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Climate Variability, Resource Scarcity, and Farmer-Herder Conflict Patterns in Adamawa State, Nigeria

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Abstract

The changing nature of resource access and social relationships between farmers and herders in northern Nigeria is increasingly shaped by climate variability, but there is limited localised evidence to explain this pathway in Adamawa State. This study looks into the socio-economic features of both farmers and herders, factors affecting climate change impacting resources, and the impact of resource scarcity on conflict between farmers and herders. A mixed method design was used, which involved conducting a structured questionnaire survey of 600 respondents representing 766 respondents across six Local Government Areas and key informant interviews. The study questions were answered by descriptive statistics and weighted mean scores. Both groups are found to be low educated, low landholders and income poor, and unexpected rainfall, drought and changing seasonal patterns are important to affect resource availability. Water shortage and farm animals destroying crops are identified as the top causes of conflict. The study finds that climate variability works by scarcity of resources to create continued risk of conflict. State and federal Governments need to provide funding for climate information services, demarcation of grazing reserves and community-based mechanisms for dispute resolution.

Keywords: Climate change, resource scarcity, farmer-herder conflict, Adamawa State, socio-economic vulnerability

1.0 Introduction

Environmental stress is increasing everywhere in sub-Saharan Africa due to climate change. It has a negative impact on the resources of a population, thereby creating competition between populations that rely on land and water for their survival. The ecological systems in Nigeria have been affected due to the increase in temperature, irregular rainfall and the spread of desert condition affecting agricultural and pastoral livelihoods. Climatic changes that decrease the predictability of farming areas and livestock grazing were cited as one of the core factors of violent conflict by Glauber and Olayemi (2020), in an area with resource scarcity. Mamman et al (2018) documented significant loss in resilience of the semi-arid rangelands in the northern Nigeria, which is attributed to weak rainfall and long-dry spells. This general trend reflects the increasing importance of studies that explore the impact of climate pressures on interdependencies between resource dependent communities.

The pressures due to the climate are compounded by the long-standing interactions between farmers and herders that have historically helped with agricultural production in West Africa. In the past, farmers were getting manure from cattle herds and the residues of their crops were used as fodder for livestock by the herders. Adebayo (2021) attributes the loss of this interdependence to increasing population, agricultural expansion and urbanization, which have reduced the grazing space within the region. Glauber et al. (2020a) connect this shrinking directly to increased conflict between farmers and herders in sub-Saharan Africa, which they suggest makes pastoral movement more likely to be a point of conflict. These structural factors have been exacerbated by deteriorating environmental conditions in Adamawa State and are driving more migration to the south by herders in search of water and pasture.

The responses of farmers and herders to climate stress and their vulnerability to conflict are influenced by socio-economic conditions. The farmers of Adamawa State depend primarily on rain-fed farming and seldom have facilities to buffer against shortages in rainfall. Herders are nomadic or semi nomadic and their way of life relies on mobility and availability of open fields for grazing. Sakiyo et al. (2020) report increased deforestation and land degradation in rural communities in Adamawa, which reduce both groups' resource base. According to Food and Agriculture Organization (2019), agriculture in Adamawa State is predominantly rain-fed agriculture with minimal irrigation potentials in the four agricultural zones. Such differences in livelihoods result in uneven exposure to climate risk and alternative land use interests for the two groups.

Land scarcity and the dwindling water sources have created a new scenario in Adamawa State, where farmers and herders used to have disagreements every once in a while, but now the situation is far more contentious and violent. According to Olufunke et al. (2023) such as crop destruction and blockage of grazing areas continue to be the most common immediate causes of conflict in northern Nigeria. Unger (2021) attributes this trend to the reduction in the size of the Lake Chad Basin, forcing herders to migrate deeper into the farming areas in the dry season. International Crisis Group (2018) reports a long-term increase in farmer-herder clashes in Nigeria and cites inadequate institutional capacity in Nigeria to resolve disputes, as well as weak land governance as the causes. These recurring wars lead to a decline in agricultural production, poor health conditions among livestock, and food insecurity among those who are affected.

Although the literature has recognized the impact of climate change on farmer-herder interactions in Nigeria, there is a great gap in the understanding of the dynamics of these interactions in Adamawa State in particular. Researchers have noted changes in rainfall patterns, water scarcity, and temperature increases, but they have not provided much research on the community-level impacts of these changes on access to water and land. Although Olagunju (2015) reports that northern Nigeria is experiencing desertification, he neglects to explore the interaction between the desertification process and the decisions that are being made by households on the farm and in the livestock herding activities in Adamawa State. The lack of trust in local institutions and disintegration of informal agreements underlie conflict escalation (United Nations Environment Programme, 2018) but the pathways by which those failures occur in Adamawa are not well understood.

Another dimension of vulnerability among the farmers and herders of the state that needs to be addressed is the socio-economic profile. Inspite of the fact that most of the evidence on pastoralist vulnerability across the Sahel cited by Ayantunde et al (2014) comes from cross-national comparison, these linkages are drawn between asset ownership and restricted mobility, and to a lesser extent, pastoralist vulnerability. If you don't know the local socio-economic conditions, climate exposure, and resource competition patterns, then interventions could miss the mechanisms that underlie acts of violence as a form of scarcity felt by the local community. This study's problem of concern is the poor understanding of the effect of combination of socio-economic characteristics, climate change factors and resource scarcity on the relationship between the farmers and herders in Adamawa State. This study addresses that gap by characterizing the socio-economic status of both groups, determining the elements of climate space that constrain the availability of resources and examining how a lack of resource leads to conflict.

2.0 Literature Review

2.1 Conceptual Review

Climate change refers to the changes in temperature and weather patterns over a longer timeframe which affects the availability of natural resources upon which rural livelihoods rely. Climatic changes cause reduced predictability of rainfall in Adamawa State, shorten growing period and limit land for farming and pasture. In this context, scarcity of resources means that the available supply of land, water and pasture is not sufficient to support the current farming and pastoralist activities. Glauber and Olayemi (2020) introduce a concept of "resource scarcity" as a threshold between environmental stress and social competition, especially in cases where institutional structures to manage access are weak.

Farmer-Herder conflict is the conflict that occurs when farmers and herders have conflicting interest over land and water resources. They can be expressed in the form of verbal argumentation when damage has occurred in plants, or they can be in the form of organised violence that entails the loss of life and property. Adebayo (2021) sees this conflict as the result of a loss of interdependence between the agricultural and pastoral livelihoods that used to work together through livestock manure exchange and grazing of crop residues. Because of the shrinking resource base with population growth and agricultural expansion, this complementary relationship becomes a competition for the same resources.

Farmers' and herders' ability to cope with climatic stress is determined by their socio-economic condition, including their age, education level, income, household size, and land ownership. In the Sahel, Ayantunde et al. (2014) link low asset ownership and mobility restrictions to increased levels of vulnerability of pastoral households. In Adamawa State, these features combine with climate exposure to create vulnerable households that face resource shocks and vulnerable households that are driven to conflict. A conceptual understanding of climate change, scarcity of resources, and socio-economic vulnerability thus forms the basis for looking at the relationship between environmental pressure and farmer-herder conflict in the study area.

2.2 Empirical Review

Climate variability and competition over resources among farmers and herders is consistently observed in Nigeria.In Nigeria, empirical evidence is consistently related to the link between climate variability and resource competition between farmers and herders. Glauber et al. (2020a) investigated the escalation of farmers/herders clashes in sub-Saharan Africa and discovered that reductions in rain reliability cause herders to enter cultivated areas ahead of the previous decades during the dry season. Their research reveals that this earlier migration results in more livestock crop contact in the most important growing periods, which, in turn, increases the likelihood of a violent encounter. Glauber et al. (2020b) have extended this work to the specific context of pastoralists and farmers in Nigeria, finding that the extent of land-use conflict is exacerbated when pastoralists' formal grazing routes are replaced with cultivated farms without compensation for pastoralists.

Mamman et al. (2018) analysed the resilience of semi-arid rangelands to climate change in northern Nigeria and reported significant reductions in the ability of the rangelands to regenerate pasture as a consequence of a prolonged dry spell. Their research shows that as rangeland becomes less resilient, herders' must travel further to find forage, and as a result, are more exposed to farming communities. Similarly, Sakiyo et al. (2020) reported on the effects of deforestation on rural communities in Adamawa State, where the reduction in buffer zones between grazing zones and croplands reduces the buffer zones that allow rural communities to graze their cattle. The results run along the lines that the competition hypothesis between farming and herding livelihoods in the state is a cause and a result of land degradation.

This is supported by socio-economic evidence. In Oyo State, Adelakun et al. (2015) studied the socio-economic impacts of farmer-pastoralist conflict on agricultural extension services delivery and discovered that farmer-pastoralist conflict disrupts farmer-extensionist contacts thereby limiting improved production information access among farmers. However, Ayantunde et al. (2014) related pastoralists' vulnerability across the Sahel, including Nigeria, with decreased ownership of assets, with households with smaller herds and less diversified income sources being affected by climate-related shocks at a higher rate. The evidence suggests that socio-economic status acts as a mediator between climate exposure and conflict impacts and outcome rather than a background variable.

The effect of these dynamics on the welfare of the community is documented in conflict outcome studies. Abbass (2014) reviewed the historical trajectory of herder-farmer conflict in northern Nigeria and identified two key drivers that lead communities to enter into organised conflict to access survival resources, especially during drought years, rather than negotiated access to resources. Between 2016 and 2018, International Crisis Group (2018) noted that farmer-herder violence in Nigeria had increased through escalation, due to the interaction of climatic pressure and poor institutional capacity. Unger (2021) attributed the southward shrinkage of the Lake Chad Basin to the rise in migration of pastoralists into the center of the farming areas in Nigeria, which he termed as a proximate cause of the farmer-herder conflicts reported throughout the region. Olufunke et al. (2023) analysed the farmer-herder conflict in Northern Nigeria and found that the

immediate triggers of farmer-herder violence that were reported most often by the communities they surveyed were: crop destruction and blocked grazing routes.

Research on the governance gap and its enabling of environmental pressures to spiral into conflict is institutional and policy oriented. However, the United Nations Environment Programme (2018) suggested that collaboration approaches for environmental protection, such as joint resource mapping and community dialogue platforms could help defuse tensions between farmers and herders, particularly in Nigeria, though these are only being implemented in pilot locations. Olagunju (2015) mapped the expansion of drought and desertification in the Nigerian environment and found that the inability to coordinate land management means that environmental degradation is allowed to go on without check, exacerbating resource pressures which fuel conflict. These studies collectively provide a consistent empirical trajectory, namely that climate variability leads to a decrease in resources, that socio-economic vulnerability influences exposure to this resource scarcity, and that institutional capacity is low, leading to escalation of competition into conflict at the community level in Adamawa State.

2.3 Theoretical Framework

This study draws its analysis from Environmental Scarcity Theory of Homer-Dixon (1999). The basic concept of the theory is that low availability of environmental resources may cause violent conflict, especially in areas of poor governance. Homer-Dixon (1999) notes that there are three different types of scarcity that are relevant to this study. Supply induced scarcity is a scarcity that is caused by environmental degradation such as drought and desertification. Demand induced scarcity is caused by population growth which puts stress on a given resource base. Structural scarcity refers to the disparity in access to resources between groups, e.g. when herders and farmers share the same grazing corridors. The theory suggests that providing resources is limited, and institutions are weak, competition for resources may escalate into violence.

Environmental Scarcity Theory suggests that reductions in rainfall and availability of grazing lead to conditions that stimulate herders to shift to farming areas, which is what has been observed throughout the study area, leading to the destruction of crops and encroachment onto routes throughout the area. The theory also accounts for the importance of socio-economic factors because, as resource access decreases, households with low assets and low education level have fewer options, and so are more likely to make use of contested land and water.

In this study, we also rely on the Institutional Analysis and Development framework, which comes with Ostrom (2010), to capture the governance aspect of resource competition. As highlighted by Ostrom (2010), multi-central institutions – where several overlapping entities control over the access to the resource – can facilitate collective action and minimize conflicts over a shared resource. Adopted to the study area, this framework underscores the capacity-impoverishment of communities due to the breakdown of customary institutions such as the local grazing committees and traditional mediation mechanisms, which helps to resolve conflict peacefully among competing users.

Environmental Scarcity Theory, combined with the Institutional Analysis and Development framework, can be used to provide a structured explanation of the pathway followed in this study. Environmental Scarcity Theory explains how material conditions create competition, and Institutional Analysis and Development explains how governing conditions influence the nature of competition, either escalating it into conflict or bringing it to negotiated accommodation. This study's combination of theoretical underpinning links together the three goals, connecting socio-economic vulnerability, climate induced resource scarcity, and conflict outcomes and providing a unified analytical framework.

3.0 Methodology

The study was carried out in Adamawa state of NE Nigeria within latitude 7-11N and longitude 11-14E. The State is about 38,700 square kilometres in size, and has boundaries with both Taraba State and Borno State, as well as Gombe State. The climate in Adamawa is tropical wet and dry, with a dry season from November to March and an average annual rainfall of 700 millimetres in the north west and 1,600 millimetres in the south. The agriculture is largely rain fed, mostly small holdings, with average holdings usually not more than 5 hectares throughout the state and there are a large number of herders throughout the 21 Local Government Areas.

The study was of the mixed method design, which involved a structured questionnaire survey and key informant interviews to elicit measured patterns and contextual narratives of climate change and resource conflict.

The population consisted of 3,921,680 farmers and 55,464 registered herders in the purposively sampled six Local Government Areas (LGAs) of Girei, Song, Maiha, Demsa, Mayo-Belwa and Guyuk, which have been identified as experiencing farmer-herder conflicts.

A multistage sampling technique was used in the study. With a standard table based procedure, the population produced a minimum sample of 382 herders and 384 farmers representing 766 respondents, proportionately distributed to the six Local Government Areas according to their population shares.

A structured questionnaire was designed and used to collect data on socio-economic and five-point Likert scale perception items, while a semi-structured key informant interview guide was used with community leaders, security personnel, judicial officers and community religious leaders.

Objective one was answered using descriptive statistics such as frequencies, percentages and weighted mean scores. For objectives two and three, the scores obtained were weighted means (WMS) calculated by dividing the sum of fiXi by the total number of respondents, n, for each scale point, with fi being the number of times that each scale point occurred. The mean calculated above 3.0 was used to denote that the respondents agreed with a given statement.

4.0 Results

Table 1 shows the socio-economic profile of the 766 respondents who were interviewed in the six selected Local Government Areas. Among the respondents, the gender distribution was 83.6 per cent male and 10.5 per cent female, of whom more farmers than herders were female. The majority of the respondents were in the age group of 40-49 years (37.3 percent) and 79.9 percent of the respondents were married. The educational attainment shows that 34.5% of the total respondents had no formal education, and 44.0% of the herders had no education at all, while 25.0% of the farmers had no education. The data for household size reveals that 56.6 per cent of the respondents indicated that they had seven or more persons in the household. Income figures showed that 48.8 percent of the respondents had an annual income between N100,000 and N500,000, which is indicative of subsistence level production and limited adaptive capacity in both groups.

Table 1: Socio-economic Characteristics of Farmers and Herders in Adamawa State (n = 766)

Variable	Category	Farmers (n=384) %	Herders (n=382) %	Total (N=766) %
Gender	Male	77.6	89.5	83.6
	Female	22.4	10.5	16.4
Age (years)	40–49 (modal group)	34.9	39.8	37.3
Marital Status	Married	76.6	83.2	79.9
Education	No formal education	25.0	44.0	34.5
Household Size	7 and above	50.5	62.8	56.6
Land Ownership	Yes	82.8	77.5	80.2
Access to Grazing Land	Yes	37.0	81.7	59.3
Annual Income (₦)	100,000–500,000	49.0	48.7	48.8

Source: Field Survey, 2026.

Table 2 shows that respondents noted the following factors related to the availability of resources to be affected by climate change, based on a 5 point Likert scale and a decision threshold of 3.0. All five items had weighted mean scores higher than threshold, indicating that factors associated with climate change are important to the reduction of resource availability in the study area. Unpredictable rainfall pattern and the effect of drought and desertification on water sources had the highest weighted mean scores with 4.05 points each. Differentiating seasonal use of farming and grazing lands due to climate change trailed closely with 4.02, as did the decreasing availability of pasture due to rising temperatures (3.97) and the effects of flooding on farmlands and grazing lands (3.94). The results show that climate variability is a regular and quantifiable limitation of resources for the communities studied. The high scores on each of the five items suggest that the perception of increasing climatic pressure to the resource base upon which livelihoods are sustained is shared across farming and herding groups.

Table 2: Climate Change Factors Influencing Resource Availability for Farmers and Herders (n = 766)

Statement	WMS	Decision
Climate change has led to unpredictable rainfall patterns.	4.05	Agreed
Rising temperatures have reduced pasture availability.	3.97	Agreed
Drought and desertification have impacted water sources.	4.05	Agreed
Flooding has affected farmlands and grazing areas.	3.94	Agreed
Climate change has altered seasonal farming and grazing patterns.	4.02	Agreed

Source: Field Survey, 2026. WMS = Weighted Mean Score. Decision threshold = 3.0.

Table 3 shows the impact of scarcity of the resources on the conflict between farmers and herders. Weighted mean scores for each item were above decision threshold of 3.0 for all five items. The top ranked weighted mean scores were for crop destruction by livestock (4.04) and water scarcity as a driver of conflict (4.03). Competition for grazing land and lack of clear land ownership policies were each weighted equally with a score of 4.00, and encroachment on grazing routes earned a score of 3.98. Results indicate that the scarcity of water and the destruction of crops is a direct and measurable driver of conflict, and water scarcity and water access are the most immediate proximate drivers among the six analysed communities. High scores in all five items suggest that there are several simultaneous effects of resource scarcity on the relations between farmers and herders rather than one primary effect.

Table 3: Influence of Resource Scarcity on Conflicts between Farmers and Herders (n = 766)

Statement	WMS	Decision
Scarcity of water has led to conflicts between farmers and herders.	4.03	Agreed
Competition for grazing land has intensified due to climate change.	4.00	Agreed
Crop destruction by livestock is a major cause of disputes.	4.04	Agreed
Encroachment on grazing routes has increased conflicts.	3.98	Agreed
Lack of clear land ownership policies contributes to resource conflicts.	4.00	Agreed

Source: Field Survey, 2026. WMS = Weighted Mean Score. Decision threshold = 3.0.

5.0 Discussion

The socio-economic profile revealed in this study, with low level of education among herders, a near subsistence income and large family size, is similar to the vulnerability profile identified by Ayantunde et al (2014) for pastoral households in the Sahel. There is a higher level of formal education gap among the herders (44.0 per cent) and farmers (25.0 per cent) which is similar to the finding by Adelakun et al. (2015) that extension service delivery disruption during conflict in Oyo State is associated with the asset and access gap between the farmers and the herders. The convergence indicates that the socio-economic disadvantage of the pastoralists of Adamawa State is not a localized phenomenon but a structural problem that exists in pastoral communities in northern Nigeria. In regions where formal education and multiple income sources are limited, households have fewer options to access land and water resources in the face of climate stress, thereby becoming more reliant on competing land and water used for grazing and farming. The size of households in this study, as it was found that more than half of the population had seven or more members, further exacerbates this vulnerability because of the pressure larger households are already facing on a constrained land space, which is further reducing as a result of climate stress.

The climate change results, especially the high weighted mean scores of unpredictable rainfall means and drought-induced water scarcity mean, are consistent with the pattern observed across the semi-arid rangelands of northern Nigeria by Mamman et al. (2018). The decline in rangeland resilience cited by the authors leads to increased herder travel to find forage, which may account for the high scores respondents in this study gave to seasonal pattern disruption. The outcome also corresponds with that of Sakiyo et al. (2020) which showed that through deforestation and land degradation, the buffer zones that were once between the grazing corridors and farmland are being reduced in rural Adamawa communities. In this study, the scores for altered farming and grazing are high, as are the chances of unintended contact between crops and livestock where degradation decreases the physical distance between cultivated and grazing land. The scores for rainfall unpredictability and drought induced water scarcity were nearly equal (both > 4.0), implying that the respondents in Adamawa State view these two climate stressors as reinforcing climate challenges in their lives, which has implications on the sequencing of adaptation programming.

The results on resource scarcity suggest that it was the destruction of crops and water access that were the main factors causing conflict, a trend that was also observed by Olufunke et al. (2023) in the communities they surveyed in Northern Nigeria. In their research, they too identified proximity of blocked grazing routes and damage to crops as the most immediate proximate causes of violent clashes, not political or ethnic grievances. The uniformity of the samples across the various geographic regions increases confidence in the likelihood that the confrontations reported in Adamawa State are not only driven by identity conflict but also by resource competition. The result also corroborates Glauber et al. (2020b), who associated land use conflict intensity with the replacement of formal (compensated) grazing routes with farmland, which is what was found in almost all cases in this study sample. In a similar vein, during drought years, competition for survival resources drive the communities to organised confrontation instead of negotiated

resource sharing (Abbass 2014), which is still the case in this study as the communities have a high conflict score.

The results have significant implications for the organisations, policy makers and other stakeholders involved in resource governance in Adamawa State. Education needs of herder communities should be targeted with adult literacy and vocational training programmes focusing specifically on this community, as this was identified by Adelakun and colleagues (2015) as a gap in education which impacted their access to formal channels of dispute resolution. There is consistency across this study and previous studies that rainfall unpredictability and conflict risk are linked, and state and federal governments should consider climate monitoring and early warning systems as infrastructure investments and not programming. Demarcation and enforcement of grazing corridors are a priority for land use authorities as the findings on encroachment align with the problems of institutional shortcomings cited by the International Crisis Group (2018) and the United Nations Environment Programme (2018) as the root of farmer-herder violence in Nigeria. Conflict mediation programming and livelihood diversification support should be integrated in development organisations' work in areas of high socio-economic vulnerability and resource scarcity, acknowledging that vulnerabilities and resource scarcity are not mutually exclusive but are, in fact, mutually reinforcing in determining the outcomes of conflict. The traditional and religious leaders, who still play an important role in resolving a significant proportion of conflicts in the study populations, should be supported and trained to do so in a structured manner to build their capacity to resolve conflict before it spirals into the organised violence observed in earlier Nigerian studies.

6.0 Conclusion and Recommendations

The main objective of this study was to explore the socio-economic profile of farmers and herders in the Adamawa State, climate change drivers of resource availability and climate change resource scarcity impacts on the farmers/herders conflict dynamics. The results reveal a significant socio-economic vulnerability in both groups, with a low level of education, especially for herders, limited earnings, and high household size. The climatic stress scores ranged consistently high for the factors of climate change, such as unpredictable rains, drought induced water scarcity and changes in seasonal patterns, indicating that climatic stress has measurably affected the resources of both farming and herding livelihoods. Resource scarcity is then directly linked to conflict, with the destruction of crops by livestock, and water access, the two most direct proximate causes of conflict in the six LGA surveyed.

The study has shown a logical pathway by which climate change contributes to the maintenance of conflict risk between farmers and herders in Adamawa State, namely through the reduction of the available resources and the presence of existing socio-economic vulnerability. This pathway is not only unforeseen but also not limited to individual cases where the weighted mean scores on the climate and conflict components are consistently above the agreement threshold throughout the sample. Nevertheless, the convergence of these findings with the empirical pattern observed in previous studies in Nigeria suggests that the Adamawa State condition is not a unique case, but

represents a broader pattern of events across the country, while the specific proximate triggers (including loss of crops and access to water) remain of particular local importance for policy design.

Based on these findings, the following recommendations are made: The Adamawa State government should give more attention to demarcating and legally protecting the use of grazing corridors to minimize encroachment of the grazing routes that respondents reported was the major conflict driver affecting the region. Increased expansion of climate information service and early warning systems across the six conflict prone LGAs by the State and Federal agencies as there is a strong relationship between the rainfall unpredictability and the competition over resources that have been documented in this study. Extension facilities must develop specific programmes for adult literacy and vocational training for herder communities to address the lack of training in herder communities, which is an obstacle to their involvement in formal dispute resolution mechanisms. Investment in common water infrastructure in communities where the water comes from boreholes or wells both for human and animal use should be made by development organisations and local governments as access to water is still one of the most pressing causes of conflict. Last, but not least, capacity-building support must be provided to traditional and religious institutions that remain as go-betweens between these communities, in a structured way, in order to enhance their capacity to prevent escalation.

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