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Journal of Ecopolitics, Peace, and Sustainable Development (JEPSD)

Investigating the Land Uses Dynamics for the Application in Farmers Herders Crisis Using Geospatial Techniques in Parts of Kebbi State, Nigeria

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Article Information

https://doi.org/10.69798/82818014

Published by: Koozakar LLC. Norcross GA 30071, United States.

Edited by:
Prof. José Mvuezolo Bazonzi
Prof. Benjamin Mwadi Makengo

Abstract

For decades, substantial progress has not been made in mitigating farmers herder's conflicts despite inter-communal transformations, revitalizing the traditional institutions and series of conflicts resolution mechanism, and Nigeria is not in exceptions. This study aims to analyze the spatial variation of land use dynamics in the study area between 1981 and 2021; identify the conflict zones and suitable areas for grazing or farming; examine the impact of the land use dynamic on the livelihoods of both pastoralist and rural farmers in Kebbi State. Primary and secondary datasets were used for this study. Primary data through questionnaire administration was used to extract socio-demographic, conflict information on sampled respondents of Bagudo, Bunza, Koko-Bese, Shanga and Suru local government areas. Secondary data through acquisition of multi-temporal satellite images were analyse and interpret the data on land use dynamics. A change detection method was then used to assess the changes in land use/cover units between 1982, 1992, 2002, and between 2012 and 2022 (Rawat and Kumar, 2015). The analysis revealed that the landscape had undergone changes of 82.4% within the years, change was intensified with about 37.3% from 1982 to 2002 and other changes of 45.1% from 2002 to 2022 having an average range of 18.7 and 22.6 respectively. The findings underscore the urgency of implementing robust conflict resolution strategies, sustainable land management practices, and environmental conservation measures to mitigate the socio-economic and ecological impacts of these conflicts.

Keywords: Investigating, Land uses dynamics, Farmers herders, Geospatial techniques

INTRODUCTION

Numerous crises have been conducted over the time in Nigeria on the alarming farmer's herders clash (Tukura & Tukur, 2023; Olaniyan *et al*., 2015; Olayoku, 2014; Okeke, 2014). In the past, crop producers and the pastoralist groups had a cordial and stable relationship that enables the people to work side by side for decades. This interdependent relationship is evident that both groups depend on each other for survival, and it formed the benchmark for exchange and which brought about even development (Shettima and Tar, 2008). Herdsmen and farmers crisis have remained the most predominately resource-use crisis in Nigeria. The necessity to provide good governance has been hampering by the activities of herdsmen. The herdsmen/farmer crises have demonstrated high potential to exacerbate the insecurity in rural communities where most of the crises are localized, with reverberating repercussions nationwide (Beetseh, 2018).

The farmers-herders crisis in Nigeria poses a significant threat to food security, peace, and sustainable development (Udosen, 2021). This recurring conflict is driven by competition for land resources, with herders seeking grazing areas and farmers protecting their crops (Udosen, 2021).The crisis has resulted in loss of lives, property damage, and displacement of communities (Udosen, 2021; Erondu & Nwakanma, 2018). New dimensions to the conflict include political, religious, and ethnic factors, further complicating resolution efforts (Erondu & Nwakanma, 2018). The crisis reflects a failure of governance and has far-reaching socio-economic implications (Beetseh, 2018; Erondu & Nwakanma, 2018). Proposed solutions include strengthening security measures, implementing reorientation programs, and adopting ranching practices (Udosen, 2021; Beetseh, 2018). Additionally, addressing the root causes of the conflict and fostering social interaction between different groups are crucial for achieving lasting peace (Lamidi *et al*., 2024; Udosen, 2021).

Similarly, Monod, (2018) noted that the survival of pastoralist was formed under interaction with sedentary farmers. Thus, it becomes apparent that the interdependent linkage flows as each group needs water, land, fodder and other land use for their economic activities. Unfortunately, such of relationship that existed for centuries has been truncated with many disputes arising across the regions that have grown into widespread violence, deaths, and internal displacement of persons. Despite series of efforts to curb this crisis while neglecting land use conflicts in the northern region where Kebbi State is located is now breeding serious threat to the existing peaceful coexistence in the state.

Although herdsmen and farmers have co-existed since the inception of agriculture (Okoli and Atelhe, 2014), the prevalence of these clashes in the Sahel zones of Nigeria has been upturned due to the fact that cattle herdsmen of the lower Guinea savannah zone and Sudan savannah areas are now migrating towards the Sahel areas zone and gradually becoming native in the zone where they find greener pasture for their herds (Murtala, 2014). In Kebbi State, disputes ranging from communal to ethno-political clashes had sprung-up in the recent times leading to land use change which had affected the grazing corridors and farming areas. In view of this, shortage of rangeland for grazing and attacks by villagers/farmers when there farms are encroached or invaded had propelled herdsmen devising new means of protecting themselves and animals with guns which had led to theft cases, competition and infringement on the territories of farmers, thereby causing destruction of crops, loss of life for both humans and animals (cattle) during clashes, resulting in food crop shortage and security challenges in the local social structure. In recent times, a large area of land in the Kebbi State, which lies within the Sahel areas zone, has been ripped of its land function giving way to rapid encroachment of land to a different use which leads to clashes in communities which prompted the bedrock of this study. Series of research studies have been carried out on land use and land cover change in various parts of Nigeria, the uniqueness of land use change is that changes are time bound and change agents most times are affected by varying factors such as environment, cultural, technological or demography that also change with time and associated with conflict.

Also, land use alteration has influenced climatic conditions in the state as climate change studies and recordings on climatic parameters had indicated significant shifts from the prevailing climatic condition due to the nature and anthropogenic activities over a long period of time affecting major ecological conditions (Odjugo, 2010). The country's conflicts and crisis are growing at alarming rate and the same rate applies to Kebbi

State, hence the need to understand the raising criminality in the rural environment between the host farming community and the pastoralist. This study seeks to analyse the spatial variation of land use dynamics in the study area between 1981-2021; identify the conflict zones and suitable areas for grazing or farming in the study area; examine the impact of the land use dynamic on the livelihoods of both pastoralist and rural farmers in the study area.

METHODS

Study Area

Kebbi State is located in the north-western part of Nigeria with its capital in Birnin Kebbi. The State was created out of the then Sokoto State in 1991. Kebbi State is bordered by Sokoto State to the North and East, Niger State to the South, Dosso Region in the Republic of Niger to the Northwest and the Republic of Benin to the West.

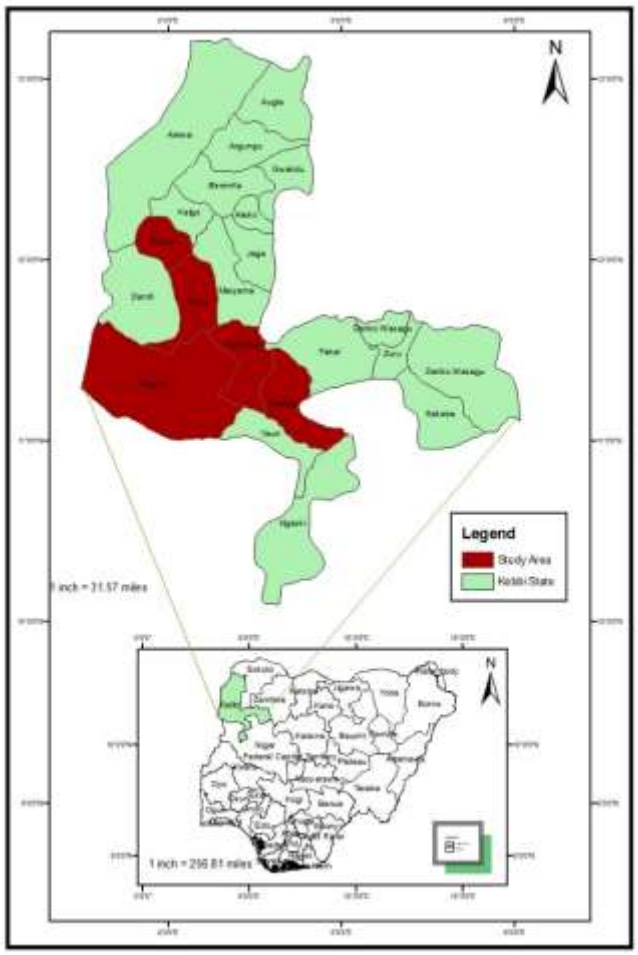

Figure 1: Map of the Study Area
Source: Authors Analysis (2024)

The State has a total land area of 36,985 Sq. Km and an estimated population of 4,617,431 according National Bureau of Statistics (2018). The State enjoys a tropical type climate, which is generally characterized by two extreme seasons: the hot and cold temperatures. Mean annual temperatures vary considerably but usually range between 70oF and 100oF, while mean annual rainfall is about 500mm. There are 21 Local Government Areas in the State. The main ethnic groups are Hausa, Fulani, Zabarmawa, Kambari, Dakarkari, with minor tribes like Yoruba, Nupe and Igbo. The main occupations of the inhabitants are farming, rearing of animals, trading and fishing. Islam and Christianity are the predominant religions with some practicing traditional religion. Like most states in the region, Kebbi State has low socio-economic indicators.

Data Acquisition

Primary and secondary datasets were used for this study. Primary data through questionnaire administration was used to extract socio-demographic, conflict information on sampled respondents of Bagudo, Bunza, Koko-Bese, Shanga and Suru local government areas. Secondary data of Topographic map (1992) and Grazing route map (1989) covering the study area was acquired from the department of Geography, Federal University, Birnin Kebbi and updated using the Google earth visualizer (2022). Conflict information was downloaded from the Nigerian Bureau of Statistics website (http://factsnigeriaviolence.org/spreadsheet/2014-2/). Four Landsat images of 3 April 1992, 6 February 2002, 7 May 2012 and 6 December 2022 of the Landsat world reference system path 188 and row 053 scene and SRTM (2022) elevation data covering the study area were obtained from the United States Geological Survey website on earth resources observation and science centre.

Data Processing

Method Analysis

Soft wares that were be used for the analysis to include: ArcGIS, TerrSet and MS Excel. The statistical package for MS Excel were be used to analyse and interpret the data from questionnaire and interviews. Data obtained from the questionnaire survey were be analysed and displayed in tables and bar charts. TerrSet were used in image interpretation and analysis while

Data	Location on WRS	Dimensions (in Pixels)	Acquisition Date	Resolution/ Scale	Source
Landsat Imagery (TM 1992)	Path 188 Row 53	7772 x 7315	03/04/1992	30m	GLCF
Landsat Imagery (ETM^{+}2002)	Path 188 Row 053	8061 x 7021	06/02/2002	30m	USGS
Landsat Imagery (OLI-TIRS 2012)	Path 188 Row 053	7549 x 8707	07/05/2012	30m	USGS
Landsat Imagery (ETM^{+}2022)	Path 188 Row 053	8061 x 7021	06/12/2022	30m	USGS
Administrative boundary map	-	-	-	1:1000	OSGOF
Topographic Information	-	-	2022	1:50,000	Global Mapper software
Conflict data	-	-	-	Digital MS Excel format	http://factsnigeriaviolence.org/spreadsheet/2013-2/
Grazing route map	-	-	1989		Geography Department, Federal University Birnin Kebbi
SRTM	-	-	December, 2022	30m	USGS

Source: Authors Analysis (2024)

ArcGIS were used in geospatial data processing and analysis.

Image pre-processing

The satellite images were processed and stacked up in TerrSet software version 2020 to produce an enhanced image composite (channels 4 in red, 3 in green and 2 in blue) for Landsat-TM and ETM+ data. The spectral channels combined produced false colour composite (FCC) display, among other multi-spectral combinations as described in Mohammed and Mostafa, (2021) and Raphael and Joseph, (2018). A shape file defining the boundary of the study area was used to mask the interest area from the Landsat satellite imageries.

Image Classification

Adopting Anderson (1976) classification scheme level I USGS and the author's familiarity with the study area alongside field observation, the enhanced images were each subjected to supervised classification employing the Maximum Likelihood Classifier. This classifier was selected because the algorithm evaluates the chance that a given pixel belongs to a particular highest class by assuming that the statistics for each class in each band are normally distributed. The pixel remains unclassified unless a probability threshold is classified. The algorithm's advantage is that it includes the covariance matrix (Swain and Davis, 1978) and (Oyinloye and Oloukoi, 2013) data. Thereafter, a change detection method was used to assess the changes in land use/cover trend between 1982, 1992 and 2002, and between 2012 and 2022 (Rawat and Kumar, 2015).

RESULTS AND DISCUSSIONS

Table 1: Primary Causes of Farmer-Herder Conflicts

Causes	Response	Percentage
Grazing on Crop Fields	120	40
Encroachment on Grazing Routes	90	30
Water Resource Disputes	45	15
Cultural/Religious Misunderstandings	25	8.3
Other Causes	20	6.7
Total	300	100

Out of 300 respondents on the primary causes of farmer-herders conflict, 120 of the respondents are view that the most significant cause of conflict can be attributed to razing on crop fields. This shows that, the area lacks clear boundaries or enforcement between farmland and grazing areas in the study area.

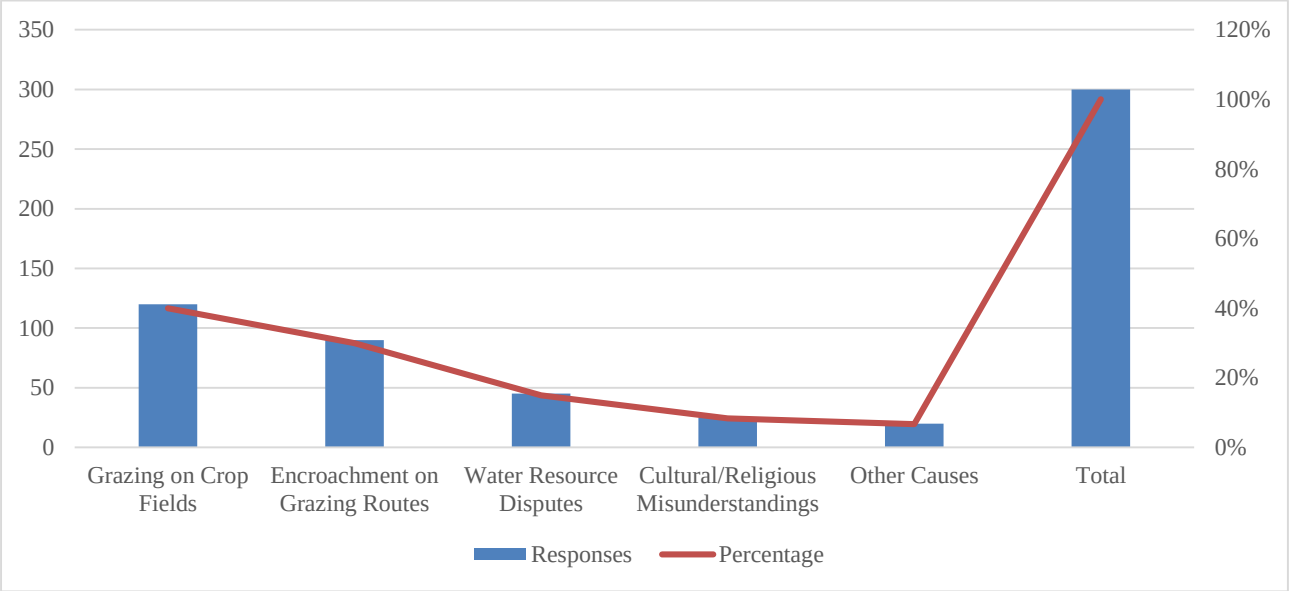

Figure 2: Primary Causes of Farmer-Herder Conflicts
Source: Authors Analysis (2024)

So also, 90 of the respondents agreed that the causes of the conflict can be attributed to encroachment on the grazing routes as a result of urbanization and farming expansion. Due to the limited water access intensifies competition between farmers and herders 45 respondents are credited the conflict to the water resources disputes, particularly in the arid region. Cultural/religious misunderstanding were cited by 25 respondents often add complexity to land disputes, while 20 respondents.

Table 2: Effects of Farmer-Herder Conflicts

Effect	Response	Percentage
Loss of Lives	120	40
Displacement	90	30
Property Damage	50	16.7
Reduction in Agricultural Output	30	10
Other Effects	10	3.3
Total	300	100

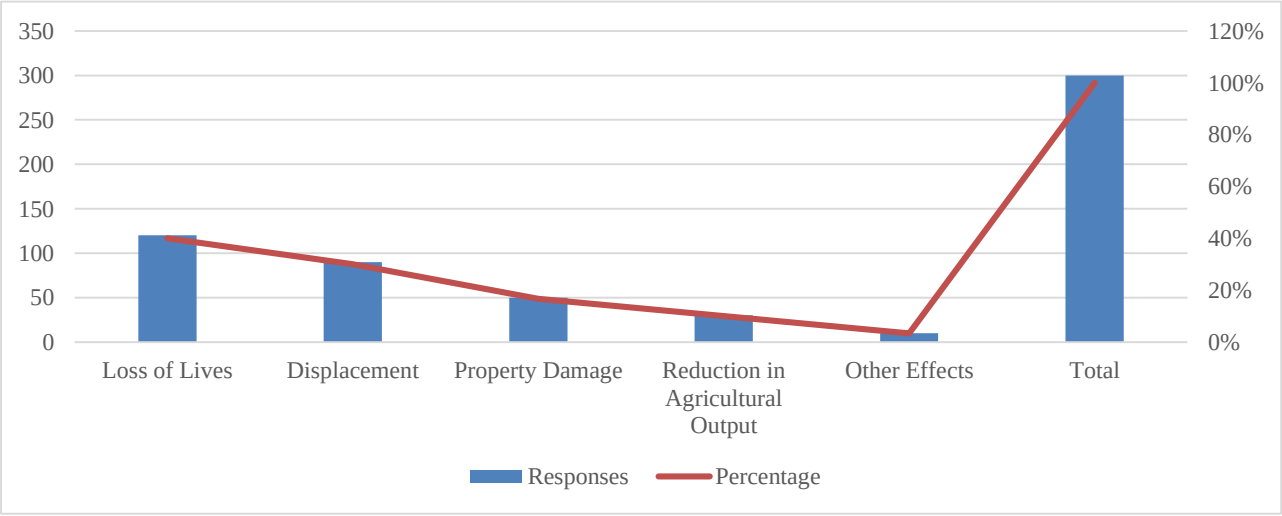

Figure 3: Effects of Farmer-Herder Conflicts
Source: Authors Analysis (2024)

Out of 300 respondents on the effects of farmer-herder conflicts, 120 respondents reported loss of lives as the primary effect. This highlights the conflict's violent nature and its impact on the community's population and security. So also, 90 responses indicate displacement, underscoring the disruption of families and livelihoods. Displaced individuals often face additional challenges such as loss of shelter and limited access to resources. Due to the limited the economic cost of these losses exacerbates community hardships. 50 responses cite property damage, including destruction of homes, farmlands, and livestock. Reduction in agricultural output, 50 responses cite property damage, including destruction of homes, farmlands, and livestock, while 10 responses capture various localized or less common issues, such as psychological trauma or social tensions.

Table 3: Changes in Agricultural Land Use

Land Use Change	Responses	Percentage
Reduction in Agricultural Land	150	50
Abandonment of Farms	90	30
Expansion into Marginal Lands	30	10
Conversion to Non-Agricultural Uses	20	6.7
Other Changes	10	3.3
Total	300	100

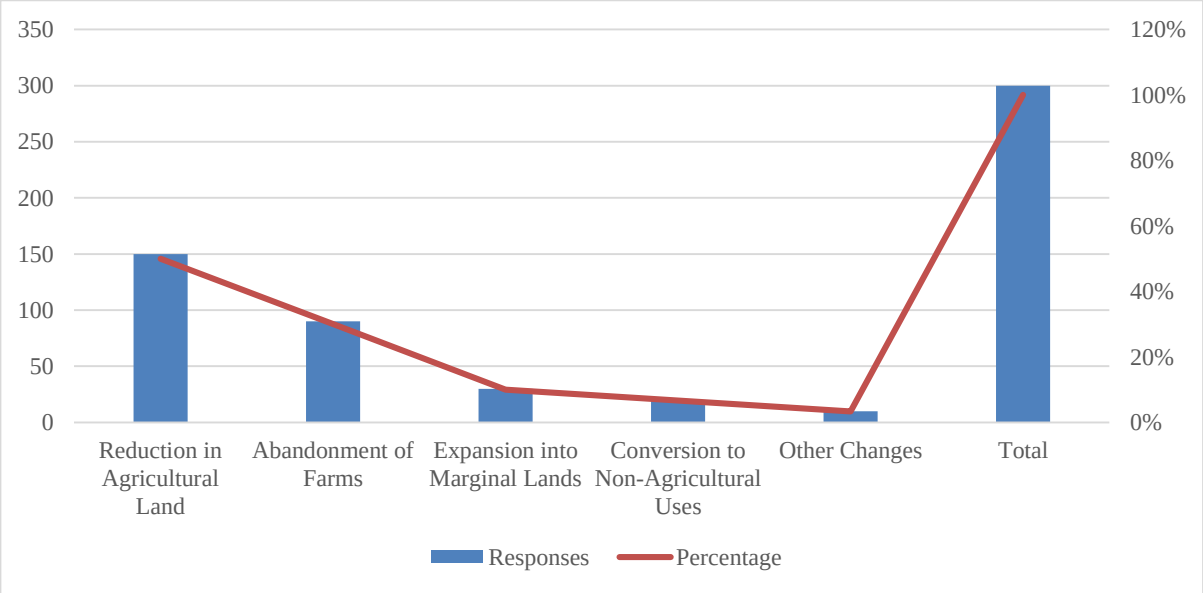

Figure 4: Changes in Agricultural Land Use
Source: Authors Analysis (2024)

Out of 300 respondents on the changes in agricultural land use, 150 respondents reported a reduction in agricultural land as the primary change. This is likely due to conflicts leading to unsafe conditions for farming or loss of farmland to other uses. So also, 90 respondents cited farm abandonment, indicating that insecurity has forced many farmers to leave their lands. This reduces food production and livelihoods in affected areas. Due to the expansion into marginal lands which intensifies competition between farmers and herders 30 respondents noted the use of less fertile or ecologically fragile lands for farming. This reflects the scarcity of prime farmland and the desperation of farmers to find cultivable land. Conversion to non-agricultural uses which constitute part of the effect, 20 responses highlighted the conversion of farmland to non-agricultural uses (e.g., urbanization or industrial development). This further limit land availability for farming or grazing, while 10 respondents identified other types of land-use changes, possibly reflecting unique local conditions.

Six classes were distinguished: waterbody, built-up area, bare-land, vegetation, flooded area, and farmland. The waterbody comprises of rivers, streams, ponds and reservoirs. The built-up area includes scattered and clustered settlements while bare-land includes open spaces and sandy areas. Vegetation comprises of riparian vegetation, shrubs and orchards.

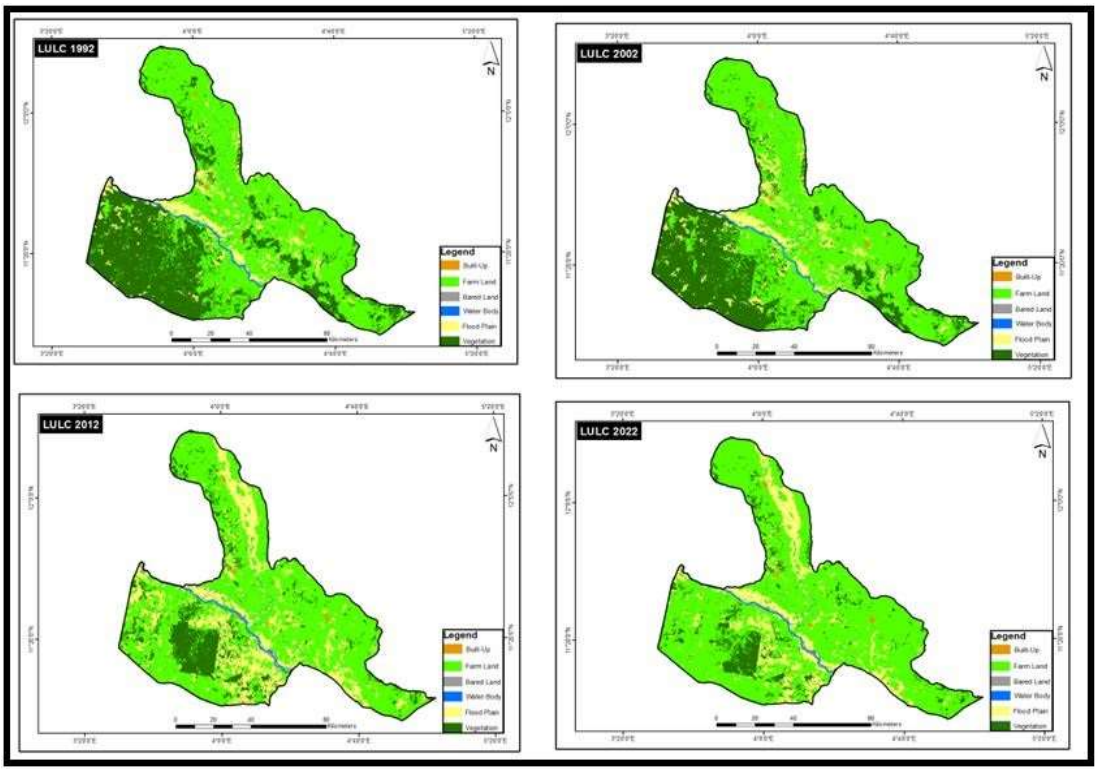

Figure 5: Land Use Land Cover
Source: Authors Analysis (2024)

Flooded area comprises of marshy areas and wetland. While the farmland comprises of farmlands and arable lands. The analysis of the land use/cover dynamics in Figure 4, 5 and 6 reveals that bare land has increased by 24.7% within 1992 to 2022. Built-up increased by 28.4% in 2002 and 47.9% in 2022. Waterbody was made exposed implying that they increased from 3.2% in 2012 to 7.6% in 2022. Also on the increase are the farmlands in 2002 by 23.4% and 42.8% in 2022 which shows that most people are into the farming due some certain factors. Vegetation cover reduced significantly from 470,557.1 hectares to 89,033.5 that is approximately 81.1% loss. This shows that deforestation is high and there are no environmental control measures in the area or the enforcement is low. Flooded areas also called marshy lands remain the same between 1992 to 2012 and had a sharp increase in 2012 to 2022 by 37.8%. Post classification accuracy assessment was carried out. An overall accuracy of 99.7%, 99.2%, 99.4% was obtained for the 1992, 2002 and 2022 images respectively.

From 1992 to 2022, the dynamics of land use/cover units was marked by a sharp decline of dense vegetation cover for the benefit of light vegetation, built-up area, agricultural land, bare soil, and flooded areas. All these changes have significantly altered the ecological landscape of the area under study. Two major conversion processes can be marked in this period of environmental transformation namely; anthropogenic and natural, which have induced variations on climatic parameters, contributing to climate change (Odjugo, 2010; Odoh, & Chilaka, 2012; Alhassan, 2013, Egboka, Okoye and Chibuzor, 2022).

Carrying out an intensity analysis of the change in landuse/cover units reveals that the landscape had undergone changes of 82.4% within the years, change was intensified with about 37.3% from 1982 to 2002 and other changes of 45.1% from 2002 to 2022 having an average range of 18.7 and 22.6 respectively (chart in Figure 4). Individually, noted from 1992 to 2002, the study identified an increase of the area of settled areas, bare land, waterbody, vegetation and especially farmland, Light vegetation, as compared to the area of dense vegetation. Between the years of 2002 and 2022, the result of the analysis indicated that there was an increase in the area of built-up, waterbody, farm land, bare-land and flooded area. As dense vegetation and light vegetation reduced by 37 %

and 45 % respectively. The average annual change in intensities of land use units of 51.8% between 1992 and 2022.

Summary

Kebbi state is one of the states in Nigeria where issues of violence and conflicts between herders and farmers that has not been properly mitigated. Many lives and properties worth of millions have been lost as the results of menace between farmers and herders in some part of Kebbi state. According to an Amnesty International report of attacks rural conflict grew and became more destructive from 1 January, 2018 to 30 June, 2018. Despite this, the government tried to manage the disputes that were spreading from urban to rural areas. The majority of the time, isolated residents surrounded by large farms are the target of a rural attack by cattle herders. The impact of the trend on the socioeconomic landscape of the state and our country as a whole makes it alarming. The increasing breakdown of intercommunity relationship between farming rural communities and cattle herders which has derived most of the divers of rural conflicts. Some of Kebbi State's rural areas experience conflict mostly due to the following reasons:

i. The primary direct causes of conflicts that farmers cite are livestock is grazing on crop fields and damage to other property (such as irrigation systems, reservoirs, and infrastructure) by herders.
ii. The effects farmers herder's conflicts on the economic of the rural livelihood is the destruction of properties worth of millions and loss of lives
iii. The land use dynamics effect as the result of the conflict include reduction in agricultural, abandon of farms, urban expansion into marginal land and conversion to non-agricultural uses.
iv. An increase in the number of cattle thefts, which frequently include violence.
v. The well-being of the local community settings has been greatly impacted by the disruption and destruction caused by violence. Plans can be created with the express purpose of reducing the impact of these conflicts. According to the findings, a significant amount of farmland and conflict zones are crossed by the current grazing corridor, which tends to fuel conflict between farmers and cattle herders and increases the number of tribes in the state. Because of this, the cattle herders have evolved into a kind of semi-tribal group in recent years as they migrate and establish themselves in one area over time.

CONCLUSION

The study provides critical insights into the primary causes, effects, and land-use changes associated with farmer-herder conflicts. Grazing on crop fields emerged as the most significant driver of conflict, reflecting inadequate demarcation and enforcement of boundaries between farmland and grazing areas. Other notable causes include encroachment on grazing routes, water resource disputes, and cultural/religious misunderstandings.

The effects of these conflicts are profound, with the loss of lives, displacement, and property damage being predominant. Additionally, the reduction in agricultural output exacerbates food insecurity and economic hardships in the affected regions.

Land-use dynamics from 1992 to 2022 reveal significant ecological transformations, including a decline in vegetation cover and a notable increase in built-up areas, farmlands, and bare land. These changes highlight the impact of anthropogenic activities and natural processes, which have intensified environmental degradation and contributed to climate change.

The findings underscore the urgency of implementing robust conflict resolution strategies, sustainable land management practices, and environmental conservation measures to mitigate the socio-economic and ecological impacts of these conflicts.

RECOMMENDATION

In the event that these disputes are not settled in a timely manner, issues with environmental and economic sustainability will arise. Nonetheless, we recommend utilizing the following:

i. There is need for government to establish clear land-use policies, conflict resolution committees, and community awareness programs to prevent disputes between farmers and herders;
ii. There is need for the stakeholders including (government and traditional institutions) to introduce compensation mechanisms,

diversify rural livelihoods, and build capacity for sustainable farming and herding practices;

iii. Government should implement integrated land management, regulate urban expansion, and rehabilitate abandoned agricultural lands;

iv. The stakeholders including (government and traditional institutions) should enhance rural security, foster collaboration between communities, and strengthen legal frameworks to deter theft and violence.

REFERENCES

Adjei, V., and Antwi, m., (2023). Land use change detection using the intensity analysis at the Bosomtwe District, Ashanti Region, Ghana. Journal of Smart Agricultural Technology, 5(1), 45-67

Alhssan, A.A., (2012). Gender and Their Role in Conflict Management: The Nigerian Perspectives. International Journal of Scientific and Research Publications, 8(10), 315-319, ISSN 2250-3153

Anderson, E.A., (1976) A Land Use and Land Cover Classification System for Use with Remote Sensor Data. Geological Survey Professional Paper No. 964, U.S. Government Printing Office, Washington DC, 28.

Canelas, J., and Perreira, M.H., (2023). Impacts of land-use intensity on ecosystems stability. International Journal of Ecological Modelling, 472(1) 10-16

Chikodiri, N. and Chukwuemeka E. (2019). Nomadic Pastoralism and Human Security: Towards a Collective Action against Herders-Farmers Crisis in Nigeria, AfriHeritage Research Work Paper, 010

Feng, W., Lui, Y., Qu, L., (2019). Effect of land-centered urbanization on rural development: A regional analysis in China. Journal of Land Use Policy, 8(2), 459-467

Ferreira, V., Almazan-Gomez, M.A., Nechifor, V., and Ferreiri, E., (2022). The Role of the Agricultural Sector in Ghanaian Development: A Multiregional SAM-Based Analysis. Journal of Economic Structures, 11(8) 23-45

Gefu, J., and Kolawole, G., (2002). Climate change and pastoral conflicts in the Middle Belt and South-East Nigeria: Implication on human resource of the regions. Global Journal of Human Resource Management, 3(5), 44-51. Across West Africa. Canadian Journal of African Studies 40(1):1-40.

Gondwe, J.F., Lin, S., Munthali, R.M., (2021). Analysis of Land use Land cover changes in Urban Areas using Remote Sensing: A Case of Blantye City. Discrete Dynamics in Nature and Society, 4(1), 24-56

Jeremy, K., and Josef, C., (2003). Land use and cover with intensity of agriculture for Canada from satellite and census data. International Journal of Environmental Sciences, 8(2), 23-45

Lambin, E.F., and Meyfroid, P., (2011). Global land use change, economic globalization, and the looming land scarcity. The Proceedings of the National Academy of Sciences (PNAS), 2(2), 23-34

Li Yu, Zhanqi Wang, Hongwei Zhang, Chao Wei (2020). Spatial-Temporal Differentiation Analysis of Agricultural Land Use Intensity and Its Driving Factors at the County Scale: A Case Study in Hubei Province, China. International Journal of Environmental Research and Public Health, 17(18), 25-37

Nicholas Cipoletti, Zachary G. Jorgenson, Jo A. Banda, Stephanie L. Hummel, Satomi Kohno, Heiko L. Schoenfuss, (2019). Land Use Contributions to Adverse Biological Effects in a Complex Agricultural and Urban Watershed: A Case Study of the Maumee River. Journal of Environmental Toxicology and Chemistry, 38(5), 41-40

Nyong, P., Fiki, D., (2005). Recurrent Conflicts among Migrant Fulani Herdsmen and Indigenous Communities of Southern Nigeria. International Journal of Health and Social Inquiry, 3(1).

Obiahu, O.H., and Elias, E., (2020). Effect of land use land cover changes on the rate of soil erosion in the Upper Eyiohia river catchment of Afikpo North Area, Nigeria. International Journal of Environmental Challenges, 1(1), 23-67

Odjugo, P.A. O. (2010). General Overview of Climate Change Impacts in Nigeria, Journal of Human Ecology, 29 (1): 47 – 55

Odoh, S.I. &Chilaka F. C. (2012). Climate Change and Conflict in Nigeria: A Theoretical and Empirical Examination of the Worsening Incidence of Conflict between Fulani Herdsmen and Farmers in Northern Nigeria. Arabian Journal of Business and Management Review (OMAN Chapter) 2, 1, 56-87

Okeke, O. E., and Elias, P., (2022). Conflicts between Fulani Herders and Farmers in Central and Southern Nigeria: Discourse on Proposed Establishment of Grazing Routes and Reserves. AFRREV IJAH: An International Journal of Arts and Humanities, 3(1), 66-84.

Oyinloye, R.O., and Oloukoi, J., (2013). An assessment of the Pull between Land use and dLandcover in Southwestern Nigeria and the Ensuing Environmental Impacts. International Journal and Environment and Sustainability, 2(2), 45-89

Rapheal, O.O., and Joseph, O., (2018). Problems and Innovative Solution for Tropical Coastal Mapping At large Scale Using Partially Cloud-Covered High-Solution Satellite Data in Southern Nigeria. Nigerian Journal of Surveying and Geoinformatics, 4(1), 72-82

Rawat, J.S. and Kumar, M. (2015) Monitoring Land Use/Cover Change Using Remote Sensing and GIS Techniques: A Case Study of Hawalbagh Block, District Almora, Uttarakhand, India. The Egyptian Journal of Remote Sensing and Space Sciences, 18, 77-84

Saaty, T.L. (1980) The Analytic Hierarchy Process. McGraw-Hill, New York

Sadeeque, A., (2017). Causes, consequences and resolution of environmental conflict in Nigeria. International Journal of Social Science and Economic Research, 2(1), 2063- 2076

Saidu, I.M., (2019), 'No retreat no surrender conflict for survival between Fulani pastoralists and farmers in Northern Nigeria', European Scientific Journal, 8(1), 331- 346.

Swain, P.H., David, S.M., (1978). Remote Sensing: The Quantitative Approach. Harvard Publishers

Watt, A., (2020). Land-Use Intensity and Land-Use Change: Impacts on Biodiversity. Encyclopedia of the UN Sustainable Development Goals 1-13

Yujing, B., Rong, G., (2021). The construction of green infrastructure network in the perspectives of ecosystem services and ecological sensitivity: The case of Harbin, China. Global Ecology and Conservation, 5(2), 56-67

Yuxin, Q., Wang, R., Shen, P., and Hu, Y., (2023). Impacts of Land Use Intensity on Ecosystem Services: A Case Study in Harbin City, China. International Journal of Sustainability, 16(10), 48-77