the violence in the Niger-Delta between 1998-2014 was positively associated with increases in international oil price. In August 2009, the Nigerian government after years of poli-

[1] Oil revenue accounted for about 26.8 percent of Nigeria GDP in 2012 and 70 percent of the federal government revenue (Udosen et al. (2009); Fenske and Zurimendi (2017))

[2] In 2008, the Nigerian government reported losing USD 23.7 billion due to the instability in the Niger-Delta region (Nwozar (2010); Oluduro and Oluduro (2012)). Natural resources related conflict are a common occurrence around the world (see Lei and Michaels (2014), Lujala et al. (2007), Dube and Vargas (2013), Brückner and Ciccone (2010)).

cies which failed to curb the conflict, announced for the first time the NDAP that aimed to disarm, demobilise and reintegrate rebel members into the society for peace in the Niger-Delta region (Okonofua (2016), Ikelegbe and Umukoro (2016), Okoi (2020)). While significant sums have been spent on the policy, research on the effectiveness of the NDAP, and amnesty policies in general, has been limited.

The effectiveness of amnesty policies in reducing conflict and improving the economy is not obvious. An important concern for implementing an amnesty policy is time inconsistency where once the conflict reduces, the incentive to follow through with the policy dissipates making such policies effective only in a short-run (Walter (1997), Walter (2009), and Blattman and Miguel (2010)). Nevertheless, amnesty policies have a natural element of concession and effort for peace by both sides, which make them more acceptable to all parties in the conflict (Nilsson (2008)). This increases the possibility that the impact of amnesty policies are more sustainable in the long run. Not surprisingly, the appeal of amnesty policies are widespread and they have been used in other conflicts such as Uganda's Lords Resistance Army (LRA), Columbia's The Revolutionary Armed Forces of Colombia (FARC), Sierra Leone's Revolutionary United Front (RUF) and Algeria's Armed Islamic Group (GIA) with varying degrees of success (Bradfield (2017), Daniels (2020), Nilsson (2008), Mallinder and McEvoy (2011)). However, despite such popularity, a quantitative evaluation of the impact of amnesty policies on conflict remain under-researched in the literature.

We make two key contributions to the literature. First, we fill the existing gap in the literature on quantitative evaluations of amnesty policies, by evaluating how the impact of the amnesty policy differ in the short and long run. Our post-amnesty data which ranges from 2010 to 2016, is divided into two parts, with the short-run covering 2010 till 2013, and long run covering 2014 till 2016. This allows us to explore the effectiveness of the NDAP in greater depth. In particular, we focus on both economic and political reasons to explain the difference in the short and long run conflict. Second, we assess the impact of the reduction in rebel and militia activities, resulting from the NDAP, on the local economy. The improvement in the local economy from any reduction of conflict due to the NDAP can be interpreted as the 'peace dividend' arising from the amnesty policy.[3]

The oil-related violence in the Niger Delta and the role of the amnesty policy in the changing dynamics of conflict in the region are of new interest to researchers. Rexer and Hvinden (2021) show that although the amnesty policy decreased violence in the oil sector, the decline in violence was accompanied by increases in oil theft in the region. The incidents of oil theft and law enforcement actions against oil theft are heterogeneous and only observed in areas where ex-rebel commanders were given lucrative oil contracts as part of the amnesty program. The increase in oil theft after the amnesty was implemented as shown in Rexer and Hvinden (2021) expose some weaknesses of the amnesty policy that can hinder its long-term effectiveness. Here, we show that the more crucial forms of violent conflict (such as rebel activities) returned to pre-amnesty levels four years after the amnesty policy was implemented. Thus, the Niger Delta amnesty policy was only effective in the short-term at reducing violent conflict in the region.

To estimate the causal impact of NDAP on conflict, we bring together data from various sources including the Armed Conflict Location and Event (ACLED) data for conflict. We employ a difference-in-differences (DiD) estimation strategy where Local Government Areas (LGAs) with and without oil fields in the Niger-Delta as our treatment and control regions respectively. By matching the data on the reported oil spill due to sabotage with our ACLED data on conflict and geo-referenced information on the location of oil fields and length of pipeline in Niger-Delta LGAs, we observe that almost every oil spill from sabotage was reported in LGAs with oil fields, and few were reported in LGAs with pipelines but no oil spill was observed in LGAs with no

[3] The concept of peace dividends – income or welfare gains from the end of conflict – is well documented in the literature (Collier (1995), Besley et al. (2015), Besley and Mueller (2012), Amare et al. (2020)).

oil facilities.[4] Sabotage of oil pipeline is the deliberate destruction of oil pipeline by rebels for oil theft or to get the government's attention (Okotie et al. (2018)). Therefore, our approach of investigating the impact of NDAP at the LGA level avoids assuming that every region within the Niger-Delta is oil producing. Otherwise, we would have untreated observations within the treated group which can bias the DiD estimation.[5]

We find that the probability of an incident of rebel or militia activities reduced by 27.3 percentage points after the program was implemented. The policy also impacted other forms of violence as defined in the ACLED database. The probability of having a violent battle between government forces and armed groups; and civilian related violence both reduced by about 19 percentage points in LGAs with oil fields after the amnesty policy. However, the effect of NDAP on rebel and militia activities was short-lived. We find no evidence of a decrease in conflict in the treatment region, several years after the amnesty policy. This is not a surprise since studies such as Okonofua (2016) claim failure of the government in solving the core issue of relative deprivation and development has resulted in new rebel groups like the Niger-Delta Avengers resurfacing in the oil-producing region.

We explore two possible reasons for such increase in conflict post amnesty. First we investigate the possibility that the NDAP was not effectively implemented towards the later years because of a change in political regime where the previous government's major polices are no longer a priority. Our second explanation is based on the idea that underlying motivation for conflict has not waned due to lack of improvement in basic aspects of living such as health and education. Our empirical analysis rules out the political explanation. Thus, our explanation for the rise in conflict focuses on the relative deprivation based on broad indicators of health and education. We provide a simple theoretical model to explain our results.

[4]Data on oil spills is from National Oil Spill Detection and Response Agency (NOSDRA). Figure 2.2 presents the plot of the data.

[5]In a similar context of conflict in India, where districts with mines are associated with greater conflict, Vanden Eynde (2018) undertakes a district level analysis.

To estimate the 'peace dividend' resulting from the reduction of conflict due to NDAP we compare changes in the night lights before and after the amnesty policy in the treated and control regions. Studies such as Hönig (2017), estimated the effect of the amnesty policy on education, health, and self-employment at state level. However, as those detailed information are not available at the LGA level, we match 1 square kilometer stable light data to LGAs across Niger-Delta, using information from National Oceanic and Atmospheric Administration (NOAA) and the National Geographical Data Center (NGDC). Our analysis shows that after 2009, the level of economic activities indicated by night-time light increased by 2.15 units in Niger-Delta LGAs with oil fields.[6]

We restrict our sample within the region of Niger-Delta to ensure the comparability between the treatment and control regions. Some literature (see Abidoye and Calì (2015), Hönig (2017)) compare observations in Niger-Delta with other parts of Nigeria when estimating economic and violent outcomes in the Nigeria Delta. However, the nature and causes of violence in Niger-Delta are very distinct to other parts of Nigeria such as the Fulani conflict in North-central Nigeria (dispute over land resources) and Boko-Haram (religious ideology) violence in North-East Nigeria. To avoid confounding oil related violence in the Niger-Delta with non-oil related violence that are more prevalent in other parts of Nigeria, we focus within the Niger Delta region.

The remainder of the paper is as follows: Section 2 provides a brief summary of the institutional context of oil resources and the consequent violence in the Niger-Delta which lead to the amnesty policy. Section 3 discusses data and the estimation strategy used in the paper. It also also addresses possible threats to identification. Section 4 presents the regression results and various robustness checks related to the estimation strategy. The following section provides a simple analytical model to explain our main results. In Section 6 we measure the peace dividend by estimating the impact of

[6]Our findings are similar to the literature on counter-insurgency (Berman et al. (2011), Berman et al. (2013), Singhal and Nilakantan (2016); Kaila et al. (2020) Dube and Vargas (2013)) which demonstrate that a reduction in violence due to government policies should lead to increased economic productivity.

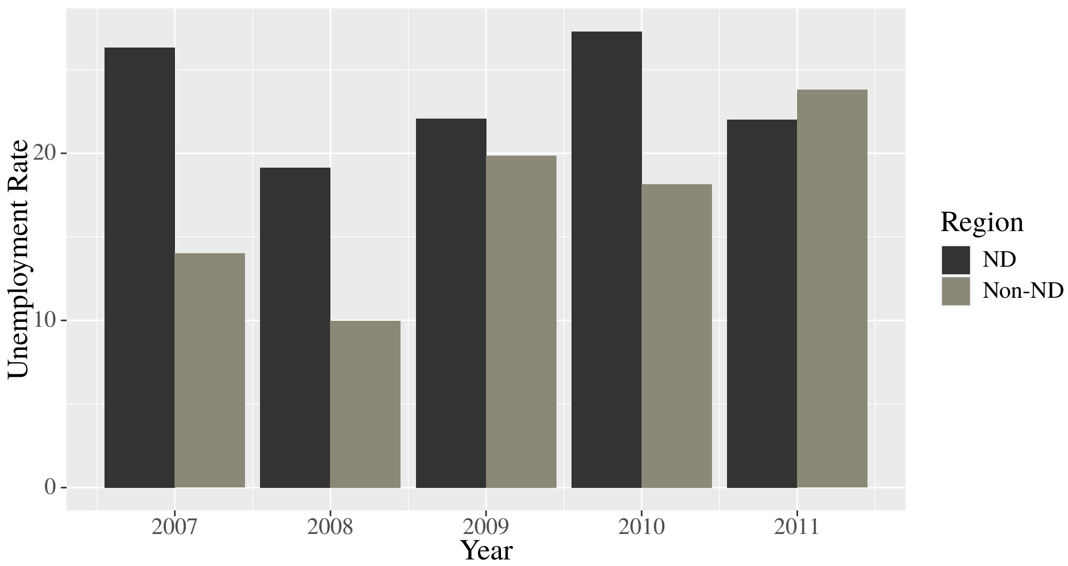
the NDAP on economic activities in the LGAs . Section 7 draws the main arguments together and puts forth some concluding remarks.

2.2 Background: Oil Conflict in the Niger-Delta

In recent years, the disputes over oil escalated and intensified into violence in the Niger-Delta. Relative deprivation in the oil-rich region is known to be one of the important factors that influence the Niger-Delta conflict (Ross (2004)). In the 1960s, according to the resource allocation formula used by the government, 50 percent of proceeds from mineral extraction used to be paid to the mineral extracting region. Under a new formula in the 1990s, five Niger-Delta states that produce 90 percent of the oil and 70 percent of government revenue are to receive only 19.3 percent of allocated revenue (Idemudia and Ite (2006)).[7] With only 13 percent of revenue allocation in 2001, the Niger-Delta remains poor with 70 percent of its people living below the poverty line (Idemudia and Ite (2006)). Agriculture, which is the primary source of income for people in the Niger-Delta (Okonofua (2016) Ikoh and Ukpong (2013)), has also suffered the negative externalities of oil extraction, including land expropriation, oil spillage and other environmental degradation (Okonofua (2016)). This is reflected in higher unemployment rates in the Niger-Delta compared to the other states in Nigeria, as shown in the figure below.

[7] On the other hand, five main non-oil Northern states received 26 percent of allocated revenue (Ikporukpo et al. (1996), Idemudia and Ite (2006)).

Figure 2.1: Unemployment Rates In Oil and Non-Oil Producing LGAs Over Time



Average unemployment rate in Nigeria-Delta states and Other states -2007-2011. *Data Source:* National Bureau of Statistics (2012)

The conflict in the Niger-Delta started as a civil protest in 1990. By 1999, it grew in to a broader rebellion covering the oil-producing region of Niger-Delta (Ikoh and Ukpong (2013)). The Gini-coefficient in the Niger-Delta increased from 0.36 in 2003-4 to 0.40 in 2009-10. The loss of revenue to the government and multinational oil companies was also significant.[8] Prior to the amnesty program, the government of Nigeria responded to the insurgency with military force. This, however, exacerbated the violence in the region (Ikoh, and Ukpong, (2013)).

In August 2009 the Nigerian government implemented the Niger-Delta Amnesty Program (NDAP), resulting from negotiations between government officials, Niger-Delta tribal leaders, and militia commanders. The policy aimed to demilitarize the Niger-Delta conflict by encouraging rebels to surrender their arms and weapons, sever linkages between fighters and the military groups and reintegrate fighters back into societies (Okonofua (2016), Ikelegbe and Umukoro (2016), Okoi (2020)). The policy provided a 60-day window from 6th August to 4th October 2009 for militants to sign

[8] Between 2003 and 2007, oil companies operating in the region reported a total of $21.5 billion (Nwozar (2010)).

up for the program. In return, the rebels receive a monthly payment of USD 407 in food and cash allowances, housing, education and vocational training in both local and international centres (Oluwaniyi (2011), Okoi (2020)).[9] In comparison, the per-capita monthly income in Nigeria for 2010 was around USD 190 at the time.

The amnesty program cost the government 127 billion Nairas ($825 million in 2010 exchange rate dollars) between late 2009-2011.[10] A total of 26,358 ex-combatants signed up for the program; 20,192 in the first phase before October 2009, and 6,166 in a second phase provided in November 2010 (Oluduro and Oluduro (2012)). Although, around 23 percent of all rebels who signed up were granted amnesty after the policy shock, the estimation strategy we employ picks up the average effect over the period after the amnesty policy was implemented in the sample.

2.3 Methodology

2.3.1 Data

Our analysis is based on data from various sources. Data on violent conflict are retrieved from the Armed Conflict Location and Event (ACLED) database, which covers events from 1997 till present and categorises the data into different classifications of violence. For this research, we focus on militia and rebel activities which the amnesty policy mostly targeted. The ACLED dataset allows us to do this, as they categorise conflict by groups based on their observed goals and structure. We sum events where the actors are classified as either a rebel group, political militia or ethnic militia for the estimation. The combination of these three groups of violent incidence by actors rather than types of violence is a good representation of the kind of parties the amnesty program targeted. We also consider other classifications of violence such as battles (mainly

[9] Okoi (2020) provides a comprehensive breakdown of how ex-combatants were allocated across various local and international institutions for rehabilitation training and education.

[10] In 2009, the government spent 3 billion nairas, in 2010, 30 billion nairas and in 2011 the expenditures on NDAP was 90 billion Nairas.

involving government forces), violence against civilians, protests and fatalities, to understand if the amnesty program affected other dimensions of violence. Also, all the different types of conflict are captured through a catch-all variable of All Events.[11]

Data on the location and distribution of oil fields in Nigeria are retrieved from Koos and Pierskalla (2016). It is geo-referenced data on the location of oil fields, gas flares, pipelines, and oil wells from GIS Solutions Nigeria (Koos and Pierskalla (2016)). Essential to this research is the number of oil fields in each local government area (LGA) and the length of the pipeline network per square kilometre for each LGA. We construct a dummy variable that takes the value of one if an oil field is present in an LGA. We use the presence of at least one oil field rather than the number of oil fields across LGAs to limit the possible bias in our estimates since some oil fields were constructed after 2009.[12] Also, the data set does not provide information on the year the oil field began production. The oil field indicator variable will serve to locate where rebel and militia groups that focus on extracting oil rents are likely to operate.

The Nigerian oil spill data comes from the National Oil Spill Detection and Response Agency (NOSDRA). The dataset records information on oil spill across Nigeria, specifically in the Niger-Delta. We use the 2009 records to check if our assumption regarding where oil field exists is correct. Our analysis will be confounded if oil spill events occurred in our control group.

The satellite night data is acquired from the National Oceanic and Atmospheric Administration (NOAA) and the National Geographical Data Center (NGDC). Their stable light product isolates man-made light from other natural sources of light. The data is available at a one square kilometer grid and reports a digital luminosity between 0 and 60, with 0 indicating a dark pixel and 60 represents the highest level of luminosity. The stable night light data is available from 1992-2013 which limits our measure of

[11] Specifically, All Events includes battles, explosions and remote violence, violence against civilians, protests, riots and strategic development, all of which are defined according to ACLED classifications.

[12] The number of oil fields in a LGA is expected to determine the intensity of rebel-militia activities and what proportion of the amnesty will be assigned to that LGA. This can exacerbate issues of reverse causality where the intensity of rebel activities determine how much amnesty resources is devoted to LGA in Niger-Delta.

economic activities in the LGAs mainly to the short-run analysis.

In our regressions we control for both rainfall and population at the LGA level. The data on rainfall is the CRU TS3.10 precipitation data from the University of East Anglia Climate Research Unit (UEA-CRU). The UEA-CRU data contains a monthly observation of rainfall from meteorological stations across the world's land area (Harris et al. (2014)). The data is available in 0.5 by 0.5 degree cells, and we aggregate cells within the 774 LGAs across Nigeria. Population data at the LGA level is the Sub-national Population Estimates Components from the US Census Bureau.[13]

The pretreatment time period we consider for the analysis is determined by when the rebellion in the Niger-delta was recorded to become more violent (see Okonofua (2016), Okoi (2020), and Rexer and Hvinden (2021)). In 2005, the Movement of the Emancipation of the Niger-Delta declared itself a rebel group and made its first violent attack. We balance the period after the policy and consider rebel events between 2010-2016. The grid cell data on conflict are aggregated at LGA level to match the data by Koos and Pierskalla (2016) on oil fields and pipelines which are recorded at LGA level. Table 2.1 presents the summary statistics of the data used in the analysis. The Niger-Delta comprises of 185 LGAs. The period for the analysis ranges from 2005 to 2016, giving us a total of 2220 observations. Hence, each of these observations is a LGA-Year which represents a LGA in one of the study years.

Table 2.1 shows that some LGAs in the Niger-Delta had no report on rebel activities, an LGA had 45 events in one year as the maximum number of rebel activities. We also see a sizeable amount of other classifications of event across the LGAs in Niger-Delta. The mean value of our main dependent variable rebel (militia and rebel) activities is 0.489. This means that over the period considered in our research, almost half the LGA-Years suffered from rebel activities. When we consider all events, a little over ninety percent of the LGA-Years in the Niger-Delta were impacted. Figure 2.A.1 (in

[13] National Bureau of Statistics in Nigeria only have population data at the state level. Therefore, we rely on LGA level estimates provided by the US Census Bureau.

Table 2.1: Descriptive Statistics - Niger-Delta

Variables	N	Mean	St. Dev.	Min	Max
Rebel	2,220	0.489	1.969	0	45
All Events	2,220	0.924	3.091	0	45
Battles	2,220	0.188	0.832	0	15
VAC	2,220	0.259	1.231	0	32
Protests	2,220	0.297	1.480	0	23
Fatalities	2,220	1.317	22.062	0	1,000
NOAA Night Light	1,665	7.732	9.522	0	52.608
Total Rainfall (mm)	2,220	2,033	372	322	2,900
Population	2,208	195,339	90,445	53,208	638,494
Pipearea	2,220	0.055	0.084	0	0.3718
Oil Field	2,220	0.330	0.470	0	1
Reported Oil Spill (2009)	185	1.130	2.549	0	55

Notes- Summary statistics for Niger-Delta. The number of violent events in each category is the sum of all entries in the ACLED dataset by LGA year. The distribution plot of All events and Rebel events is presented in Appendix 2.A

Appendix 2.A) plots the histogram of number of incidence of rebel activities and all events.[14]

2.3.2 Estimation Strategy

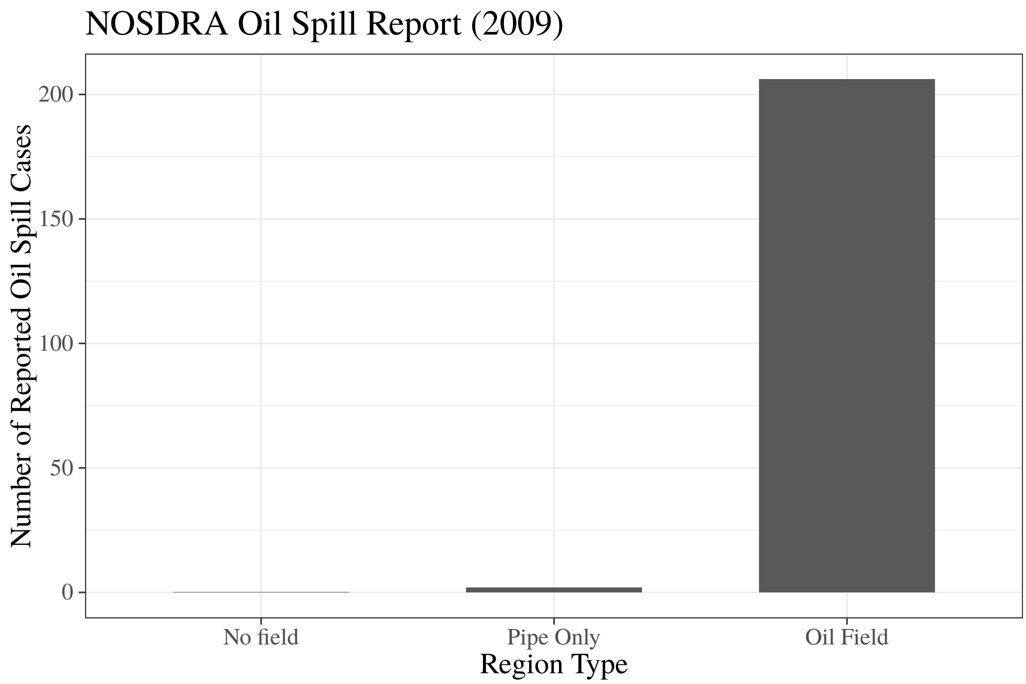
In the difference-in-differences (DiD) estimation we compare the incidence of violence between LGAs that have oil fields with those without oil field, before and after 2010. Although the entire Niger-Delta region is oil-rich, rebel activities relating to oil resources are mainly concentrated in LGAs with oil field. Based on the literature on conflict ((Lujala (2009), Lujala (2010), Lujala et al. (2005), Ross (2006)) where the ease of access distinguishes lootable and non-lootable resources, we assume that only oil resources in LGAs with oil fields are accessible to rebel groups.[15] This is borne out in the evidence from oil spill which demonstrate that rebel groups mainly focus on areas of existing oil fields. Figure 2.2 shows the distribution of the oil spill report across our LGA classifications.

We observe that almost all cases of oil spillage from sabotage were reported in LGAs

[14]In Appendix 2.A we present the equivalent numbers for whole of Nigeria. While the values are quite similar to Niger-Delta, more LGA-Year's in Niger-Delta suffer from violent events (all events) compared to Nigeria.

[15]Lujala et. al. (2005) explains that only the fraction of resources that can be extracted by simple methods are lootable. Such extraction also do not require skilled labour and high investment in technology

Figure 2.2: The Incidence of Pipeline Sabotage



A bar chart of the number of oil spills from sabotage of oil facilities by third parties recorded by National Oil Spill Detection and Response Agency (NOSDRA). We match the report in 2009 with our data that categorise LGAs with oil fields, LGAs with pipeline only and LGAs with no oil facilities in the Niger-Delta.

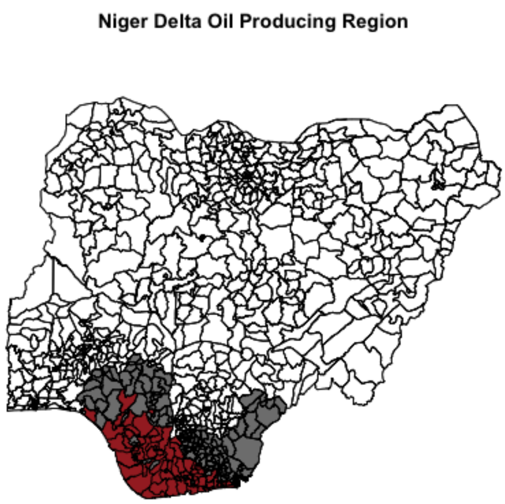
that we assigned as having active oil fields, very few were reported in LGAs with pipelines but no oil fields and none was reported in LGAs with no oil facilities that form the most part of our control group in the Niger-Delta. Therefore, oil resources are only lootable when either the government or Multinational companies (MNC) install oil fields. Thus, rebel activities related to oil resources are more prevalent in Niger-Delta LGAs with oil fields, which we consider as our treatment region.

As mentioned earlier, unlike other studies (see Abidoye and Calì (2015), Hönig (2017)), we ensure the comparability between treatment and control regions by restricting the sample of LGAs to only the Niger-Delta region. It allows us to avoid confounding oil related violence in the Niger-Delta with non-oil related violence that are more prevalent in other parts of Nigeria.[16] Figure 2.3 shows the regions we com-

[16]Our robustness check in section 2.B considers other parts of Nigeria as the control group. In this case we allow every part of the Niger-Delta to be treated and test for heterogeneous treatment effects between LGAs with and without oil fields.

pare in the analysis: the grey area is LGAs in the Niger-Delta that have oil in reserve (no oil field); the red region is LGAs in the Niger-Delta that have oil fields.

Figure 2.3: Niger Delta Oil Producing Region



Map of Nigeria showing the Niger-Delta region. The LGAs shaded grey are the LGAs that have oil in reserve, while the LGAs in red have oil fields.

Rebel, political and ethnic militia activities are a broad classification of violence by ACLED. According to ACLED, this classification of violence was recorded across all parts of Niger-Delta—with different groups operating in different areas within the Niger-Delta. Our research evaluates the impact of the amnesty policy on rebel/militia events in LGAs with oil fields given the policy was interested in lowering oil-related violence. In section 2.A.1, we present a balance test using some characteristics across the Niger Delta in 2009, separating LGAs with and without oil fields. Table (2.A.1) estimates the differences in rainfall, the number of ethnic groups, the proportion of households with electricity and fiscal allocation in LGAs with and without oilfields. We observe that there is no significant difference in these characteristics across LGA with and without oil fields. We also do the same analysis with results in table (2.A.2) comparing the Niger Delta with other parts of Nigeria. We observe that although the differences negligible are there are statistically significant differences in characteristics between Niger-delta LGAs and LGAs in other parts of Nigeria. Hence the treatment and control regions for our analysis will be the LGA's with and without oil fields in the Niger-Delta respectively.

Baseline Specification

Our baseline model for estimating the impact of amnesty on conflict is as follows:

$$Conflict_{lt} = \alpha_l + \delta_t + \beta \boldsymbol{OilField_l} \times \boldsymbol{Policy_t} + \gamma_l t + \epsilon_{lt}, \tag{2.1}$$

where $Conflict_{lt}$ is a dummy variable that takes a value of 1 if there was a recorded conflict in any LGA l at time t, α_l and δ_t are the LGA and time fixed effect respectively. We also include $\gamma_l t$, an LGA-specific time trend. The whole of the Niger-Delta region fall into nine states, and LGA's within each state may have similar economic and political structures allowing the possibility of serial correlation among LGAs in the same state. Therefore, the errors term ϵ_{lt} is wild cluster bootstrapped at the state level. The wild cluster bootstrapped standard errors account for arbitrary auto-correlation in the errors of LGAs within states by assigning the identical weight to every residual within the cluster in the bootstrap procedure (Cameron et al. (2008), Webb (2013), and Roodman et al. (2019)).[17] The variable of interest is β, the coefficient of the interaction term between a dummy variable that identifies LGA with oil fields and the policy dummy.

There are, however, several threats to identification in our model. First, implicit in the DiD assumption is that LGAs with and without oil fields in the Niger-Delta should have the same trend of conflict before the amnesty policy was enacted. That is, without the amnesty policy, conflict in Niger-Delta LGAs with oil fields will maintain on their pre-treatment level. While we demonstrate the existence of parallel trends between the treatment and control region for conflict through trend plots of conflict and event study

[17]The wild cluster bootstrap has several advantages over alternatives like the block bootstrap procedure. The most important is that it creates bootstrap samples of the same size as the original sample size. The wild cluster bootstrap method also ensures that all observations in the main sample will be included in every bootstrap sample, which is necessary since few units are treated. The block bootstrap procedure can generate unequal samples and exclude some observations when creating blocks, leading to wrong inference (Webb (2013))

methods, we also include LGA-specific time-trends in our regressions to take account of this issue.

Second, for DiD estimation, strict exogeneity assumption needs to be satisfied. The treatment timing must be statistically independent to the entire distribution of the potential outcome (see Angrist and Pischke (2008), Imbens and Wooldridge (2009), and Wing et al. (2018)). In our context, it means the rebels in Niger-Delta LGAs should not alter their conflict behaviour in anticipation of the amnesty policy. Thus, rebel violence in Niger-Delta LGAs without oil fields should not significantly increase or decrease in the year before the policy. We deal with this threat by undertaking a placebo test which includes an interaction term of oil field dummy with observation in the year 2009. We find no evidence of the policy anticipation in the amnesty policy.

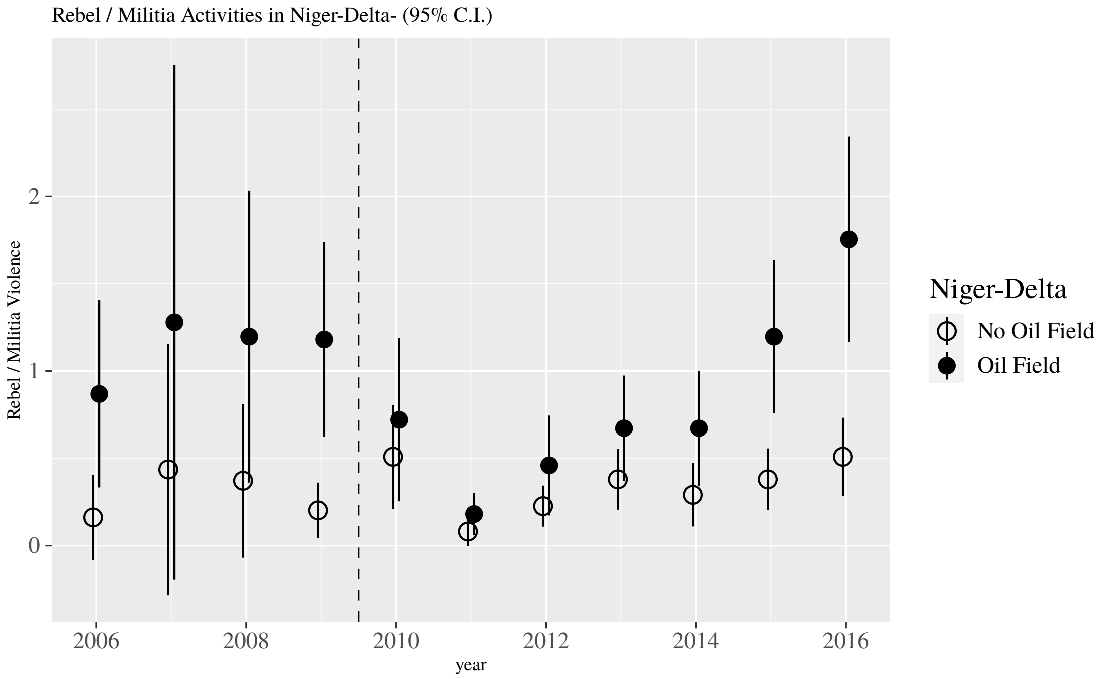
Third, although the policy is designed to demobilise rebel groups by moving rebel members that signed up to camps thus limiting the possibility that participants who receive the payment to operate in other regions, it is vital to ensure that there are no spillover of conflict from the treatment to the control region. To test for possible spillovers, we include an interaction of the length of oil pipelines in LGAs in Niger-Delta with no oil field. We expect that if rebel and militia groups who engage in oil theft move out of LGAs with oil field as a result of the amnesty policy, they can operate in LGAs with no oil fields but oil pipelines, which gives them alternate access to oil resources. We do not find evidence of spillover effects in our mode.

2.4 Results and Discussion

2.4.1 Parallel Trends

One of the pre-conditions for difference-in-differences (DiD) estimation is to establish parallel trends in rebel activities between the control and treatment regions. As a first evidence, in the figure below we plot average rebel and militia activities in the treatment and control regions in Niger-Delta for each year from 2006 to 2016.

Figure 2.4: Average Level of Rebel and Militia Events in Niger Delta

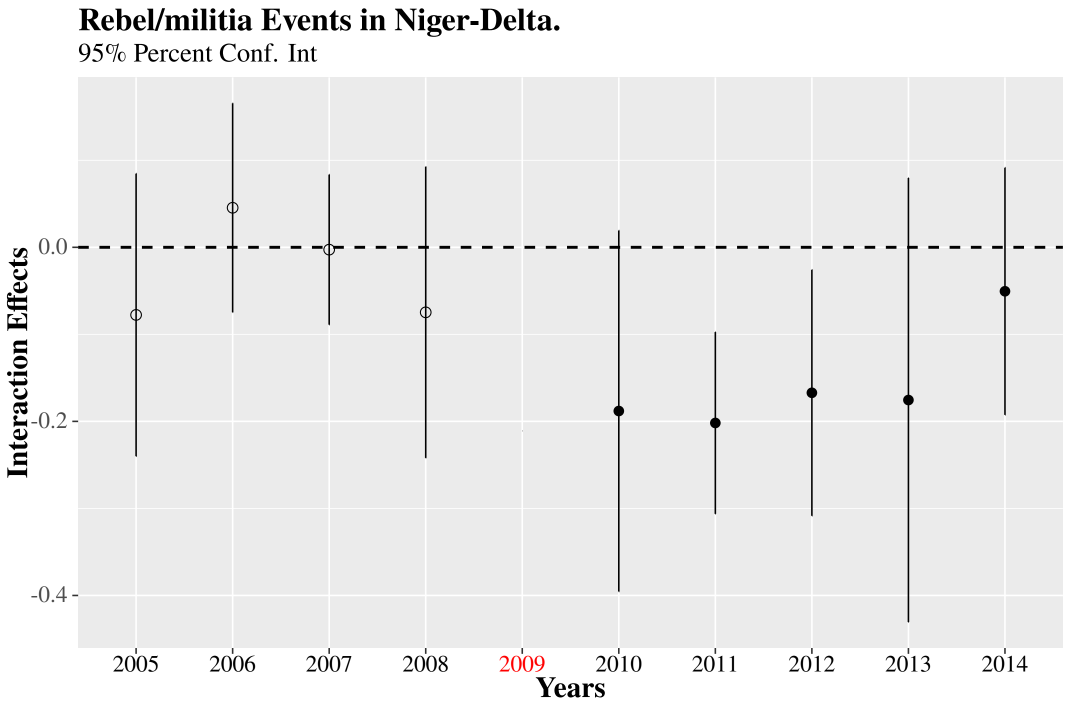


Note-The diagram shows the average incidence of rebel/militia activities over time in LGAs with and without oil fields. The figures shows a sharp drop in rebel/militia activities in LGAs with oil fields just after the amnesty policy. However, the level of violence seems to have reverted back to pre amnesty policy level after 2014. The estimation strategy tests if the impact of the policy was significant all through the period after the amnesty policy.

Broad observations of Figure (2.4) show that pre-2010, although the treatment region had a higher rebel and militia activity compared to the control regions, the trend in these activities were very similar in both the regions with a slight increase in 2007 followed by a slight decrease in 2008. It is only in 2009 that the gap between the control and treatment regions increased slightly. On the other hand, post-amnesty the difference in militia activities in the control and treatment regions almost disappears. The gap between the two regions, however, begins to rise after a few years.

We further undertake an event study, which estimate the changes in rebel and militia activities between treatment and control regions every year relative to 2009, just before the amnesty policy was implemented.[18] For evidence of the parallel trends, estimates for dummies before 2009 should be relatively stable and insignificant while estimates after 2009 are expected to be negative and statistically significant.

Figure 2.5: Event Study Coefficient Plot



AIC =1672, BIC =3909

The coefficient plot for the event study estimate of equation 2.2—in the footnote. Estimation strategy controls for LGA fixed effect, year fixed effect and LGA specific time trend. The standard errors are wild cluster bootstrapped at state level. Estimates that are significant below 5% level are shown in the diagram.

It is clear from the Figure (2.5) that for the pre-amnesty years the coefficient in the treatment region is mostly positive, whereas post-amnesty in 2010, it becomes negative or insignificant. This implies that relative to the reference year, pre-amnesty years experienced similar incidence of rebel activities on average, whereas post-amnesty years experienced lower rebel activities in the treatment region relative to the control region.[19]

[18] We use the following equation to estimate the difference in conflict in the treatment and control region in each year. β_j are the estimates of the regression.

$$Conflict_{lt} = \alpha_l + \delta_t + \sum_{j=2006}^{2016} \beta_j \boldsymbol{OilField_l} \times \boldsymbol{(Year = j)} + \gamma_l t + \epsilon_{lt} \tag{2.2}$$

[19] In Table D1 (Appendix 2.C), we provide the estimates for equation 2.2. They show that the differences in rebel and militia

Both the plot of average rebel activity in the treatment and control region and the event study indicate that while there is broad evidence that parallel trends in conflict between the regions have been maintained, we observe significant changes in rebel activities in the treatment region post-amnesty.

2.4.2 Regression Estimates

For the impact of amnesty on conflict, first, we estimate the baseline regression. Although our focus is on the impact of the policy on the violence by rebel and militia actors, we also check the impact of the policy on other forms of violence such as battles involving government forces, violence against civilians, protests, fatalities, and a catch-all term that aggregates all violent events. In addition, we include in the baseline regression two additional control variables for total population and rainfall in each LGA in each period. We estimate the following equation,

$$Conflict_{lt} = \alpha_l + \delta_t + \beta \boldsymbol{OilField_l} \times \boldsymbol{Policy_t} + \boldsymbol{\theta X_{lt}} + \gamma_l t + \epsilon_{lt}, \tag{2.3}$$

where X_{lt} is the vector of additional control variables. There is evidence that rainfall (or lack of it) can play a role in engendering conflict in Africa (Miguel et al. (2004), Burke et al. (2015)). In our context, rainfall, through its impact on agriculture, where much of the population work, can affect conflict by changing the opportunity cost of joining the rebels. Total population can also increase the risk of conflict by generating pressure on resources. We take the log of both these variables as our controls. Thus, we are estimating the conditional impact of amnesty on conflict.

Our estimation of the impact of the amnesty policy is provided in Table 2.2 below. The top panel of table is based on equation (2.1) and the bottom panel estimates the same regression but with additional control variables as in equation (2.3). In this table and for the rest of the paper, unless specified otherwise, different forms of $Conflict_{lt}$

activities in 2005-09 are fairly stable with the average close to zero.

that we consider are as follows: in column 1, Rebels is a dummy variable that takes value of one when either a Rebel, Ethnic or Political Militia event occurred as recorded by the ACLED; in column 2, Battles is a dummy variable which takes value one, when the event involving government forces takes place; in column 3, Violence against Civilians is a dummy variable that takes value one, when it occurs; in column 4, Protests is a dummy variable that takes value one when the protests take place; in column 5, All Events is a dummy variable that takes value one, when any form of violence occurs; while in column 6, Fatalities is a dummy variable that takes value one, when fatalities are recorded.

Table 2.2: Amnesty Policy and Violence

	Rebels	Battles	Violence against Civilians	Protests	All Events	Fatalities
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: No Controls						
Policy Yr * Oil Prod	−0.273**	−0.191**	−0.197**	0.033	−0.184*	−0.115
	(0.096)	(0.065)	(0.074)	(0.045)	(0.093)	(0.090)
R^2	0.450	0.370	0.420	0.429	0.508	0.393
Adjusted R^2	0.336	0.240	0.300	0.310	0.407	0.267
Panel B: Including Controls						
Policy Yr * Oil field	−0.272**	−0.187**	−0.199**	0.029	−0.184*	−0.117
	(0.098)	(0.066)	(0.075)	(0.046)	(0.096)	(0.090)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.449	0.370	0.420	0.431	0.508	0.393
Adjusted R^2	0.334	0.239	0.299	0.313	0.405	0.266
LGA Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
LGA Specific Trends	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,220	2,220	2,220	2,220	2,220	2,220

Notes- Standard errors are wild cluster bootstrapped at state level. ***, **, * represents significance at the 1%, 5% and 10% respectively

The estimates in Table (2.2) show that the amnesty policy successfully reduced violence perpetrated by the rebels. Panel A, column 1 shows that the probability of rebel violence in the Niger-Delta LGAs with oil fields reduced by 27 percentage points. The amnesty policy also reduced the probability of having violent battles involving government forces by 18 percentage points and violence against civilians by close to 19 percentage points. Additionally, in column 5, the probability of having any form of conflict in our treatment region, also reduced by little over 18 percentage points, implying a reduction in total conflict due to the amnesty policy, although it was weakly significant.[20] This result is driven by the reduction in violent conflict, since All Events also includes non-violent conflict, such as protests, arrests, non-violent transfer of territory, none of which were targeted by the policy. The results remain very similar when we include additional control variables in panel B.

However, as shown in columns (4) and (6) (in both Panel A and B), there was no reduction in the number of fatalities or protests in the region after 2009. The ineffectiveness of the amnesty policy on protests and fatalities suggests that rebel activities mainly involved kidnappings and vandalization of oil facilities. The rebel strategy did not involve increasing fatalities as a means to get the government's attention. Also, we do not expect the policy to have any effect on non-violent conflict, such as protests.

Given the success of the amnesty policy in reducing conflict, a natural question is whether the reduction in conflict from the amnesty policy was sustained. To address this question, as alluded before, we divide the post-amnesty period from 2010-2016 in to two parts. We capture the short-run by the years 2010-2013 and the more long-run effect through the years 2014-2016. Thus, we estimate the following equation:

$$Conflict_{lt} = \alpha_l + \delta_t + \beta_0(\boldsymbol{Oil_l} \times \boldsymbol{Yr(10-13)}) + \beta_1(\boldsymbol{Oil_l} \times \boldsymbol{Yr(14-16)}) + \gamma_l t + \epsilon_{lt} \tag{2.4}$$

The interaction of the oil field with Yr(10-13) controls for the effect of the amnesty policy in the years 2010 to 2013. The Yr(14-16) compares the probability of rebel and militia activities between 2014 to 2016 and the pre-treatment period. A negative and significant estimate in the two interaction will indicate that the effect of the amnesty policy persisted through the period considered in the research. Table 2.3 below shows the results for equation (2.4).

[20]The impact of amnesty policy is significant for All Events only at 10 percentage points level of significance.

Table 2.3: Short-run and Long-run Impact of the Amnesty Program

	Rebels	Battles	Violence against Civilians	Protests	All Events	Fatalities
	(1)	(2)	(3)	(4)	(5)	(6)
Policy(2010-13) * Oil field	-0.242^{**}	-0.222^{**}	-0.158^{***}	0.104	−0.129	−0.073
	(0.072)	(0.071)	(0.047)	(0.075)	(0.086)	(0.080)
Policy(2014-16) * Oil field	−0.180	-0.283^{**}	−0.083	0.241	−0.024	0.009
	(0.125)	(0.102)	(0.103)	(0.149)	(0.130)	(0.111)
Diff. in Coefficient (p-value)	(0.293)	(0.1705)	(0.388)	(0.137)	(0.188)	(0.205)
Fixed Effects and Time Trend	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,220	2,220	2,220	2,220	2,220	2,220
R^2	0.450	0.371	0.421	0.432	0.509	0.394
Adjusted R^2	0.336	0.240	0.300	0.314	0.407	0.268

Notes- Policy(2010-13) is a variable controlling for observations in time period 2010-13 while Policy(2014-16) controls for observation between 2014 and 2016. The regression model does not include controls for rainfall and population. The table also includes a ttest for the equality of the coefficient for the two time periods. The results shows they are not significantly different, which is expected as treated observations are included in both time periods. Standard errors are wild cluster bootstrapped at state level. ***, **, * represents significance at the 1%, 5% and 10% respectively

Column 1 in Table 2.3 shows that the estimate for rebel and militia activities in the main result was mostly accounted for in periods between 2010-13. The policy variable in LGAs with oil field between 2014-16 is statistically insignificant. The same is true for violence targeting civilians in Column 3. However, violent battles between government forces and rebel groups decreased by the same magnitude in both periods compared to pre-policy levels. The probability of having a battle reduced by 22.2 percentage points in 2010-13 and 28.3 percentage points in 2014-16 compared to the levels observed before the amnesty policy. This implies that the government pulled out its forces from the Niger-Delta, resulting in a persistent decrease in battles involving government forces. However, rebel and militia violence in the LGAs with oil field may have gone back to pre-treatment levels as has been suggested in Okonofua (2016) and Ikelegbe and Umukoro (2016). For total conflict captured through All Events (column 5), although the impact of the policy is negative in both the short and long-run, they are statistically insignificant. As such it is not surprising since the effect of policy on total conflict which includes non-violent forms of conflict, was weakly significant in our baseline assessment in Table 2. Splitting the post amnesty period into two parts and controlling for each of them in the regression, may have resulted in an increase in standard error due to increased variance, tipping the weakly significant result to insignificant.

2.4.3 Robustness Checks

Placebo Analysis

In order to test whether the amnesty policy was anticipated by the rebel groups, we undertake a placebo analysis using the following equation:

$$Conflict_{lt} = \alpha_l + \delta_t + \beta_0 \boldsymbol{Oil_l \times Policy_t} + \beta_1(\boldsymbol{Oil_l \times Year = 2009}) + \gamma_l t + \epsilon_{lt} \tag{2.5}$$

We include an interaction of LGAs with oil field with a dummy variable where $Year = 2009$. It controls for differences in violent outcomes between groups in 2005-08 and 2009. [21] The results are presented in table below.

Table 2.4 contains estimates of equation (2.5) and includes a control for the interaction of observation in 2009 − before the amnesty policy − and LGAs with oil fields. The estimation can be interpreted as a test for the parallel trend assumption too. The interaction of 2009 and oil field was insignificant across all measures of violence. The estimate of interest, the probability of rebel and militia activity retains its magnitude and statistical significance in column 1. The estimate for all conflict event taken together, however becomes insignificant compared to the baseline results. All other estimates for other classification of violence retain their magnitude and statistical significance compared to the baseline results in Table 2.2.

[21] The assumption that LGAs with and without oil fields in Niger-Delta were on parallel trends before 2010 will be false if the interaction is negative and statistically significant. The negative significant variable will signify that rebel violence in LGAs with oil-field was already in decline before the amnesty program was in effect in 2010.

Table 2.4: Amnesty Policy and Violence: Placebo Analysis

	Rebels	Battles	Violence against Civilians	Protests	All Events	Fatalities
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: No Controls						
Policy Yr * Oil Field	-0.295^{**}	-0.184^{**}	-0.200^{*}	0.010	-0.189	-0.158
	(0.104)	(0.073)	(0.096)	(0.045)	(0.102)	(0.124)
Yr = 2009 * Oil Field	-0.042	0.013	-0.006	-0.046	-0.009	-0.084
	(0.034)	(0.027)	(0.070)	(0.041)	(0.055)	(0.069)
R^2	0.450	0.370	0.420	0.429	0.508	0.394
Adjusted R^2	0.336	0.239	0.299	0.310	0.406	0.268
Panel B: Including Controls						
Policy Yr * Oil field	-0.293^{**}	-0.182^{**}	-0.200^{*}	0.008	-0.187	-0.159
	(0.106)	(0.074)	(0.097)	(0.045)	(0.104)	(0.123)
Yr=2009 * Oil field	-0.042	0.011	-0.002	-0.040	-0.007	-0.083
	(0.034)	(0.027)	(0.071)	(0.043)	(0.056)	(0.070)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.449	0.370	0.420	0.432	0.508	0.394
Adjusted R^2	0.334	0.239	0.299	0.313	0.405	0.267
Fixed Effects and Time Trend	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,220	2,220	2,220	2,220	2,220	2,220

Notes- Standard errors are wild cluster bootstrapped at state level. ***, **, * represents significance at the 1%, 5% and 10% respectively

Conflict Spillovers

It is possible that the amnesty policy had not reduced conflict, but simply shifted it from the treatment region to other LGAs. In this section, we test for the possible spillover of conflict using the equation 2.6 below:

$$Conflict_{lt} = \alpha_l + \delta_t + \beta_0 \boldsymbol{Oil_l} \times \boldsymbol{Policy_t} + \beta_1 (\boldsymbol{PipeNear_l} \times \boldsymbol{Policy_t}) + \gamma_l t + \epsilon_{lt} \qquad (2.6)$$

In equation (2.6), we interact the length of oil pipelines in LGAs in the control group (LGA without oil field) with the policy variable. These are mostly LGAs that are near the treated LGAs where the network of oil pipelines moves across. The LGAs in the control group with oil pipelines allows us to test if there was policy effect spillover into our selected treated group. This follows from our discussion before, where accessibility to resources is an important factor in conflict. Since our treatment region is LGAs with oil fields in the Niger-Delta, rebels would simply move their focus to next easy targets of pipelines in LGAs without oilfields. A positive and significant estimate of β_1 will mean that rebels that extract oil resource increased their activities in LGAs with only oil pipelines. Table 2.5 presents the results.

Table 2.5: Amnesty Policy and Violence: Spillover Effect.

	Rebels	Battles	Violence against Civilians	Protests	All Events	Fatalities
	(1)	(2)	(3)	(4)	(5)	(6)
Policy Yr * Oil field	-0.267^{**}	-0.197^{**}	-0.183^{**}	0.043	-0.184^{*}	-0.118
	(0.099)	(0.065)	(0.079)	(0.042)	(0.094)	(0.088)
Policy Yr * Near Pipeline	0.251	-0.253	0.568^{*}	0.393	0.002	-0.115
	(0.584)	(0.348)	(0.298)	(0.676)	(0.426)	(0.411)
LGA Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
LGA Specific Trends	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,220	2,220	2,220	2,220	2,220	2,220
R^2	0.450	0.370	0.420	0.429	0.508	0.393
Adjusted R^2	0.336	0.239	0.300	0.310	0.406	0.267

Notes- Near Pipeline captures LGAs without active oil fields but have oil pipelines. Standard errors are wild cluster bootstrapped at state level. ***, **, * represents significance at the 1%, 5% and 10% respectively

Table 2.5 shows an insignificant estimate of β_1 across all measures of conflict except for violence against civilians. In particular, for rebel violence (column 1) which is the primary variable of interest in our context, we find that there is no evidence that the conflict shifted to other LGAs in the Niger-Delta after the amnesty policy. However, it seems that violence against civilians had increased in LGAs with pipelines, while it reduced in LGAs with oil fields. This perhaps reflects the fact that civilians are being used to compensate for any drop in earnings by the militias from the reduction in conflict. When we consider all events (column 5), we do not find any evidence of spillover of conflict to other LGAs.

Alternatively, we test for spill over using other non-Niger-Delta parts of Nigeria as the control group.[22] We estimate how rebel activities changed differentially in LGAs with and without oil fields in Niger-Delta after the amnesty policy. The results provide

[22] See Appendix 2.D for more discussion on this.

evidence that the amnesty policy had barely any impact on violence in LGAs without oil fields compared to other non-Niger-Delta states, whereas, the result in LGAs with oil fields are robust in this specification.

Intensity of Conflict

The previous estimations examined how the amnesty program impacted the probability of having at least one violent incidence under different forms of conflict. Next, we estimate if the impact of the amnesty policy affected the intensity of violence in the Niger-Delta oil-producing region. To achieve this, we replace the dummy dependent variables with the number of incidences that occurred in each LGA-year across the Niger-Delta. The variable is transformed using a log (event + 1) transformation. Result of the regressions are presented in Table 2.6.

Table 2.6: Intensity of Violence

	Rebels	Battles	Violence against Civilians	Protests	All Events	Fatalities
	(1)	(2)	(3)	(4)	(5)	(6)
Policy Yr * Oil field	−0.429***	−0.212**	−0.232**	0.058	−0.377**	−0.165
	(0.118)	(0.080)	(0.080)	(0.036)	(0.127)	(0.183)
Fixed Effects and Time Trend	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,220	2,220	2,220	2,220	2,220	2,220
R^2	0.565	0.425	0.509	0.623	0.668	0.401
Adjusted R^2	0.475	0.306	0.407	0.544	0.599	0.277

Notes- The dependent variables reflect the intensity of violent incidences. Standard errors are wild cluster bootstrapped at state level. ***, **, * represents significance at the 1%, 5% and 10% respectively.

The intensity of rebel and militia activities tends to decrease by 42.9 percent in Niger-Delta LGAs with oil fields after 2010. All violent conflict reduced by 37.7 percent, including violent battles involving government forces by 21.2 percent and violence against civilians by 23.2 percent. We still find no significant decrease in the number of fatalities and the number of protests in the estimation. Therefore, the amnesty program did not only decrease the probability of violence but also the intensity of rebel and militia activities in LGAs with oil field in the Niger-Delta.

2.5 Increase in Conflict Post Amnesty

While conflict had declined in the years immediately after the amnesty, in the longer run we see conflict has increased. There can be several competing factors for this increase in conflict. We discuss some plausible reasons in this section.

One possibility is that the initial reduction in conflict had lead to a situation where both parties did not adhere fully to the agreement due to poor implementation and corruption associated with developing countries (Okonofua (2016), Ikelegbe and Umukoro (2016)). Thus, it may be that government did not keep up with the payments and the rebels who had sought amnesty had taken up arms. There are no mechanisms in the policy through which parties could credibly commit to the agreement in the long-run. The calculations for short-run political expediency may be quite different from policies for long-term peace. However, this possibility is not borne out by the empirical facts on the ground. Till 2015, the Presidency was in the hands of the party which was involved in the NDAP.[23] In 2015, the new government made an open commitment to uphold the governments side of the peace deal.[24] Further, the payment to rebels have been generous, and besides the monthly payments they have received housing and other forms of assistance. It is, therefore, hard to envisage that those rebels already benefiting from the program had taken up arms again.

Hence we focus on two other possibilities: (a) the difference in the political regimes at the state and federal level and (b) a decline in the standard of living in the Niger-Delta states.

[23] Infact, Goodluck Jonathan, the Vice-President at the time when the NDAP was signed, became President from 2011 to 2015. See the discussions in the Appendix 2.E

[24] See Appendix 2.E.

2.5.1 Differing Political Regimes

Policy effectiveness can be hampered when state governors and the country's president belong to different political parties (Hodler and Raschky (2014), Burgess et al. (2015), Fetzer and Kyburz (2018)). Favouritism from patronage and public policy can result in the unequal distribution of resources across ethnic or political party lines (Burgess et al. (2015)) can result in discontent and conflict.

In order to examine whether the difference in the political affiliations of the state governors in Niger-Delta and the President of Nigeria leads to conflict, we first show how the affiliations for each of the state governors in the Niger-Delta region and the President differed in our sample period in Figure 11 (in Appendix 2.D). We find that particularly for the major oil producing states of Niger-Delta, the political affiliation of the governors were different from the President after 2015. Thus, it is possible that the increase in conflict that happened after 2014 for the Niger Delta has to do with the differing affiliation of the governors and Presidents differed leading ineffective implementation of the NDAP and thus leading to conflict. We estimate the following equation:

$$Conflict_{lt} = \alpha_l + \delta_t + \beta \boldsymbol{OilField_l} \times \boldsymbol{Policy_t} + MajorOil_{lt} + MinorOil_{lt} + \gamma_l t + \epsilon_{lt}, \tag{2.7}$$

Equation 2.7 captures the impact of state governors and the president's political party affiliation on the level of conflict in the oil-producing region in Niger-Delta. We use the data in Figure (2.E.1) to code $MajorOil$ and $MinorOil$ dummy variables. The variable $MajorOil$ takes a value of 1 for oil-producing LGAs in the major Niger-Delta states (Abia, Akwa-Ibom, Cross-River, Bayelsa, Delta and Rivers state) in periods when the state government was not in the same party as the president (years 2015-16). Alternatively, the variable $MinorOil$ takes a value of 1 for oil-producing LGAs in the minor Niger-Delta states for periods when the state government was not in the same party as the president. The major oil-producing states in the Niger Delta are states with some LGAs that actively produce oil. The minor oil states have oil in reserve but are not known to be actively oil-producing. The distinction between major and minor oil-producing states in the estimation tests for differences in effect political transition on conflict.

The data presented in figure (2.E.1) show that the political transition commonly occurred within these two classifications of oil-producing states. We include LGA fixed effect, LGA specific time trend and year fixed effect identical to our main estimation model. We expect $MajorOil$ and $MinorOil$ to be positive and statistically significant if state governors and the president belonging to different political parties increase conflict. In addition, if including these variables render the interaction measure of the amnesty policy ineffective, then the governor's affiliation to the president's party adversely impacted the effectiveness of the amnesty policy. On the other hand, insignificant results will exclude such political transitions as an explanation for the return of violence in the region after the amnesty policy.

Table 2.7: Political Affiliation and Conflict

	Rebel	Battles	Violence against Civilians	Protest	All Events	Fatalities
	(1)	(2)	(3)	(4)	(5)	(6)
Policy Yr * Oil field	−0.198*	−0.183**	−0.159**	0.059	−0.147	−0.049
	(0.090)	(0.076)	(0.061)	(0.064)	(0.103)	(0.087)
Major Oil (2015-2016)	0.167	0.037	0.092	0.068	0.099	0.168*
	(0.112)	(0.058)	(0.159)	(0.122)	(0.082)	(0.080)
Minor Oil (2011-2014)	0.008	0.102	0.045	0.062	0.083	0.119
	(0.143)	(0.075)	(0.197)	(0.140)	(0.130)	(0.115)
Fixed Effects and Time Trend	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,220	2,220	2,220	2,220	2,220	2,220
R^2	0.452	0.371	0.421	0.430	0.510	0.398
Adjusted R^2	0.338	0.240	0.300	0.311	0.407	0.272

Notes- The dependent variables are dummy variables that represent the labels that classifies various conflict. The variable $MajorOil$ takes a value of 1 for oil-producing LGAs in the major Niger-Delta states (Abia, Akwa-Ibom, Cross-River, Bayelsa, Delta and Rivers state) in periods when the state government was not in the same party as the president (years 2015-16). Alternatively, the variable $MinorOil$ takes a value of 1 for oil-producing LGAs in the minor Niger-Delta states for periods when the state government was not in the same party as the president. The values of $MajorOil$ and $MinorOil$ are coded from 2.E.1. Standard errors are wild cluster bootstrapped at state level. ***, **, * represents significance at the 1%, 5% and 10% respectively.

Table 2.7 shows that state governors and the president's affiliation to a political party did not impact conflict, and only weakly increased fatalities in the major oil-producing LGAs. The result show that although the effects of political affiliation were positive across all our definitions of violent events, they were all statistically insignificant. However, for the probabilities of fatalities from conflict in column 6, we find that when the governor and president belong to different political parties, the probability of having a conflict-related fatality seemed to increase by 16.8 percent. We also observe that the main estimate of the policy's impact still retains its statistical and economic significance. Thus, from the estimation results, the affiliation to the president's political party can be ruled out as a factor that rendered the Niger-Delta post amnesty ineffective after 2014.

2.5.2 Relative Deprivation

We hypothesise that the increase in conflict is driven by new members joining the rebel movements, which is evident from formation of new rebel groups such as the Niger-Delta Avengers.[25] This might be motivated by greed, where the generous package offered by the government to the existing rebels had prompted other to undertake rebel activities with a hope of securing such deals for themselves too. If we agree to this view, then we should have also observed an increase in conflict after the amnesty was offered. Note that the Niger-Delta region suffered from high levels of unemployment. However, we saw a decline in conflict in the subsequent years after the amnesty program. There was also no evidence that government would offer another amnesty.

Instead, a lack of improvement in the standard of living of the general populace in Niger-Delta might be the driving factor for new people joining rebel groups. For instance, when it comes to education, from Figure 2.D.4 (Appendix 2.D), we can see that since 2010, there has been a steep increase in per-capita primary school enrollment in the Niger-Delta states. However, after 2013, the primary school enrollment starts

[25] See BBC report, Niger Delta Avengers: Nigeria's newest militiants, by Chris Ewokor (https://www.bbc.co.uk/news/world-africa-36414036).

decreasing sharply and by 2016 it is lower than what it was in 2010. This mirrors the post-amnesty decline in conflict in the short-run and increase in conflict in the longer run. A similar pattern can be observed when it comes to health in the Niger-Delta states, with per-capita malaria incidence (Figure 2.D.5 (Appendix 2.D)), sharply increasing since 2012 and remaining higher thereafter, relative to 2010. These important social indicators have not improved much, and in fact has worsened in the long-run post-amnesty. While generous payments were made to the existing militias to surrender, the underlying reasons of grievances remained unaddressed by the amnesty program. While we do not have detailed data to conduct a full analysis, based on these broad observations we develop a simple model to explain our empirical observation where amnesty policy reduces conflict in the short-run, but not in the long-run.[26]

2.6 Peace Dividend: Amnesty and the Economy

In this section, we estimate if the amnesty policy had any effect on the level of economic activity in the Niger-Delta. There are no direct data on economic activity available at the LGA level for our time period. Thus, following similar studies, we use satellite data on night light as a proxy for economic activity in the LGAs (Chen and Nordhaus (2011); Henderson et al. (2012); Lessmann and Steinkraus (2019)). Using data from 2005-13 of the stable Night-time light provided by NOAA, we estimate how the economy in the delta changed before and after the amnesty policy. Given the NOAA data on stable night light is only available till 2013, we are not able to separate the short and long run effect of the policy on economic activities in the Niger-Delta.[27]

The stable light data picks up luminosity from residences, offices, retail shopping areas, factories, street lighting, road vehicles, fishing boats, and gas flaring facilities

[26] In particular, we do not have information on living standards at the LGA level to separate out the impact of living standards. We do consider LGA-specific time trends in our model. Our intention here is mainly to put the results in the context of a theoretical framework.

[27] Figure 3.C.8 in Appendix 2.E provides the map of Nigeria showing some of the night light data in raster (.tif) between 2008-2011.

(Addison and Stewart (2015)). We observe that the level of night light in the Niger-Delta seems higher relative to other parts of Nigeria. The observation at the very top is Lagos state, which is the commercial capital of Nigeria. However, the Niger-Delta states, with oil fields (coloured in blue) are not far behind. They have relatively high values of night light in the sample.

Table 2.8 presents the result of a DiD estimation of NDAP and night light. The estimation uses the same model specified in the baseline regression (equation (1)) except the dependent variable now is luminosity.

Table 2.8: Rebel and Militia Violence

	Stable Light	Stable Light	Stable Light	Stable Light
	(1)	(2)	(3)	(4)
Poilcy Yr × Oil Field	2.151**	2.170**	1.789**	2.339**
	(0.660)	(0.677)	(0.721)	(0.791)
Yr=2009 × Oil Field			−0.452	
			(0.455)	
Policy Yr × Near Pipeline				7.581
				(7.232)
Controls	No	Yes	No	No
Fixed Effects and Time Trend	Yes	Yes	Yes	Yes
Observations	1,665	1,656	1,665	1,665
R^2	0.978	0.978	0.978	0.978
Adjusted R^2	0.971	0.971	0.971	0.971

Notes- The dependent variable is the NOAA night time light. Standard errors are wild cluster bootstrapped at state-level. ***, **, * represents significance at the 1%, 5% and 10% respectively.

Column 1 of Table 2.8 shows that the amnesty policy seemed to have increased the night light in the Niger-Delta state with oil field after NDAP by 2.15 units. Column 2 controls for log population and log rainfall. The results are similar to that in column 1 with NDAP increasing night light by 2.17 units. Column 3 of Table 2.8 shows a placebo analysis as before, where we include a placebo variable which is the interaction term of the presence of oil field and observations in 2009. The inclusion of the placebo variable checks if there was an increase in the night time lights in the treatment region before the amnesty policy. The estimates in column 3, show that while the placebo term is insignificant, nigh lights improved by 1.79 units after the policy. Overall, there is a strong evidence of improvement in economic activities in the LGA's with oil fields in the Niger-Delta as a result of the amnesty program.

The estimates on peace dividend from the amnesty policy show some improvement to the local economy in LGAs with oil fields. The conclusion that the improvement in night light was due to the reduction in violence would be true if no other policy/investment aimed at economic improvement occurred simultaneously with the amnesty policy. Such investments related to the oil industry is expected to occur in LGAs with oil facilities (oil fields and pipelines). We test for the effect of the amnesty on night lights in LGAs with only oil pipelines in the Niger Delta. The estimate in table 2.8, column 4 shows no statistically significant improvement to night light in LGAs with only pipelines in the Niger Delta. Since we observe the policy effect on economic improvement in the same period as the reduction in violence (Table 2.8, column 3) and LGAs that are nearby and similar to LGAs with oil fields did not experience similar improvement (Table 2.8, column 4), it is unlikely that improvement to nightlight in LGAs with oil fields came from other investment policies unrelated to the amnesty policy.

2.7 Conclusion

Using a difference-in-differences (DiD) framework, we examine the effect on conflict of an amnesty policy offered by the Nigerian government in August 2009 to rebel group members in the oil-producing region of the Niger-Delta. We find that the amnesty policy reduced violence in Niger-Delta LGAs with oil fields. Rebel and militia activities reduced substantially both in terms of the probability of occurring and in the intensity of the violence levels. We also find that other dimensions of violence, such as battles between government forces and civilian violence reduced as a result of the policy. We also find no evidence of spillover of violence into other LGAs in the Niger-

Delta.

Surprisingly, the effect of the amnesty policy was short-lived. Compared to the level of violence between 2005 and 2009, the amnesty policy significantly reduced it in Niger-Delta LGAs with oil fields between 2010-13. However, it had no significant impact on rebel violence between 2014-16. We explore both economic and political reasons for the increase in violence. Our analysis rules out the political angle. Instead, based on observed trends in social indicators and other complementary evidence, we believe that economic factors such as the lack of improvement in the standard of living in Niger-Delta states may play an important role behind the increase in conflict. As we highlight in our analytical model, the underlying causes of why people join the rebel groups and militias need to be addressed effectively, perhaps through increased social expenditure, otherwise the whole cycle of rising conflict followed by amnesty will repeat itself.

The impact of the amnesty policy was not just limited to reduction in conflict. By using night light as proxy for economic activity, we find that there has been statistically significant increase in the economic activity in the LGAs of Niger-Delta where the policy was targeted. This peace dividend perhaps is a reflection of the reduction in conflict and particularly the reduction of violence against civilians, allowing space for increase in normal economic activities. While we do not have monetary estimates of the peace dividend and thus a direct comparison with the cost of the amnesty policy is not feasible, this paper demonstrates that the policy led to reduction in conflict and improvement in economic activities in the regions where it was implemented.

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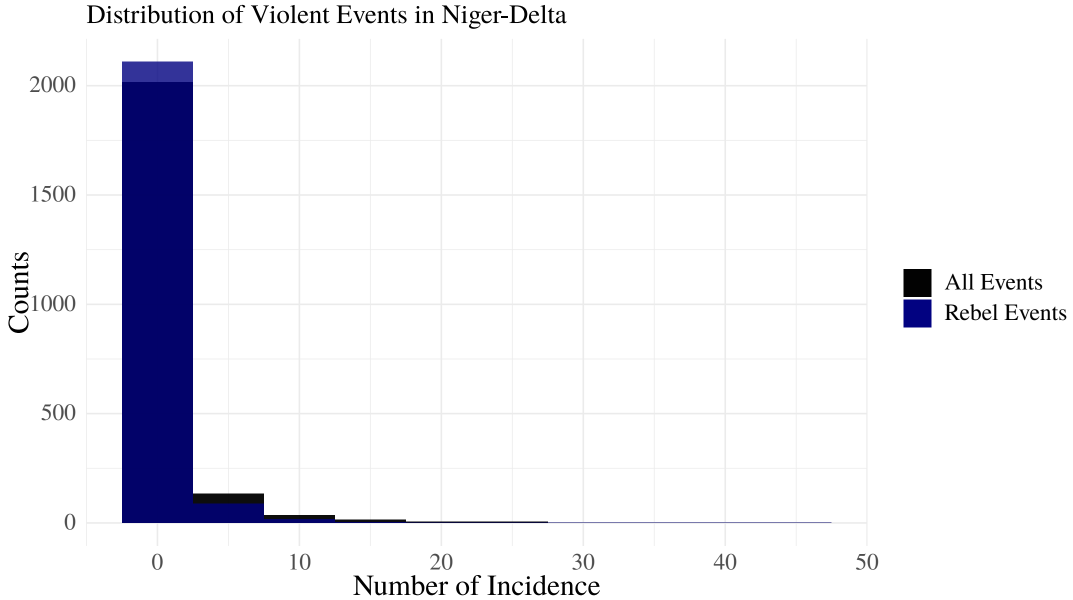
Appendix

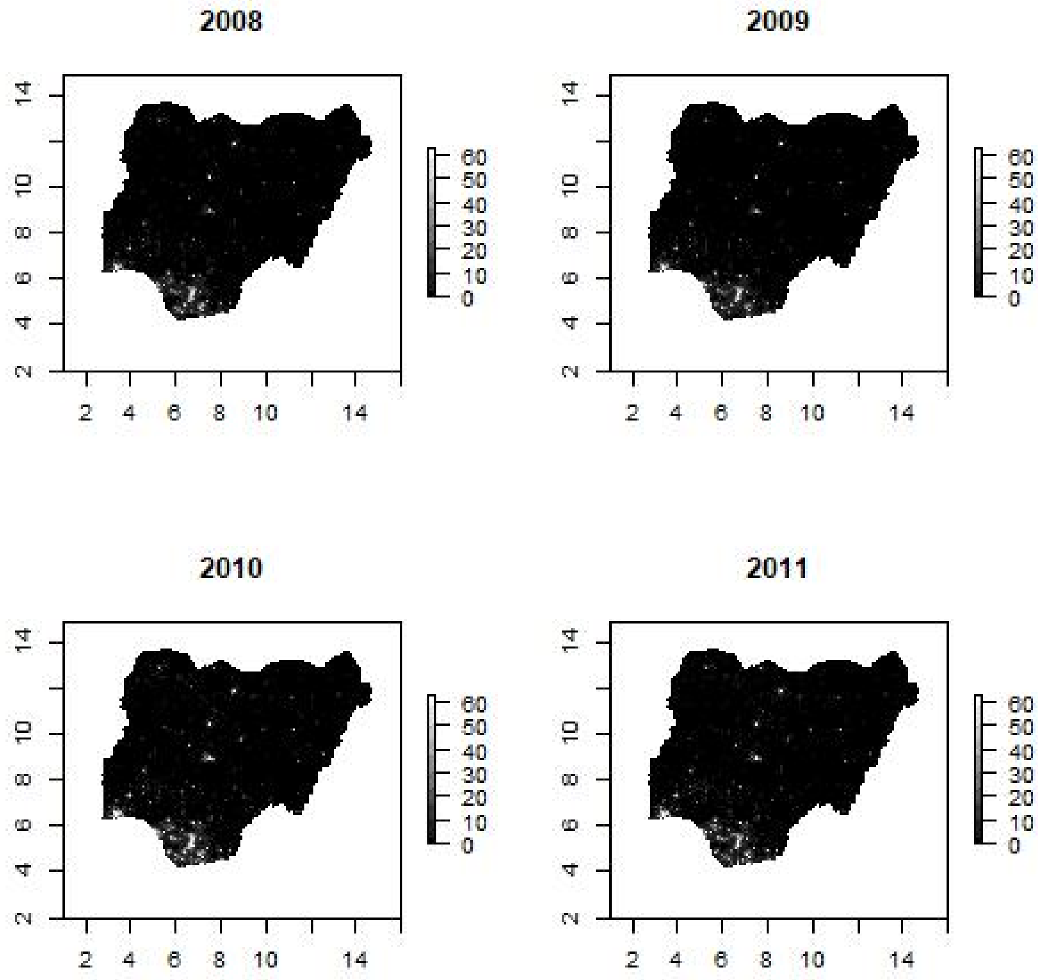
2.A Tables and Figures

Figure 2.A.1: Distribution of the Number of Violent Incidence



Histogram of all violent events and Rebel/Militia activities in Niger-Delta. The y-axis shows the number of observations (LGAs) that recorded the range of incidences (x-axis) in our dataset. The plot uses data from the descriptive statistics in Table 2.1. We observe that most LGAs experienced less than 10 incidence of violent activities over the time period considered in the research.

Figure 2.A.2: The Spatial Distribution of Night Light in Nigeria



The National Oceanic and Atmospheric Administration (NOAA) Stable Night light data in Nigeria. The data reflects the intensity of light ranging from 0-62 to reflect no light and maximum luminosity respectively.

2.A.1 Balance Test

Table 2.A.1: Socio-Economic Characteristics of Oil And Non-Oil LGAs in Niger-Delta.

	No Oil	Oil Field	Difference	St Err	t value	P value
Total Rainfall	1967.33	2004.60	-37.28	45.55	-0.8	0.42
No. of Ethnic Group	1.27	1.39	-0.12	0.09	-1.35	0.18
Electricity (%)	37.11	36.54	0.56	3.89	0.15	0.89
Fiscal Alloc. (per cap)	0.02	0.02	0.001	0.001	0.65	0.52
No. of observations	124	61	(Total = 185)			

Notes- The table presents a balance test for LGAs with and without oil fields using some observed social economic characteristics at LGA level. Except for total rainfall, the data is retrieved from Koos and Pierskalla, 2016 and was used to measure economic outcomes in estimation with time periods 2006 and 2012. We take that the baseline measure is an average over the time period or the latest year they represent is 2012, since the source did not state when exactly the data represents. The ethnic group data reclassifies the ethnic groups in Nigeria into 17 distinct ethnic group by Rainer and Trebbi. Electricity measures the percentage of household with electricity, Fiscal Alloc. (per cap) is the proportion of fiscal allocation per capita of the federal government that reaches the LGA.

Table 2.A.2: Socio-Economic Characteristics of LGAs In and Out of Niger-Delta

	Non-ND	ND	Difference	St Err	t value	P value
Total Rainfall	1142.65	1979.62	-836.97	26.01	-32.17	0.000
No. of Ethnic Group	1.23	1.31	-0.08	.045	-1.82	0.070
Electricity (%)	36.70	36.91	-0.22	2.16	-0.10	0.930
Fiscal Alloc. (per cap)	0.017	0.016	0.002	0.001	3.519	0.001
No. of observations	589	185	(Total = 774)			

Notes- The table presents a balance test for LGAs with and without oil fields using some observed social economic characteristics at LGA level. Except for total rainfall, the data is retrieved from Koos and Pierskalla, 2016 and was used to measure economic outcomes in estimation with time periods 2006 and 2012. We take that the baseline measure is an average over the time period or the latest year they represent is 2012, since the source did not state when exactly the data represents. The ethnic group data reclassifies the ethnic groups in Nigeria into 17 distinct ethnic group by Rainer and Trebbi. Electricity measures the percentage of household with electricity, Fiscal Alloc. (per cap) is the proportion of fiscal allocation per capita of the federal government that reaches the LGA.

2.B Spill Over - Other Parts of Nigeria as Control Group

Using a sample of all LGAs across Nigeria, equation (2.8) estimates if there is any difference in rebel activities between non-Niger-Delta LGAs and Niger-Delta LGAs without oil fields.

$$Rebel_{lt} = \alpha_l + \delta_t + \beta_0 \boldsymbol{ND_{ls}} \times \boldsymbol{OilField_l} \times \boldsymbol{Policy_t} + \gamma_l t + \epsilon_{lt} \tag{2.8}$$

The estimation answers the question of whether the amnesty policy affected rebel activities in Niger-Delta LGAs with no oil-field relative to other LGAs in Nigeria. Equation (2.8) is a three-way interaction of a dummy ND (all LGAs in the Niger-Delta with and without oil fields) with the dummy oil field (only LGAs with oil fields in the original baseline estimate). The estimates compare the probability of violence occurring in non-Niger-Delta LGAs across Nigeria with LGAs with and without oil fields in Niger-Delta. If Niger-Delta LGAs without oil-field saw a substantial decrease in violence after the amnesty policy compared with the rest of Nigeria, this will give an indication the policy affected the Niger-Delta as a whole, or the effect of the policy in LGAs with oil-fields spilt-over into Niger-Delta LGAs without oil field – bringing to question the same trend assumption the difference-in-difference estimation depends.

Table D1 presents the results of the estimation of equation 2.8. We expect the interaction of the policy variable (Policy Yr) and Niger-Delta LGA dummies to be insignificant. A significant negative estimate imply that the amnesty policy also impacted violence in Niger-Delta LGAs with no oil fields. The result shows that all estimates of the interaction of Niger-Delta oil-fields with the policy variable is consistent with estimates of the main result in Table 2 as expected. We see limited evidence in column 1 that the policy reduced the probability of rebel activities by 6 percent in LGAs without oil fields in Niger-Delta – indicating policy effect spill-over. However, it is worth noting that the estimate was close to the ”refuse-to-reject the null” region of statistical significance with a p-value of 0.098. Column 5 also shows that taking all forms of violence together, the probability of conflict in Niger-Delta LGAs without oil-fields seems to decrease by 9.2 percent. We find no evidence of a decrease in violent battles involving government forces and civilian related violence in Niger-Delta LGAs without oil-field after 2009.

Table D1: Policy Effect Across Nigeria

	Rebels	Battles	Violence against Civilians	Protests	All Events	Fatalities
	(1)	(2)	(3)	(4)	(5)	(6)
Policy Yr * ND	−0.060*	−0.036	−0.023	0.011	−0.092**	−0.087***
	(0.034)	(0.023)	(0.022)	(0.028)	(0.035)	(0.029)
Policy Yr * Oil Field	−0.273***	−0.191***	−0.197***	0.033	−0.184**	−0.115
	(0.092)	(0.062)	(0.070)	(0.043)	(0.089)	(0.086)
Fixed Effects and Time Trend	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,288	9,288	9,288	9,288	9,288	9,288
R^2	0.469	0.402	0.432	0.496	0.520	0.463
Adjusted R^2	0.361	0.281	0.318	0.395	0.423	0.354

Notes- The sample used in the estimation is all LGAs across Nigeria. The estimation accounts for the differential effect of teh amnesty program on all types of violence between non-Niger-Delta Nigerian LGAs and LGAs with and without oil fields in the Niger-Delta. ND is a dummy variable that indicates all Niger-Delta LGAs (with and without oil fields). The Oil Field is a dummy variable that indicates LGAs with oil fields in the Niger-Delta. Standard errors are boot clustered at state level. ***, **, * represents significance at the 1%, 5% and 10% respectively

One concern is that the amnesty policy also impacted conflict in LGAs without the oil field. In this case, if the impact on the control LGAs is significant enough, the SUTVA assumption will be violated. This problem can arise if the eligibility criteria for rebels receiving the amnesty payment does not exclude rebel members operating in LGAs without oil fields. There is barely any publicly available document that shows the agreement reached by the government and militant leaders to understand the eligibility criteria of the amnesty program (Nextier, 2020). We use a report by Nextier, 2020 which interviewed some of the early government and rebel members of the amnesty panel as anecdotal evidence of the eligibility criteria. Nextier, 2020 reports that the ex-militant leaders are in charge of the list of beneficiaries of the amnesty program. They explain that the amnesty stipends are first paid in bulk to the ex-militant leaders for onward disbursement to their subordinates (see Nextier, 2020). This method of selecting beneficiaries will make it unlikely that rebel militias from other parts of the region whose activities were not oil-related will be eligible for the amnesty payments.

We conduct an empirical analysis to test if there was any change to rebel activities in LGAs without oil fields (the control group) after the amnesty policy was implemented. Although figure 2.5 suggests a change in rebel activities in LGAs without oilfields after 2009, our analysis tests if this change was statistically significant compared to the change observed in the LGAs with oil fields using other parts of Nigeria as the control group. Equation 2.8 estimates the difference in conflict outcomes between LGAs in the Niger Delta compared to other parts of Nigeria. The estimation allows for treatment effect heterogeneity between LGAs with and without oil fields in the Niger Delta. β_0 is a three-way interaction that includes ND, a dummy that indicates Niger Delta LGAs; $OilFields$, a dummy that indicates Niger Delta LGAs with oil fields; and $Policy$, the policy variable. If the estimate for $ND \times Policy$ is statistically significant, it will imply that the policy altered conflict level in the control group relative to other parts of Nigeria, possibly violating both the parallel trend and SUTVA assumption. Also, we expect the estimate of $Oilfield \times Policy$ to be similar in magnitude and statistical significance to the baseline estimation.

Table 2.5 shows the amnesty policy had no statistically significant impact on violence in LGAs without oil fields except for battles mostly involving government forces. Column 2 shows the probability of battles involving government forces seem to have decreased by 5.7% in LGAs without oil fields (the baseline control group) after the amnesty policy. The result implies that the government likely pulled out its military forces from the Niger Delta after implementing the amnesty policy. We also observe that the estimates of the amnesty policy in LGAs with oil fields are very similar to the baseline estimation as expected. Overall, we see no evidence of the policy effect spillover in the control group except those battles with government forces tend to have decreased across the Niger Delta due to the amnesty policy.

2.C Event Study

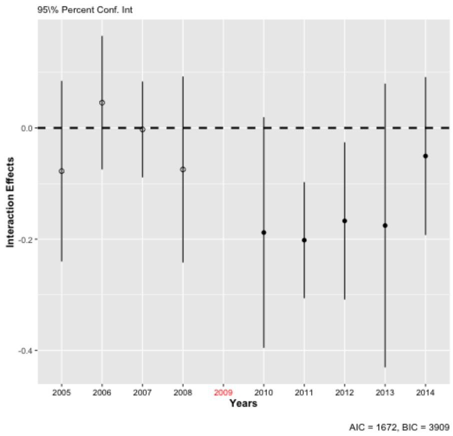
We conduct an event type study using 2.9. The event study allows us to see how violence evolved in treated and control LGAs. Also, we can detect any sudden shift in the trend of violence when the amnesty program was implemented. The outcome variable is the incidence of violence in Niger Delta LGAs. We consider the same definitions of violence used in the baseline estimation. The j is an indicator for all observation of each year in the dataset. β_j estimates the differences in violence between LGAs with and without oil fields over time compared with the base year (2005). The other parts of the estimated model for the event study are similar to the baseline estimation model. We include year fixed effect, LGA fixed effect, LGA specific time trend, and region year fixed effect to resolve arbitrary unobserved heterogeneity in the estimation.

$$Conflict_{lt} = \alpha_l + \delta_t + \sum_{j=2006}^{2016} \beta_j \boldsymbol{OilField_l} \times \boldsymbol{(Year = j)} + \gamma_l t + \eta_{rt} + \epsilon_{lt} \tag{2.9}$$

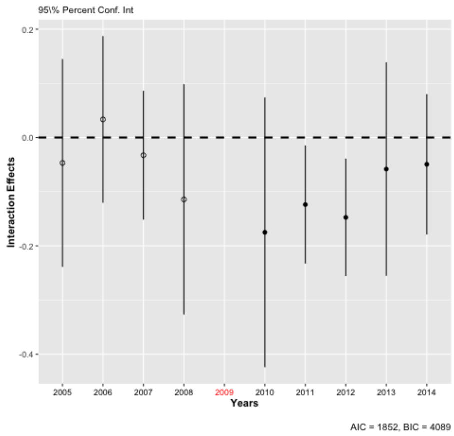
Figure 2.5 is the coefficient plot of the event study. The plots indicate a statistically significant decrease in most forms of violence after the amnesty policy; this is consistent with the baseline estimation. The plot suggests that the amnesty policy reduced violence in LGAs with oil fields after it was implemented. Specifically, subplot (a.) shows a statistically significant reduction in violence in LGAs with oil fields in 2011, 2012 and 2014. For all forms of violence taken together, subplot (b.) shows a statistically significant reduction in violence in 2011. Government battles and civilian violence in subplots (c.) and (d.) respectively show similar patterns observed in subplot (b.). For non-violent protest, subplot (e.) shows that protests were lower in oil-producing LGAs before the amnesty program. However, the level of protest between the two types of LGA was similar after the amnesty, as evidenced by the statistically insignificant result after 2010. Overall, the figures suggest that although the amnesty program was implemented in 2010, the program was most impactful in decreasing violence in 2011.

Table D1 shows the estimates from the event study. We see that the impact on rebel/militia, battles involving government forces and civilian violence are most significant in the year 2011. Rebel/militia violence decreased in LGAs with oil fields by 15.3%, 17.4% and 16.1% in year 2011, 2012 and 2014 respectively compared to their level in 2005. For battles involving government forces, we observe a positive and statistically significant estimate in LGAs with oil fields in 2009. After the amnesty policy, however, the estimates become negative—showing the amnesty decreased battles involving government forces. We also find that civilian violence only differed in treatment and control LGAs in 2011. Non-violent protests tend to be relatively lower in LGAs with oil fields prior to the amnesty policy. However, there was no observed difference in the level of violence between both types of LGAs after the amnesty program. Overall, the results show evidence of a significant decline in violent incidents relevant to the amnesty in LGAs with oil fields in the Niger Delta.

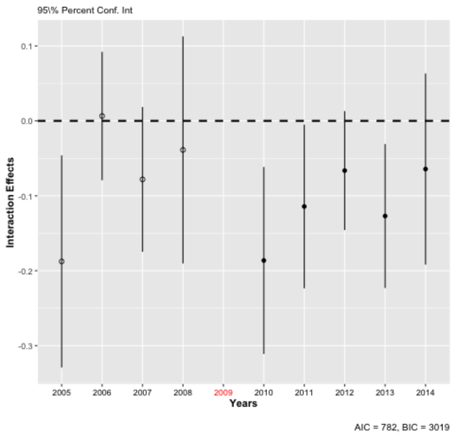
(a) Rebel and Militia Events



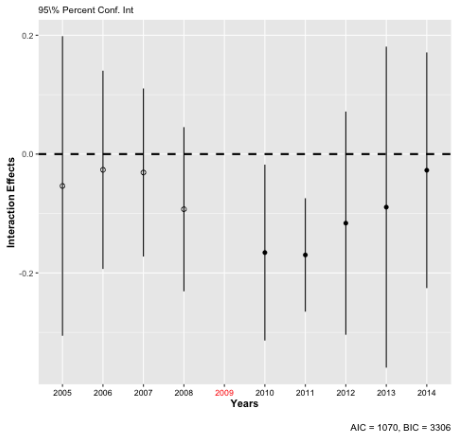
(b) All Events



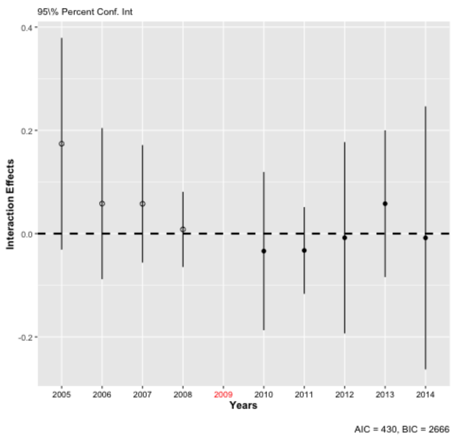
(c) Government Battles



(d) Civilian Violence



(e) Protests



(f) Fatalities

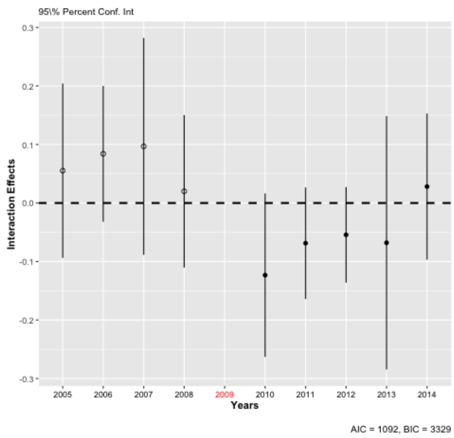


Table D1: Event Study Estimates

	Rebel	Battles	Civilian Violence	Protest	All Events	Fatalities
	(1)	(2)	(3)	(4)	(5)	(6)
Oil Field ×2005	−0.078	−0.188**	−0.054	0.174	−0.047	0.055
	(0.083)	(0.072)	(0.129)	(0.105)	(0.098)	(0.076)
Oil Field ×2006	0.045	0.006	−0.026	0.058	0.033	0.084
	(0.061)	(0.044)	(0.085)	(0.075)	(0.078)	(0.059)
Oil Field ×2007	−0.003	−0.078	−0.031	0.058	−0.033	0.097
	(0.044)	(0.049)	(0.072)	(0.058)	(0.061)	(0.095)
Oil Field ×2008	−0.075	−0.039	−0.093	0.008	−0.114	0.020
	(0.085)	(0.077)	(0.070)	(0.037)	(0.108)	(0.066)
Oil Field ×2010	−0.211*	−0.133*	−0.151*	0.091	−0.155	−0.004
	(0.106)	(0.064)	(0.076)	(0.078)	(0.127)	(0.071)
Oil Field ×2011	−0.188***	−0.186**	−0.166***	−0.034	−0.175**	−0.123**
	(0.053)	(0.056)	(0.049)	(0.043)	(0.056)	(0.049)
Oil Field ×2012	−0.202**	−0.114**	−0.170	−0.033	−0.124*	−0.069
	(0.072)	(0.041)	(0.096)	(0.095)	(0.055)	(0.042)
Oil Field ×2013	−0.167	−0.066	−0.116	−0.008	−0.147	−0.054
	(0.130)	(0.049)	(0.138)	(0.073)	(0.101)	(0.110)
Oil Field ×2014	−0.175**	−0.127*	−0.089	0.058	−0.058	−0.068
	(0.072)	(0.065)	(0.101)	(0.130)	(0.066)	(0.064)
Oil Field ×2015	−0.051	−0.064	−0.027	−0.008	−0.049	0.028
	(0.092)	(0.077)	(0.062)	(0.094)	(0.084)	(0.090)
LGA & Year FE	Yes	Yes	Yes	Yes	Yes	Yes
LGA Specific Trend	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,220	2,220	2,220	2,220	2,220	2,220
R^2	0.453	0.375	0.422	0.434	0.511	0.397
Adjusted R^2	0.336	0.241	0.299	0.313	0.406	0.268

Notes- Estimates are the interaction of the oil field dummy with year fixed effect. The estimated result in each year is relative to the baseline of Oil Field * 2009. To avoid perfect collinearity we drop Oil Field * 2016. Standard errors are boot clustered at state level. ***, **, * represents significance at the 1%, 5% and 10% respectively.

2.D Social Indicators - Niger-Delta

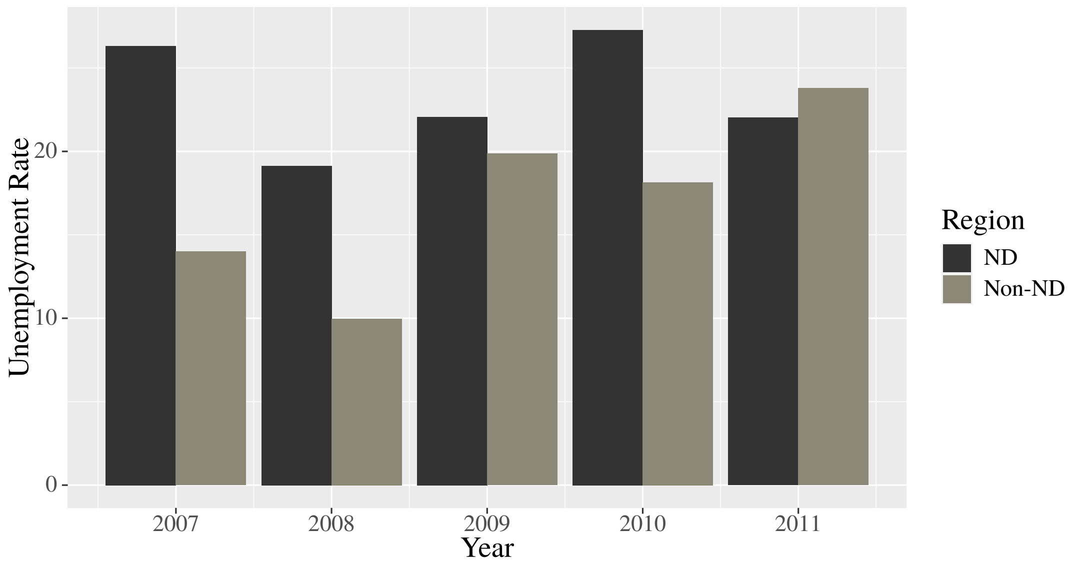
Exploring social-economic indicators allow us to access the local conditions around the Niger-delta after the amnesty program. The analysis examines if changes to social and economic conditions in the region co-occurred with increased violence after the amnesty policy was implemented. The data used is from the National Bureau of Statistics (NBS); however, this data is limited in the time coverage and contains missing data. We focus the exploratory analysis on unemployment education and the incidence of malaria. These indicators are relevant measures of the local economic outcome with the region Sachs and Malaney (2002), Duflo (2004), "Can Hearts and Minds Be Bought? The Economics of Counterinsurgency in Iraq", (and Barro and Lee [2013].

2.D.1 Unemployment Rate

The unemployment rate has a directly significant effect on conflict outcomes. When employment is low, violent conflict is expected to increase (Collier and Hoeffler [2004], Miguel et al. [2004], "Can Hearts and Minds Be Bought? The Economics of Counterinsurgency in Iraq", [Dube and Vargas (2013), and Crost et al. (2016)). In this session, we explore the data to see if the increase in conflict after the amnesty policy co-occurs with any sudden unemployment shifts. The result in this section will help us understand the estimated result in section 2.5.2. However, the result is in no way argues for causation between Unemployment and conflict in this context.

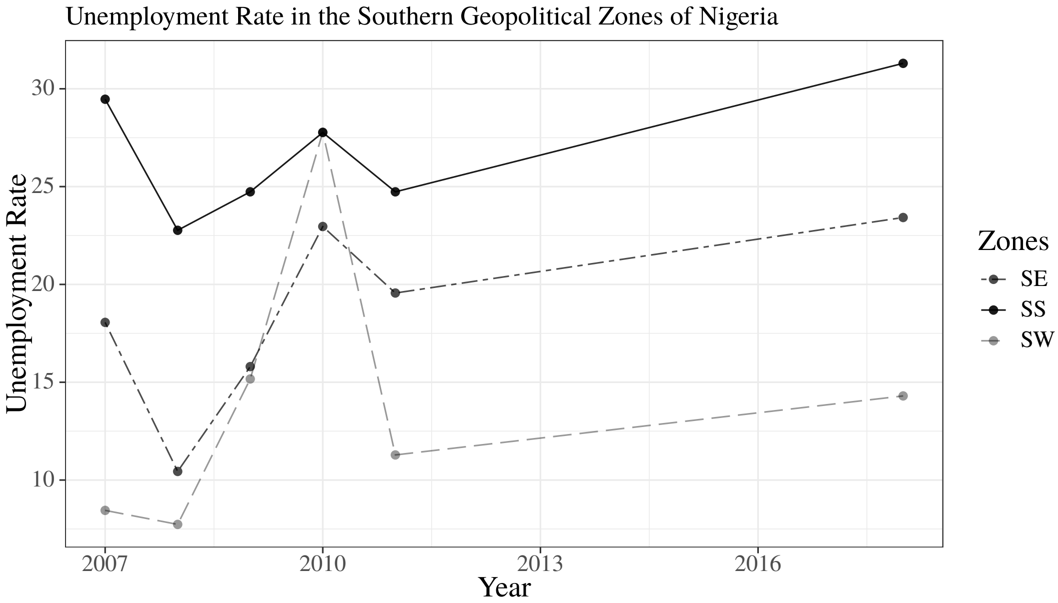
We use data on the state level rate of Unemployment to examine how Unemployment changed in Niger-Delta states compared to other parts of Nigeria. Figure (2.D.1) shows no observable change in the level of Unemployment between 2009-2011, around when the amnesty policy was implemented. Figure (2.D.2) plots the unemployment level by geopolitical region in the southern part of Nigeria. The Niger Delta cuts across the three geopolitical zones south of Nigeria and comprises all 6 South-South (SS) states; 1 of 6 South-West (SW) state and 2 of 5 South-Eastern (SE) state. In this case, we use LGAs in the South-South in the Niger Delta to examine how Unemployment has changed through the amnesty policy. We observe that the South-South region had the highest level of Unemployment in the Southern parts of Nigeria. Although we do not see the trend continuously, the level of unemployment is highest in 2016, a period after the amnesty program. Figures 2.D.1 and 2.D.2 suggests that the amnesty program did not change the levels of Unemployment in the oil-producing region, and this can have negative implications for violent outcomes.

Figure 2.D.1: Unemployment Rate in Nigeria by Oil and Non-oil Producing LGAs



Average unemployment rates in Nigeria-Delta states and Other states -2007-2011. *Data Source:* National Bureau of Statistics (2012)

Figure 2.D.2: Unemployment Rate in Southern Nigeria by Geo-political Zones



The plot of unemployment rates by southern geopolitical zones in Nigeria. The Niger-Delta comprise of all 6 South-South (SS) states; 1 of 6 South-West (SW) state and 2 of 5 South-Eastern (SE) state. The unemployment rate in the South-South geopolitical zones represents the unemployment condition in the oil region. Due to lack of data from the Nigeria Bureau of Statistics, 2012 to 2017 are exempted.

2.D.2 Primary and Secondary School Enrolment

Figure 2.D.3 shows primary school enrolment by states and year in the Niger Delta. In the same way as before, we compare the primary school enrolment in the South-South region with other parts of the southern part of Nigeria (South-West and South-East). The figure shows that in 2010, all the geopolitical region had relatively the same level of primary school enrolment. However, after 2010, primary school enrolment in the South-South region declined relative to other southern regions. This implies that whatever development came to the Niger Delta due to the amnesty, it seems to have not changed its enrolment rate.

Secondary school enrolment tends to show different results from what we observe in the primary school enrolment data. We see from figure2.D.4 after 2010, the school enrolment in all southern states of Nigeria tend to have increased and declines afterwards from 2014. Overall, secondary school enrolment across the region follows the same trend from what we observe in the data.

Figure 2.D.3: Primary School Enrolment in Niger-Delta

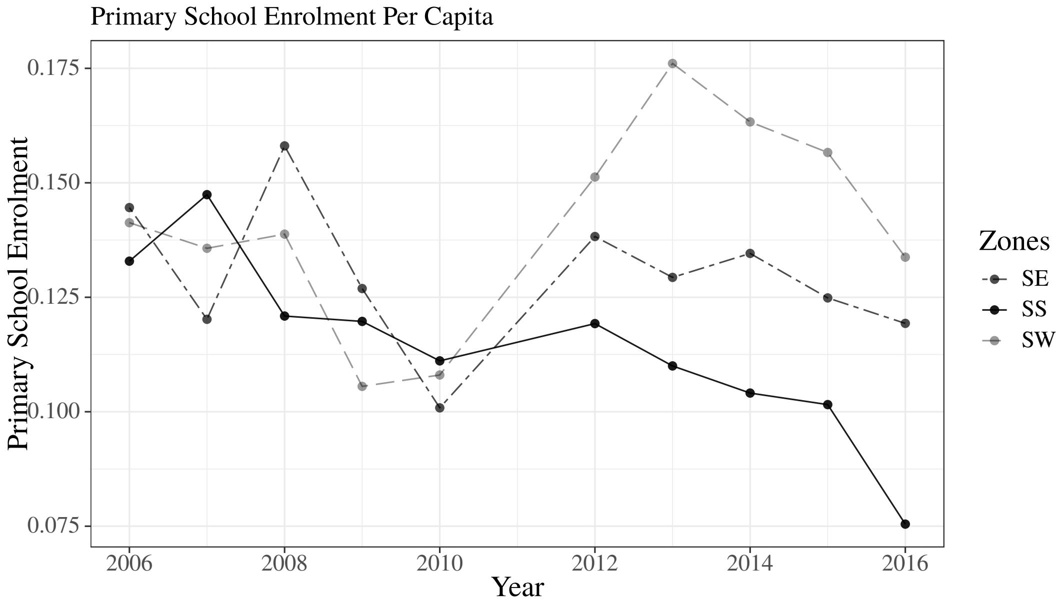


Figure 2.D.4: Secondary School Enrolment Per-Capita in Southern Nigeria Geo-political Region

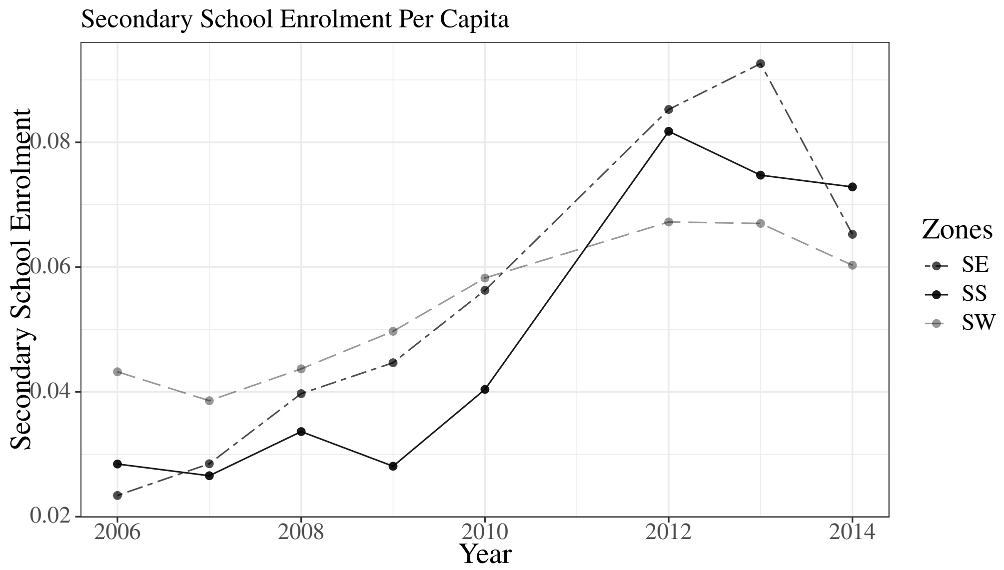
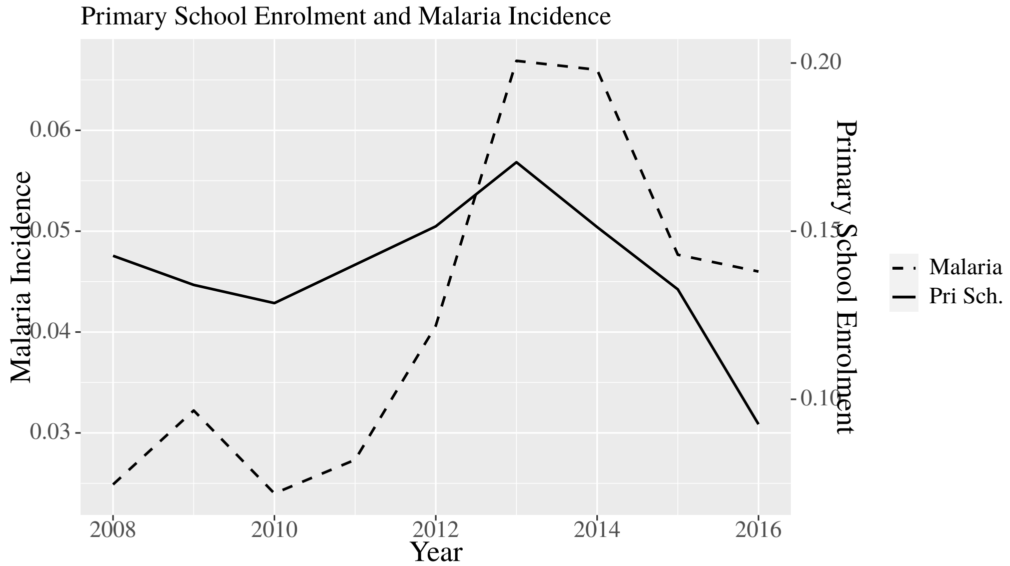


Figure 2.D.5: Malaria Incidence Per-capita in Niger-Delta

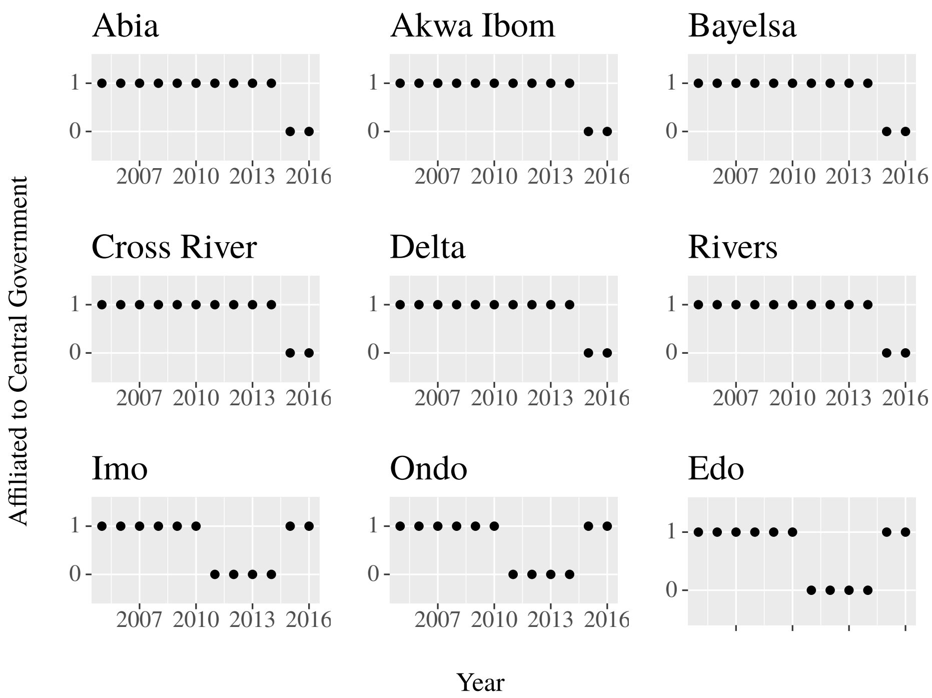


Note - The diagram shows the incidence of malaria in Niger Delta over time.*Data Source:* National Bureau of Statistics, 2012; National Bureau of Statistics, 2017

2.E Political Party Affiliation and Post-Amnesty Violence

We explore the possibility that Niger-Deltans accepted poor economic conditions in the region post-amnesty only when the country's president was from the region. The increase in Niger-Delta violence after 2014 can be attributed to the shift in politics that occurred about the same time.

Figure 2.E.1: Political Party Affiliation to the Central Government in Niger Delta States Over Time



The figure shows the years a state governor is in the same political party with the president of Nigeria. The y-axis takes a value of 1 in any year the state governor shares the same political party as the president of Nigeria. *Data Source: Wikipedia*

State governor's affiliation to the president's political party can impact policy effectiveness. Figure (2.E.1) shows that after the presidential election in 2015, the core Niger-Delta States (Abia, Akwa-Ibom, Cross-River, Bayelsa, Delta and Rivers) all lost their political affiliation to the president's political party. We explain how this shift could incentivise rebels to pick up arms in the Niger-Delta irrespective of the continued amnesty payments.

The amnesty policy was announced in 2009 under President Umaru Musa Yar'Adua's regime. Umaru Musa Yar'Auda was from Katsina State in the North-Eastern part of Nigeria. Umaru Musa Yar'Adua's tenure as president was between 2007 and 2011 with Goodluck Jonathan serving as vice president—both in the People's Democratic Party (PDP). However, Umaru Musa Yar'Adua died in May 2010, and Goodluck Jonathan became president. Goodluck Jonathan is from Bayelsa, one of the major oil-producing states in the Niger-Delta.

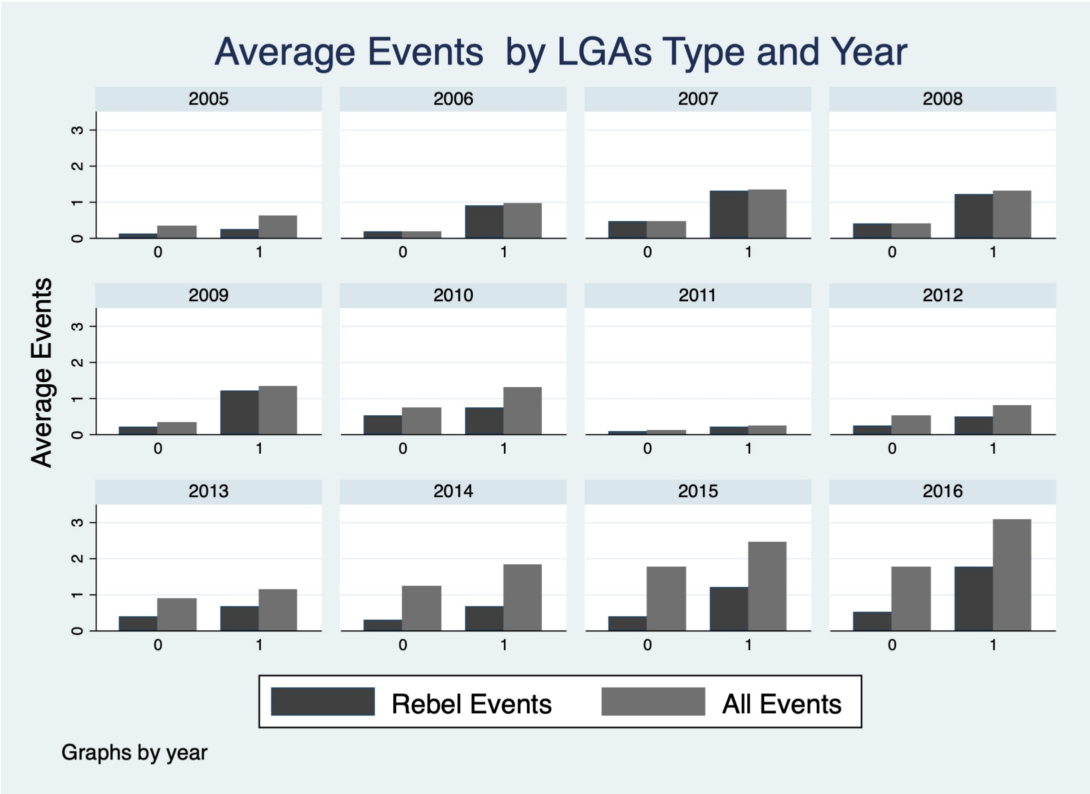
Goodluck Jonathan was elected in 2011, after the Yar'Adua/Jonathan administration ended. This was considered his first term in office as the President of Nigeria, as his previous presidency was fulfilling his role as Yar'Adua's vice. Again, Goodluck Jonathan tried getting re-elected for a second term in 2015 but lost to Muhamadu Buhari|Nigeria's current president. The 2015 election shifted the presidency from a Niger-Deltan to a Northerner; and shifted the president's political party from People's Democratic Party (PDP) to All Progressive Congress (APC). The election was the first time PDP lost the presidency in the 17 years of democracy after the last military regime in Nigeria.

Muhammadu Buhari is from the same state as Yar'Adua, Katsina state in North-Eastern Nigeria. Muhammadu Buhari's current presidency is expected to run out in 2023.

President Buhari has continued to pay rebels who signed for the amnesty program in 2009. However, violence increased in the Niger-Delta after he took office as president. The shift in political party, and loss of the 2015 presidential election by an incumbent Niger-Delta candidate can explain the increase in rebel activities in the region after 2014.

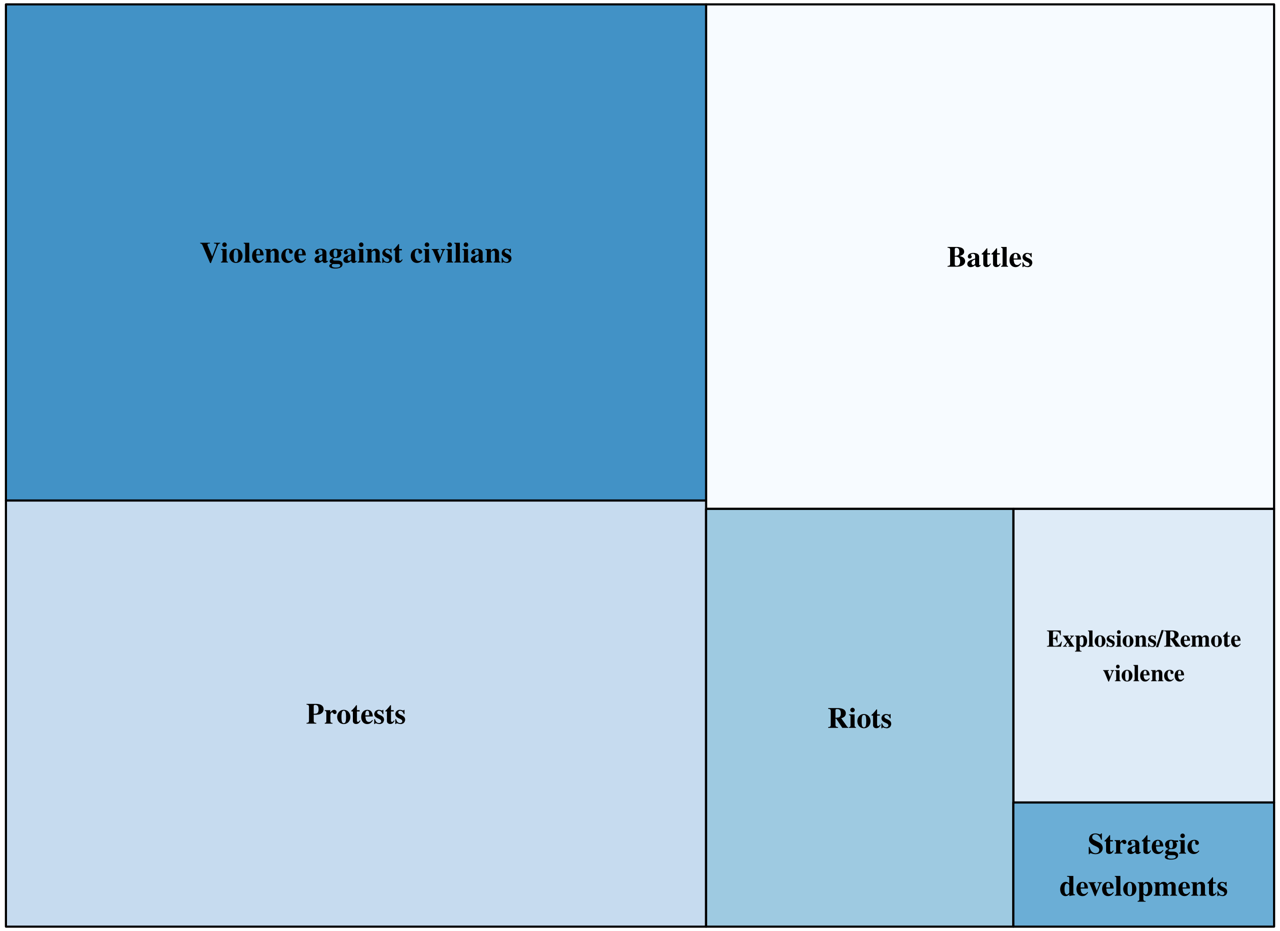
2.F Data Visualization

Figure 2.F.1: Average of Rebel/Militia and All Events Over Time



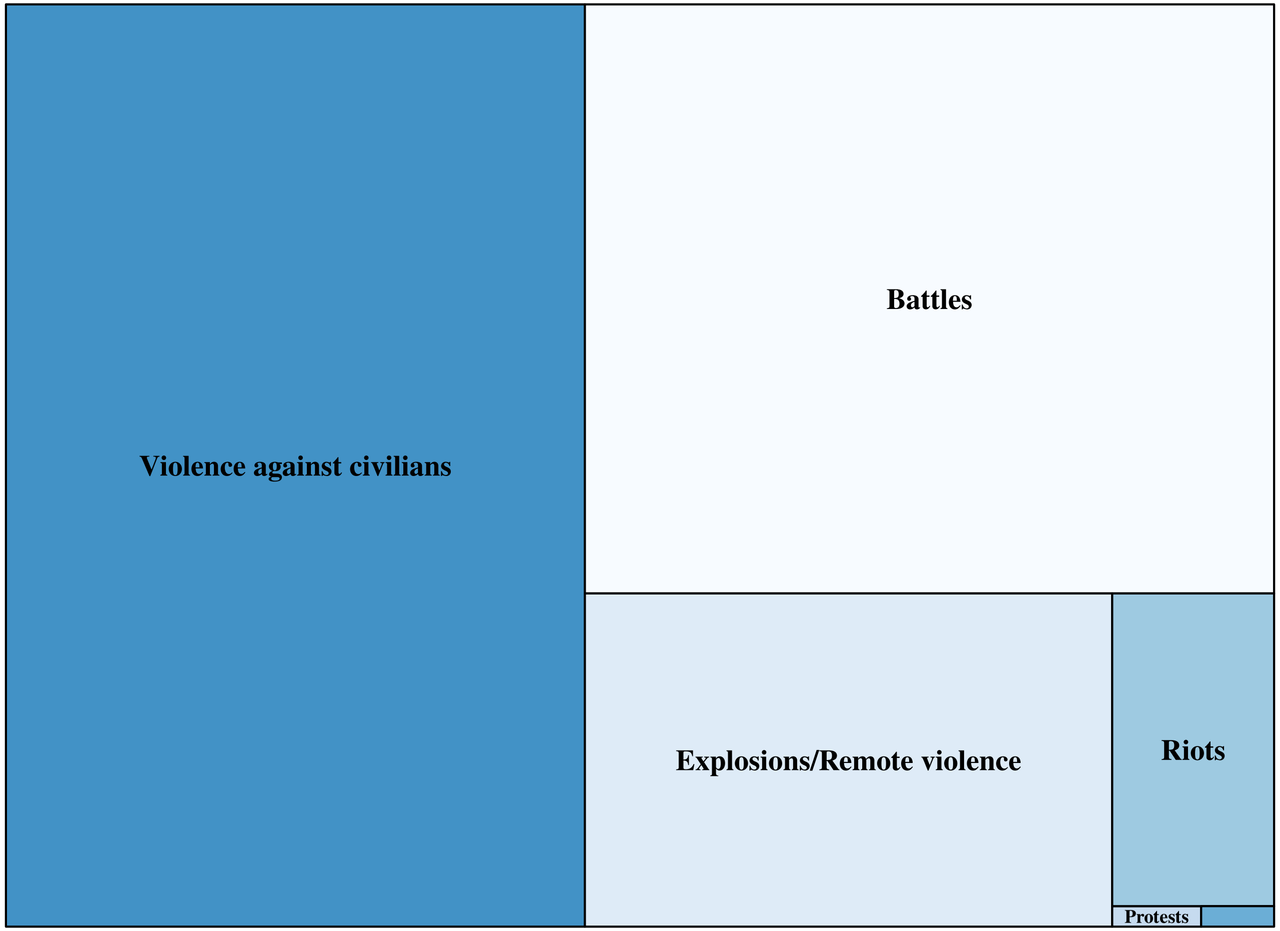
Note - The figure shows the average level of violent incidence in LGAs with (1) and without (0) oil-fields. The figure shows that the level of violence was relatively stable in Niger-Delta. After the amnesty was implemented in 2010, we observe a sharp decrease in events in 2011. However, from 2013 the amnout of incidence in the two types of LGA returns back to their previous levels.

Figure 2.F.2: ACLED Event-Types by Number of Incidence (2005-2016)



Note- Treemap showing the number of violent incidence by event type recorded in ACLED between 2005-16. The top 3 recorded event types in descending order are civilian violence, protests and battles.

Figure 2.F.3: ACLED Event-Types by Number of Fatalities (2005-2016)



Note- Treemap showing the number of fatalities by event type recorded in ACLED between 2005-16. The figure shows that about half of the fatalities generated are from civilian violence. Protest produced the lowest amount of fatalities as we should expect.

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Chapter 3

The Impact of Drought on Pastoral Conflict: Evidence from the Fulani-Farmer Violence in Nigeria

3.1 Introduction

The number of fatalities from pastoral conflict incidence has intensified across Africa. In Nigeria alone, between 2017-18, about 1500 deaths and 300000 people were displaced by Fulani herder related incidence (International Crisis Group (2017)). In Africa, the widespread pastoral violent events have had devastating consequences on the local economy of countries where they occur the most (see Sundberg and Melander (2013)).

The rise in global temperature and population expansion are some factors that explain the increase in pastoral violence (Burke et al. (2009), Moritz (2010), Hsiang et al. (2013), Abbass (2014), Kitchell et al. (2014), SB Morgen (2016), Brottem (2016), Harari and Ferrara (2018), and McGuirk and Nunn (2020)). Increasing drought in the arid North of Nigeria force herders to move southward in search of fodder and water to sustain cattle production. Also, population expansion over the last four decades has forced sedentary farmers to put marginal lands to use, leading to the loss of 114 grazing routes of the 415 mapped out by the government in 1960 (International Crisis Group, (2017)). These changes have increased disputes over crop damage, water pollution, and cattle rustling, especially in the river basins of North-central Nigeria (Blench (2010) and International Crisis Group (2017)). With the devastating impact, however, the channels through which climatic shocks can cause pastoral violence is not well established in the empirical literature (see McGuirk and Nunn (2020) and Eberle et al. (2020) for the recent research in the literature relating to pastoral violence).

This study estimates the channel through which the climate impacts pastoral violence within agro-pastoral settlements. To achieve this, we study the age-old pastoral conflict in North-central Nigeria, a region plagued by herder-farmer conflict since 1923 (Blench 2010).[1] We also focus on a homogeneous classification of conflict incidence involving the largest herding tribe in Africa and other pastoral conflict incidences to effectively identify drought's impact on pastoral violence. Our analysis combines conflict incidence information from the Armed Conflict Location and Event Dataset (ACLED) with geographical data on local precipitation from the University of East Anglia Climate Research Unit (UEA-CRU). We also use a measure of pasture availability from the Food, Insecurity, Poverty and Environmental Global GIS Database (FGGD) to pin down the areas that are most attractive to herders. From observed historical patterns, herders are attracted to locations with more pastures around the river basins, resulting in higher probability of conflict around the river basin.[2] Using a linear probability model (LPM), we identify adverse shocks to contested land by interacting the drought and pasture availability measures to estimate its impact on pastoral conflict. Our interaction model measures how drought and pasture availability differentially impact pastoral conflict in North-central Nigeria's river basins.

Agriculture is the main source of employment in North-central Nigeria. In the region, sedentary farmers are comprised of various ethnic groups in Nigeria (including

[1] Figure 3.3.1 shows the North-Central Nigeria river basin region on the map of Nigeria. This specific region has had high incidence of pastoral conflict involving Fulani ethnic actors since 1923 (see Blench (2010))

[2] See figure 3.C.11

Tiv, Idoma, Eggon, Mumuye, Berom and Jaba, among others). However, agricultural production in Nigeria is still highly rainfall dependent, and only a small proportion of total cropland are irrigated (see figure 3.C.6). The Fulani herders, the other party in the conflict, originate from the Republic of Guinea. The Fulanis are the predominant herders in Nigeria, owning about 90 per cent of livestock (Ajibefun (2018)). North-West Nigeria is mostly arid, with a long spell of dry season and low levels of seasonal rainfall.[3] To sustain cattle production all year round, herder migrate to North-Central Nigeria in the dry season for pastures. The dry season usually runs between October and May, and the rainy season comes between June and September. This seasonal pattern historically determined when Fulani herders migrate into and out of North-central Nigeria every year (Blench (1984), Blench (1988), and Blench (2010)).

Violent conflict is triggered when cattle trample on farm output in the North-central Nigeria river basin. The pastoral conflict occur at high intensity with the destruction of lives and properties around the region (see International Crisis Group (2017)). The conflict has intensified further because of global warming (that force more herders to migrate) and an increase in the sedentary population around the river basin. Our estimation strategy exploits agricultural output's dependency on rainfall and the fact that herders are attracted to pasture land to estimate how drought impacts the pastoral conflict.

For the estimation, drought is defined as a negative deviation from the long-run mean of rainfall. The result shows that on average when drought increase by one standard deviation, a one percent increase in the initial pasture available in North-Central Nigeria LGAs tend to reduce the probability of pastoral conflict by 0.30 (30 percentage points). This estimate implies that drought substantially decreases pastoral violence in areas where they are most likely to occur. The main estimate is statistically significant at one

[3] The dry season in North-West Nigeria runs from October to May, while the rain season comes between June and September with rainfall level between 600 to 900 mm International Crisis Group (2017), Odekunle (2004), and Amanambu et al. (2019). Figure 3.C.7 shows the sample average level of rainfall in North-western Nigeria (858.98mm in the dataset). North-western Nigeria has the lowest level of rain in the sample, while North-central Nigeria has the highest in Northern Nigeria.

percent level with standard errors clustered at state-level, and are equally significant when standard errors are boot clustered which accounts for possible limitations from the small amount of clusters. Alternatively, we find that drought has no impact on pastoral violence in other parts of Nigeria. The contrast in the drought estimate in and out of the river basins implies that not all observed pastoral violence are struggles between herder and farmer over agricultural lands.[4] Overall, the estimates suggest that decreases to land productivity reduce the pastoral conflict and that drought only impacts pastoral violence within the river basin, where farmers and herders interact.

Given the estimated result, we argue that farmers engage less in violence with herders when agricultural output is low in drought years. However, there are two main challenges in the estimation for this explanation to be true. First, since herder migration into the river basin triggers the pastoral conflict, the level of rainfall in the herders' homeland should determine migration and conflict in the river-basin. McGuirk and Nunn (2020) show the spillover effect will make the model underestimate the local impact of drought on conflict. Thus, our baseline estimate captures both the negative local impact and positive spillover effect of drought from herder's homeland. Second, crop and cattle production depend on land productivity, if local drought reduce land productivity, farmers and herders would respond in the same way— their decreased land use will result in reduced conflict. In this case, the baseline result captures both herder and farmers' response and we cannot conclude that only farmers reducing land use accounts for all the estimated effect. Eliminating these alternative pathways in our estimation model is essential to identify the effect of farmer's response to drought on conflict.

Correcting for the identification issues strongly influenced the magnitude of the baseline result. Following McGuirk and Nunn (2020), we address drought spillover by controlling for the impact of weather conditions in the homeland of herders on mi-

[4] Mkutu et al. (2001) discuss different forms of pastoral violence. For example, cattle rustling, the raiding of cattle between herding communities, are pastoral conflicts that are not impacted by rainfall.

gration and pastoral violence in the river basins. We also include controls for cattle production to disentangle the local conflict-drought effect of herders in the river basin. The new estimate shows that on average when drought increase by one standard deviation, a one percent increase in the initial pasture available in North-Central Nigeria LGAs tend to reduce the probability of pastoral conflict by 0.516 (52 percentage points). Therefore, in the absence of rainfall-induced migration to the river basin, drought tends to strongly decrease farmers' incentive to engage in pastoral violence in suitable agro-pastoral areas.

We also show that the overall level of economic activities do not drive the estimated result. If controlling for income level renders the estimate of interest insignificant, this would suggest that the impact of drought on conflict is not necessarily from agricultural productivity or shocks specific to agricultural income. We measure the level of non-farm income for each LGA using the average stable night-light across all LGAs between 2010-2013. The result shows that including this alternative measure of income in the estimation did not change the main drought coefficient. Therefore, as expected for pastoral conflict, only agricultural productivity shocks impact herder-farmer violence.

We conduct various robustness checks and expand the relevance of our result to an alternative measure of pastoral conflict. This exercise measures the sensitivity of the result to slight changes in the specified model. First, we replace Fulani related incidence with violence classified as a pastoral conflict by ACLED as the dependent variable. Second, we also consider intensity measures where the number of Fulani and pastoral conflict incidence; and the number of fatalities from the Fulani related conflict incidence are dependent variables. The estimate of interest retained its economic and statistical significance across the various specifications. In addition, we use the absolute value of shocks measuring both positive and negative deviation from the long-run mean of rainfall as an alternative measure of drought. The absolute shock measure considers the impact of drought and flooding, which altogether decrease farm output. The estimate of interest still impacts pastoral conflict when adverse shock to agricultural productivity is measured by the absolute deviation of rainfall from its long-run mean. Overall, our estimates imply that adverse shock to agricultural productivity reduces the pastoral conflict in the river basin.

This research focuses on pastoral conflict events involving the Fulani ethnic group in Nigeria. This focus allows us to disengage herder-farmer violence from other forms of pastoral conflict.[5] We find drought strongly determines the pastoral conflict only within the river basin. Since the agricultural sector across Nigeria depends on rainfall, but drought only impacts conflict in the river basins, our result supports Mkutu et al. (2001)—not all pastoral conflict are herder-farmer related. Focusing our estimate on pastoral conflict actors and events help us to identify the farm productivity channel through which drought impacts pastoral conflict.[6]

Recent research in the literature on nomadism and conflict test the impact of weather shocks on violence in Africa. Eberle et al. (2020) using variation in temperature across Africa finds that a one-degree increase in temperature leads to a 54 percent increase in conflict within agro-pastoral regions. Their result shows a much more significant effect of temperature in areas with a mixed herder-farmer population. McGuirk and Nunn (2020) use precipitation as a measure of agricultural productivity. McGuirk and Nunn (2020) show that the spillover effect of drought from the herder homeland explain most of the relationship between precipitation and conflict in agro-pastoral areas. All the estimated impact of precipitation on conflict at the geographical cell-level resulted from herders/nomads migrating into agro-pastoral regions. Our research contributes to the literature by focusing on pastoral violence in Nigeria and we show local drought reduce conflict within the agro-pastoral region. After accounting for precipitation spillover from herder homeland, we find a positive relationship between precipitation and con-

[5] McGuirk and Nunn (2020) lists and explain other reasons for pastoral conflict that are not herder-farmer violence. Some of these include - government anti-tribal policies and cattle rustling.

[6] In the appendix, we use household-level maize and cassava production data to test the impact of drought on agricultural output. We find that drought substantially decreases maize and cassava production across the country.

flict in North-central Nigeria river basin. We attribute the impact of local weather shocks on conflict to decreases in farm output. Reduction in output leads farmers to engage less in conflict with herders around the agro-pastoral region.

Pastoral violence is caused by a myriad of factors. Cross country analysis, even using only African countries, may not adequately detect the mechanisms at work in herder-farmer conflict because conditions that generate pastoral violence vary across these countries. For example, Maystadt and Ecker (2014) show how drought impact conflict in Somalia through the market price of livestock. Their reduced-form analysis showed drought increase conflict. They explain that increases in drought force herders to destock their herds into unfavourable markets. Following the opportunity cost theory, households are then pushed into poverty traps and are recruited as soldiers in conflict. From Maystadt and Ecker (2014) discussion, the pastoral conflict in Somalia does not involve herders interacting with the farming community. Conflating this type of effect with herder-farmer conflict can misrepresent the true impact of drought on pastoral conflict in estimations across Africa. Here, we specifically estimate pastoral conflict using events related to the herder-farmer struggle over productive land. The mechanism around the pastoral conflict in the study area is typical of conflict between farmers and herders where productive land is contested over. We examine drought as a climatic factor that can directly influence farmers' incentive to engage herders in conflict over productive land.

This research also relates to the broader literature that tries to understand how income shocks impact conflict. Country-wide and disaggregated analysis show a causal relationship between income and violence (Collier and Hoeffler (2004), Miguel et al. (2004), Dube and Vargas (2013), and Mitra and Ray (2014)). Income shocks impact conflict in two ways. First, higher-income can reduce conflict through the opportunity cost channel (see Becker (1968), Grossman (1991), Collier and Hoeffler (1998), Collier and Hoeffler (2004), Miguel et al. (2004), Fearon (2004), and Dal Bó and Dal Bó

(2011)). Collier and Hoeffler (2004), explain that rebel recruits must be paid, and the amount paid is related to the income forgone by enlisting as a rebel. Therefore, rebellion is more likely to occur when forgone income is low. Second, higher-income increase conflict through a rapacity channel (see Grossman (1991), Dal Bó and Dal Bó (2011), and Dube and Vargas (2013)). A rise in income can increase the gains from appropriation and violence (Dube and Vargas (2013)). Understanding the determinants of the direction of income's impact on conflict is of interest to the economics literature on conflict.

Dube and Vargas (2013) show the direction of income effect on conflict depend on the nature of the sector; whether the sector is labour or capital intensive. Through an opportunity cost channel, positive income shocks to labour-intensive commodities reduce conflict (see Ploeg (2011), Brückner and Ciccone (2011), Dube and Vargas (2013), Dell et al. (2019), and Fetzer (2020)). On the other hand, when commodities are capital intensive, higher-income, by raising the return to predation on the commodities will increase conflict through a rapacity channel (see Dal Bó and Dal Bó (2011); Dunn (2018)). Overall, labour income induces the opportunity cost effect, and rising income from capital-intensive commodities induce a rapacity effect. From studying the pastoral conflict in Nigeria, this research contributes and shows the possibility of a rapacity channel in the labour-intensive agricultural sector. Although we observe herders participate in conflict through the opportunity cost channel from their homelands (Herders respond to drought in their homeland by migrating and engaging with farmers in conflict), farmers' response to drought is in line with the rapacity channel (Higher farm output tend to increase farmer's participation in pastoral conflict).

The remaining part of the paper is as follows. Section 2 discusses the research context, where we present a brief discussion on the herder-farmer conflict in Nigeria. Section 3 discusses the data and empirical strategy used in our estimation. Section 4 presents the main results and identification of farmers' mechanism. Section 5 conducts robustness checks on the analysis, and section 6 concludes.

3.2 Background of the Study: The Fulani-Farmer Pastoral Conflict

The context used for the study is the herder-farmer conflict in Nigeria. This pastoral conflict is between transhumance Fulani herders and sedentary farmers in North-central Nigeria. The conflict is predominant in states around the North-central Nigeria river basin (see Figure 3.3.1). These states include: Benue, Kaduna, Nasarawa, Plateau and Taraba (McDougal et al. (2018)). Around the region, the main source of employment and income is agriculture.[7] The sedentary farmers in the region comprise of people from diverse ethnic groups (Tiv, Idoma, Eggon, Mumuye, Berom and Jaba, among others). These farmers mostly cultivate roots and tubers (yam and cassava), maize, beans and millet (see Figure 3.C.5 and 3.C.6). These crops are known to require a substantial amount of water supply for their growth (Daryanto et al. (2016)). However, agricultural production in Nigeria still depends on rainfall, forcing agricultural productivity to vary with climatic conditions.[8] Our estimation strategy will rely on this dependency to test how weather shocks impact the pastoral conflict through agricultural productivity.

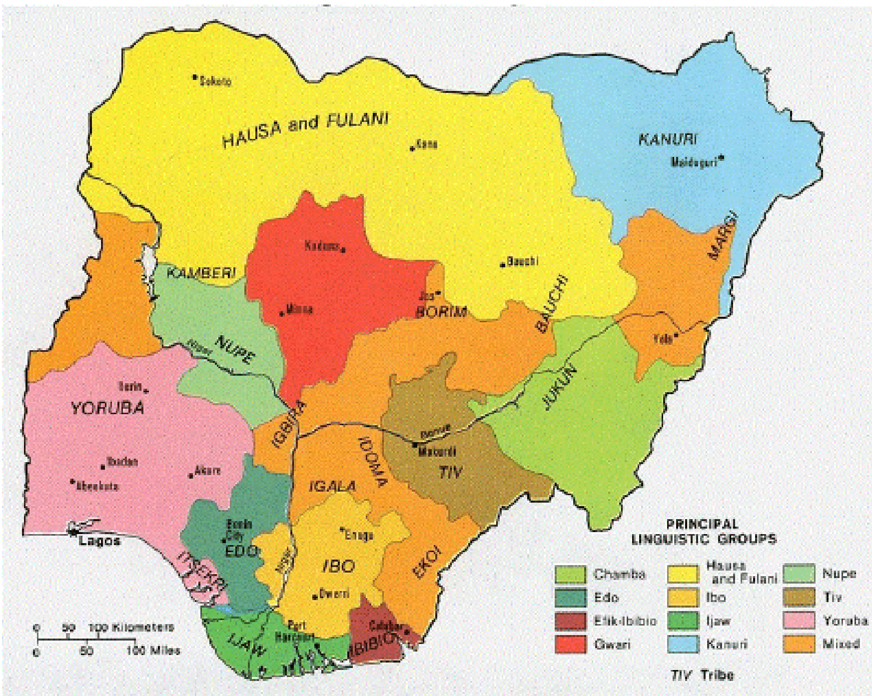
The herders, Fulani or Fulbe, originate from the Republic of Guinea and make up the largest cattle pastoralist in Africa (Blench (1984), Blench (1988), Blench (2010), and Anene, Iyala, et al. (2020)). The Fulani migration into Nigeria dates back to the 19th century. Fulanis currently own 90 percent of livestock that accounts for one-third of agricultural GDP and 3.2 percent of national GDP of Nigeria (Ajibefun (2018)).[9]

[7] We see from figure 3.C.4, that relative to the total population of employable people in the region, a large proportion of people are employed in the agricultural sector.

[8] Figure 3.C.7 shows the proportion of total agricultural lands that are irrigated across states in Nigeria. We observe that a small proportion of agricultural lands are irrigated, which implies production in the region is susceptible to variation in rainfall.

[9] Figure 3.2.1 maps Nigeria according to the settlement of predominant ethnic groups. We see that all of North-Western Nigeria is occupied by Hausa and Fulani ethnic groups.

Figure 3.2.1: Map of Nigeria by Ethnic Occupation



Note - *Source - Ekong et al. (2012), Bakare (2015)*

The North-West Nigeria where the Fulani herders dwell is mostly arid, experiencing longer spells of dry season relative to other regions. To sustain livestock in the dry season, Fulani herders migrate to the sub-humid region of North-central Nigeria.[10] Overall, where herders migrate to is determined by: 1) the availability of dry season pasture and 2) the prevalence of the tsetse fly, a vector of trypanosomiasis (Blench (2010)). Within North-central Nigeria, the areas we observe the most pastoral conflict incidence is linked with the pattern of seasonal migration—more favourable lands for dry-season pastoralism in North-central river basins experience more conflict (see figure 3.C.10 and 3.C.11). The Fulani migration pattern was thus characterised through movement away from semi-arid North towards open dry-season pastures around the Niger-Benue river belt. After the dry season, when the rains begin in June to September, Fulani herders migrate back to the arid North-West Nigeria as tsetse fly, which have devastating effects on livestock infests the Niger-Benue belt (Blench (2010) and

[10]Dry season migration to source for food and fodder for animals.

Anene, Iyala, et al. (2020)). The Fulani herders' seasonal use of the river basin region in North-central Nigeria tend to make it more challenging to set up land property right contracts with local farmers.

The trigger of violent conflict is when cattle trample on farm output (Abbass (2014), Higazi and Yousuf (2016), McDougal et al. (2018), and Anene, Iyala, et al. (2020)). The limited land and water resources around the Niger-Benue river basins result in a contest between herders and sedentary farmers over pasture and cropland. As far back as 1923, settlers in the Mambila area-present day Taraba state–complained about the Fulanis freely letting their cattle trample on crops (Blench (2010)). Similar issues are still reported today as a cause of the pastoral violence (International Crisis Group (2017)).

The incidence of conflict and fatalities relating to pastoralists has intensified recently. The International Crisis Group estimates that about 1500 deaths and 300000 people were displaced in 2018 by the pastoral violence. The pastoral conflict also has significant implications for the local economy of the region. McDougal et al. (2018) estimates that Benue, Kaduna, Nasarawa and Plateau states combined lost about USD 2.3 million in internally generated revenue in 2010 due to farmer-pastoralist conflict.[11] The lack of an understanding about the mechanisms triggering the conflict has hampered the creation of policies that could mitigate the onset of violence.

The pastoral violence is further intensified by global warming and population expansion (Abbass (2014) and SB Morgen (2016)). Increasing temperature and shorter rainy season in the arid North has raised the need for Fulani transhumance migration to sustain cattle production. Also, the expansion of agriculture in the river basin has resulted in the loss of about 114 of the 415 grazing routes mapped out by the government in 1960 (International Crisis Group (2017)). Pastoral herders moving into the North-central and parts of Southern Nigeria are met with higher pressure on land and more

[11] We focus our estimate on local government areas in states around the Niger-Benue river basins. This includes the 4 states used in McDougal et al. (2018) and Taraba state.

contest with sedentary farmers. Thus, instances of disputes over crop damage, water pollution and cattle rustling has increased substantially (International Crisis Group (2017) and Blench (2010)).

This research identifies the mechanism through which drought impact the pastoral conflict in North-central Nigeria. We expect drought to impact this conflict in three ways. First, drought decreases the value of agricultural output on farmland, and farmers become less likely to defend or engage in conflict with herders over low output. Second, drought also decreases the land value for herders, who make less use of the land, and are less likely to create situations where cattle trample on farm output. Third, herders could cease migrating into North-central Nigeria if they observe the lower rainfall and drought around the river basin. The challenge in the estimation will be to tease out alternative channels and provide evidence that farmers reduce conflict with herders when drought negatively impact crop production as the main mechanism.

3.3 Methodology

3.3.1 Data

The data on violence is from the Armed Conflict Location and Event Dataset (ACLED) Raleigh et al. (2010). The relevant information from ACLED used in constructing the variable of interest are 'ACTOR1', 'ACTOR2', which records organized violent actors' names; and ASSO_ACTOR_1, ASSOC_ACTOR_2 which records the socio-political affiliation, actor associates and other information about actors in ACLED. The actor names allow us to note events relevant to the Fulani ethnic group recorded as "Fulani Ethnic Militia (Nigeria)". We use ASSOC_ACTOR_1 and ASSOC_ACTOR_2 as an alternative measure of events; events labeled "Pastoralists (Nigeria)". It is worth noting that 95.6 percent of events with actor names "Fulani Ethnic Militia (Nigeria)" had "Pastoralists (Nigeria)" recorded in their ASSOC_ACTOR_1,2 columns.

Other relevant information from the ACLED dataset used for the research is admin1 and admin2, which record the state and local government areas (LGAs) where events occurred. We also use the Year variable that give information on the year the event took place in the study area. Since ACLED only records local government areas where violence occurred, we merged the dataset from ACLED with a master dataset with observation for the 774 local government areas between 2010-16. Observations in the master dataset with no entry from ACLED were filled with zeros to reflect no incident in such locations.

The data on rainfall is precipitation information from the University of East Anglia Climate Research Unit (UEA-CRU). The UEA-CRU data contains monthly observation of rainfall from meteorological stations across the world's land area (Harris et al. (2014)). The station data are interpolated on 0.50 X 0.50-degree cells covering the entire earth surface except for Antarctica. The rainfall information used in constructing the dataset is from numerous sources, including the World Meteorological Organization and the US National Oceanographic and Atmospheric Administration.

The pasture measure is the 2007 Occurrence of Pasture and Browse data from the Food Insecurity, Poverty and Environmental Global GIS Database (FGGD). The data measures the occurrence of Browse/pasture land used for livestock breeding. The FAO created rain-fed agriculture and pasture data after excluding land covered in build-up areas and forest cover protected areas, barren and sparse vegetated lands. Then the measurement for pasture land carefully separates cropland and pasture/browse land strictly used for grazing animals (Van Velthuizen (2007), pg 54). The separation of pasture from farmlands within the same region is essential to pick up the impact of pasture lands located close to croplands. The pasture data set ranges from 0 to 100, measuring the percentage of area covered by pasture that was observed in every 0.50 X 0.50-degree cell across Africa. We aggregate this to reflect the percentage of land area in a local government area covered in pasture.

The data on cattle distribution is from the Food and Agricultural Organization (FAO) Global Livestock of the World data. Administrative survey and census data at the country level in 2009 is used to construct the data (Robinson et al. (2014)). The dataset is an update of the previous publication by the same organization in 2007. The update related to improvements in the subnational census; the method by which missing data were predicted and interpolated (Robinson et al. (2014)). The cattle density data represents 1 Km X 1Km at the equator. The values are extracted using ”rgdal” and Raster packages in R. Figure 3.C.8 displays the dataset in raster picture format with every pixel tagged with the value of the number of cattle.

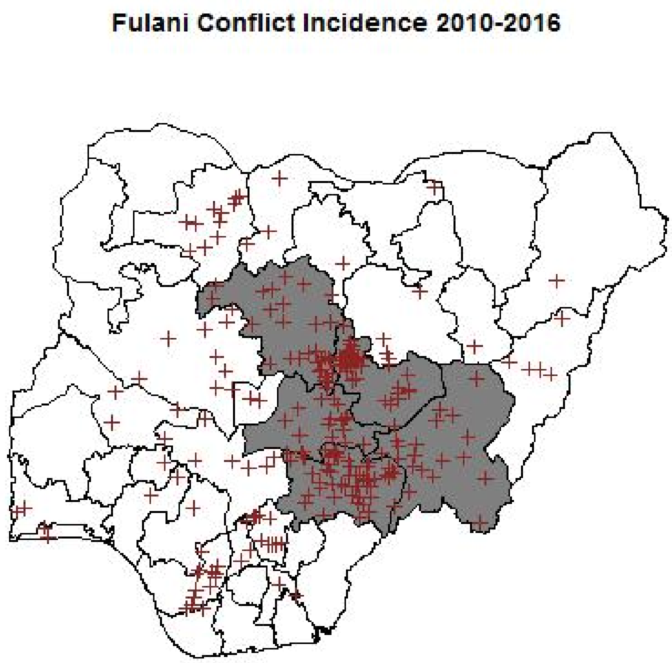
The data on agro-ecological zones in Nigeria is retrieved from Harvest Choice. This identifies how conducive the area which the cell represents is for crop growth; taking into account the temperature, precipitation, evaporation and soil moisture-holding capacity of the earth’s surface area (Harvest Choice (2010)). The data classifies Nigeria into 6 categories ranging from warm-arid to cool-sub-humid. These datasets are combined to form the data for the analysis comprising the 774 LGAs in Nigeria from 2010-2016 giving 5418 LGA-year observations.

Table 3.3.1: Descriptive Statistics

VARIABLES					
Local Government Area-Level Variables	N	Mean	Std. Dev	Min	Max
No. of Fulani Event	5,418	0.09	0.68	0	15
No. of Pastoral Confict Event	5418	0.09	0.65	0	15
Probability of Fulani Incidence	5418	0.04	0.20	0	1
Probability of Pastoral Incidence	5418	0.04	0.20	0	1
No. of Fulani Fatality	5,418	0.88	8.35	0	266
Total rainfall (mm)	5,418	1,297	532.8	322.4	2,739
Total Cattle (Head)	774	6060.48	16321.42	0	309428
Average Cattle Density/km^2 (Head)*	774	16.81	25.36	0	220
Percent Pasture and Browse (percent)	774	0.32	0.18	0	0.95
Stable Night Light	5418	5.98	12.52	0	63

Notes- The panel is the summary of the LGA-level data used in the main estimation. The sample is for the 774 LGAs in Nigeria between 2010-16. The Fulani events are conflict incidence related to Fulani ethnic group. The pastoral conflict events are event classified as pastoral conflict by ACLED. The total cattle density is the number of cattle heads assigned to a 0.5 X 0.5 degree cell by FAO (2010). The Average Cattle Density is the sum of the total cattle density within an LGA shape-file, divided by the number of cells in an LGA.

Figure 3.3.1: The location of the Occurrence of Fulani Related Conflict Incidence



Note - The figure shows the location of the incidence of Fulani related violence in the dataset. The diagram shows that Fulani conflict incidence occurred across Nigeria, however, they are concentrated around the North-central Nigeria area. (The grey area) *Source: Armed Conflict Location and Event Data)*

3.3.2 Estimation Method

The main objective of the research is to estimate the impact of drought on pastoral conflict. We aim to show that the mechanism through which drought impacts pastoral conflict is agricultural productivity. The decrease in output provides farmers with less on contested lands to fight over with herders. The mechanism we test is consistent with the observed trigger of pastoral conflict: cattle trample and feed on farm output while grazing on pasture land close to farmlands. To estimate the channel, we use a three-way interaction to capture the differential impact of drought in pasture land around the river basin in North-central Nigeria. The three-way interaction term includes a control for the Niger-Benue river basin, a measure of drought, and land suitability for herding cattle. Equation 3.1 is the estimated baseline model. Essentially, the model will show how the North-central Nigeria river basin region modifies the interaction effect of adverse productivity shocks on pastoral conflict (interaction between drought and our pasture measure).

The estimation model is a linear probability model (LPM) with fixed effects. We choose LPM over other binary dependent variable methods—probit and logit—because of the complex structure of fixed effects included in the model to control for state and regional level confounders.[12] LPM is better suited for this type of model with several dimensions of fixed effects and is standard in the literature (Berman et al. (2017)). The fixed-effect estimator accounts for time-invariant unobserved heterogeneity across LGAs that could bias the estimates (Angrist and Pischke (2008) and Wooldridge (2010)). The fixed-effect estimation will only consider within-individual LGA variation in the dependent and independent variable in estimating the model coefficients. The method thus accounts for differences between the individual LGAs that could bias the model estimates. The main assumption is that no other time-varying omitted factor impacts conflict and agricultural income measure after controlling for

[12] In a similar way, Berman et al. (2017) used LPM to get around the computational issues that arise when using other limited dependent variable methods in models with multiple fixed effects.

the fixed unobserved heterogeneity. If any important omitted variable exists, then fixed effects estimates will still be biased even after accounting for fixed unobserved heterogeneity. To ensure the assumption is satisfied, and because agricultural production in Nigeria is highly rainfall dependent, we use exogenous rainfall variation to measure agricultural production. Because rainfall is exogenous, the proxy measure of agricultural productivity in the model will be independent of other factors that determine pastoral conflict in Nigeria.

$$
\begin{aligned}
Conflict_{lst} =& \alpha_l + \lambda_{st} + \beta_1 Drought_{lst} + \beta_2 (Drought_{lst} \times Pastures_{ls}) + \\
& \beta_3 (NC_{ls} \times Drought_{lst}) + \boldsymbol{\beta_4 (NC_{ls} \times Drought_{lst} \times Pasture_{ls})} + \\
& \delta_1 Drought_{lst-1} \times \delta_2 (NC_{ls} \times Drought_{lst-1}) + \omega_{zt} + \epsilon_{lst}
\end{aligned}
\tag{3.1}
$$

In equation 3.1, l indexes the 774 LGAs, s indexes the 37 states and t is the years in the sample. The dependent variable measures pastoral conflict incidence in LGA l, state s in year t. It takes a value of one if a pastoral conflict occurred and zeroes otherwise. α_l is the LGA fixed effect; λ_{st} is a state-year fixed effect that captures non-linear trends in pastoral violence across states in Nigeria.[13] The year fixed effect is nested in λ_{st}, which is an interaction between the state and year dummy variables. ω_{zt} is the agro-ecological zone-year fixed effect that capture non-linear climate trends in the six climatic zones across Nigeria. ϵ_{lst} is the error term, which is clustered as the state level.

NC_{ls} is an indicator of whether an LGA is located within states around the North-central Nigeria river basin (the conflict area of interest). The selected states in NC are similar to the ones used in McDougal et al. (2018) analysis on the economic cost of the

[13] The state year fixed effect controls for all state level factors that impact conflict over time. This strategy for holding state factors fixed has been used by other researchers in the conflict literature. See Dube and Vargas (2013), Berman et al. (2017), and Vanden Eynde (2018)

pastoral conflict in Nigeria. $Drought_{lst}$ measures negative deviation of rainfall away from its long-run average across LGAs, and is calculated as:

$$Drought_{lst} = \frac{R_{l,t} - \bar{R}_l^m}{\sigma_l}$$

$R_{l,t}$ is the yearly (monthly average) rainfall in LGA l. $\bar{R}_l^m$ is the long run yearly average—from 2000 to 2016—of rainfall, calculated for every LGAs, and σ_l is the standard deviation of rainfall over time in each LGA. To measure drought, positive deviations from the long-run mean are set to zero while negative deviations are set to positive values by multiplying with a negative sign (Maystadt and Ecker (2014) and Vanden Eynde (2018)). Using this drought measure in the main specification effectively measures the impact of transitory drought shocks on conflict.

$Pasture_{ls}$ is the LGA average of FGGD data on percentage of land area covered by pasture observed in 2007/2008. Higher values of $Pasture_{ls}$ represent areas in the river basin where herders are more likely to migrate into in search of dry-season pastures. One concern is that the intensity of conflict in the river-basin over time can impact the observed percentage of LGA land area covered by pasture. This problem is not relevant in the estimation since the sample on conflict starts in 2010 after the measure of pasture.

β_4, the estimate of interest, interacts pasture and drought measures within the Niger-Benue river basin (NC). We expect β_4 to be negative and statistically significant if drought reduces the pastoral conflict in the river basins through agricultural output.[14] Since β_4 is a three-way interaction, it is necessary to include the individual variables in the interaction and all other combinations of two-way interactions of the variables.[15] The strategy will ensure β_4 picks up only the interaction effect and is not confounded by the individual main effects in the model (Balli and Sørensen (2013)). We show the

[14] The interaction model will include all main effects of variables and the combination of two-way interactions of variables in β_4.

[15] The interaction and individual main effects include: $Drought \times Pastures$, $NC \times Drought$ and $Drought$. The variable $NC \times Pastures$ and $Pastures$, even though they are possible interactions will be sucked up by the fixed effect - as NC and $Pastures$ are both fixed quantities.

estimates of the main and interaction effects in the result tables. δ_1 and δ_2 controls for the impact of drought in period $t-1$ on pastoral violence in period t and is also interacted with the NC variable to account for differential effects. The lag drought variable accounts for migration and conflict anticipation from the previous year's weather condition (Hsiang et al. (2013)). Arbitrary sources of autocorrelation in the error term are accounted for by the clustered standard error at state level. We believe that for many reasons, the incidence of pastoral conflict across LGAs are correlated within states.[16]

3.4 Result and Discussion

3.4.1 Baseline Result

The results in Table 3.4.1 show that increased drought in highly pastured land around the river basin tend to decrease the likelihood of pastoral conflict. The baseline estimate is robust to the inclusion of several dimensions of fixed effect from column 1 to 4. We compare the estimate in β_4 with the value in $Drought \times Pastures$ to capture how an LGA being in the river basin modifies the interaction effect of drought and pasture availability. With drought defined as a negative deviation from the long-run mean of rainfall; the estimate of interest in column 4 shows that on average when drought increase by one standard deviation, a one percent increase in the initial pasture available in North-Central Nigeria LGAs tend to reduce the probability of pastoral conflict by 0.30 (30 percentage points). The result is statistically significant at one percent level with the standard errors clustered at the state level and is robust to boot clustered standard errors at the state level.[17] The estimate implies that with drought of a certain degree, decreases in agricultural productivity tend to reduce the likelihood of a pastoral conflict incidence around the river basin.

[16] With 37 states, the asymptotic requirement for clustering errors might be violated. As a robustness check, we also present P-values from bootstrap clustered standard errors with 9999 replications for some key estimates using the STATA command from Roodman et al. (2019).

[17] The square bracket of 0.0034 shows that p-value of the boot clustering errors and we still reject the null below 1 percent significant level.

The estimates of other two-way interactions included in equation 3.1 are insignificant. The result suggests that drought is only relevant to the pastoral conflict around the river basin. $NC \times Drought$ captures the impact of drought in areas with zero pasture within the river basin. The magnitude of this estimate should be interpreted with caution because the minimum pasture cover observed around the river basin is 3 percent. There is no area around the river basin in our sample with zero pasture value.[18] The estimate of $Drought$ is the impact of dryness in areas with no pastures outside the river basin. Overall, the baseline results show drought and pasture have no impact on pastoral conflict outside the river basin. The result supports our argument that not all pastoral conflict is agro-pastoral related.

3.4.2 Identifying Non-Herder Drought Response

So far, the research estimates drought's impact on pastoral conflict through farm output. Using the pasture measure, the results imply that drought decrease conflict in areas more suitable for herding cattle around the river basin. However, it does not clearly distinguish if herders or farmers decrease land use in the river basin following drought shocks. In this research, we are interested in understanding how farmers who engage in conflict respond to drought. The two main threats to identifying farmer's response are: First, drought induces herders to migrate from their ethnic homelands; thus, β_4 also captures this drought spillover. McGuirk and Nunn (2020) explains that the local effect of drought will be underestimated if researchers neglect the spillover effect from herder homelands. Second, farmers and herders respond to drought in the same way within the contested region. Therefore, β_4 captures both farmers and herders' response to drought. To identify how decreases to farm output impact pastoral conflict, it is paramount that we eliminate these alternative pathways from the estimate of β_4.

[18] We rerun the regression using a centred measure of pasture (by subtracting the mean of the pasture measure in the sample from each observation) and find weak evidence of a drought decreasing effect on the conflict at the mean level of pasture in the river basin.

Table 3.4.1: Fixed Effect Estimates of the Effect of Drought on Conflict

VARIABLES	(1) OLS RE Incidence	(2) OLS FE Incidence	(3) OLS FE Incidence	(4) OLS FE Incidence
NC × Drought × Pasture	-0.309***	-0.300***	-0.305***	-0.306***
	(0.032)	(0.047)	(0.040)	(0.035)
		[0.0120]	[0.0133]	[0.0034]
Drought × Pasture	0.004	-0.017	0.004	0.006
	(0.011)	(0.014)	(0.014)	(0.014)
NC × Drought	-0.011	0.005	0.019	0.033*
	(0.019)	(0.018)	(0.019)	(0.019)
NC × Pasture	0.433			
	(0.310)			
Drought	0.000	-0.007	-0.001	0.001
	(0.002)	(0.004)	(0.006)	(0.007)
Pasture	0.027			
	(0.022)			
NC	0.198***			
	(0.064)			
Lag Drought	0.002	-0.012***	0.005	0.004
	(0.003)	(0.004)	(0.005)	(0.008)
NC × Lag Drought	-0.027**	-0.009	-0.008	-0.018
	(0.011)	(0.584)	(0.018)	(0.022)
Observations	4,644	4,644	4,644	4,644
R-squared	0.155	0.402	0.477	0.479
LGA FE	No	Yes	Yes	Yes
Year FE	No	Yes	Yes	Yes
State-by-Year FE	No	No	Yes	Yes
Agro-Year FE	No	No	No	Yes

Notes- The table presents the estimates of equation 3.1. The standard errors in parenthesis are clustered at state level. The brackets contain the p-value for boot clustered standard errors at state-level as a robustness check. The dependent variable is the incidence of Fulani related conflict across LGAs in Nigeria between 2010-2016. Drought is standardized using sample mean and standard deviation of negative deviation from the mean of rainfall across LGAs. The pasture measure $Pasture$ is the proportion of pasture land observed across LGAs in 2007, and ranges in value from 0 to 100. The difference in estimates across columns results from the inclusion of a more complex sturcture of fixed effects into the model. *** p<0.01, ** p<0.05, * p<0.1.

Further, we describe in what directions the identification issue biases our estimate. Since β_4 is negative in the baseline estimate, the direction of the bias will depend on: First, the correlation between drought in herder homelands and pasture in the contested area. Since drought in their land causes herders to migrate, we expect drought to negatively impact the percentage of total area of an LGA comprising of pasture. Therefore, the drought spillover effect from herders' homeland if unaccounted for would positively bias β_4 (McGuirk and Nunn (2020) considers a similar situation using precipitation levels and conflict across Africa). Second, the correlation between herders' presence in the contested region and pastures. Since herders migrate to the river basin searching for pasture in the dry-season, we expect a positive correlation between the number of herders in a location and the percentage of LGA land area covered in pasture. Therefore, with the estimated negative sign of β_4 and the positive correlation between herders and pasture within the river basin, $\beta 4$ is negatively biased for farmer effect when it also accounts for herder's response to drought within the river basin. From the discussion, correcting for the identification issue will either decrease or increase β_4. Whether the estimate of β_4 increases or decreases depends on the magnitude of the bias from cattle herders in the river basin and drought spillover from herder homeland.

Following McGuirk and Nunn (2020), we address drought spillover by controlling for the impact of weather conditions in herders' homeland on migration and pastoral violence in the river basins. We also control for cattle production to disentangle the drought-conflict effect of herders from β_4. Since the pastoral conflict we are interested in is violence between herders and farmers, controlling for cattle production within LGAs will hold herders' activities fixed. Controlling for cattle production allows us to interpret β_4 as non-herders (farmers) response to drought shock on pastoral conflict.

$$\begin{aligned} Conflict_{lst} =& \alpha_l + \boldsymbol{\beta_1(NC_{ls} \times Drought_{lst} \times Pasture_{ls})} \\ &+ \beta_2(NC_{ls} \times Drought_{lst} \times Cattle_{ls}) \\ &+ \beta_3(NC_{ls} \times NWRain_{lst} \times Pasture_{ls}) \\ &+ \beta_4(NC \times Drought_{lst-1}) + \lambda_{st} + \omega_{zt} + \epsilon_{lst} \end{aligned} \tag{3.2}$$

Equation 3.2 is the baseline regression model that accounts for drought spillover and cattle production. Since β_1, the estimate of interest is a three-way interaction effect; we control for drought spillover and cattle production at the same level of interaction. β_2 captures the differential impact of increasing drought and cattle production on pastoral conflict within the river basin. β_3 captures the effect of increasing precipitation in herder homeland and the percentage of pasture on the conflict in the river basins. We expect β_3 to be negative and statistically significant; higher rainfall levels in North-Western Nigeria should decrease herder migration and conflict incidence in the river basin. Controlling for the spillover and cattle production allows β_1 to effectively capture the impact of farmers' response to drought on conflict within the river basin. Similar to the baseline equation, we include all level of two way interaction and main effect that is required in order to interpret the three-way interaction effect in the model. We present the estimates of the omitted interaction in the result table.

Table 3.4.2 shows that after controlling for drought spillover and cattle production, local drought strongly decreases pastoral conflict. β_1 captures the interaction effect of drought and pasture on conflict in the river basin after holding cattle production and drought spillover from herder homelands fixed. Column 1 and 2 are the estimates of random effect models. In column 2, we see that the estimated β_1 is larger than in the similar model presented in the baseline result. The estimate of β_2 is also negative and statistically significant. This implies herders also tend to decrease conflict interaction in drought years. With $NWRain$ measuring the log of total rainfall in North-Western Nigeria, β_3 is negative and significant as expected. A percent increase in average rainfall in North-western Nigeria differentially reduce the probability of pastoral conflict within the contested region. Overall, a more negative β_1 implies that the drought spillover from herder homeland accounts for most of the bias in the baseline model.

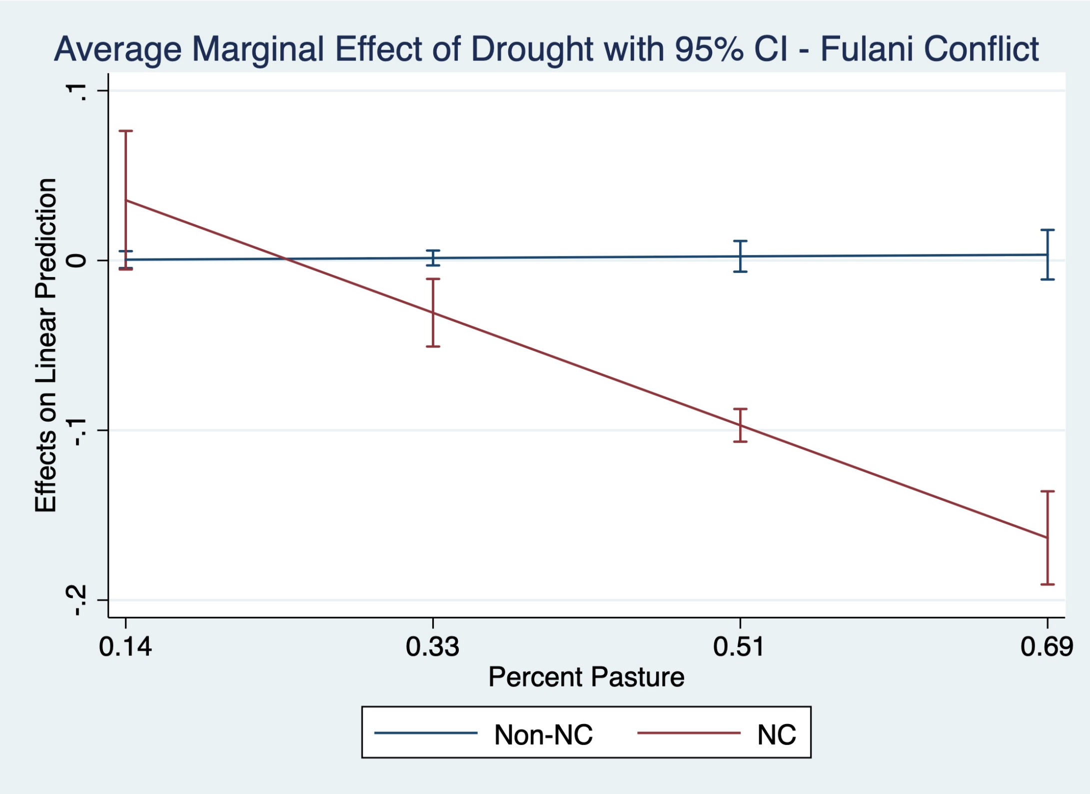
Column 4 are the estimates of equation 3.2 including all fixed effects. β_1 is the differential impact of the interaction of $Drought * Pasture$ in the Niger-Benue river basins. The result shows that on average when drought increase by one standard deviation, a one percent increase in the initial pasture available in North-Central Nigeria LGAs tend to reduce the probability of pastoral conflict by 0.516 (52 percentage points) on average. The result implies that farmers are far less likely to engage in pastoral conflict around the river basin in drought years.

Table 3.4.2: Fixed Effect Estimates of the Impact of Drought on Conflict

VARIABLES	(1) OLS RE Incidence	(2) OLS RE Incidence	(3) OLS FE Incidence	(4) OLS FE Incidence
NC × Drought × Pasture	-0.312***	-0.369***	-0.405***	-0.530***
	(0.025)	(0.063)	(0.063)	(0.106)
				[0.007]
NC × Drought × Cattle	-0.004	-0.011**	-0.013**	-0.017**
	(0.004)	(0.005)	(0.006)	(0.007)
NC × NW Rain × Pasture		-2.228**	-2.477***	-4.475***
		(1.010)	(0.889)	(1.536)
NC × Drought	0.112***	0.088***	0.117***	0.243***
	(0.016)	(0.030)	(0.032)	(0.059)
Drought × Pasture	0.001	0.005	-0.018	0.014
	(0.012)	(0.016)	(0.018)	(0.019)
Drought × Cattle	0.001	0.001	0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)
NW Rain × Pasture		0.055	-0.030	0.146
		(0.218)	(0.213)	(0.196)
NC × Pasture	0.448	15.207**		
	(0.290)	(6.832)		
NC × Cattle	0.015	0.015		
	(0.014)	(0.014)		
NW Rain × NC		-0.061	0.137	
		(0.528)	(0.464)	
Drought	-0.001	-0.000	0.003	-0.004
	(0.004)	(0.005)	(0.006)	(0.007)
NC	0.027	0.428		
	(0.141)	(3.592)		
Pasture	0.025	-0.343		
	(0.024)	(1.426)		
Cattle	0.001	0.001		
	(0.001)	(0.001)		
NW Rain		-0.001		
		(0.052)		
Lag Drought	-0.000	0.003	-0.007*	0.002
	(0.003)	(0.003)	(0.003)	(0.007)
NC ×Lag Drought	0.026	0.042**	-0.002	-0.012
	(0.018)	(0.016)	(0.018)	(0.022)
Observations	4,644	4,644	4,644	4,644
R-squared	0.156	0.180	0.424	0.483
LGA Fixed Effect	No	No	Yes	Yes
Year Fixed Effect	No	No	Yes	Yes
State-Year Fixed Effect	No	No	No	Yes
Agro Ecol-Year Fixed Effect	No	No	No	Yes

Notes- The table presents the estimates of equation 3.2. The dependent variable is the incidence of Fulani related conflict across LGAs in Nigeria between 2010-2016. Drought is standardized using sample mean and standard deviation of negative deviation from the mean of rainfall across LGAs. $NWRain$ is the log of average rainfall in North-Western Nigeria (Herders homelands). The pasture measure $Pasture$ is the proportion of pasture observed across LGAs in 2007, and ranges between 0 to 100 percent. Cattle is the centered variable of the number of cattle per km2—cattle density. The inclusion of a more complex structure of fixed effect in the model accounts for the differences in estimate across columns. The standard errors in parenthesis are clustered at state level. *** p<0.01, ** p<0.05, * p<0.1. The bracket contains the p-value derived when standard errors are boot clustered at state-level.

Figure 3.4.1: The Estimate of the Impact of Drought on Fulani Conflict



Note - The figure shows that adverse weather shocks to pastured land in the North Central river basins decrease the probability of a Fulani pastoral conflict but have no significant effect in other parts of Nigeria. The figure plots the marginal effects of a standard deviation drought in lands with percent pasture: one standard deviation below the sample mean; the sample mean (0.33); one and two standard deviation above the sample mean. The estimates are from the random effect estimation in Table 3.4.2. The marginal impact of drought in the river basins states NC and other parts of Nigeria $Non - NC$ are in red and blue, respectively

Figure 3.4.1 is the coefficient plot from the estimation. It shows how increasing the pasture level differentially impacts conflict in North-central Nigeria river basins when droughts occur. The coefficients are from the random effect model in column 2. We explore random effect results because NC and $Pastures$ are fixed quantities that the individual fixed effects would otherwise suck up.[19] However, the estimates from the fixed effect model are expected to be larger from our result. We consider pasture values of one standard deviation below the mean; the sample mean (0.33); one and two standard deviation above the sample mean. Figure 3.4.1 shows that for a standard deviation drought, the pasture values considered differentially impact the probability of pastoral conflict in the river basin by an insignificant 0.04, and statistically significant

[19] Stata margins command returns “not estimable” when fixed effects are included.

-0.03, -0.10 and -0.16 respectively. The plot agrees with the explanation that drought impacts the pastoral conflict in highly contested areas—measured by increasing pasture—in the river basin.

3.5 Robustness Check

We conduct robustness checks to examine the sensitivity of our result. First, we switch conflict measures in the dependent variable to reflect: (i) the number of Fulani events as a measure of pastoral conflict intensity; (ii) the number of pastoral conflict events as classified by ACLED; (iii) the probability of ACLED pastoral conflict events; and (iv) number of fatalities from pastoral conflict. Table 3.5.1 shows that the main result is not sensitive to how we measure pastoral conflict. The number of Fulani incidence, pastoral incidence, fatalities, and the probability of pastoral conflict tends to decrease substantially in the river basin with an increase in drought and pasture.

Second, we analyse only the sample of LGAs in North-central Nigeria. The differential effect of drought in the main result is based on the assumption that all LGAs in Nigeria are similar and comparable. When not accounted for, structural differences across LGAs could bias the estimate. Although rainfall is random and the inclusion of fixed effects considerably correct such problems, we test for the local impact of drought using only LGAs within the river basin. Table 3.5.2 present the results of the estimation with a subsample of LGAs in North-central Nigeria. The dependent variable is switched across columns to represent either Fulani incidence, pastoral conflict classified by ACLED, and the number of fatalities from pastoral conflict. The estimates in Table 3.5.1 are consistent with the main results.

Third, we test if any deviation (positive or negative) from average rainfall reduces the pastoral conflict. If drought impacts conflict through agricultural production, then any adverse weather shock to agricultural production (drought and flooding) should yield similar results. We use a measure of absolute deviation from the long-run mean to capture drought and flooding. Table 3.5.3 shows the absolute deviations of rainfall tend to reduce the pastoral conflict. The estimates are statistically significant, especially when the dependent variable measure probability of conflict incidence. The result implies that any adverse precipitation shock to farm productivity will reduce farmers' incentive to engage in pastoral conflict.

Next, we account for alternative sources of income. If rainfall impacts conflict only through agricultural income, our estimate should not be sensitive to controls for non-agricultural income. We use the average night light between 2010-2013 as a proxy for local income across LGAs in Nigeria. The NOAA stable night light data is used extensively in economics research to control for local income (See Chen and Nordhaus (2011), Henderson et al. (2012), and Lessmann and Steinkraus (2019)). Table 3.5.4 presents the result of the estimation with the luminosity variable. Columns 1,2; 3,4; 5,6 are the incidence of Fulani conflict, the incidence of pastoral conflict and the number of fatalities from the Fulani related incidence, respectively. We find that the interaction of drought and pasture remain statistically significant within the North-central Nigeria river basin area. The result shows that non-farm economic activities do not drive our drought-pasture interaction measure.

Lastly, we replace the drought variable with an alternative proxy for agricultural productivity—growth in the level of rainfall. Research in the literature have used growth in rainfall measures to test the impact of agricultural productivity on conflict (Miguel et al. (2004), Brückner and Ciccone (2011), and McGuirk and Nunn (2020)). In this case, we expect that increases to agricultural productivity through precipitation in areas with higher pasture measure should increase the pastoral conflict. Also, by measuring the local and spill over effect in the same way using precipitation, we can analyse how the effect of the response of herders to drought in their homeland compares to farmers' response in the river basin, impacting conflict. Table 3.8 presents the estimation results using log(conflict+1) as the dependent variable and log of total rainfall to measure precipitation.

In column 1 and 2, the dependent variable measure Fulani actor incidence, while column 3 and 4 are pastoral conflict according to ACLED. Exempting the control for spillover accounts for the difference between columns 1-2 and 3-4. The bias underestimates the impact of local-level precipitation in the river-basin (McGuirk and Nunn (2020)). In columns 2 and 4, we observe a contradictory effect of precipitation from herder homeland and local precipitation within the river basin. An increase in rainfall in the herder homeland significantly decreases the pastoral conflict in the river basin. With more rain in the herder homelands, the incentive to migrate in search of dry season pasture around the river basin decreases, leading to lower contest within the river basin. On the other hand, an increase in precipitation within the river basin tend to increase pastoral violence in the river basin. Similar to McGuirk and Nunn (2020), herders respond to higher rainfall in their homelands in line with the opportunity cost effect. On the other hand, farmers within the river basin tend to increase pastoral violence when there is increased precipitation. The Farmer's response is in line with the rapacity effect.

Table 3.5.1: Fixed Effects Estimates of the Impact of Drought on Alternate Measures of Pastoral Conflict

VARIABLES	(1) Number Fulani	(2) Number Pasture	(3) Probability Pasture	(4) Number Fatality	(5) Probability Fatality
Drought * Pasture * NC	-2.182***	-1.991**	-0.388***	-23.344***	-0.516***
	(0.760)	(0.756)	(0.122)	(5.608)	(0.108)
	[0.1271]	[0.1332]	[0.0222]	[0.0635]	[0.0103]
Drought * Cattle * NC	-0.047	-0.027	-0.011	-0.556**	-0.016***
	(0.029)	(0.034)	(0.008)	(0.272)	(0.006)
NW Rain * Pasture * NC	-18.643**	-15.815*	-3.564**	-205.856***	-4.145**
	(8.580)	(8.370)	(1.581)	(67.657)	(1.633)
Drought * Pasture	0.035	0.045	0.023	0.202	0.007
	(0.038)	(0.039)	(0.020)	(0.241)	(0.013)
Drought * Cattle	0.001	0.001	0.000	-0.023	-0.000
	(0.002)	(0.002)	(0.001)	(0.022)	(0.001)
NW Rain * Pasture	0.207	0.197	0.146	2.824	0.090
	(0.251)	(0.259)	(0.204)	(1.731)	(0.157)
Drought * NC	0.941***	0.822**	0.193**	11.684***	0.255***
	(0.346)	(0.362)	(0.075)	(2.511)	(0.062)
Drought	0.004	-0.005	-0.011	-0.341	-0.003
	(0.017)	(0.017)	(0.008)	(0.213)	(0.007)
Lag Drought	-0.023	-0.034	-0.004	-0.409	-0.002
	(0.029)	(0.027)	(0.008)	(0.255)	(0.007)
Constant	0.312***	0.198	-0.013	5.804***	0.197***
	(0.105)	(0.122)	(0.080)	(1.278)	(0.045)
Observations	4,644	4,644	4,644	4,644	4,644
R-squared	0.489	0.493	0.474	0.446	0.466
Number of lga	774	774	774	774	774
LGA FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
State-by-Year FE	Yes	Yes	Yes	Yes	Yes
Agro-Year FE	Yes	Yes	Yes	Yes	Yes

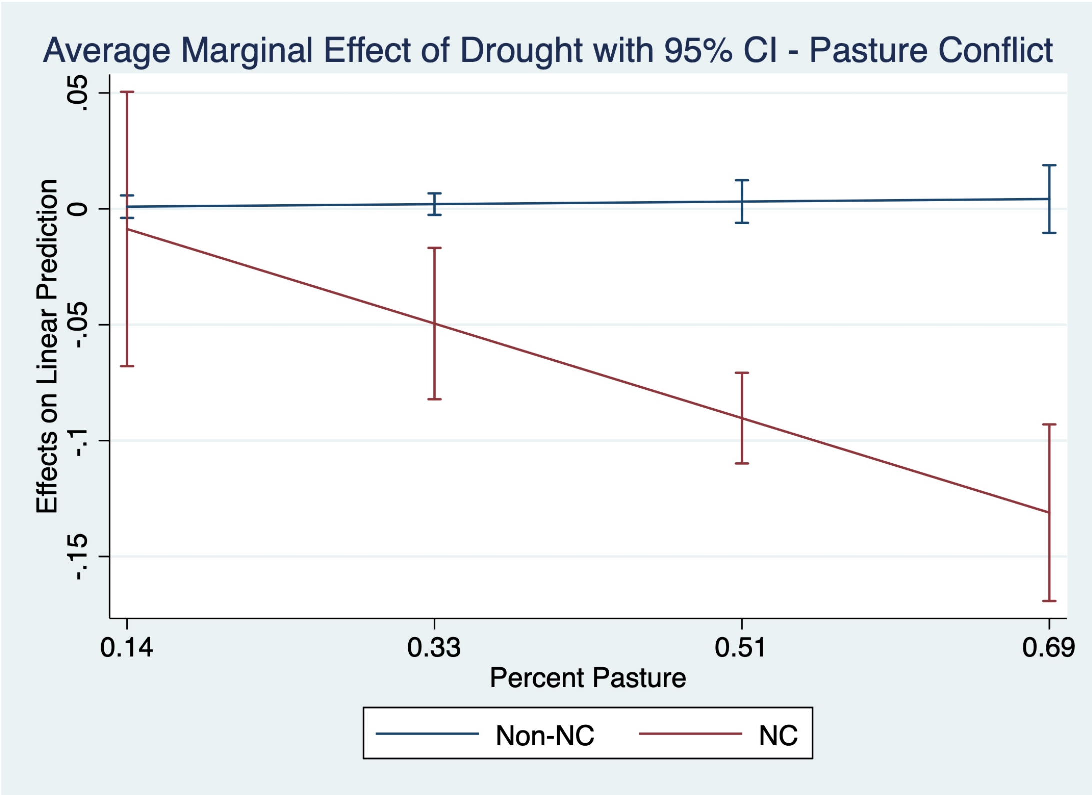
Notes- The table present the estimates of equation 3.2. The dependent variable alternates between measuring the number of Fulani Incidence; number of pastoral incidence; the probability of pastoral conflict; the number and probability of fatalities from Fulani related between 2010-2016. Drought is standardized—using the sample mean and standard deviation—of negative deviation from the mean of rainfall across LGAs. $NW Rain$ is the log of average rainfall in North-Western Nigeria (Herders' homelands). The pasture measure $Pasture$ ranges from 0 to 100 percent. Cattle is the centered variable of the number of cattle per km2—cattle density. The standard errors in parenthesis are clustered at state level. *** p<0.01, ** p<0.05, * p<0.1. The brackets contain the p-value for boot clustered standard errors at state-level as a robustness check.

Table 3.5.2: Estimates of the Effect of Drought on Pastoral Conflict in North-Central Nigeria Only

VARIABLES	(1) Fulani Incidence	(2) Fulani Incidence	(3) Pasture Incidence	(4) Pasture Incidence	(5) Fatalities Number	(6) Fatalities Number
Drought × Pasture	-0.278***	-0.486**	-0.170*	-0.347*	-12.631**	-22.319**
	(0.038)	(0.109)	(0.080)	(0.130)	(3.220)	(6.070)
	[0.0228]	[0.0261]	[0.0861]	[0.0444]	[0.0626]	[0.0606]
Drought × Cattle		-0.026**		-0.018		-0.750*
		(0.008)		(0.010)		(0.323)
NW Rain × Pasture		-4.979*		-4.037*		-207.204*
		(1.809)		(1.866)		(81.496)
Drought	0.120**	0.230**	0.079	0.170	6.228**	11.021**
	(0.029)	(0.068)	(0.046)	(0.087)	(1.816)	(2.820)
Lag Drought	-0.021	-0.014	-0.040	-0.035	-2.577	-2.322
	(0.028)	(0.029)	(0.036)	(0.037)	(1.446)	(1.375)
Constant	0.263***	15.285**	0.245***	12.426*	7.596***	632.785*
	(0.012)	(5.452)	(0.009)	(5.627)	(0.345)	(245.613)
Observations	546	546	546	546	546	546
Number of LGA	92	92	92	92	92	92
R-squared	0.499	0.510	0.516	0.523	0.438	0.444
LGA Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
State-by-Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes

Notes- The table present estimates for the sub-sample of North-central Nigerian river basin states. The dependent variable in column 1-2; 3-4; 5-6 measure Fulani conflict incidence; pastoral conflict incidence; and number of fatalities from Fulani incidence respectively. Drought is standardized—using the sample mean and standard deviation—of negative deviation from the mean of rainfall across LGAs. $NWRain$ is the log of average rainfall in North-Western Nigeria (Herders' homelands). The pasture measure $Pasture$ ranges from 0 to 100. The standard errors in parenthesis are clustered at state level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. The brackets contain the p-value for boot clustered standard errors at state-level as a robustness check.

Figure 3.5.1: The Estimate of the Impact of Drought on Pastoral Conflict



Note - The figure shows that adverse weather shocks to pastured land in the North Central river basins decrease the probability of all pastoral conflict incidence but have no significant effect in other parts of Nigeria. The figure plots the marginal effects of a standard deviation drought in lands with percent pasture: one standard deviation below the sample mean; the sample mean (0.33); one and two standard deviation above the sample mean. The estimates are from the random effect estimation in Table 3.4.2. The marginal impact of drought in the river basins states NC and other parts of Nigeria $Non - NC$ are in red and blue, respectively

Table 3.5.3: Fixed Effect Estimates of the Impact of Absolute Shocks on Conflict

VARIABLES	(1) Prob Fulani	(2) Number Fulani	(3) Number Pasture	(4) Prob Pasture	(5) Number Fatality	(6) Prob Fatality
Rain Dev * Pasture * NC	-0.371***	-1.168*	-0.942	-0.227***	-11.770*	-0.360***
	(0.102)	(0.588)	(0.576)	(0.033)	(6.587)	(0.097)
	[0.0217]	[0.2633]	[0.2943]	[0.0063]	[0.2651]	[0.0167]
Rain Dev * Cattle * NC	-0.015	-0.051*	-0.034	-0.010*	-1.090***	-0.023**
	(0.009)	(0.026)	(0.030)	(0.006)	(0.354)	(0.009)
NW Rain * Pasture * NC	-0.954	-3.985	-2.556	-0.966	-48.248	-0.784
	(0.820)	(4.256)	(3.968)	(0.848)	(42.944)	(0.842)
Rain Dev * Pasture	0.007	0.009	0.007	0.006	0.351	0.005
	(0.008)	(0.015)	(0.015)	(0.009)	(0.227)	(0.009)
NW Rain * Pasture	0.092	0.063	0.014	0.054	2.532*	0.071
	(0.149)	(0.161)	(0.165)	(0.153)	(1.438)	(0.133)
Rain Dev * Cattle	-0.001	-0.001	0.000	-0.001	-0.033*	-0.001
	(0.001)	(0.001)	(0.002)	(0.001)	(0.018)	(0.001)
Rain Dev * NC	0.204***	0.634**	0.515**	0.138***	8.726***	0.219***
	(0.056)	(0.238)	(0.239)	(0.017)	(2.085)	(0.048)
Rain Dev	-0.007	0.006	0.000	-0.010	-0.211	-0.004
	(0.008)	(0.015)	(0.014)	(0.008)	(0.145)	(0.008)
Lag Rain Dev	0.007	0.008	-0.004	0.001	0.015	0.006
	(0.006)	(0.022)	(0.020)	(0.005)	(0.153)	(0.006)
Constant	0.189	1.395	0.985	0.274	12.685	0.169
	(0.398)	(1.553)	(1.455)	(0.413)	(15.127)	(0.385)
Observations	4,644	4,644	4,644	4,644	4,644	4,644
R-squared	0.482	0.483	0.487	0.472	0.444	0.466
Number of lga	774	774	774	774	774	774
LGA FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State-by-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Agroclim-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
F	8.263	6.561	4.281	15.33	4449	33.56

Notes- The dependent variable in column 1,2; 3,4; 5,6 measure the incidence of Fulani incidence, pastoral incidence and number of fatalities respectively. Rain Dev measures positive and negative deviation from long run mean of rainfall (all set to positive values in years they occured). $NW Rain$ is the log of average rainfall in North-Western Nigeria (Herders homelands). The pasture measure ($Pasture$) ranges from 0 to 100. The results differing across columns is from the inclusion of a more complex sturcture of fixed effects into the model. The standard errors in parenthesis are clustered at state level. *** p<0.01, ** p<0.05, * p<0.1. The brackets contain the p-value for boot clustered standard errors at state-level as a robustness check.

Table 3.5.4: Fixed Effect Estimates with Controls for Alternative Income Source

VARIABLES	Prob Fulani Incidence	Prob Fulani Incidence	Prob Pasture Incidence	Prob Pasture Incidence	No. Fatality Incidence	No. Fatality Incidence
NC × Drought × Pasture	-0.255***	-0.516***	-0.190***	-0.396***	-10.854***	-22.826***
	(0.039)	(0.103)	(0.063)	(0.116)	(3.512)	(5.198)
		[0.0123]		[0.0257]		[0.0502]
NC × Drought × **Light**	0.018***	0.011	0.005	-0.003	0.491	0.326
	(0.006)	(0.013)	(0.009)	(0.015)	(0.633)	(0.942)
NC × Drought × Cattle		-0.013		-0.012		-0.443
		(0.011)		(0.011)		(0.478)
NC × NW Rain × Pasture		-4.504***		-3.537**		-207.081***
		(1.511)		(1.571)		(68.196)
Drought × Pasture	0.002	0.013	0.008	0.020	-0.021	0.220
	(0.014)	(0.019)	(0.015)	(0.020)	(0.135)	(0.231)
Drought × Light	-0.002	-0.002	-0.003*	-0.005*	0.035	0.031
	(0.001)	(0.002)	(0.002)	(0.003)	(0.034)	(0.047)
Drought × Cattle		-0.000		-0.002		-0.011
		(0.001)		(0.002)		(0.030)
NW Rain × Pasture		0.147		0.147		2.804
		(0.196)		(0.202)		(1.732)
NC × Drought	0.103***	0.229***	0.096**	0.196**	5.659***	11.250***
	(0.024)	(0.060)	(0.039)	(0.073)	(2.048)	(2.386)
Drought	0.001	-0.002	-0.003	-0.005	-0.334*	-0.377*
	(0.007)	(0.008)	(0.007)	(0.008)	(0.186)	(0.191)
Lag Drought	0.002	0.002	-0.003	-0.003	-0.427	-0.412
	(0.008)	(0.007)	(0.008)	(0.008)	(0.281)	(0.257)
Constant	0.047***	1.346**	0.045***	0.996	0.983***	69.209***
	(0.001)	(0.640)	(0.001)	(0.670)	(0.020)	(23.855)
Observations	4,644	4,644	4,644	4,644	4,644	4,644
R-squared	0.479	0.483	0.471	0.474	0.441	0.446
Number of LGA	774	774	774	774	774	774
LGA FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State-by-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Agroclim-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
F	8.490	39.62	6.443	12.04	13.01	1329

Notes- The dependent variables in columns 1-2; 3-4; 5-6 measure Fulani conflict incidence; pastoral conflict incidence; and number of fatalities from Fulani conflict respectively. $Light$ is the average luminosity observed across LGAs between 2010-2013. Drought is standardized using sample mean and standard deviation of negative deviation from the mean of rainfall across LGAs. $NW Rain$ is the log of average rainfall in North-Western Nigeria (Herders homelands). The pasture measure ranges from 0 to 100. The standard errors in parenthesis are clustered at state level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. The brackets contain the p-value for boot clustered standard errors at state-level as a robustness check.

Table 3.5.5: Growth in rainfall and conflict

VARIABLES	(1) Log Fulani	(2) Log Fulani	(3) Log Pasture	(4) Log Pasture
NC × Rain (Log) × Pasture	1.546***	4.317***	1.690***	4.721**
	(0.437)	(1.360)	(0.590)	(1.797)
NC × NW Rain × Pasture		-5.925**		-6.466**
		(2.409)		(3.154)
NC × Rain (Log) × Cattle	0.031	0.061	0.035	0.067
	(0.043)	(0.042)	(0.060)	(0.066)
Rain (Log) × Pasture	-0.045	-0.076	-0.113	-0.223
	(0.048)	(0.080)	(0.094)	(0.165)
Rain (Log) × Cattle	-0.001	-0.001	-0.005	-0.004
	(0.003)	(0.003)	(0.008)	(0.008)
NW Rain × Pasture		0.042		0.197
		(0.066)		(0.204)
NC × Rain (Log)	-0.446**	-1.669***	-0.534	-1.862**
	(0.220)	(0.607)	(0.327)	(0.910)
Rain (Log)	-0.016	-0.008	0.017	0.049
	(0.026)	(0.029)	(0.048)	(0.057)
Lag Rain (Log)	0.162*	0.165*	0.183**	0.185**
	(0.084)	(0.083)	(0.087)	(0.080)
Constant	-1.149*	0.818	-1.334**	0.494
	(0.611)	(1.144)	(0.644)	(1.233)
Observations	4,644	4,644	4,644	4,644
R-squared	0.453	0.460	0.522	0.526
LGA FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
State-Year FE	Yes	Yes	Yes	Yes
Agroecol FE	Yes	Yes	Yes	Yes
F	9.113	305.2	31.41	78.95

Notes- The table present estimates of equation 3.2 with the log of total rainfall as the drought measure. The dependent variable in columns 1,2; 3,4; are the natural log of the number of Fulani conflict incidence; and pastoral incidence respectively (log(conflict + 1)). $NW Rain$ is the log of average rainfall in North-Western Nigeria (Herders' homeland). Pasture ranges from 0 to 100. The standard errors in parenthesis are clustered at state level. *** p<0.01, ** p<0.05, * p<0.1.

3.6 Conclusion

Pastoral conflict events specifically between herders and farmers have surged across Africa in recent years. The increase in this form of violence is attributed to global warming due to climate change that impacts herding and farming activities. In Nigeria, increasing aridity in the North-West force herders to migrate southwards into North-central Nigeria in search of water and fodder for cattle. Also, in the river basins of North-Central Nigeria, sedentary farmers have continuously employed marginal lands into production to provide a livelihood for their growing population. The increased agricultural production in North-central Nigeria has closed up 144 grazing routes used by herders in the past. Therefore, as a consequence, herders and farmers compete over limited land resources, often through violence. Between 2017 and 2018, ICG recorded 1500 deaths and 300,000 displaced people due to violence relating to herders in Nigeria. This research contributes to the literature on conflict regarding how climatic shocks impact pastoral conflict.

The literature on conflict documents how weather impact conflict. Adverse weather shocks are estimated to increase the incidence of a broad definition of conflict. Such broad definitions of conflict do not provide a concrete explanation of the mechanism through which weather patterns can specifically impact pastoral conflict. The most recent and relevant investigation shows that an increase in temperature substantially increases conflict in herder-farmer mix settlement region; and most of the conflict in the agricultural areas can be explained by the spillover effect of drought conditions in herder's homeland (Eberle et al. (2020), McGuirk and Nunn (2020)). The recent research contributes substantially to the literature; however, it remains unclear if or how weather conditions —drought and rainfall— incentivize farmers and herders to engage in conflict within the contested agricultural region.

This research investigates the impact of drought on pastoral conflict within the contested agricultural region. We focus of pastoral conflict and combine conflict incidence information from Armed Conflict Location and Event Dataset (ACLED) with geographical data on local precipitation from the University of East Anglia Climate Research Unit (UEA-CRU). We also measure contestability within a locality using a measure of pasture availability from the Food, Insecurity, Poverty and Environmental Global GIS Database (FGGD). To identify farmers' response to drought in the agricultural region, we control for drought spillover from herders' homeland in Nigeria and control for cattle production in the contested river basins in North-central Nigeria. We find that in the absence of drought spillover effect from herder homeland, drought in the contested river basins substantially reduces the pastoral conflict. The result shows that with droughts of one standard deviation increasing pasture land by one percent tend to decrease pastoral conflict probability by about 51percent. We attribute this effect to farmers responding to drought and its adverse impact on agricultural output. The result implies lower agricultural production in years of drought decrease farmer's incentive to engage in conflict.

This research also relates to the broader literature on conflict. In the literature, income is causally related to violent conflict. Income relates to conflict in two ways: First, higher income can reduce conflict through an opportunity cost effect. This channel is relevant to income generated in the labour-intensive sector. Second, on the other hand, higher income from the capital-intensive sector has been shown to increase conflict. This known rapacity effect arises when the value of the contested output increase, making conflict more likely. Our research seems to find a rapacity effect between labour-intensive agricultural income and conflict. When the value of agricultural lands diminishes from drought, farmers have less incentive to fight and thus reduce conflict incidence with herders. The research findings imply that the direction of the effect of income on conflict might not strictly depend on whether the sector is labour or capital intensive.

Our suggestion for further research is as follows: First, it is essential to investigate how population expansion and its interaction with weather patterns impact conflict incidence. Descriptive evidence has shown that conflict has intensified in recent years, co-occurring at the same time with the population expansion. Understanding if population expansion aggravates the impact of drought or affects conflict independently will help understand why conflict occurs. Second, although evidence currently suggests that pastoral conflict are resource problems, farmers and pundits in the region explain the importance of ethnic and tribal factors on the conflict. Further research should investigate if drought still impacts conflict in populations where herders and farmers are from the same ethnic grouped as opposed to being from different tribes. The heterogeneity in preferences across tribal groups can adversely impact negotiation and settlement between farmers and herders. The extent to which this has mitigated local and regional policies that try to resolve the pastoral conflict is an important course of inquiry.

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Appendix

3.A Sensitivity Analysis—Weather Conditions in Herders' Ethnic Homeland and Pastoral Conflict

In this section, we show that the spillover effect from herder homeland is not spurious. The research studies a pastoral conflict involving herders who migrate from North-Western to North-central Nigeria's River Basin during the dry season. Due to the intense competition with sedentary agrarian farmers over land, violent conflict occurs. We estimate the impact of drought on violent pastoral conflict. The results show that a significant proportion is explained by weather condition in herder homeland.

We aim to estimate if rainfall in other geopolitical regions in Nigeria also impacts the pastoral conflict in North-central Nigeria in the same way as the weather condition in herder homeland. Figure 3.C.1 shows Fulani permanently settle in North-Western Nigeria. To identify the effect of herder homelands, the spillover effect of precipitation should not be significant for other geopolitical regions in Nigeria. We construct the variables $NWRain$, $NERain$, $SWRain$, $SSRain$, $SERain$; the natural log of average rainfall in North-Western, North-Eastern, South-Western, South-South and South-Eastern geopolitical region, respectively. We interact with these variables with the

North-central Nigeria dummy (NC) and the percent pasture ($Pasture$) measure.

$$\begin{aligned} Conflict_{lst} = &\alpha_l + \beta_1(NC_{ls} \times Drought_{lst} \times Pasture_{ls}) \\ &+ \boldsymbol{\Pi_j(GeoRain_{jrt} \times NC_{ls} \times Pasture_{ls})} \\ &+ \lambda_{st} + \omega_{zt} + \epsilon_{lst} \end{aligned} \tag{3.3}$$

Equation 3 estimates the impact of average rainfall around Nigeria's geo-political region on the pastoral conflict in the river basin. As specified previously, the dependent variable is the incidence of conflict in LGAs across Nigeria. β_1 still captures the impact of local rainfall on conflict in the river basin. The variable Π_j is a vector of the interactions of the average rainfall and NC for every geo-political region in Nigeria except North-central Nigeria. A statistical significant interaction for any variable in the vector Π_j will imply rainfall in the geo-political region impact violence in the river basin.

Table 3.A.1 present the results of the estimation. The result shows that aside from the spillover from North-Western Nigeria, the rainfall in other geopolitical regions had little to no effect on the river basins' conflict. We do however see significant results for the average precipitation from South-South Nigeria. One common feature between the River Basin and South-South geopolitical zone is that they are both riverine. A possible explanation for the effect from South-South SS rainfall is that the region serves as an alternative source of dry-season pastures for herders. Therefore, more rain in the South-South region reduces land-use pressure in the North-central parts of Nigeria.

Table 3.A.1: Conflict and Rainfall In Fulani Ethnic Homeland

VARIABLES	(1) OLS FE Incidence	(2) OLS FE Incidence	(3) OLS FE Incidence	(4) OLS FE Incidence	(5) OLS FE Incidence
NC × Rain × Pasture	3.597***	3.573***	4.012***	3.645***	3.566***
	(1.041)	(1.262)	(1.048)	(0.985)	(1.047)
NC × NW Rain × Pasture	-5.609***	-5.680***	-5.704***	-4.898***	-5.746***
	(1.596)	(1.436)	(1.578)	(1.696)	(1.596)
NC × NE Rain × Pasture		0.079			
		(0.739)			
NC × SE Rain × Pasture			-0.894		
			(1.047)		
NC × SS Rain × Pasture				-2.701**	
				(1.187)	
NC × SW Rain × Pasture					0.261
					(0.505)
NE Rain × Pasture		-0.039			
		(0.131)			
SE Rain × Pasture			-0.253		
			(0.169)		
SS Rain × Pasture				-0.318	
				(0.259)	
SW Rain × Pasture					-0.183
					(0.203)
NC × Rain	-0.253	-0.252	-0.281	-0.275	-0.250
	(0.322)	(0.323)	(0.342)	(0.304)	(0.323)
Rain × Pasture	-0.141	-0.136	-0.094	-0.106	-0.114
	(0.152)	(0.154)	(0.141)	(0.145)	(0.152)
NW Rain × Pasture	0.167	0.210	0.217	0.227	0.259
	(0.188)	(0.195)	(0.198)	(0.219)	(0.248)
Rain	-0.008	-0.008	-0.013	-0.011	-0.010
	(0.046)	(0.046)	(0.046)	(0.046)	(0.045)
Constant	0.484	0.486	0.609	0.763*	0.486
	(0.377)	(0.375)	(0.400)	(0.381)	(0.377)
Observations	5,418	5,418	5,418	5,418	5,418
R-squared	0.463	0.463	0.463	0.464	0.463
LGA FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
State-Specific Trend	Yes	Yes	Yes	Yes	Yes
Agroecol-Year FE	Yes	Yes	Yes	Yes	Yes
F	3.394	4.968	4.962	10.78	2.625

Notes- The dependent variable are the incidence of Fulani related conflict. $Rain$ measures the natural log of precipitation across 774 LGAs. $NWRain$, $NERain$, $SWRain$, $SSRain$, $SERain$ are the log of average rainfall across 5 geo political zones in Nigeria. The geo political zone precipitation measures are interacted with percent pasture ($Pasture$) and the River Basin dummy (NC) to capture their spillover effects into NC. The pasture measure ranges from 0 to 100 percent. The standard errors in parenthesis are clustered at state level. *** p<0.01, ** p<0.05, * p<0.1.

3.B Drought Shocks and Agricutural Output

In this section, we test the main assumption of the research. We argued that drought impact conflict through agricultural productivity because agricultural production in Nigeria is rainfall dependent. We use cassava and maize production in Nigeria to provide evidence of the rainfall dependence. The data is from the Living Standard Measurement Survey (LSMS) conducted in 2010/11, 2012/13 and 2015/16. The estimation involves matching household information at the LGA level with the drought variable.

Table 3.B.1: Descriptive Statistics

VARIABLES	N	Mean	Std. Dev	Min	Max
Cassava Output (KG)	3,913	899.5	5,101	0	200,000
Maize Output (KG)	3,457	1,119	2,766	0.0100	76,320
Age of HH Head	14,046	51.40	15.16	15	150
Farm Size (Ha)	8,935	0.937	1.737	0	63.96
Fertilizer Use	8,860	0.890	0.951	0	2
Gender of HH Head	14,354	1.168	0.374	1	2
HH Size	14,350	5.829	3.211	1	31
Number of HH Livestock	8,394	28.27	357.0	0	24,250
Total Labour Mandays	8,826	514.0	3,135	0	244,341
HH Average Days Spent on Farm	1,479	39.56	63.30	0	1,040

Notes- The panel is the summary of the household level data from the Living Standard Measurement Survey (LSMS) conducted in the years 2010-2011, 2012-2013 and 2015-2016. Total labour maydays is the sum of all labour used in the farm (including hired labour) in 8 hour periods. The Average Days Spent on Farm is the sum of the number of days household members reported working on their farm-plots.

To estimate the impact of drought on cassava and maize production, we specify the following model -

$$QTY_{ilst} = \alpha_l + \lambda_t + \theta_l t + \boldsymbol{\delta_1 Pasture_{ls} * Drought_{lst}} + \delta_2 Drought_{lst-1} + \boldsymbol{X}_{ilst}\phi + \epsilon_{ilst} \tag{3.4}$$

QTY_{ilst} measures either the log of household maize or cassava output. We include α_l, the LGA fixed effects, and λ_t the year fixed effect to account for time-invariant unobserved LGA factors and common changes over-time in agricultural productivity. The $Pasture_{ls} * Drought_{lst}$ interacts the drought variable with the pasture measure. $\theta_l t$ is the LGA-specific time trend that accounts for trends in agricultural productivity across LGAs overtime. X_{ilst} includes farm size, household size, the gender of household head

Table 3.B.2: Regression Estimates of the Effect of Drought on Farm Output in Nigeria

	Cassava Output			Maize Output		
	(1)	(2)	(3)	(4)	(5)	(6)
Drought	0.395**	0.058	-0.015	-0.044	-0.049	-0.083
	(0.167)	(0.185)	(0.218)	(0.071)	(0.083)	(0.094)
Drought × Pasture	-0.646*	-0.850**	-0.717*	-0.429	-0.745**	-0.664*
	(0.331)	(0.394)	(0.398)	(0.350)	(0.350)	(0.384)
Drought × Cattle			-0.090			0.036
			(0.072)			(0.031)
Lag Drought	-0.947***	-0.737**	-0.701**	-0.256**	-0.253*	-0.148
	(0.269)	(0.294)	(0.299)	(0.112)	(0.130)	(0.149)
Farm Size (Ha)		0.041	0.043		0.058***	0.059***
		(0.070)	(0.071)		(0.016)	(0.016)
HH Size		0.010	0.008		0.035***	0.035***
		(0.020)	(0.020)		(0.008)	(0.008)
Gender HH Head		-0.044	-0.039		-0.206**	-0.200**
		(0.147)	(0.147)		(0.089)	(0.089)
Age of HH Head		-0.001	-0.002		-0.003*	-0.003*
		(0.004)	(0.004)		(0.002)	(0.002)
Educ of HH Head		-0.002	-0.003		-0.017***	-0.017***
		(0.012)	(0.012)		(0.006)	(0.006)
Fertilizer (Dummy)		0.091	0.088		0.033	0.030
		(0.069)	(0.070)		(0.036)	(0.036)
No. of Lifestock (Log)		0.028	0.031		0.024	0.024
		(0.054)	(0.054)		(0.022)	(0.021)
Number of Man Days		0.190***	0.202***		0.113***	0.112***
		(0.045)	(0.043)		(0.018)	(0.018)
Constant	2.376***	1.939***	1.902***	6.053***	5.639***	5.643***
	(0.119)	(0.390)	(0.384)	(0.036)	(0.196)	(0.196)
Observations	3,874	3,140	3,140	3,428	3,068	3,068
R-squared	0.478	0.530	0.531	0.542	0.588	0.589
LGA Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
LGA Time Trend	Yes	Yes	Yes	Yes	Yes	Yes
F	5.930	3.591	4.768	4.243	10.07	9.465

Notes- The Table presents the estimates of equation 3.4. The dependent variable in the first and second panel are the natural log of total output in kilogram of cassava and maize respectively. The level of farm output across LGAs is retrieved from Nigerian General Household Survey (GHS) and is matched with the measure of drought acorss LGAs in Nigeria. $Pasture$ is the percent pasture across LGAs in 2007 with values ranging between 0 to 100 percent. Cattle is the centered variable of the number of cattle per km2, giving cattle density. HH is acronym for household and Ha is hectares. The standard error in parenthesis are clustered at LGA level. *** p<0.01, ** p<0.05, * p<0.1.

(Female=1), age of household head, educational level of household head, fertiliser use, number of livestock and number of man-days used by farm household.

Table 3.5.2 shows that drought decrease agricultural conflict and the effect is more significant in areas with higher pastures. The right and left panel show the result for cassava and maize respectively. In each panel, the first column includes the interaction of $Pasture * Drought$, the second column adds household level controls, and the third column includes the cattle control. With droughts of one standard deviation, increasing the percent pasture by one unit reduce cassava and maize output by 71.7 and 66.4 percent, respectively. The estimates however are only significant at the 10% level. We also observe that previous year's drought impact farm productivity with a similar magnitude as contemporary drought. This has to do with the how planting and harvest seasons overlap between two years and the fact that the first visit of the survey occurs at the end of a year and the fact that the first visit of the survey occurs at the end of a year while the second visit in a round happens early the next year.

3.C Herder Migration and Settlement in Nigeria

3.C.1 Fulani Herder Migration into Nigeria

The Fulani or Fulbe ethnic group originate from the Republic of Guinea, and make up the largest cattle pastoralist in Africa (Blench (1984), Blench (1988), Blench (2010)). The Fulani migration into Nigeria dates back to the 19th century. In 1804, Usman dan Fodio, a Fulani leader, conducted a Jihad in Sokoto, Nigeria and overtook the region they settle in today. The northern region of Nigeria, predominately settled by the Hausa-ethnic group, fell under Usman dan Fodio within the next 30 years. Currently, the North-Western region of Nigeria is predominantly settled by both the Fulani and Hausa ethnic groups.[20]. This section describes the employment, seasonal migration,

The majority of Fulani are herders. However, some become more sedentary take up farming for their occupation (Akpa et al. 2012). Fulanis own 90% of livestock that accounts for one-third of agricultural GDP and 3.2% of national GDP (Ajibefun, 2018). The North-Western part of Nigeria is arid, experiencing longer spells of dry season relative to other regions. To sustain livestock and their source of livelihood in the dry season, Fulani herders engage in transhumance migration to the sub-humid part

[20] Figure 3.C.1 shows the map of Nigeria by geo-political zones and dominant ethnic groups.

Table 3.B.3: Impact of Drought on Conflict - Centered Percent Pasture

VARIABLES	(1) Incidence	(2) Incidence	(3) Incidence	(4) Incidence
NC × Drought × Pasture	-0.312***	-0.369***	-0.405***	-0.530***
	(0.025)	(0.063)	(0.063)	(0.106)
NC × Drought × Cattle	-0.004	-0.011**	-0.013**	-0.017**
	(0.004)	(0.005)	(0.006)	(0.007)
NC × NW Rain × Pasture		-2.228**	-2.477***	-4.475***
		(1.010)	(0.889)	(1.536)
NC × Drought	0.010	-0.032***	-0.016	0.070**
	(0.010)	(0.010)	(0.013)	(0.028)
	[0.9679]	[0.0416]	[0.4329]	[0.1712]
Drought × Pasture	0.001	0.005	-0.018	0.014
	(0.012)	(0.016)	(0.018)	(0.019)
Drought × Cattle	0.001	0.001	0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)
NW Rain × Pasture		0.055	-0.030	0.146
		(0.218)	(0.213)	(0.196)
NC × Pasture	0.448	15.207**		
	(0.290)	(6.832)		
NC × Cattle	0.015	0.015		
	(0.014)	(0.014)		
NC × NW Rain		-0.789***	-0.673***	
		(0.212)	(0.190)	
Drought	-0.001	0.001	-0.003	0.001
	(0.002)	(0.002)	(0.003)	(0.007)
NC	0.174***	5.398***		
	(0.055)	(1.446)		
Pasture	0.025	-0.343		
	(0.024)	(1.426)		
Cattle	0.001	0.001		
	(0.001)	(0.001)		
NW Rain		0.017		
		(0.033)		
Lag Drought	-0.000	0.003	-0.007*	0.002
	(0.003)	(0.003)	(0.003)	(0.007)
Constant	0.019***	-0.092	0.831***	0.503***
	(0.004)	(0.214)	(0.085)	(0.156)
Observations	4,644	4,644	4,644	4,644
R-squared	0.156	0.180	0.424	0.483
LGA Fixed Effect	No	No	Yes	Yes
Year Fixed Effect	No	No	Yes	Yes
State-Year Fixed Effect	No	No	No	Yes
Agro Ecol-Year Fixed Effect	No	No	No	Yes

Notes- The dependent variable is the incidence of Fulani conflict incidence between 2010-2016. We centered the percent pasture variable to estimate how drought impact the Fulani related incidence in LGA with average level of pastures. Drought measures the sample standard deviation of negative drop in rainfall from its mean across LGAs. Cattle is the number of cattle per kilometer square of the LGAs in 2009. In parenthesis is the standard error clustered at state-level. The square bracket is the p-value derived with bootclustered standard error as robustness check. *** p<0.01, ** p<0.05, * p<0.1.

of North-central Nigeria.[21]

The Fulani migration pattern is characterized through movement away from the semi-arid North towards open dry-season pastures around the Niger-Benue river belt (Glover et al. (1961)). The region is mostly humid all year which make it useful for dry season livestock breeding. Although the region can potentially provide fodder for cattle all year round, the increased tsetse fly-infestation in the wet season make the Niger-Benue river belt unfavourable for cattle herding (Blench, 2010). Therefore, Fulani settlement in the North-central region is temporary; when the rains begin, Fulanis migrate back to the arid region. Also, attempts to move further south of the Niger-Benue river belt, comprising mostly of the rain forest, resulted in cattle deaths from trypanosomiasis (Blench 2010). The characteristic Fulani migration in and out of the river basin region made permanent land ownership unlikely and expensive.

The topographical and agro-ecological factors in North-central Nigeria made the region more suitable for dry-season cattle production. Most importantly was the abundance of the high-land plateau around the Northcentral Nigeria region, which solved the tsetse fly problems (Blench 1984; 2010; Majekodunmi et al. (2014)). The plateaus have dry season pastures all year round, with the high altitude controlling the prevalence of tsetse fly (Blench 2010). Most especially in the Jos and Taraba state, the features of the plateaus were attractive to the Fulani's. Blench (2010), documented the early migration of Fulani into the Mambila plateau in 1875. The Mammilla plateau is vastly located around present-day Taraba state in Nigeria. Taraba state, in recent times, still records one of the highest incidences of pastoral conflict in Nigeria (Taraba is one of the 5 North-central Nigerian states we focus on in the research).

[21] Transhumance is the migration of cattle herders in the dry season migration to source for food and fodder for animals.

3.C.2 Pastoral Conflict Of The 18th Century In North Central Nigeria

Following the establishment of dry season settlements, conflict occurred between the agrarian farmers in North-central Nigeria and the Fulani-pastoralist. The struggle was over productive land around farms, grazing routes and access to water used in both farm and animal production (Mc Dougal et al., 2018; Higazi and Yousuf (2016); Abbass (2014)). The primary cause of violence recorded was the movement of herds into farmlands, feeding and trampling on farm output: the farm output and income of farmers were adversely affected by the activities of the pastoralist herders. As far back as 1923, sedentary farmers in the Mambila area complained about the Fulani freely letting cattle trample of their farm crops (Blench, 2010). Since then, the North-central Nigeria river basin region still records the most incidence of Fulani and pastoral violence—making it our study focus in this research (see Figure 3.3.1).

The absence of well-defined property rights contributed to the conflict. Violent conflict arose when disagreements over land use could not be settled between farmers and herders using pre-existing social/property contracts. During British colonization, land use laws in Nigeria were written favouring pastoralists who largely contributed to revenues from the cattle grazing tax established (Blench, 2010). After independence, the Nigerian Land Use Decree of 1978 was enacted. The decree assigned all lands to the Federal government and the local government, resulting in land redistribution in favour of the local communities. Afterwards, pastoralist allegedly retained ownership of the traditional grazing route assigned by the British pre-independence. Farmers backed by the local government and traditional leaders regarded all uncultivated lands open for cultivation (Blench, 2010). Disagreement regarding what lands belong to herders and which was owned by sedentary farmer led to conflict. The inability of state governments to enforce land contracts and protect property rights escalated to conflict.

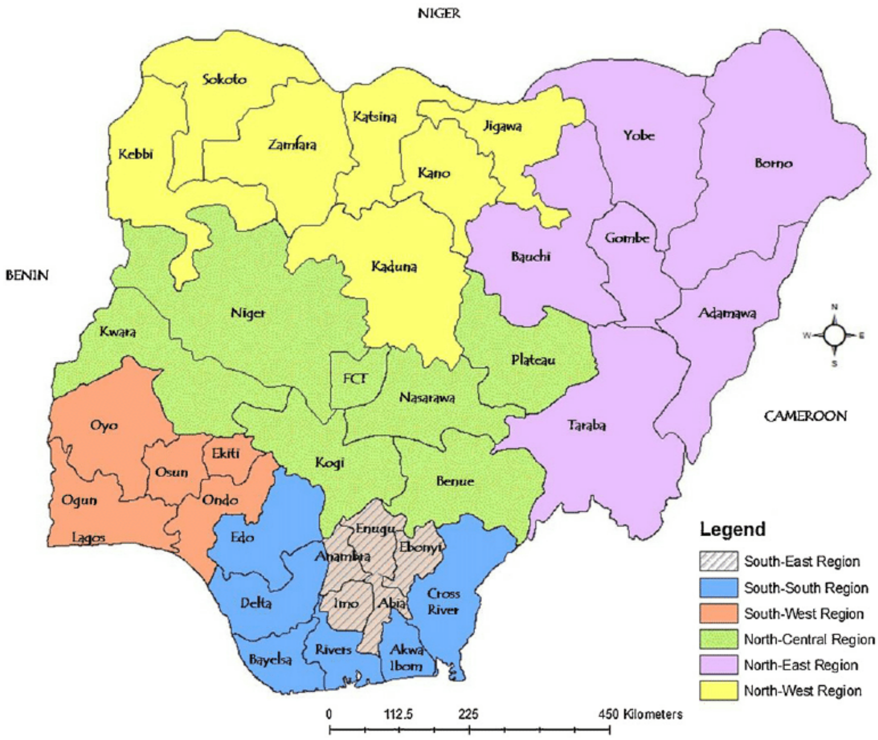
In recent years the number of conflict incidence and fatalities relating to the pastoral conflict has intensified further. Global warming from climate change and population expansion are two reasons for the upsurge in violence (Abbass (2014); SB Morgen (2016)). Rising temperature and shorter rainy season in the arid North have raised the need for Fulani transhumance migration to sustain cattle production. Also, the population expansion in Nigeria has put marginal lands to use to increase agricultural output over the past four decades. Land for agricultural production has resulted in the loss of about 114 grazing routes of the 415 mapped out by the government in 1960 (ICG, 2017). Pastoral herders moving into the North-central and parts of Southern Nigeria are met with higher land competition. Thus, instances of disputes over crop damage, water pollution and cattle rustling also increased substantially (International Crisis Group (2017)). Increased pressure on land resources precedes higher intensity of conflict (Blench 2010).

3.C.3 Consequences of the Pastoral Conflict

In recent times, the conflict is estimated to have devastating effects on the economy. McDougal et al. (2018) using synthetic counterfactual analysis estimates that Benue, Kaduna, Nasarawa and Plateau states – four of the five states of focus in this research - made a combined loss of 2.3 million in 2010 USD in internally generated revenue due to farmer-pastoralist conflict. The International Crisis Group counts that from September 2017 to June 2018, about 1500 deaths and 300000 people were displaced due to the pastoral violence. The regions in the country most affected in the present day are linked with the pattern of transhumance migration – more favourable lands for pastoralist in North-central Nigeria experience more conflict. The availability of dry season pasture and the absence of tsetse fly—the vector of trypanosomiasis—in the dry season make North-central Nigerian favourable for seasonal herder migration (Blench 2010).

In recent years, the observation of pastoral violence is not only restricted to North-central Nigeria. Improvements in veterinary medicine and cattle immunization have

Figure 3.C.1: Map of Nigeria by Geo-political Zones



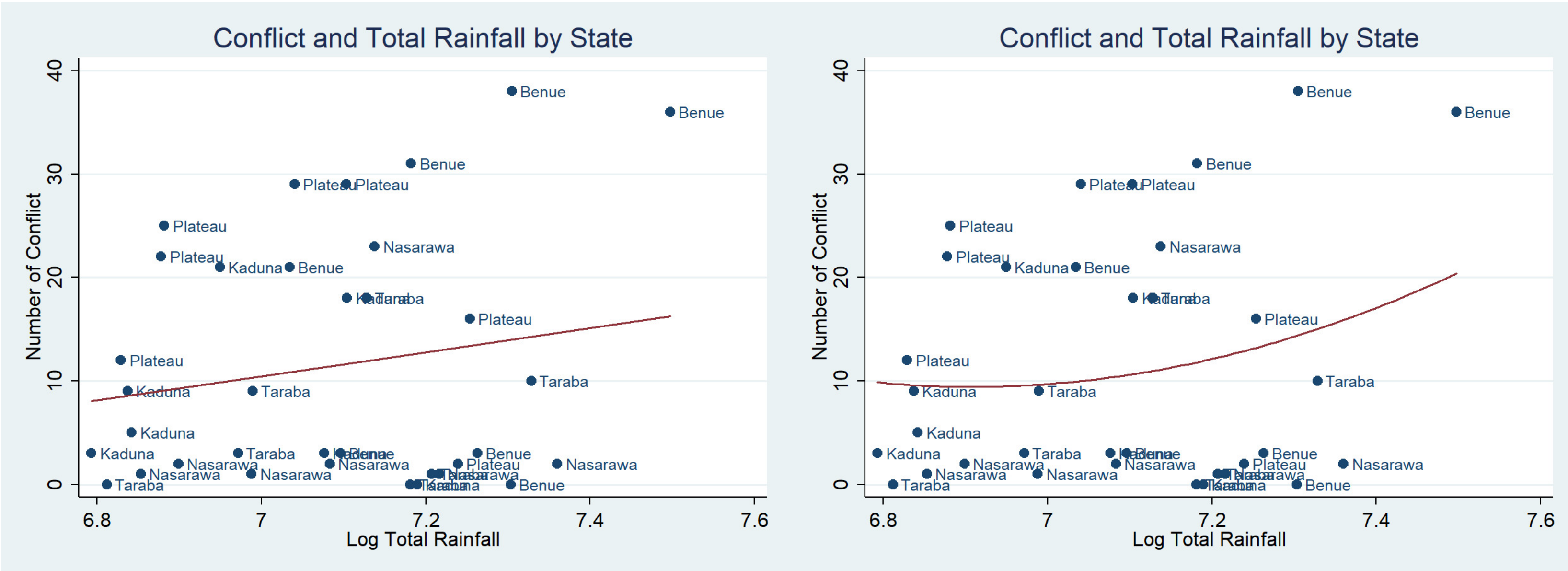
Note - *Source - Ekong et al. (2012), Bakare (2015)*

allowed pastoralist to explore southwards and stay longer in sub-humid zones, even in wet seasons when tsetse flies are prevalent (Blench, 2010). The availability of cheaper medicine explains some Fulani-related conflict incidence throughout the south in recent times.[22] Nevertheless, these alternative grazing routes comes at a high cost of herd vaccination (Cattand et al. (2006) and Fadiga et al. (2013)). Therefore, the Fulani pastoralist still finds it optimal to use land in North-central Nigeria.

The research estimates the disproportionate effect of drought shocks on the Fulani related conflict in areas more suitable for rearing cattle in North-central Nigeria river basins. Although the estimation will account for all conflict incidence, we focus on herding areas in North-central Nigeria. It most likely picks up the effect of the pastoral conflict between herders and farmers.

[22]Figure3.3.1 is the dataset we use for the estimation. We observe some incidence of Fulani related incidence outside North-central Nigeria river basins. From records and anecdotal evidence, it is not clear whether these incidences are herder farmer related.

Figure 3.C.2: Pastoral Conflict Incidence and Rainfall in North-Central Nigeria



The figure shows a positive correlation between pastoral conflict and the amount of rainfall in the Northcentral Nigerian states. The x-axis is the log of total rainfall at the state level. the y-axis is the number of conflict incidence at the state level.

Figure 3.C.8: Gridded Livestock of the World: Nigeria

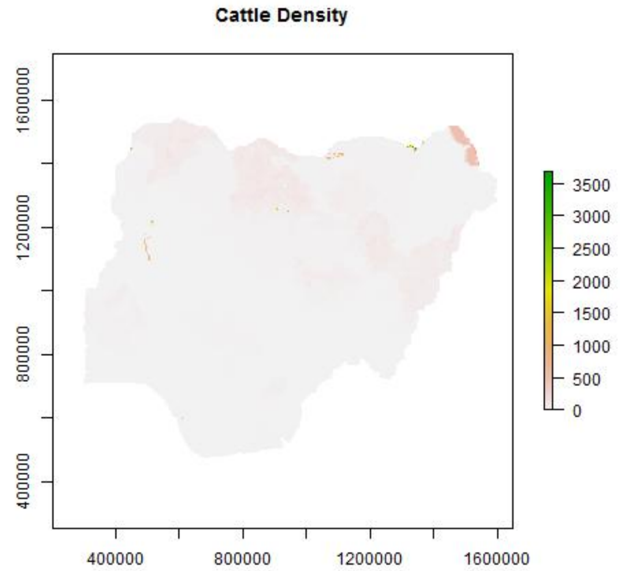


Figure 3.C.9: Harvest Choice: Agro-ecological Zones in Nigeria by States

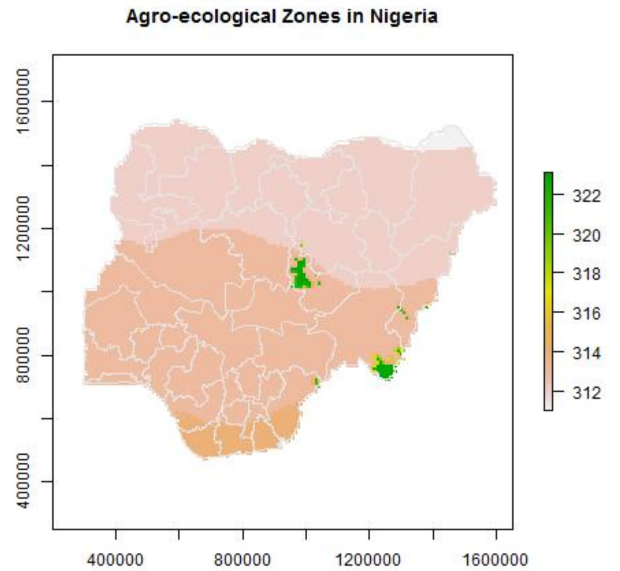
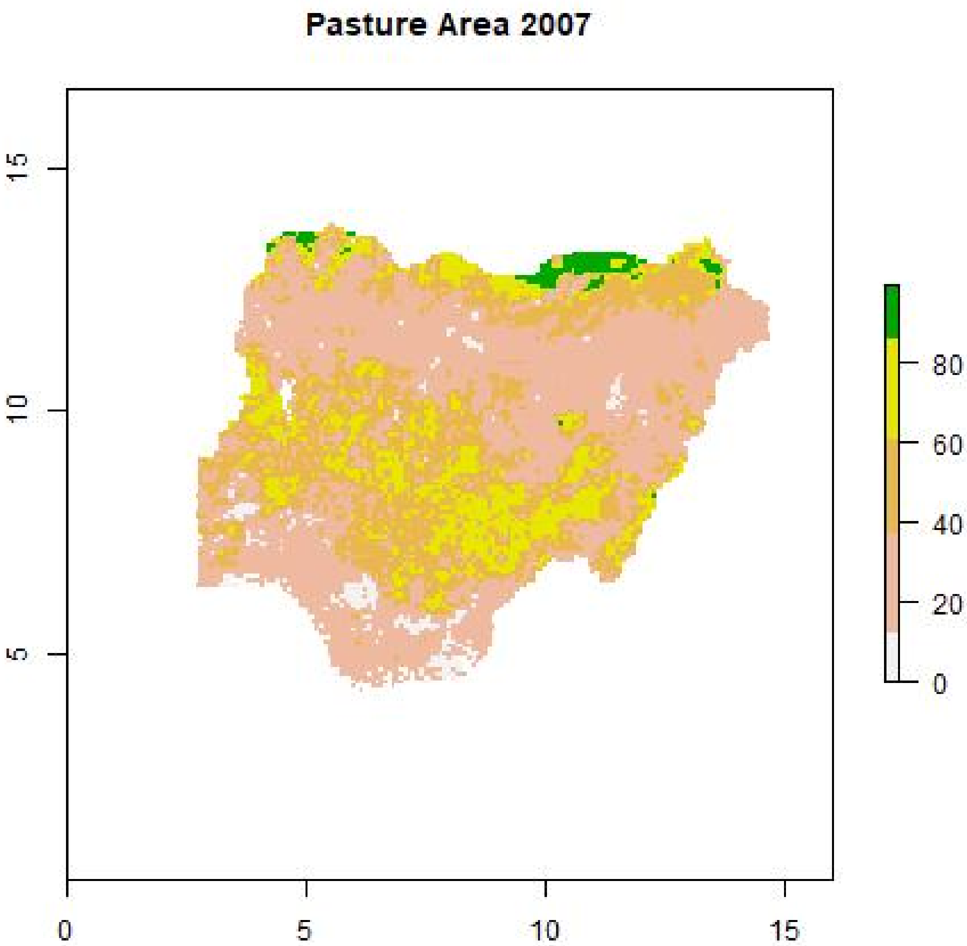
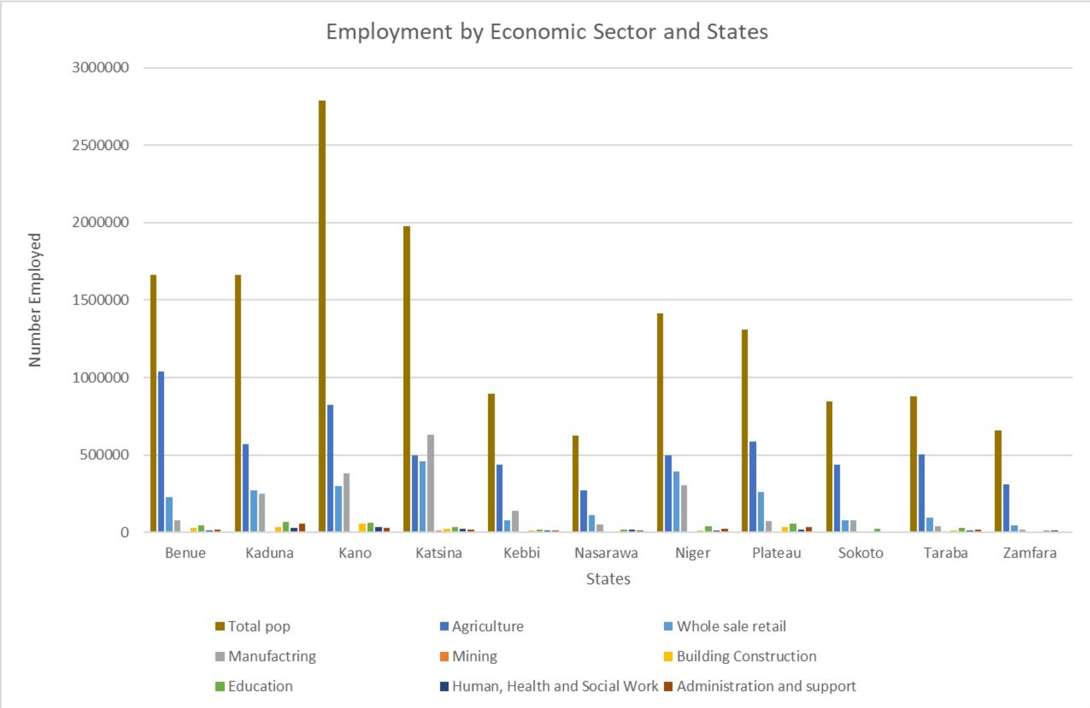


Figure 3.C.3: Occurrence of Pasture and Browse (FGGD) in Nigeria



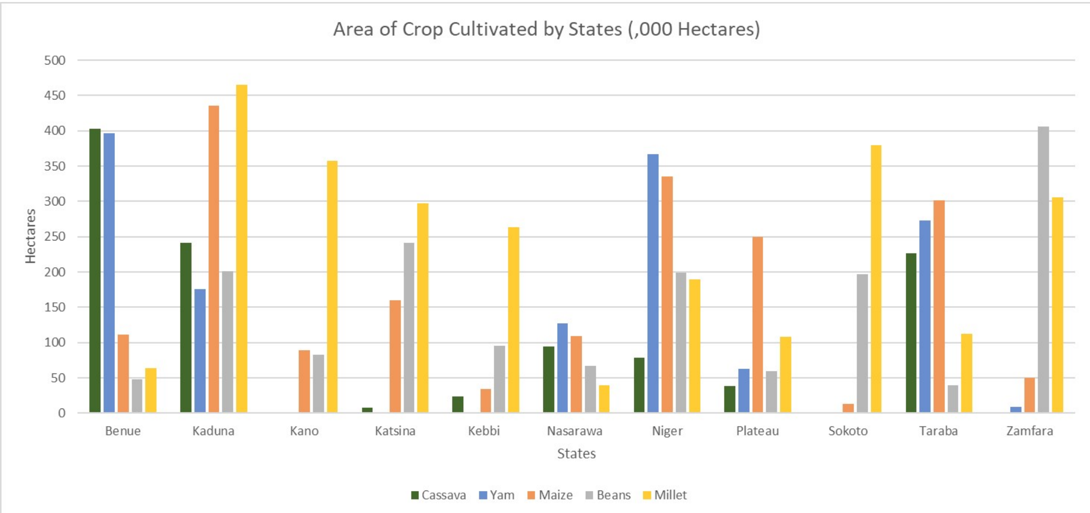
The figure shows the level of pasture lands across Nigeria. The greener area reflect higher occurrence of browse land. The highest occurrence of browse land is found in the farthest North of the country.

Figure 3.C.4: Employment by Economic Sector and States Relevant to the Pastoral Conflict.



Note - The diagram shows the number of people employed across relevant states. It also presents the distribution of the work force across sectors in the economy. We observe that across most of the states, agriculture (blue) seems to employ the highest number of people in the states in Nigeria. Data source: National Bureau of Statistics (2010)

Figure 3.C.5: Distribution of the Types of Crops Planted Across States in Nigeria



Note - The diagram shows the area of cultivated crops across states in Nigeria. The most important crops are cassava, yam, maize, beans and millet. National Bureau of Statistics (2010)

Figure 3.C.6: The Proportion of Irrigated Lands

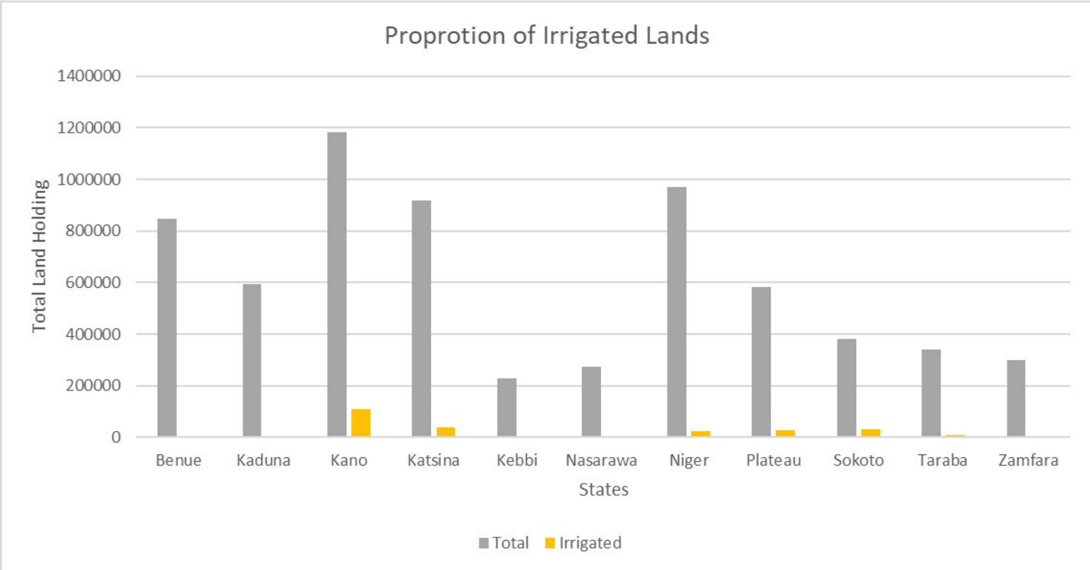
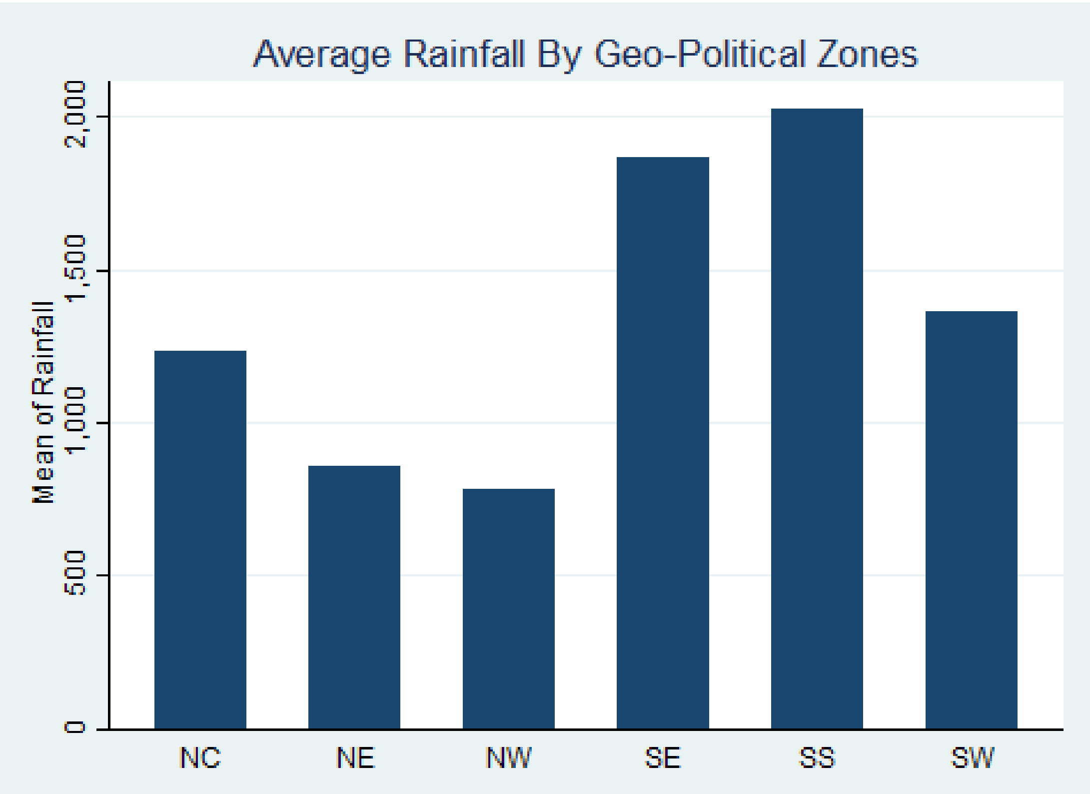
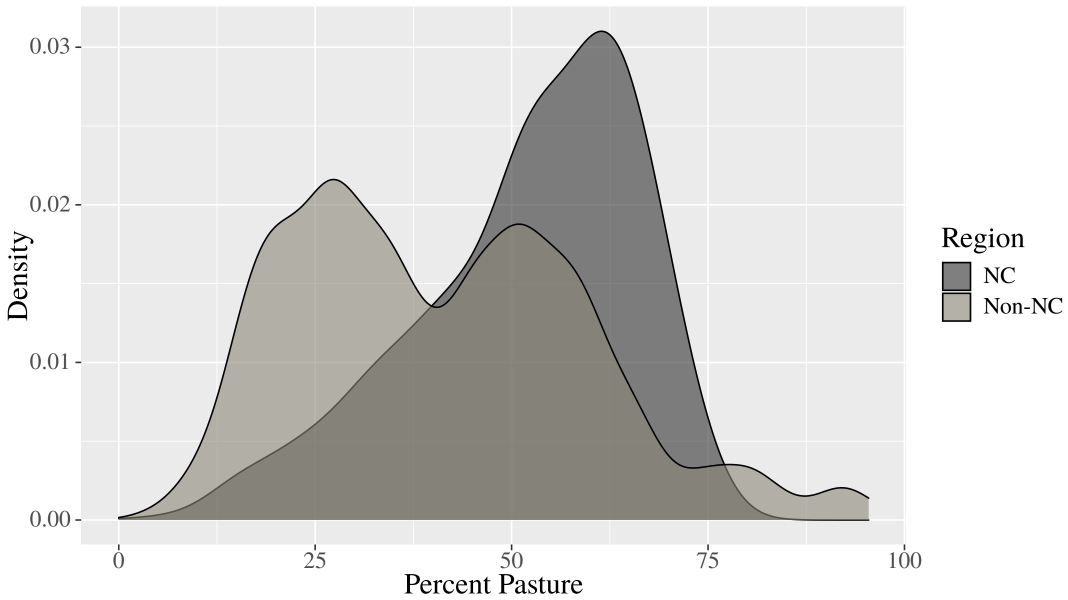


Figure 3.C.7: Average Rainfall Across Geo-Political Zones in Nigeria (2010-2016)



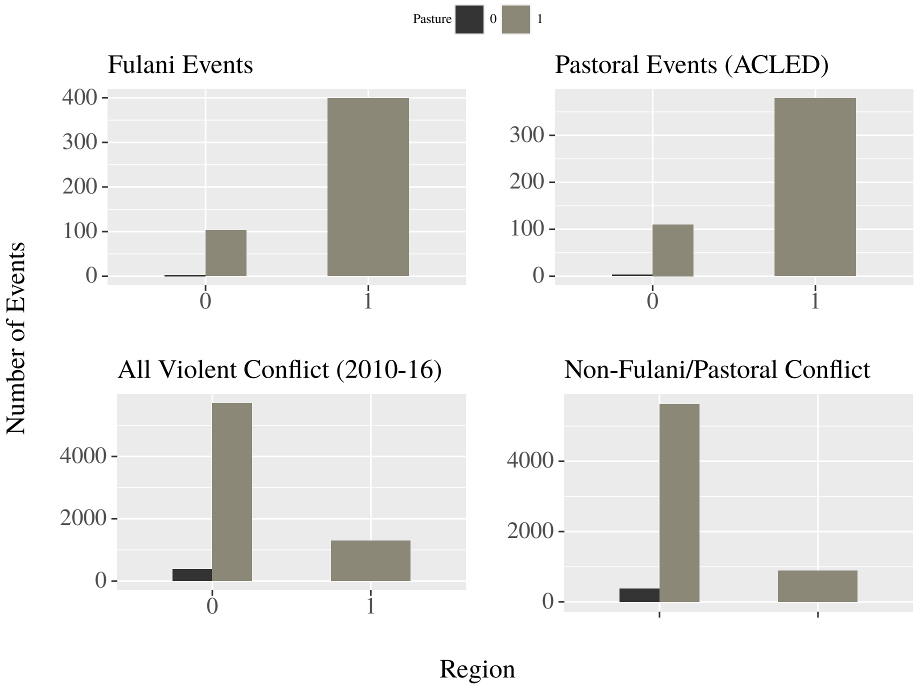
Note - The diagram shows the average rainfall observed across geo-political zones in the dataset. Among Northern Nigeria States, the North-Western region, the Fulani pastoralist homelands has the lowest level of rainfall at 858.78mm. While the North central Nigeria has the highest observed rainfall in the northern parts of Nigeria. The level of rainfall in southern Nigeria reported the highest levels of rainfall in the sample we use for the analysis.

Figure 3.C.10: The distribution of pastures across Nigeria by region.



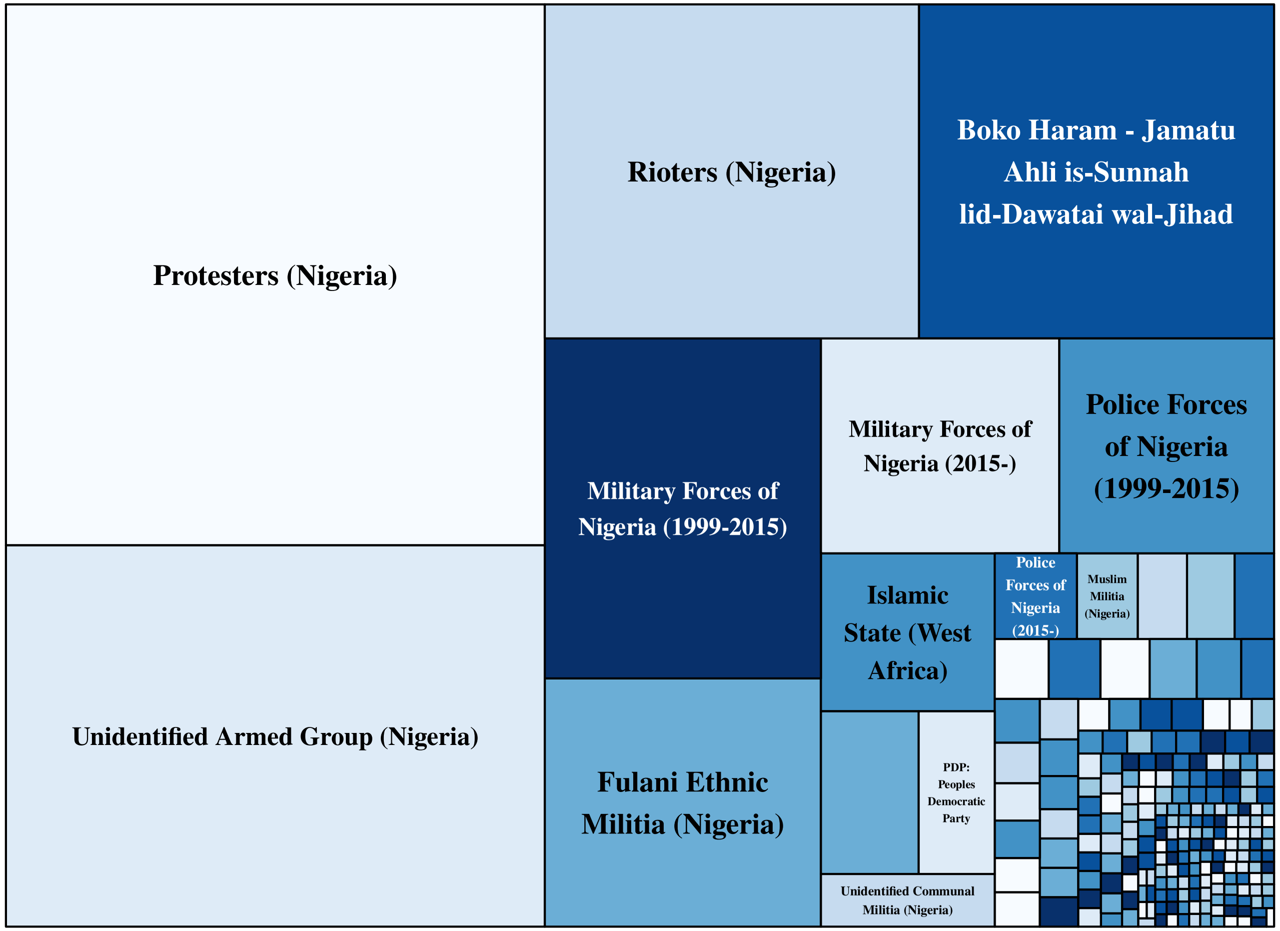
Note - NC is the North-central Nigerian states around the river basin, and Non-NC is all other parts of Nigeria. We observe that the distribution of LGAs in North-central Nigeria is centered around higher values of percentage pastures than in Non-NC LGAs.

Figure 3.C.11: The distribution of violence across Nigeria by region and the presence of pasture land.



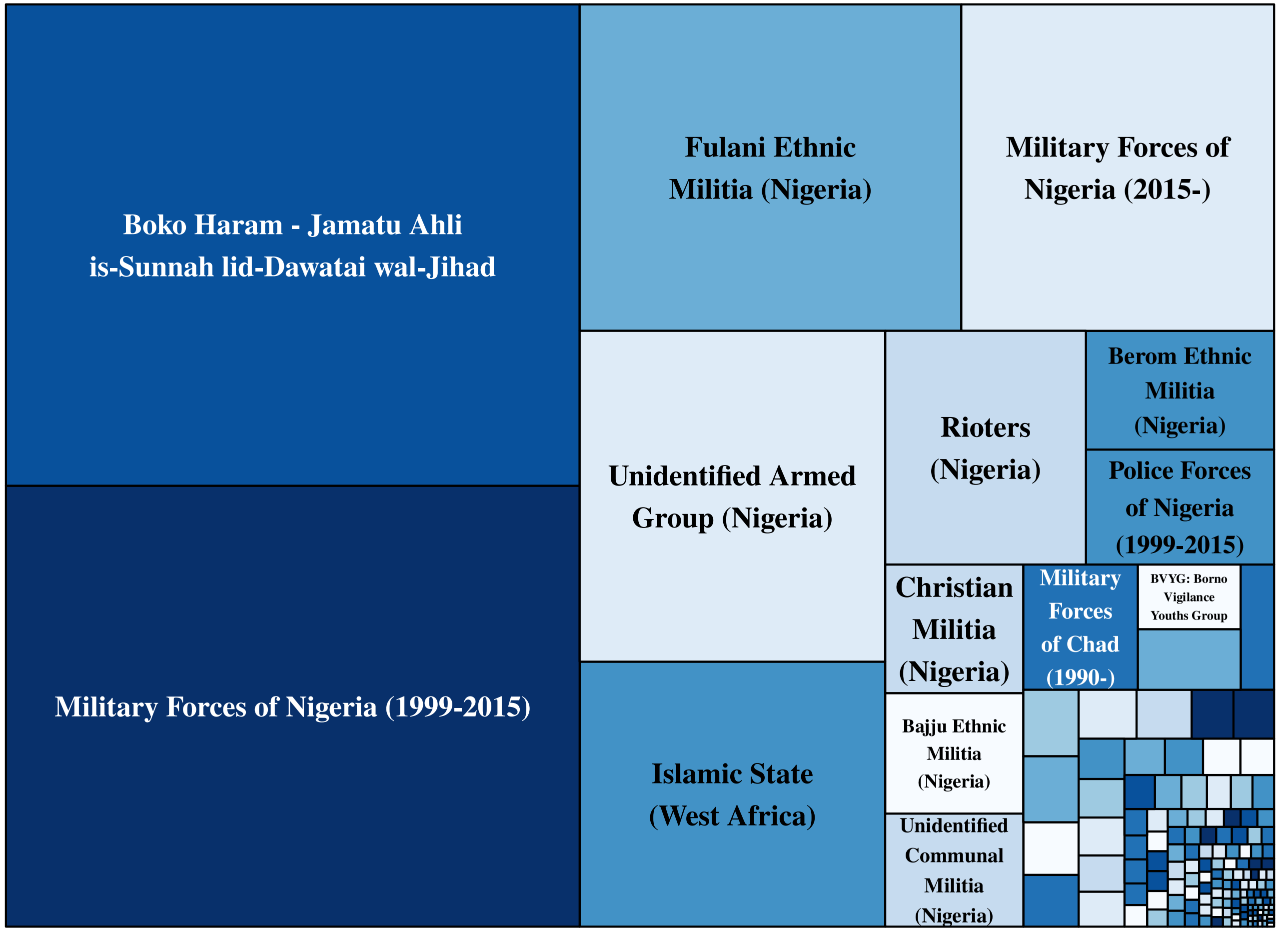
Note: The "Region" takes a value of one for North-central Nigerian states around the river basin. Pasture takes a value of one if an LGA is recorded to have a positive value for percent pasture in the FGGD dataset. Figure 3.C.10, we observe that no LGA in NC has zero percent pasture, thus the pasture value of one represents all LGA in the region. The first and second panel shows that Fulani and pastoral conflict events in the sample occured mostly in NC LGAs, which all contain pastures to some degree. We also observe that even in Non-NC LGAs, Fulani and Pastoral conflict were mostly recorded in areas with postive pasture values. The lower panels plots all conflict in the sample (including Fulani/pastoral conflict) and all conflict except pastoral conflict. We observe that in both cases, conflict mostly occurs in LGAs outside NC.

Figure 3.C.12: ACLED Number of Violent Incidence by Actors between 2010-16



Note- The treemap shows the number of incidence by actors in the dataset by 2010-16. Protests and unidentified armed groups accounted for most of the violent incidence around Nigeria within the time period. We also see that by the area covered, Fulani actors are relevant and account for a significant number of incidence in the time period considered in the research.

Figure 3.C.13: ACLED Number of Fatalities by Actors between 2010-16



Note- The treemap shows the fatalities generated by actors in Nigeria between 2010-16. We see that the highest level of violence is by Boko-Haram terrorist group and the Nigerian military. The Fulani ethnic group generated the third highest number of fatalities within the time period. The figure shows the relevance of Fulani related conflict incidence, which are mostly pastoral conflict.

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Chapter 4

Conclusion

In this chapter, we conclude the thesis. The chapter discusses and concludes the individual research in chapters 2 and 3 and shows how they contribute to the conflict literature. Finally, we discuss policy implications that can be derived from the thesis.

The statistical model used to test the hypotheses in the research is the linear probability model (LPM). The most significant advantage of using LPM over other binary dependent variable methods (logit or probit) is its ease of use, especially with a high dimensional fixed effect.[1] Adding fixed effects and linear trends in the model was necessary for eliminating aggregate level confounders (at state and local government area). However, using these fixed effects alone does not guarantee exogeneity.[2] The first research relied on a parallel trend assumption that ensures the difference-in-differences (DiD) estimation produces the estimate of the policy effect. The second research relied on exogenous rainfall variation to estimate the impact of adverse agricultural productivity on pastoral conflict. Using these statistical techniques reduce omitted variable bias in the models as we tried to get the population parameters of interest.

Chapter 2 evaluates the Niger Delta amnesty program. The amnesty program paid rebels for peace in the oil-producing region in Nigeria. Chapter 2 estimates if enacting the amnesty led to a significant reduction in violence around the Niger Delta region.

[1] In a similar way, Berman et al. (2017) used LPM to get around the computational issues that arise when using other limited dependent variable methods in models with multiple fixed effects.

[2] The fixed effect estimator is still biased if any unmeasurable factor correlates with both dependent and independent variable.

The policy is accessed based on its short- and long-run effects on violence between 2010-13 and 2014-16, respectively. The classification of violent incidents that the policy was considered to impact were: rebel/militia activities, battles involving government forces, civilian violence, protests, and fatalities. By analyzing the amnesty program, we contribute to the literature as the first assessment of amnesty policies as a potential vehicle for transitioning from conflict to peace in a developing countries.

For the analysis, we use data from the Armed Conflict Location and Event (ACLED) dataset. The dataset provides information on the time and location of conflict incidence, mostly in Africa and Asia. The way the information was collated in the dataset allowed us to create various measures of conflict incidence in Nigeria relevant to the amnesty program. For example, rebel/militia activity is a dummy dependent variable constructed with incidence recorded in the dataset for actors in either rebel groups, political militia or identity militia. Battles mostly involving government forces are the subset of "Battle" incidence by "State forces". These incidents involved state security forces, including the army, police and other state military outfits. Violence against civilians is used as recorded by ACLED; these are one-sided violence perpetrated by armed groups. Also, protests and fatalities are used as ACLED registers them. The ACLED dataset is widely used in conflict research because the information is collected in a way that allows researchers to focus on incidence of conflict for specific research contexts.

To capture the policy impact, we employ a difference-in-differences (DiD) estimation strategy. Since the policy was implemented at some point in some local government area (LGAs) while other areas were left untreated, DiD is the appropriate strategy for capturing the policy effect. The method compared violence in oil and non-oil producing LGAs within the Niger-Delta, before and after the policy was implemented. The choice of treatment and control group is driven by the fact that the amnesty program mostly targeted active rebels in oil-producing LGAs in the Niger Delta. Also, LGAs within the Niger Delta share very similar socio-economic and political characteristics, making them fit for comparison. As an alternative, we use other parts of Nigeria as the control group for robustness check. Other robustness checks also show limited evidence of any spillover between treated and control LGAs in the estimation. Our model and estimators were also tested to ensure they satisfy the parallel trend assumption required for the DiD to be an unbiased estimate of the policy effect.

The results show that the amnesty only had short-term effects in reducing violence in the LGAs with oil field in the Niger-Delta. The amnesty substantially reduced violence in observations between 2010-13. However, the policy was mostly ineffective across our measures of violence in observations between 2014-16. The amnesty program significantly impacted rebel activities, battles involving government forces and violence against civilians by 27.3, 19.1 and 19.7 percent, respectively. In contrast, we find neither short- nor long-term effects of the amnesty program on non-violent protests and fatalities. However, after 2014, the policy had no impact on all forms of violence except for battles involving government forces which persistently reduced by 28.3 percent. The persistent effect of the program on battles involving government forces even after 2014 supports the fact that there are no records the Nigerian government have re-engaged militarily with rebels in the region after the amnesty program was implemented.

We also find that the amnesty program had a peace dividend while it was successful at reducing conflict in the oil-producing region. The peace dividend is any observed increase in economic activities following reductions in violence (see Berman et al. (2011), Berman et al. (2013), Dube and Vargas (2013), Singhal and Nilakantan (2016), and Kaila et al. (2020)). We find that the amnesty program improved night light measures in the treated areas—the sable night light data is a proxy of the local economy (see Chen and Nordhaus (2011), Henderson et al. (2012), and Lessmann and Steinkraus (2019)). In the Niger-Delta oil-producing case, this improvement to night light may not directly imply improvement to the economic outcome but reflects increased gas flare from oil production, implying increased employment around the region. Overall, our results indicate that sustaining peace in the oil-producing region would yield economic benefit.

We conduct various checks on our results to ensure the DiD assumptions were satisfied and test for policy spillovers. First, a placebo specification tests if rebels in the Niger-delta anticipated the policy. Suppose rebels in either the control or treated groups changed their violent behaviour in anticipation of the amnesty program. In that case, the trend assumption will fail because of the sudden shift in trend just before the policy cut off year. The placebo estimation shows no evidence of changes in rebel activities in observations before the policy was implemented (2009). Second, we test for policy effect spillover into the control group by estimating if the policy impacted violence in LGAs without oil fields but had oil pipelines (these observations fall into the control groups in the baseline estimation). We find no evidence of policy spillover in this estimation. Third, we use other parts of Nigeria as the control group and allow all LGAs in the Niger Delta to be treated. This estimation will allow for heterogeneous treatment effects around the Niger-Delta; where we expect the amnesty program to only have effects on violence in LGAs with oil fields. The third analysis corroborates with our choice of treated and control group, as we find effects only in LGAs with oil fields. The estimation also suggests no policy effect spillover, as Niger-Delta LGAs without oil fields experienced no significant difference in violence when compared to other parts of Nigeria after the amnesty program was implemented.

Chapter 3 estimates the impact of drought shocks on pastoral conflict. The number of fatalities related to pastoral conflict incidence has risen substantially in recent years across Africa. This class of violent conflict is predominantly between herders and farmers who struggle over productive lands. Chapter 3 focuses on the age-old pastoral conflict between Fulani pastoralist and sedentary farmers in North-central Nigeria. With the research context, we examine how adverse shocks to land productivity impacts pastoral violence. To measure adverse shocks to land productivity and estimate its effect on pastoral conflict, we use drought shocks in pasture lands around the agro-pastoral region (The river basins in North-Central Nigeria). By doing this, the research focuses on the channels through which drought affects conflict while isolating other forms of violent activities not related to herder-farmer violence.

The research used pastoral conflict incidence by actor type (Fulani) and other classifications that identify these type of incidents. ACLED records the names of actors allowing us to identify the predominant pastoral actors in Nigeria. Alternatively, we use the incidence of conflict by groups associated as "Pastoralist" in the ACLED dataset. We combine this dataset with weather data from the University of East Anglia-Climate Research Unit (UEA-CRU); data on the percent pasture observed across LGA from the Food Insecurity, Poverty and Environment Global GIS Database (FGGD). With the dataset, we conduct an exploratory data analysis to understand how pastoral conflict is distributed across time and space in our sample period between 2010-16. The exploratory data analysis show that the pastoral/Fulani conflict mostly occurred in North-central Nigeria—the primary study area, and violence was concentrated in pastured lands around the agro-pastoral region.

Drought shock is a good measure of land/farm productivity in the research context. Farm productivity across Nigeria depends strongly on rainfall (Varrella (2020) and Kurukulasuriya and Rosenthal (2013)). Using drought to measure land/farm productivity has the advantage of its randomness and suffers less from endogeneity than other direct measures. However, some threats to identification had to be addressed. McGuirk and Nunn (2020) show that a large proportion of violence in the agro-pastoral region is explained by herders migration from their ethnic homelands. Therefore, neglecting this effect will underestimate the local impact of drought within the agro-pastoral area (McGuirk and Nunn (2020)). We follow McGuirk and Nunn (2020) spillover design to address this concern in our estimation. Also, we expect drought to impact productivity for both farmers and herders, so both actors should respond to conflict in the same way. Failing to account for the herder effect in the region will bias the estimate of farmer's response to drought. We address this issue by controlling for the cattle density, which accounts for the number of herders in the region. After working out these confounders, we interpret the estimate in our model as reflecting farmer's response to drought in the conflict context.

The identification strategy allows us to pin down the role of farmers in pastoral conflict specifically. Our result shows that while herders respond to drought in their homeland by migrating and engaging in conflict—in line with the opportunity cost effect—we find that farmers in the agro-pastoral region tend to respond to local drought through the rapacity effect. Drought in pastured areas around North Central Nigeria tends to decrease pastoral conflict. This implies a direct relationship between agricultural productivity and conflict, such that increases to agricultural productivity increase pastoral conflict in the agro-pastoral region. This finding contributes to the literature on the effect of adverse labour-income shocks on conflict (see Collier and Hoeffler (2004), Miguel et al. (2004), Dube and Vargas (2013), and Mitra and Ray (2014)). The literature shows that negative shocks to labour income increase conflict; we find that for pastoral conflict negative, shocks to agricultural labour income tend to reduce conflict. Farmers have less agricultural output in drought years to engage herders in violent conflict over land resources.

Recent research in the literature on nomadism and conflict test the impact of weather shocks on violence in Africa. Eberle et al. (2020) using variation in temperature across Africa finds that a one-degree increase in temperature leads to a 54 percent increase in conflict within agro-pastoral regions. Their result shows a much more significant effect of temperature in areas with a mixed herder-farmer population. McGuirk and Nunn (2020) use precipitation as a measure of agricultural productivity. McGuirk and Nunn

(2020) show that the spillover effect of drought from the herder homeland explains most of the relationship between precipitation and conflict in agro-pastoral areas. All the estimated impact of precipitation on conflict at the geographical cell-level resulted from herders/nomads migrating into agro-pastoral regions. Our research contributes to the literature by focusing on pastoral violence in Nigeria and shows local drought reduce conflict within the agro-pastoral region. After accounting for precipitation spillover from herder homeland, we find a positive relationship between precipitation and conflict in North-central Nigeria River Basin. We attribute the impact of local weather shocks on conflict to decreases in farm output. Also, our result provides relevant insights into pastoral conflict; we show that competition between herders and farmers are more likely to increase when there are booms to agricultural productivity.

4.1 Policy Implication

Amnesty policies that pay rebels for peace should not ignore the low economic outcomes that incentivised people to pick up arms in the first place. Paying existing insurgents amnesty in handouts without improving the local economy only creates a vacuum for new rebels to form and recruit soldiers. In the case of the Niger Delta Amnesty Program (NDAP), the policy paid rebels higher wages than is obtainable in the local economy.[3] The possibility of earning higher wages through amnesty payment can subsequently reduce the opportunity cost of conflict for new rebel recruits (as discussed in Nextier (2020)). In this case, it becomes economically favourable to join rebel groups in anticipation of amnesty payments than to earn wages from the local labour market.

The inability of the government to consistently raise the opportunity cost of conflict through economic and infrastructural investments sustains the supply of soldiers,

[3]Some of the challenges to the amnesty program discussed in the Nextier (2020) report relates the size of rebel payment relative to the minimum wage in the Niger-Delta. The report shows that the local wage was 18000 naira monthly (30000 Naira in 2020); because the amnesty paid rebels 65000 Naira monthly, ex-militants who received payment refused to take full employment even with the best employments that pay a premium of 45000 Naira. The amnesty program was required to sustain these ex-militants until they were gainfully employed.

raising the possibility for conflict to occur continuously. Increasing spending and social expenditure on schools, labour employment and other infrastructure that raises will, in turn, raise the opportunity cost of joining rebel groups. We see from the observed data (Section 2.D figure 2.D.2 to 2.D.4) that these issues remain unchanged in the Niger Delta, and the situation in Niger-Delta was relatively worse-off than other southern geopolitical areas post amnesty. As noted, such social expenditures can be expensive, and governments are left to continuously choose between military expenditure or more amnesty payment to maintain peace and sustain oil output. Therefore, providing amnesty to rebels while neglecting the economy can fail to reduce violent conflict outcomes after such programs are implemented, as observed in the Niger-Delta context.

For the Fulani herder-farmer conflict, agricultural development projects that aim to improve farm output can increase the risk of conflict in areas where herder-farmer disputes occur. The exercise on the herder-farmer conflict in chapter 3 shows the importance of property right on the onset and incidence of pastoral conflicts. The conflict over productive agricultural land in North-central Nigeria was fostered because land rights are not well-defined between herders and farmers. This economic setting is prone to the onset of violent conflict, especially in periods of increased agricultural productivity. This kind of rapacity effect is not normally observed in labour-intensive sectors as shown in Dube and Vargas (2013). If it is indeed the case that increased agricultural productivity increases conflict, then policies aimed at increasing agricultural income for farmers need to consider that such improvements can heighten pastoral conflict, as observed in the herder-farmer conflict in Nigeria.

The Nigerian government needs to work on establishing a better property rights within the region. Although, in general, property rights are not well defined in many developing countries and tend to be the leading cause of conflict (See Butler and Gates (2012) and Fetzer and Marden (2017)), some effort can be made to improve the outcomes in the most conflict-ridden region in North-Central Nigeria. Developing an effective way to demarcate agro-pastoral lands for both herding and farming groups should suffice. Setting up herding ranches that corner off cattle from farmlands should be effective in mitigating the primary trigger of conflict in North-central Nigeria. The boundaries that separate cattle from farmlands will prevent cattle from wandering into and trampling on farm output, especially in periods of high agricultural productivity when violent pastoral incidents are most likely to occur.[4]

With two chapters, this thesis has shown how intractable violent conflict can become and present some challenges to civil conflict resolution. Paris (2004) argues that marketising and democratising post-conflict societies as a strategy for conflict resolution can result in the onset of new conflict.[5] By examining an amnesty that failed to sustain peace in the long run in chapter 2, this thesis shows that even though offering amnesties to rebels can have genuine intentions, such policies are difficult to construct and implement. We also explore the possibility of violent conflict in the labour-intensive sector due to a boom in agricultural productivity in chapter 3. A large part of the existing literature has been devoted to showing that violent conflict is inversely related to low economic outcomes; violent conflict is expected to reduce with positive shocks to the labour-intensive sector (see Miguel et al. (2004), Burke et al. (2009), Moritz (2010), Hsiang et al. (2013), Harari and Ferrara (2018), and McGuirk and Nunn (2020)). In chapter 3, we find that increased land productivity tends to increase pastoral conflict. Therefore, to instil long term peace post-conflict, policymakers need to consider our findings in building a more holistic conflict resolution framework.

[4]It is worth stating that some of the previous attempts to construct ranches have been plagued by problems of corruption, nepotism and ethnic favouritism. These common qualities of institutions in Nigeria have hindered any progress towards improving property rights and conflict between herders and farmers as discussed in Anene, Iyala, et al. (2020)

[5]Paris (2004) explains that the level of competitiveness associated with market democracies can exacerbate social tension and undermine peace when political institutions remain unstable post-conflict.

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