Dissection of Hazardous Climate and Farmer-herder Conflicts in Nigeria

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Abstract
This study analyses the impacts of hazardous climate on Nigeria's farmer-herder conflicts. Using variables - temperature, droughts, and rainfall – this paper dissects hazardous climate on the conflicts in terms of duration, incidents, and deaths. Relying on data from Nigerian Security Tracker, Nigeria Watch, World Bank's Climate Portal, Climate.org, and the Federal Ministry of Environment, from 2014 to 2019, this study analyses the temporal and spatial dimensions of the conflicts using regression - a statistical technique used to examine the correlations between two or more variables having cause-effect relations which also have predictive abilities. This study found evidence that temperature, rainfall, and droughts are climatic factors that influence the farmer-herder conflicts in Nigeria. In addition, the study found some seasonal and spatial patterns with North Central region of the country being the hard-hit.

***Keywords**: Hazardous climate, farmer-herder conflicts, droughts.*

Introduction
The past few decades have seen scholars making frantic attempts to establish a potential link between climate vulnerabilities/hazards and political violence in Africa. Despite the considerable amount of time, efforts, and resources, there is still no consensus regarding the estimated

effects of climate hazards, variability, and vulnerabilities on conflicts (von Uexkull, Croicu, Fjelde, & Buhaug, 2016; Buhaug, Benjaminsen, Sjaastad, & Magnus, 2015). Literature in this area has largely suffered from the seeming lack of generalization or replication (Hegre and Sambanis, 2006; Blattman and Miguel, 2010).

Nonetheless, recent studies suggest that there is evidence of climate-violence link (Adigun, 2019, Hsiang, Burke, and Miguel, 2013; Hsiang and Burke, 2014). This claim has not, however, gone uncontested by scholars who contended that there are no relationships between them (Madu & Nwankwo 2020; Bejaminsen 2016). These scholars reject the notion that conflicts in the Sahel region of Africa are linked to climate change. They argued such linkage is too simplistic. One way to look at the lack of scholars' consensus in this area may be due to the different scopes and methodologies adopted. Also, many scholars focus on different forms of violence or contentions – from small to large - as units of analyses which has contributed to these mixed results (Nett & Rüttinger, 2016). But there seems to be consensus in the literature that even if a link is found between climate change and conflicts, such relations will be substantially weak (Buhaug, 2016) as a result of the fact that there are several other factors – political and socio-economic – that have more explanatory capacities than climate change (Detges, 2017; von Uexkull et al., 2016).

Due to the lack of consensus on the climate-conflict link in Africa, some scholars have shifted their attention to attempting to find a link between climate vulnerability and conflicts. While some authors argue that climate change-induced droughts, desertification, and hazards can lead to the loss of livelihoods which in turn leads to higher risks of conflicts, some others maintain that the opposite is the case. They contend that droughts reduce the chances of conflicts rather than increase it because organized violence requires huge resources (including food supply).

In their reasoned opinions, droughts prohibit conflict, because with decreasing resources less fighting is possible (Butler & Gates, 2012).

However, there has been little attention from both sides of the divide about *empirically* establishing how the intensity of climate vulnerability changes the incidents and durations of low-intensity conflicts. Since military operations and standing armies could be too expensive, cheap forms of political violence might still be conceivable. An example of this is the farmers/pastoral conflicts in Nigeria. Thus, when looking at political violence, including all arrangements of civil conflict can distort the effect of droughts on more specific phenomena. This consideration would explain why many studies are unable to find the expected positive relationship. Moreover, it offers an objection to the argument that scarce resources lead to less conflict. Consequently, in this paper, we ask: Is there positive or negative relationship between climate-induced hazards and rural violence?

To answer this question, we will be analyzing the current data using standard research methods. This paper attempts to fill a research gap – finding evidence of the intensity of climate-induced hazards and variability causing rural violence in Africa. There appears to be less emphasis in literature in this aspect largely due to scholars either overlooking it or because it is one area that has been conspicuously *empirically* under-researched in the context of farmers/herdsmen relations between 2014 and 2019.

This paper is organized as follow: the next section provides reviews of previous studies on the climate-conflict connections, their shortcomings, and contributions concerning this current study. The paper proceeds to examine climate vulnerability in Nigeria concerning the West African context. After that, we proceeded to explain our data sources, methods and analytical models used in this paper. Next, we presented the results, empirical analysis, and discussions of our findings. Finally, the summary and conclusions from the paper were presented and suggestions for future research.

Related Literature

Scholars have examined the link between drought and conflict. Olsson (2016), in a study of Darfur conflicts, suggests there is evidence of climate change in the protracted war. Olsson's model shows that climate change can lead to resource disputes, market collapse, and weak trade among groups which may increase the risks of conflicts. The study argues that dwindling natural resources in vulnerable environments might cause conflict over these over-contrasting means. Like many studies before this (Kevane and Gray 2008) which found the changing weather conditions to be predictive factors and evidence of conflicts, it did not sufficiently explain the outbreak of violence. Maystadt, De Luca, Sekeris, and Ulimwengu (2014) explores the possible links between regional and monthly weather variation and conflict in Somalia. The study finds a cogent relationship linking droughts, measured by temperature anomalies, to the protracted unrest/conflicts in the Horn of Africa. Maystadt *et al.,* (2014) notes that the presence of lootable resources provides the right climate for conflicts as witnessed in the Democratic Republic of Congo, Sierra Leone, Liberia, and Sudan.

In their study, Adams, Ide, Barnett and Detges (2018) observed most studies on the link between climate and conflict tend to focus solely on areas where violence already occurred. This, they argue, is like working from answers to questions and that can lead to bias results.

von Uexkull (2014), Fjelde and von Uexkull (2012), established that there is inverse relationship between rainfall and risks of rural conflicts in Africa. von Uexkull (2014) notes that Agricultural communities depend on rain and often feel marginalized in the period of poor rainfall and will likely be triggered into violence in their absence of external support.

Walch (2017), contends that climate change in the past years has led to a situation where insurgent groups take advantage of the frustrations of local populations caused by drought or poor rainfall as part of recruitment drives. When resources get depleted as a result of increased droughts, insurgent groups may tempt the local population their much-needed resources in exchange for their support. There is ample evidence, however, to reject this claim. As Bejaminsen (2016) stated, this causal explanation as too simplistic and points out that historical tensions are at the root of the problem.

In a similar vein, Madu & Nwankwo (2020) analyse the spatial dimension of the farmer-herder conflicts in Nigeria. They observed that, while climate change vulnerabilities may cause conflicts, the regions (in Nigeria) prone vulnerable to climate changes records lesser farmer-herder conflicts. They contend that while climatic hazards could influence herders' migration pattern, there is no evidence of droughts causing farmer-herder conflicts in Nigeria.

In their study on climate change vulnerabilities in the Sahel region of Africa, Joiner, Kennedo, and Sampson (2012) examines the impacts of hazardous climate, population vulnerability, and poor governance as triggers of political violence in the region. They observed that climate change vulnerabilities vary across countries which makes it difficult to generalize the impacts of climate-induced hazards on conflicts in the region (ibid: 20).

On the impacts of climate change on conflicts, Joiner, Kennedo, and Sampson (2012)'s study concludes that factors like ethnic polarization, religious diversity, and extractive industries expose governments' vulnerability – through lack of accountability and responsiveness - in West Africa which creates room for conflicts. Poor governance, they observed, increases the likelihoods of conflicts which causes some ethno-religious groups to feel excluded or marginalized and adapt to climate change. As a result of these, rural communities are prone climate-related hazards with weak adaptive capacities from the state (Ibid: 31).

Couttenier and Soubeyran (2014) explored the link between climatic vulnerabilities and civil war in sub-Sahara Africa. Examining rainfall and temperature as variables, they observed a weak (insignificant) positive relationship between weather volatilities and civil war in Africa. While, like us, Couttenier and Soubeyran set out to establish a strong positive correlation between climate-induced hazards and conflicts, we resisted the temptations to use cross-country data which may not always tell the relationships due to peculiar local conditions. Also, the study examines large scale civil wars which depends on the heavy mobilization of resources and more decisive political, ethnic, and socio-economic factors than climate change.

Most of these studies, like Couttenier and Soubeyran (2014), suffer from the tendency to rely on annual data which are largely aggregated and inadequate to capture in-year variabilities. Also, many based their studies on national data with little or no efforts to observe the subnational variabilities and dynamics because all conflicts have local dimensions (Aas, Buhaug, Falch, and Gates, 2011, Fayomi 2009). Also, most empirical studies attempting to establish direct causal relationships between climate variability and conflict leading to diverse results depend upon methodological issues like design, variables adopted, case studies, or units of analysis (Ide, 2017). Two studies by Gleditsch (2012), Nordås and Gleditsch (2007) analyzed pieces of research on how climate affects conflict events and present different evidence on the climate-conflict relationship. The tendency for scholars' sampling bias led Adams *et al.,* (2018) to conclude that the fact that some studies may have concentrated on a few cases which may have led to biases in the claims made. Also, the link between climate vulnerability and conflicts could be dependent on several other environmentally sensitive variables which include ethno-religious polarization, resource contention, and governance vulnerability (Schleussner, Donges, Donner, and Schellnhuber, 2016).

The farmer-herder conflicts in Nigeria happen mostly in the rural areas which are largely under-reported in the media. Another challenge observed in our search in literature is that most scholars focus on large scale violence like civil war or insurgencies.

This study, on the other hand, firmly establish a model linking drought severity to the incidence of farmer-herder conflicts in Nigeria between 2014 and 2019. This approach provides a more rigorous statistical analysis of data in contrast with much of the current literature. This study focuses on a case-specific context as it largely avoids the issue that the process that links climate change and conflict is statistically obscured due to divergent effects that might affect cross-country studies. Restricting the analysis to a single case can help account more easily for the common historical social and political factors that have shaped society. As such, as far as we know, studies that offer a quantitative analysis of the link between the intensity of climate-induced hazards and farmer-herder conflicts in Nigeria are scanty.

Nigeria: Climate Vulnerability in the West African Conflict Model

To adequately situate our study, we need to understand Nigeria in West African contexts. West Africa's geography has shaped Nigeria's cultural demographics and political economy. Due to dense forests, the region is an ideal location for the formation of distinct ethno-religious groups across the landscape. Most West African countries are multi-ethnic and religiously diverse. Nigeria alone is home to over 250 distinct ethnic groups. Also, an important political dynamic of West African counties is a distinct North-South divide between Muslim and Christian religious groups. For about a millennium, the Islamic religion spread from North Africa to West Africa but halted by the dense tropical forest. At about this same period, the Europeans had contact with coastal populations and spread Christianity towards the North but were resisted by Islamists (Stanford Program on International and Cross-Cultural Education, 2009). This religious divide is evident across West African countries and Nigeria in particular. These religious and ethnic diversities have created tensions, acrimonies, and competitions among national groups over control resources. These tensions have led to civil wars, ethno-religious conflicts, and electoral violence such as recurrent coups in West Africa over the past three decades (Moran 2011; Siollun 2009, 2013).

Nigeria possesses an abundant deposit of minerals and other natural resources. The country is rich in oil and natural gas deposits, with the government primarily depending on the exploitation of oil for government revenue (de Oliveira 2007, Siollun 2009).

The mining industry in Nigeria accounts for a small portion of global trade in minerals like many of its counterparts in West Africa. However, her rich, untapped mineral deposits continue to be a source of worry for many. Illegal mining of minerals has accounted for many violent deaths in some parts of Nigeria with the most recent case being Zamfara, North-West Nigeria. Oil extraction requires huge logistics, capital requirements, and efficient handling at every stage. Despite these, some armed groups have found ways to get involved in illegal mining through the use of cheap and locally-made implements to finance illicit operations. These illegal extraction activities has contributed in no small ways to the "resource curse" and people's vulnerability to climate hazards.

The Inter-governmental Panel on Climate Change (IPCC) in 2007 estimated that West African countries were vulnerable to climate changes. The projections of changes in rainfall, droughts, and climate-induced hazards in the region may vary but will continue to be a source of concern about the abilities of countries to adapt or cope with more extreme seasonal droughts in the north and overflooding in the south. There have been some severities in droughts in the region's history and the last two decades have taken a substantial toll on the livelihoods and food security of hundreds of thousands of people (Jackson School of Geosciences, 2009).

As the severity of droughts increases in some regions and decreases in other places, people's vulnerabilities to climate-induced hazards as a result of their reliance on climate-dependent socio-economic activities such as agriculture, herding, and fishing. Most Nigerian rural dwellers engage in subsistence farming who depend on rain-fed agricultural practices during planting seasons and harvest decisions. The volatile weather makes farmers vulnerable to failed crops, loss of income, hunger, and huge debts. Also, a significant number of rural populations are herders. Like the farmers, herders depend on stable weather to keep the soils healthy enough for their animals (cattle) to graze. The herders, mainly pastoralists, are particularly vulnerable to drought because herders tend to reside in relatively dry areas or deserts. There have been stringent attempts by the Nigerian government to limit the mobility of pastoralists, coupled with the drying of the Sahel region, have been identified as a source of conflict in Nigeria (Adigun 2019). Despite successive government's best efforts, Nigeria's agriculture is still largely primitive or subsistence in the rural areas with certain activities synonymous with particular ethnic groups, such as the herdsmen (who are largely ethnic Fulani). Due to disputes related to herders trespassing people's lands, there has been an increase in the clashes between the Fulani herdsmen and local farmers over the years (Adigun 2019), because of the seemingly irreconcilable differences with both groups.

The farmer-herder violence has largely escalated due to the use of guns which possess far more lethal impacts than machetes, knives, broken bottles etc. since 2014 according to Nigeria Watch and Nigerian Security Tracker databases. Most notable examples of violence between the two groups are the 2018 New Year Day attacks by herdsmen on a community in Benue state, North-Central Nigeria and later attacks on Mambilla Plateau, a Fulani community in Taraba state by local militias killing 20 persons and stealing of over 300 cows in the process.

Nigeria faces other vulnerability including sea-level rise and deforestation due to its intemperate climate. The sea level is rising as ocean temperatures increase, and large urban coastal populations will be particularly vulnerable to these changes. The Nigerian government have been trying to cope with this challenge of protecting livelihoods as saltwater intrusion changes the composition of agricultural land and destroys fisheries but with little results. With over 25 per cent of Nigeria's population concentrated in coastal cities vulnerable to sea level rise, and the IPCC estimates that more than millions of people who inhabit the coast of the Niger-Delta and Lagos will be hugely affected.

As a result of the link between violence and the stiff competition over resources, there are concerns that rural violence could increase due to fueled by droughts which about 11 states in the Sahelian part of Nigeria (mainly in the Northern part) are currently highly vulnerable (Federal Ministry of Environment, 2018). In the instance of farmer-pastoral conflicts, it is not difficult to imagine the scenario where changes in farming patterns and climate-induced herder migrations could lead to stiffer competitions of access to land, water, and grazing routes thereby giving rise to violence (Federal Ministry of Environment 2018 and Adigun 2019) at a time when there has been a complete breakdown of the traditional mechanisms of conflict resolutions between both parties. Even though this is highly speculative, the empirical aspect of this study will shed more light on the impacts of droughts on conflict risks in Nigeria.

Data Sources and Methods

This study relied on databases, online reports, and authoritative publications. For climate data, this study used the following variables: rainfall, temperature, droughts (as independent variables) with incidents and durations (measured in days) as (dependent variables) for this study.

For climate data – temperature, rainfall, droughts – we relied on data from the Climate-Data.org (https://en.climate-data.org/) which gives both national and subnational (including monthly and yearly) data and the World Bank Climate Change Knowledge Portal (https://climateknowledgeportal.worldbank.org/) which provides a rich data source for temperature, rainfall, droughts, precipitation, and other climatic variables from 1901-2016). The database also contains projections for variables for different countries for the next twenty years (2020-2040).

For state-specific database on droughts, we relied on recent calculations of scholars in the field. We used the Standardized Precipitation Index (SPI) and complemented with maps from Nigeria's

Federal Ministry of Environment's National Drought Plan (2018) (https://knowledge.unccd.int/sites/default/files/country_profile_documents/1%2520FINAL_NDP_Nigeria.pdf). In the absence of reliable nationwide SPI calculations, we created, 1 or 0, which were assigned based on whether the state is prone to drought or not. These values were determined from the geographical map of Nigeria.

For conflict data, we relied on two databases - Nigerian Security Tracker (NST) and Nigeria Watch (NW). The NST (https://www.cfr.org/nigeria/nigeria-security-tracker/p29483) is a project of the Council on Foreign Relations' Africa program, which documents and maps violence in Nigeria that is motivated by political, economic, or social grievances. The database has lists of different forms of violence that can occur – including sectarian, political, religious, or gang violence in Nigeria extracted from online news platforms. The NST database records details of every incident from their locations, weapons used, actors involved, sources of information etc.

The Nigeria Watch (NW) is a research project that monitors lethal violence, conflicts, and human security in Nigeria founded in 2006. The NW (http://www.nigeriawatch.org/index.php?html=10) is hosted by the French Institute for Research in Africa (IFRA-Nigeria) on the campus of the nation's premier University of Ibadan. The project records the durations, deaths, locations, etc. of lethal violence on its website based on both traditional and online media sources.

The authors choose both databases because they have proven to be reliable sources of data since its commencement in 2006 for Nigeria Watch and 2011 for Nigerian Security Tracker. Also, they have a rich history of non-partisanship and credibility which are two essential requirements for a study of this nature. The databases also depend on several sources to generate the data in addition to their field staff. The coding schemes adopted by both databases firmly tally with the design of this study.

The databases overt reliance on newspaper reports suffer from obvious limitations. First, even by Nigerian Security Tracker's admittance, the media can be inherently overt and covert partisan, especially in election periods. There is the tendency to either over (or under) report particular incidents or events and not others or to portray these events in ways that can be prejudicial for various economic or political motives. Therefore, newspaper reports about a sensitive issue like the farmer-herder conflicts may not be fully accurate (Earl, Martin, McCarthy, and Soule, 2004). Also, information about security issues in Nigeria may be grossly exaggerated by political actors during elections or non-governmental organisations (NGOs) for electoral, donor or other purposes. To address these limitations, we triangulate our data sources to avoid relying exclusively on one source of information. Also, we chose a timeframe that covers two election cycles (2015 and 2019) in Nigeria. To further ensure the quality of our data, we took extra steps to independently verify the sources provided to determine the veracity or otherwise of the reports. In doing so, we discovered some of the incidents reported have either been found to be untrue, improperly coded, or news have been deleted from the websites in what constitutes about 5 per cent of what would have constituted part of our data.

These limitations, notwithstanding, we made efforts to compare our data with some other databases to ensure regularity and standardization. The authors extracted information regarding location, incidents, dates, and duration from these sources which are analytically relevant to our study. It was our responsibilities to code, analyse and interpret the data so generated from these sources using Microsoft Excel 2016.

For analysis, we deployed the use of regression (and correlation) analysis – a statistical procedure used "to determine the correlations between two or more variables having cause-effect relations" (Uyanik and Guler, 2013) which also have predictive abilities.

We used the 12 months of the year as units of our temporal analysis and the 36 states and Federal Capital Territory (making 37) as units of our geographical analysis. We grouped these states into clusters or hotspots depending on their vulnerabilities to climate change or intensity of incidents of conflicts. Clustering is used to "identify subgroups or profiles of individuals within the larger population who share similar patterns on a set of variables" (Bolin, Edwards, Finch, & Cassady, 2014). The technique is used widely in criminology, epidemiology, social, and physical sciences (ibid). We came up with three clusters based on the degree of concentration of conflicts and severity of climatic hazards.

Results and Discussions

Based on data from the Nigerian Security Tracker (NST), there were a total of 6274 cases of violence from January 2014 to December 2019 out of which 309 relate to the farmer-herder conflicts leading to 3087 deaths which represent about 5 per cent of violent conflicts in Nigeria. The patterns of these conflicts show a duration of few hours to about 273 days as the case of 2018 as records from the Nigeria Watch (NW) database shows. Also, in the period under review, data from NST and NW show that 2015 witnessed the lowest with 10 cases and 227 deaths, while the conflicts reached the peak in 2018 with 122 incidents and 962 fatalities. The NW database shows that the farmer-herder conflicts spanned 534 days in the years under review. Also, the databases shows that an overwhelming number of the incidents of farmer-herder conflicts took place in the rural areas – outside state capitals and urban centres – which are the hubs of farming activities in Nigeria. Table 1 below shows the summary of farmer-herder conflicts in Nigeria from 2014 to 2019.

Table 1: Farmer-Herder Conflicts, Incidents, and Deaths (January 2014 – December 2019)

	2014		2015		2016		2017		2018		2019	
Month	**Incidents**	**Deaths**	**Incidents**	**Deaths**	**Incidents**	**Deaths**	**Incidents**	**Deaths**	**Incidents**	**Deaths**	**Incidents**	**Deaths**
Jan	1	33	0	0	2	40	7	29	24	194	6	16
Feb	6	72	2	19	4	334	4	42	17	68	2	4
Mar	9	182	2	96	4	25	11	41	23	179	3	19
April	6	131	0	0	9	91	3	35	21	273	4	40
May	2	4	2	35	3	27	8	79	11	85	6	33
June	5	82	1	8	8	68	2	3	11	74	1	7
July	1	11	1	40	7	23	3	55	3	14	2	3
Aug	0	0	0	0	6	43	0	0	6	35	2	3
Sept	2	14	0	0	3	4	0	0	4	15	3	8
Oct	2	34	1	7	5	69	3	41	2	25	1	1
Nov	0	0	1	22	3	40	3	57	0	0	4	22
Dec	0	0	0	0	3	12	6	19	0	0	2	20
Sum	**34**	**563**	**10**	**227**	**57**	**776**	**50**	**401**	**122**	**962**	**36**	**176**

Source: Authors' Compilations from Nigerian Security Tracker database

The data further revealed that Adamawa, Benue, Kaduna, Nasarawa, Plateau, and Taraba States account for 236 cases and 2816 deaths in the period under review while states like Bauchi, Gombe, Kano, Lagos, Osun, Sokoto, and Yobe recorded no incident of farmer-herder conflicts in the period.

In this study, we investigate these numbers using temporal and geographical analyses with variables relating to climate hazards and vulnerability to interpret their patterns. The next section will be devoted to this.

Climate Hazards and Farmer-herder Conflicts: Temporal and Geographical Analyses

The timeframe nationwide regarding the farmer-herder conflicts shows a rapid and steady increase in cases and lethality since 2016 according to both Nigeria Watch and Nigerian Security Tracker databases. The database shows the farmer-herder conflicts have produced 34 cases (with 563 deaths), 10 cases (with 227 deaths), 57 cases (776 deaths), 50 cases (401 deaths), 122 cases (962 deaths), and 36 cases (176 deaths) in 2014, 2015, 2016, 2017, 2018, and 2019 respectively. The Nigeria Watch database reports the conflicts lasts over two days or have possibilities of retaliatory attacks. However, the yearly breakdowns of the farmer-herder conflicts do not immediately reveal their relationship with climatic hazards, vulnerabilities, and sensitivities since 2014.

The monthly breakdown of the conflicts durations and incidents may provide some important clues to the relationship between the conflicts and climate variations. Taking a cursory look at the table below, we can see that the conflicts tend to be more intense at the beginning of the year than any other part. As Figure 1 shows, there exists a similar pattern between the incidents of farmer-herder conflicts, deaths, and their durations.

Table 2: Durations of Farmer-Herder Conflicts in Nigeria (January 2014 – December 2019)

	2014	2015	2016	2017	2018	2019
Month	**Durations (in days)**					
January	4	0	6	6	62	10
February	1	2	3	3	28	10
March	4	1	4	12	28	13
April	0	8	9	2	60	16
May	1	0	3	6	28	12
June	2	4	1	2	22	8
July	2	3	3	2	93	
August	2	6	0	4	10	3
September	0	3	1	3	11	3
October	1	1	0	12	6	8
November	4	4	1	14	3	4
December	1	2	1	12	6	5
Total	**22**	**34**	**32**	**78**	**273**	**95**

Source: Authors' Compilations from Nigeria Watch database

Table 2 shows that the first four months of the year – which records the least amount of rainfall and often the hottest in many states (according to Climate-Data.org) – tend to have the most prolonged conflicts. With averages of 15, 8, 10, and 15 days of farmer-herder conflicts in January, February, March, and April respectively, the data shows that these months may not only be climatically volatile, but the spark of conflicts may be longer than every other month in the year.

The months of May to August -which cover the farming seasons - took the nest highest average in durations of the farmer-herder conflicts with averages of 9, 7, 4, and 4 days respectively.

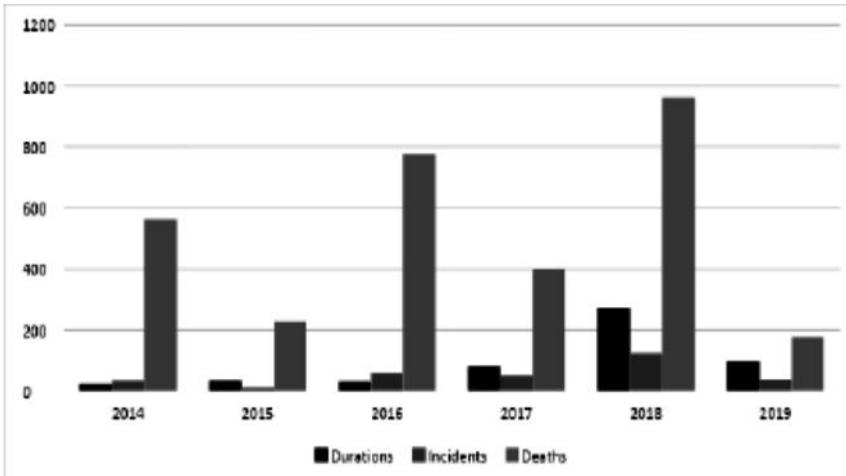

Figure 1: Incidents, Deaths, and Durations of Farmer-Herder Conflicts in Nigeria (2014-2019)

Source: Authors' Compilations from Nigeria Watch and Nigerian Security Tracker databases

The data also shows the last four months of the year – September, October, November, and December – equally record high durations. So far, our temporal analysis has not shown any evidence of the relationship between climatic variations and farmer-herder conflicts. But, with the average of the January to April summing up to 48 as against 24 for May-August and 19 for September to December, we shall, therefore, be running further tests to examine this relationship. Table 3 shows the average monthly rainfall, temperature, incidents, and deaths in the period under review.

Table 3: Average Monthly Rainfall, Temperature, Incidents, and Duration (2014-2019)

Month	Temperature	Rainfall	Incidents	Durations
Jan	25.32	1.82	6.67	14.67
Feb	27.85	5.26	5.83	7.83
Mar	30.41	39.26	8.67	10.33
Apr	30.63	59.29	7.17	15.83
May	29.68	112.02	5.33	8.33
Jun	28.31	165.91	4.67	6.5
Jul	26.7	148.69	2.83	3.67
Aug	25.77	235.39	2.33	4.17
Sep	26.49	217.26	2	3.5
Oct	27.68	108.45	2.33	4.67
Nov	27.26	10.13	1.83	5
Dec	25.01	2.08	1.83	4.5

Source: Authors' Calculations and Compilations from World Bank Climate and Climate-Data.org databases.

When the data was subject to regression analysis, we saw a strong positive correlation (0.6562) between temperature and the incidents of farmer-herder conflicts and another significant relation (0.4593) with the durations of the conflicts. The data equally shows negative correlations between rainfall, incidents, and durations of the conflicts. The negative correlations between rainfall and incidents (-0.3916) and durations (-0.4862) simply mean lower rainfall (especially at the begging of the year) tend to increase the incidents and durations of the farmer-herder conflicts. These results are summarized in the table at the Appendix.

These results seem to confirm the findings of von Uexkull (2014) and Fjelde and von Uexkull (2012) which found that low rainfall tends to increase the risks of conflicts in rural Africa. However, the p-values depicting the relationships between incidents, durations, and rainfall are 0.2081 and 0.1089 respectively which are greater than 0.05. This shows that our data may not be statistically significant for us to conclude on the relationship. The p-value for the regression between the incidents of farmer-herder conflicts and temperature shows greater significance at 0.0205 which is less than 0.05. with this, we can conclude with over 95 per cent confidence that there is a significant positive relationship between temperature variation and the rising incidents of the farmer-herder conflicts.

Excessive temperature arising from climate volatility can lead to severe crop damage or poor output. And, with little or no hope of support or subsidies from the government, herders' incursions into farmlands – especially during the dry seasons or periods of low rainfalls can trigger violence between the farming and herder communities in large scales. As observed by von Uexkull (2014), seasons of poor harvests or severe crop damage in farming communities will likely be triggered into violence in these delicate periods of climate vulnerabilities.

In our temporal analysis, unlike the study by Couttenier and Soubeyran (2014) which explored the relationship between climatic volatility and civil war in sub-Sahara Africa, we found a positive relationship between temperature and the increasing incidents and duration of the conflicts on the one hand. And, like Couttenier and Soubeyran, we found a relatively weak positive relationship between rainfall and the incidents of farmer-herder conflicts in Nigeria. Also, like Couttenier and Soubeyran, our data shows the p-values depicting the relationships between incidents, durations, and rainfall are 0.2081 and 0.1089 respectively which are greater than 0.05. This agrees may not be statistically significant to make a firm connection between rainfall, incidents, and durations of the farmer-herder conflicts. Unlike Couttenier and Soubeyran, what our study did not do is to fall into the temptations of using cross-country data which may not always tell the relationships due to peculiar local conditions. With our study focusing strictly on a single case – Nigeria's farmer-herder conflicts – our temporal analysis found evidence that the conflicts could be linked to climate vulnerability. We also did not rely on too many aggregated data in this study.

The geographical analysis of the patters of the farmer-herder conflicts shows the clusters and hotspots of the conflicts since 2014. Our exploratory analysis reveals that Adamawa, Benue, Kaduna, Kogi, Nasarawa, Plateau, and Taraba states account for 236 (77 per cent) of the incidents of farmer-herder conflicts leading to 2816 (or 71 per cent) deaths in the period under review. The locations of these states, except for Adamawa, shows they are in the "Middle Belt" area of Nigeria where religious identities get complicated with ethnicity (Dayil 2015, Egwu 2011). Most of these states have a history of ethno-religious conflicts (Dayil 2015, Egwu 2011) and are surrounded mostly by states prone to climatic hazards such as desertification, droughts, and ecological disasters. This seems to explain why the conflicts have often been tagged "Fulani herdsmen killings" "invasion", "attacks" etc. in the media (Adigun 2019) which appears to complicate the problems.

While many people seem to have made the conflicts an ethno-religious issue in the Middle Belt, many aspects of criminal activities have been tagged as committed by "Fulani herdsmen" in other places like kidnapping, assassination, robbery, or rape. In 2018, after series of attacks in Benue communities, some Tiv residents in Oke Ako area of Ikole in Ekiti state killed a herdsman reportedly as a retaliation to the mass burial of some 73 persons reportedly killed by herdsmen in Benue state. It took the intervention of the state Governor, Ayo Fayose, to broker a peace meeting in what would have led to bloodletting in the state.

Taking a look at the map (in Figure 2), we noticed that 11 states in the northernmost part (the Sahelian region) of Nigeria - Borno, Bauchi, Gombe, Adamawa, Jigawa, Kano, Katsina, Yobe, Zamfara, Sokoto and Kebbi are some of the most vulnerable states to droughts. Odoh & Chilaka (2012) reports that about 35% of fertile lands about five decades ago have now been seen off by the forces of droughts, desertification, and other climatic hazards posing serious threats to the livelihoods of 15 million farmers and pastoralists (Odoh & Chilaka, 2012). More frightening is the fact that these states, according to some estimates, could become mere dunes in the next two decades (ibid). According to recent World Bank estimates, droughts in the north may get more severe in the next few years which may threaten livelihoods production for both farmers and herders (https://climateknowledgeportal.worldbank.org/).

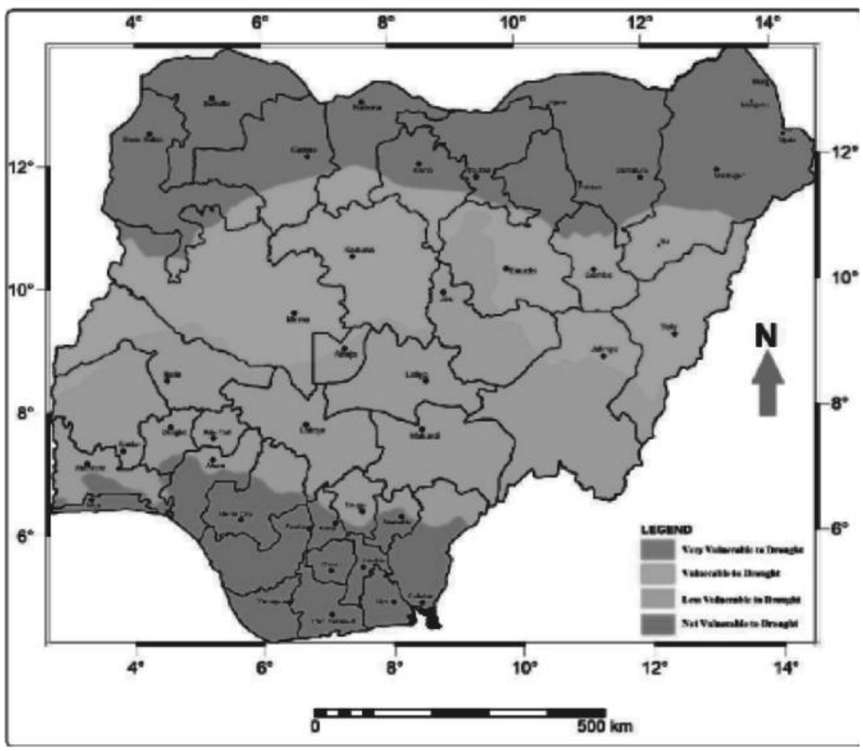

Figure 2: Nigeria's Drought Vulnerability

Source: Federal Ministry of Environment, National Drought Plan, 2018

The coastal states of Delta, Akwa Ibom, Rivers, Lagos, Bayelsa, Anambra, and Abia States are less prone to droughts or desert encroachment largely due to proximity to water and fertile lands. Even at that, Delta state has recorded more incidents of farmer-herder conflicts than Bauchi, Gombe, Kano, and Yobe States put together even though these states face some of the worst incidents of droughts and desert encroachments. The "Middle Belt" states' record of droughts ranges from mild to moderate droughts.

To establish the relationship between droughts (and other variables) and farmer-herder conflicts in Nigeria, we shall be running a regression analysis.

When we ran a regression analysis between the drought indices for the seven hotspots (Group A) states – Adamawa, Benue, Kaduna, Kogi, Nasarawa, Plateau, and Taraba, the results showed some interesting results as shown in the table in the Appendix.

From the table in the Appendix, we can see that our data points to evidence that there is a relationship between drought – as measured by Standardized Precipitation Index (SPI) – durations and incidents of the farmer-herder conflicts in Nigeria. The positive correlations between SPI and the incidents as given by 0.152034 are not too strong to make an emphatic claim to the effect that drought severity may account for the increasing incidents of the conflicts. But, it certainly points to the fact that there is a shred of evidence that some climatic hazards may actually fuel the conflicts. Also, the relationship between drought and the durations of the conflicts is given by 0.34553. These two results point to the fact that relationship exists between the two.

When the dummy variables for droughts vulnerability were, there were no states in the seven hotspots states that could be classified as "Very Vulnerable" to drought, so the "0s" were recorded all through. Even though most of them are classified as states as "Less Vulnerable" to droughts, they still recorded a positive relationship (0.514896547 and 0.271101234) with duration and incidents respectively.

In the 20 Group B states which are medium hotspots and low droughts. There was a negative correlation (-0.092080105 and -0.027007306) between states that are vulnerable to droughts and duration and incidents respectively. The weak negative correlations in these states – most of them in the South-South and South-East of the country shows that droughts may not be too much of a factor causing or triggering the conflicts in those parts of the country. The fact that the coefficients are closer to 0 suggests there may be no relationship between the conflicts and droughts in those areas. These results seem to be in line with Butler & Gates (2012) who note that high droughts discourage fighting.

In the 10 states in Group C which recorded the least of incidents of farmer-herder conflicts yet are the most vulnerable to droughts and desertification in the country. Most of these states are in the Sahelian region of the country. The coefficients shows there are positive relationships (0.216644561 and 0.259259259) between duration and incidents of the conflicts. The data here points to the fact that there may be evidence of likely conflicts in regions prone to droughts between farmers and herders.

These results seem to be in line with the study carried out by Maystadt, De Luca, Sekeris, and Ulimwengu (2014) which explores the possible links between regional and monthly weather variation and conflict in Somalia. Their work concludes that there is a strong link between droughts, measured by temperature anomalies, and the protracted unrest/conflicts in the Horn of Africa. And, as Adams, Ide, Barnett and Detges (2018) observed that most studies in this area tend to focus squarely on areas where violence already occurred. Our study as shown by these results, however, rely on data from areas *historically* vulnerable to conflicts – ethno-religious, electoral, or communal riots – to be able to arrive at its conclusion.

In studying the spatial dimensions of farmer–herder conflict in Nigeria, Madu & Nwankwo (2020) argue that since the regions prone to eco-violence in Nigeria actually recorded the least incident of farmer-herder conflicts, there is no basis for the assertion that the conflicts take droughts could instigate the farmer-herder violence. Unlike, Madu & Nwankwo (2020), our study found evidence that droughts can not only induce herder movement in search for greener pastures, their movement also poses, or increases the chances of clashes with farmers due to ever depleting land issues and resources. This is because the states with the highest incidents and durations of farmer-herder conflicts and those with the highest drought vulnerabilities have higher risks of conflicts as our data show.

Summary and Conclusion

This paper situated and examined the impacts of climate hazards on the incidents and durations of the farmer-herder conflicts in Nigerian from 2014 to 2019. Relying on data from several conflicts and climate databases, we found evidence that temperature, rainfall, and droughts as climatic factors that influence the farmer-herder conflicts since 2014.

Based on the temporal analysis, we found the durations and incidents of the conflicts tends to be higher during the dry and hot seasons with little or no rainfall (December to around April). These periods are very delicate, especially after poor harvests, severe crops damage, or unusually low rainfall. The geographical analysis reveals that the conflicts have hotspots in areas less vulnerable to droughts. In areas with no droughts, our data shows there is no relationship between droughts and the farmer-herder conflicts. Our data show that, in areas highly vulnerable to droughts, there is evidence (albeit weak) that climate hazards could trigger the conflicts.

The variables – temperature, rainfall, drought – were rigorously dissected in this paper using a statistical procedure known as regression technique to establish their relationships with the incidents and durations of the farmer-herder conflicts from 2014 to 2019 in Nigeria. Several recent studies by von Uexkull (2014), Fjelde and von Uexkull (2012), Butler & Gates (2012), Madu & Nwankwo (2020), Adigun

(2019), Maystadt, De Luca, Sekeris, and Ulimwengu (2014), Butler & Gates (2012), Olsson (2016), Joiner, Kennedo, and Sampson (2012) and Couttenier and Soubeyran (2014) have been done in the area of climate-conflict link but there has been few which successfully established the connections. Most of these studies found either weak, insignificant, or no relationship between them. This study provides evidence of the link between the hazardous climate and the farmer-herder conflicts in Nigeria. Due to the conflicts' implications on food security, government-funded ranches and irrigation systems should be constructed across the country. Future studies can examine the impacts of climate vulnerability on the ethno-religious polarization of conflicts in Africa.

APPENDIX

RESULTS

1. Temporal Analysis

	Temperature	*Rainfall*	*Incidents*	*Duration*	
Temperature	1				
Rainfall	-0.09	1			
Incidents	0.656	-0.392		1	
	Duration	0.459	-0.486	0.848	1

N=12

2. Geo-spatial Analysis

All States

	Very Vulnerable	*Not Vulnerable*	*Less Vulnerable*	*Vulnerable*	*Duration*	*Incidents*
Very Vulnerable	1					
Not Vulnerable	-0.297775	1				
Less Vulnerable	-0.442325868	-0.4097756	1			
Vulnerable	-0.249423298	-0.231068515	-0.343237617	1		
Duration	-0.30596674	-0.154539328	0.34099462	0.080070399	1	
Incidents	-0.241170378	-0.154179089	0.250658749	0.1231056	0.931259	1

N=37

Group A: High Hotspots and Medium Droughts

	Less Vulnerable	*Vulnerable*	*Incident*	*Durations*	
Less Vulnerable	1				
Vulnerable	-1	1			
Incident	0.271101234	-0.271101234	1		
Durations	0.514896547	-0.514896547	0.903655684	1	N=7

Group A: High Hotspots and Medium Droughts (With SPI)

	Incidents	*SPI*	*Duration*
Incidents	1		
SPI	0.152	1	
Duration	0.904	0.346	1

N=7

Group B: Medium Hotspots and Low Droughts

	Duration	*Incidents*	*Very Vulnerable*	*Not Vulnerable*	*Less Vulnerable*	*Vulnerable*
Duration	1					
Incidents	0.920739159	1				
Very Vulnerable	#DIV/0!	#DIV/0!	1			
Not Vulnerable	-0.023406057	-0.038589903	#DIV/0!	1		
Less Vulnerable	0.078181221	0.054014613	#DIV/0!	-0.816496581	1	
Vulnerable	-0.092080105	-0.027007306	#DIV/0!	-0.272165527	-0.33333	1

N=20

Group C: Low Hotspots and High Droughts

	Duration	*Incidents*	*Very Vulnerable*	*Not Vulnerable*	*Less Vulnerable*	*Vulnerable*
Duration	1					
Incidents	0.216644561	1				
Very Vulnerable	0.216644561	0.259259259	1			
Not Vulnerable	#DIV/0!	#DIV/0!	#DIV/0!	1		
Less Vulnerable	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	1	
Vulnerable	-0.216644561	-0.259259259	-1q	#DIV/0!	#DIV/0!	1

N=10

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