

ASSESSMENT OF COMMUNITY-BASED APPROACHES TO LAND DEGRADATION MANAGEMENT IN BOSSO LOCAL GOVERNMENT AREA, NIGER STATE

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Abstract

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This study assessed community-based strategies for land degradation management in Bosso LGA of Niger State. A mixed-method research design was adopted to examine the relationship between Community-Based Disaster Risk Reduction (CBDRR) initiatives and land degradation. Primary data were obtained through questionnaires and field observations, while secondary data included Landsat satellite imagery from 2000, 2011, and 2023, which were processed to analyse the extent and trends of degradation. A total of 400 respondents were sampled across selected communities, and responses were analysed using a four-point Likert scale. The findings reveal a 71.7% decline in land availability over the past 10–20 years, while 97% experienced reduced soil fertility. Other major forms of degradation include vegetation loss (73%), soil erosion (72%), bush burning (71%), sand encroachment (51%), and salinization (16%). On average, respondents had observed these issues for approximately 12.5 years. Remote sensing analysis supports these perceptions, indicating a significant decline in vegetation health, with mean NDVI dropping by over 50% and degraded land expanding within the study period. The key barriers that hinder the adoption of sustainable land management practices include a lack of tools and inputs, financial constraints, insecurity, land tenure issues, limited extension services, labour shortages, and restricted market access. The findings suggest that land degradation in Bosso LGA is extensive and worsening. The study recommends strengthening community support systems and adopting continuous remote sensing monitoring to ensure sustainable land management.

Keywords: Land degradation, Community-Based, Vegetation, Encroachment, Sustainability.

1.1 Introduction

Land degradation, characterized by the decline in land quality and productivity, poses a significant threat to global ecosystems and human livelihoods. According to UNESCO, approximately 75% of the Earth's land is already degraded, with projections indicating this could rise to 90% by 2050 if current trends persist. This degradation undermines food security, water availability, and biodiversity, necessitating urgent and effective management strategies (UNESCO, 2024).

Land degradation manifests in a reduction or loss in the capacity or quality of land resources to provide ecosystem services. It affects about 1.5 to 3.2 billion people, with estimates of the spatial distribution of degraded land varying from less than 1 billion Ha to over 6 billion Ha (Ademola, 2022). Affected regions include Africa, Central Asia, and Latin America. Currently, about 5% of the reduction in total global net primary productivity is attributed to land degradation, and 8% of global losses in soil organic carbon, which indicates healthy soil, are linked to activities involving land conversion and unsustainable land management practices (Ademola, 2022).



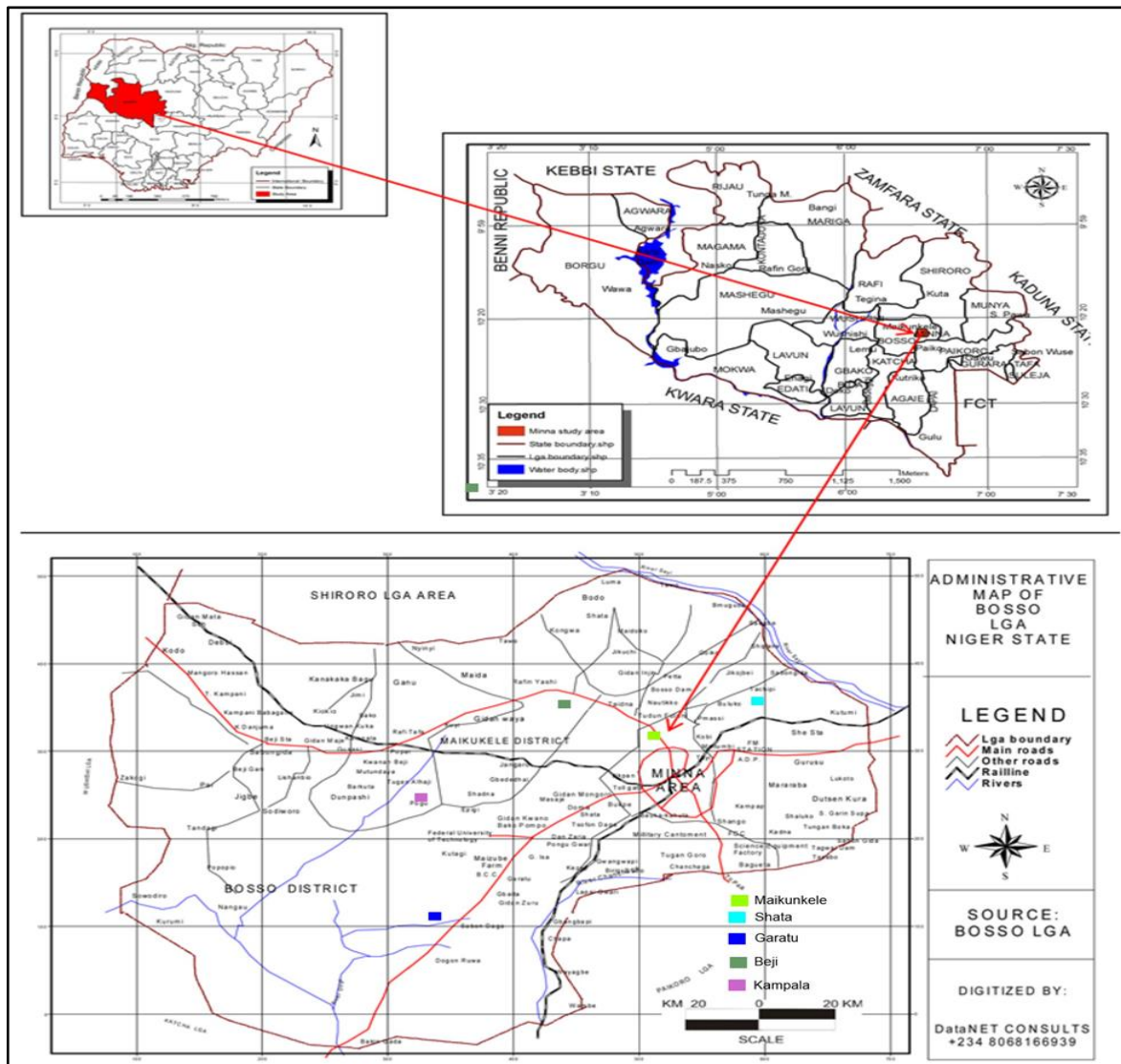
In Sub-Saharan Africa, and specifically within the Nigerian Guinea Savannah zone, the pressures of accelerated population growth, unchecked agricultural expansion, and erratic climate shifts have intensified the vulnerability of fragile ecosystems. Nigeria loses an estimated 0.35% of its total land area to land degradation annually, which threatens the livelihoods of millions of smallholder farmers (Baba, 2025). The state of land degradation neutrality (LDN), defined by the United Nations Convention to Combat Desertification (UNCCD) as a condition where the quantity and quality of land resources remain stable or increase to support ecosystem functions, remains compromised at sub-national and local levels due to fragmented environmental governance and unsustainable land-use patterns (Olumba *et al.*, 2024). In regions like Niger State, where rural households depend on rainfed subsistence agriculture, the degradation of topsoil, loss of vegetative cover, and structural breakdown of land resources trigger a cycle of declining crop yields, resource competition, and acute food insecurity.

According to Hudson (2023), community engagement refers to the active involvement of individuals, groups, and organizations within a community in decision-making processes, planning, and implementation of disaster risk reduction initiatives. This participatory approach recognizes the inherent knowledge, resources, and capacities within communities, thereby enhancing the effectiveness and sustainability of disaster management efforts. While the concept of community engagement is widely acknowledged, its implementation varies significantly across different regions and contexts. Factors such as cultural norms, governance structures, levels of social cohesion, and access to resources influence the extent and nature of community participation in disaster reduction activities.

Community-based approaches to land degradation management have gained traction as effective strategies that leverage indigenous knowledge, collective action, and participatory governance (Ahmed *et al.*, 2021). These approaches prioritize local involvement in conservation efforts, promoting sustainable land use practices while enhancing community resilience. Studies suggest that when communities actively engage in land restoration initiatives, long-term sustainability is more likely to be achieved (Oladipo *et al.*, 2022). However, challenges such as inadequate funding, weak institutional support, and socio-economic constraints often hinder the success of these initiatives. This study seeks to assess the effectiveness of community-based approaches to land degradation management in Bosso LGA, examining their impact, sustainability, and the barriers to their implementation.

2.1 Description of the Study Area

Geographically, the study area is located between Lat. 9.08° N to 9.64° N and Long. 6.01° E to 6.53° E. The study stations comprise of Maikunkele, Shata, Garatu, Beji and Kampala of Bosso LGA, Niger State, Nigeria (Figure 1). Niger State encounter a different arid period (which persists from October – March) then a rainy period (which persists from April – October). Yearly precipitation differs from a reasonable range of 1,200 mm within north region to 1,600 mm within south region.

**Figure 1: Study Area, Bosso LGA, Niger State****Source: Urban and Regional Planning Department, FUT Minna (2025)**

3.1 Materials and Methods

A mixed research design (qualitative and quantitative) was employed to examine land degradation. It was used to collect data on the relationship between Community-Based Disaster Risk Reduction (CBDRR) initiatives and land degradation in Bosso LGA.

The research used simple random and purposive sampling, which are probability and non-probability techniques, respectively. The rationale behind this approach is that each element in affected communities (households and sites) has an equal chance of being selected, and the institutions sampled was adjudged to have adequate knowledge and answers suitable to the questions raised by this research.

The population of Bosso is projected from the 2006 National Census figure of 148,136 to 2024.

Using the exponential formula $P_n = P_o (1 + r/100)^n$. The total projected population of Bosso LGA to 2024 is thus:

Exponential Population Projection

Exponential population projection formula $P_n = P_o (1 + r/100)^n$

Where: P_n = projected population, P_o = base population, r = growth rate (3.4%) n = projected number of years. $\therefore P_n = 148,136 (1 + \frac{3.4}{100})^{18}$

$$\therefore P_n = 148,136 (1.034)^{18}$$

$$\therefore P_n = 148,136 (1.8255)$$

$$\therefore P_n = 270,422.27$$

$$\therefore 2024 = 270,422 \text{ approx.}$$

The sample size is determined by using Glenn (2003) as illustrated in the formula below.

$$n = \frac{N}{1 + N(e^2)}$$

Where; n = Sample size, N = Population size in the sample unit, where $N = 270,422$, e = Level of precision which is +5% (0.05), at 95% confidence level. Therefore, the sample size using the above formula which was based on the projected population of Bosso LGA from 2006 to 2024.

$$n = \frac{270,422}{1 + 270,422(0.05^2)}$$

$$n = \frac{270,422}{677.055} = 399.4 \quad \text{Therefore, the sample size is approximately 400.}$$

3.2 Processing of Remote Sensing Data

The satellite imagery data for the research were processed using image processing to obtain the desired output using Erdas Imagine 9.2.

Image pre-processing: Information extraction from satellite imagery is preceded by Image Pre-Processing steps, which include image registration, radiometric correction, image enhancement and display. Image registration is meant to correct for image displacement, while radiometric correction is meant to adjust radiation values to standard values. Failure to observe them or imprecise observation may render change detection meaningless.

The intent of the image classification is to categorize all pixels in a digital image into one of several land cover classes, or "themes". This categorized data would then be used to produce thematic maps of the land cover present in an image. In this study, a supervised classification technique using the Maximum Likelihood Algorithm (which classifies imagery based on the covariance and variance of spectral response patterns) was employed to classify the images. From visual and digital interpretations of the satellite imagery, different land use and land cover categories were distinguished in the study area and since emphasis are mainly given to degraded lands, therefore land use and land cover classification scheme, the various land use and land cover types within the study

area were classified into six: Built-up land, forest cover, mix vegetation, farm land, water body and bare surfaces.

To test classification accuracy, 25 ground-truth points for each land-use type were randomly collected in the field using a GPS. These points were imported into ArcGIS 10.6, and the Kappa tool was used to assess classification accuracy.

4.0 Results and Discussions

4.1 Socio-Demographic Attribute of Respondents

The age distribution of respondents is presented in Table 1. The result shows a mature farming population with a mean age of 47.6 years (SD = 8.5). Ages range from 19 to 66 years, with 50% of respondents between 42 and 54 years old. The median age is 49 years.

Table 1: Age Distribution Statistics (n=99)

Statistic	Value
Count	99
Mean	47.6 years
Standard Deviation	8.5 years
Minimum	19 years
25th Percentile	42 years
Median	49 years
75th Percentile	54 years
Maximum	66 years

All 99 respondents (100%) are male. This reflects either survey targeting of male household members or gender patterns in household representation for agricultural surveys in the study area. The educational profile of respondents. The academic profile shows relatively high attainment levels, with 36.4% having a tertiary education. Over one-quarter (27.3%) have no formal education, while 23.2% completed secondary education and 10.1% completed primary education. A small proportion (3.0%) completed adult education or other programs. This finding is consistent with Meinzen-Dick *et al.* (2022), who found that gender plays a significant role in land restoration, inclusion, and strategies for sustainable impact.

The mature age profile (mean = 47.6 years) indicates that land management decisions are governed by individuals with knowledge of local ecological transformations. However, the complete exclusion of females (100% male) in the active survey response underscores the deeply entrenched patrilineal land administration and institutional barriers characteristic of the West African Sahelian and Savannah zones. According to Olumba *et al.* (2024), gender-biased land administration systems and traditional customary norms severely constrain women's land property rights and their active participation in formal Land Degradation Neutrality (LDN) frameworks. This structural imbalance implies that while community-based strategies are effective, they risk overlooking the gender-differentiated impacts of ecological decline, as women often interact with natural resources in unique ways for household survival, such as fuelwood extraction and secondary cultivation.

4.2 Main Livelihood Activities

The respondents' livelihood activities are presented in Figure 2. Livelihood strategies are predominantly diversified, with 42.4% combining crop farming, livestock farming/pastoralism, trading, and casual labour. Pure crop farming is practiced by 28.3% of households. The remaining households engage in various combinations of crop farming, trading, and/or casual labour (17.2%), or in other mixed livelihood strategies. This pattern indicates high livelihood diversification as a risk-management strategy, with most households maintaining multiple income sources rather than relying on a single activity. This finding aligns with Hamdy and Aly (2014) and Ezech *et al.* (2023), who show that people engage with their environment through crop farming, livestock farming, and mixed livelihood strategies for survival, thereby having an adverse effect on the environment over time.

This high degree of multi-sectoral livelihood diversification (with over 68% of households engaging in three or more activities) reflects a systemic co-adaptation mechanism against environmental volatility and climate stress. As historical farming paradigms fail due to progressive topsoil exhaustion and unpredictable rainfall, rural households are forced to split their labour across crop production, livestock, and off-farm casual work. While this diversification serves as an immediate socioeconomic buffer, recent systematic reviews by Burkart and Mwendia (2024) demonstrate that highly fragmented livelihood portfolios often dilute the household labour capital available for capital- and labour-intensive Sustainable Land Management (SLM) interventions. Consequently, the simultaneous pursuit of multiple survival strategies reduces communities' capacity to implement long-term soil conservation and erosion-control projects, thereby accelerating land degradation through neglect or short-term resource exploitation.

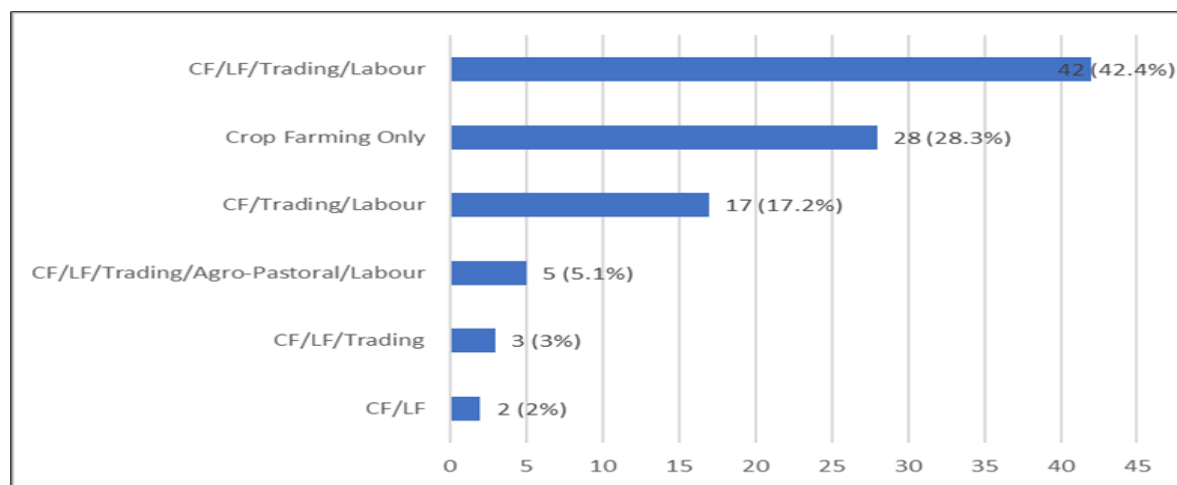


Figure 2: Livelihood Activities of the Respondents

Furthermore, Figure 3 shows that 29.3% of respondents are involved in a single livelihood activity. However, 42.4% and 21.2% of the respondents are engaged in four and three livelihood activities, respectively. Those involved in five activities accounted for 5.1%, while only 2% are involved in two livelihood activities. This finding echoes the work of

Ijeomah *et al.* (2020) and the International Union for Conservation of Nature (IUCN) (2024), which state that as a result of climate change and other advanced factors, community dwellers diversified their means of livelihood in order to withstand the harsh reality faced annually from poor crop yield, insufficient rainfall and increased temperature.

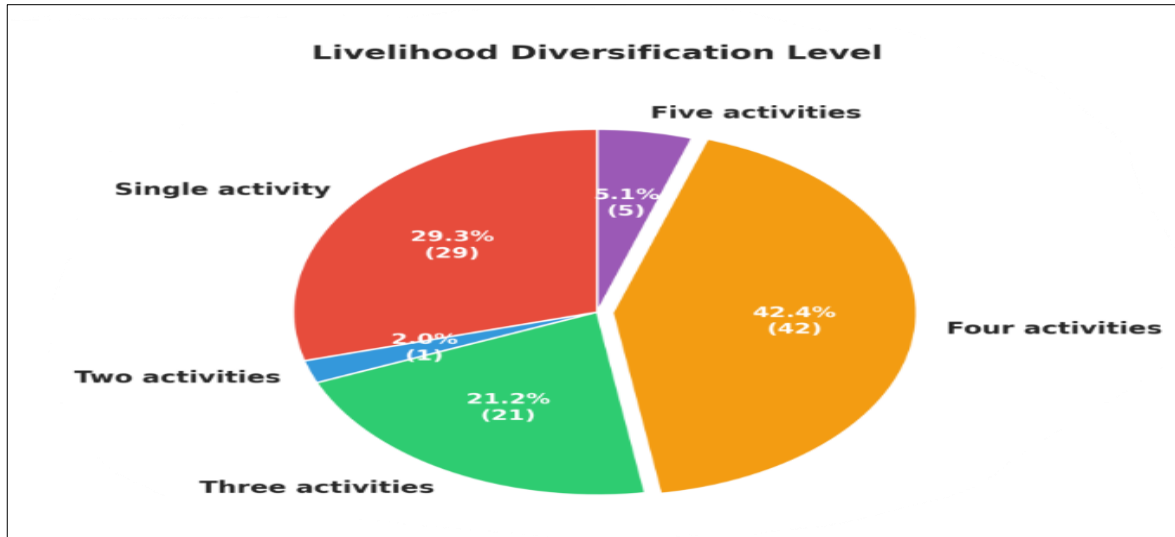


Figure 3: Livelihood Diversification Level of the Respondents

4.3 Land Ownership Status

The land ownership status of respondents is presented in Table 2. The majority of households (78.8%) own their land, while 10.1% rent or lease land, and another 10.1% use communal land. One household (1.0%) reported both owning and using communal land.

Table 2: Land Ownership Status of Respondents

Ownership Status	Frequency	Percentage
Own	78	78.8%
Rent/Lease	10	10.1%
Use Communal Land	10	10.1%
Own + Use Communal Land	1	1.0%
Total	99	100.0%

4.4 Changes in Land Availability (10-20 Years)

A substantial majority (71.7%) reports decreased land availability over the past 10-20 years. One-quarter (25.3%) report increased land availability, while only 3.0% report no change. The paradox of high land ownership (78.8%) juxtaposed against a widespread contraction in land availability (71.7%) highlights acute land pressure driven by population expansion and fragmentation. In customary tenure regimes across Sub-Saharan Africa, individual ownership does not protect against physical land shrinkage. Elmahal (2026) points out that fragmented customary tenure systems, coupled with competing urban and agricultural expansion, undermine traditional land-use planning. As plots are continually subdivided across generations, the land base shrinks below economically viable thresholds. This prompts agricultural intensification without fallow cycles, rapidly exhausting the organic topsoil and driving smallholders onto marginal, erosion-prone lands.

Table 3: Changes in Land Availability

Change Type	Frequency	Percentage
Decreased	71	71.7%
Increased	25	25.3%
No Change	3	3.0%
Total	99	100.0%

4.5 Nature of Land Degradation in Bosso LGA

Land degradation in Bosso LGA manifests through several dominant types. A total of 97% of respondents experienced reduced soil fertility, 73% experienced vegetation loss, 72% experienced soil erosion, 71% experienced bush burning, 51% experienced sand encroachment, and 16% experienced salinization. Remote sensing data across three epochs (2004, 2014, and 2024) indicate that mean LGA-wide NDVI dropped from 0.47 in 2004 to 0.22 in 2024, representing an overall reduction of 53.2%. Concurrently, bare and degraded land expanded by 169.1%, from 124.0 km² to 333.7 km² (Figure 4, 5 & 6).

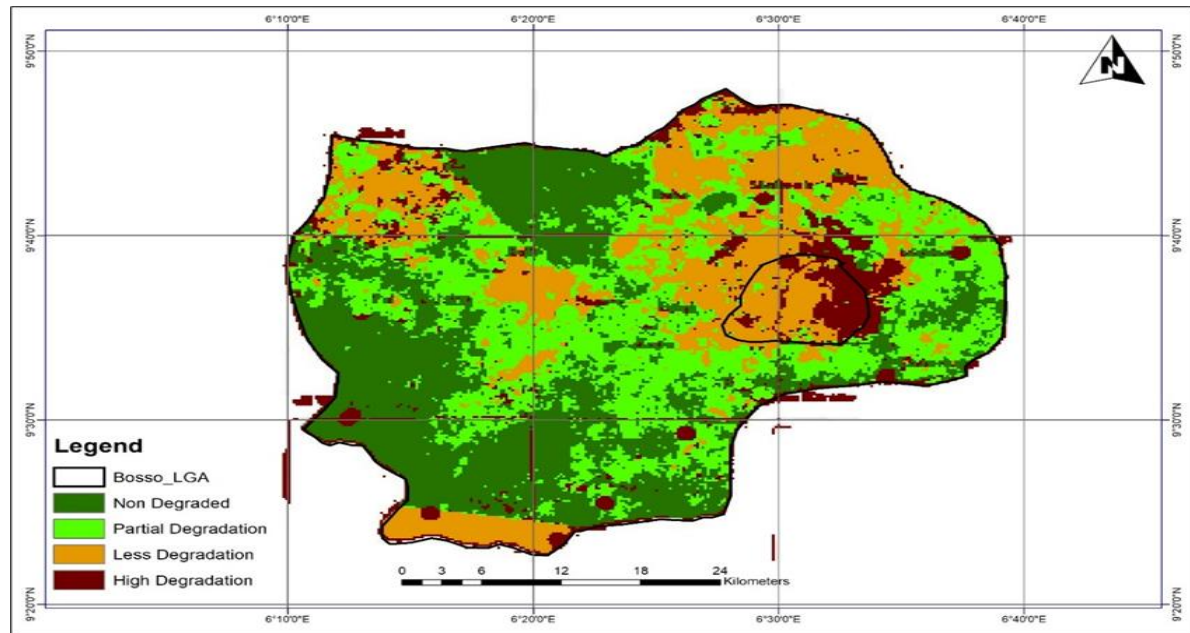
**Figure 4: Land Degradation Map of Bosso LGA, Niger State in 2004**

Table 4, the drop in mean NDVI (53.2%) and the expansion of bare surfaces (169.1%) provide objective, spatiotemporal validation of local community perceptions of severe environmental decline. This rapid transition from dense/moderate vegetation to sparse and bare categories reflects intense degradation within the Nigerian Guinea Savannah zone. Similar multi-index satellite-based assessments by Anucha (2026) confirm that sharp declines in regional NDVI trends serve as strong indicators of soil surface stress, structural erosion, and loss of ecosystem functionality. When vegetative protective canopies are removed, largely driven by bush burning (71%) and wood harvesting, the highly vulnerable tropical topsoils are exposed to intense rainfall erosivity. These triggers accelerated gully formation and topsoil loss, as observed across northern Nigerian states (Muhammad and Adamu, 2025). The expansion of bare surfaces to 21.1% of the LGA's total area directly restricts future carbon sequestration and agricultural potential.

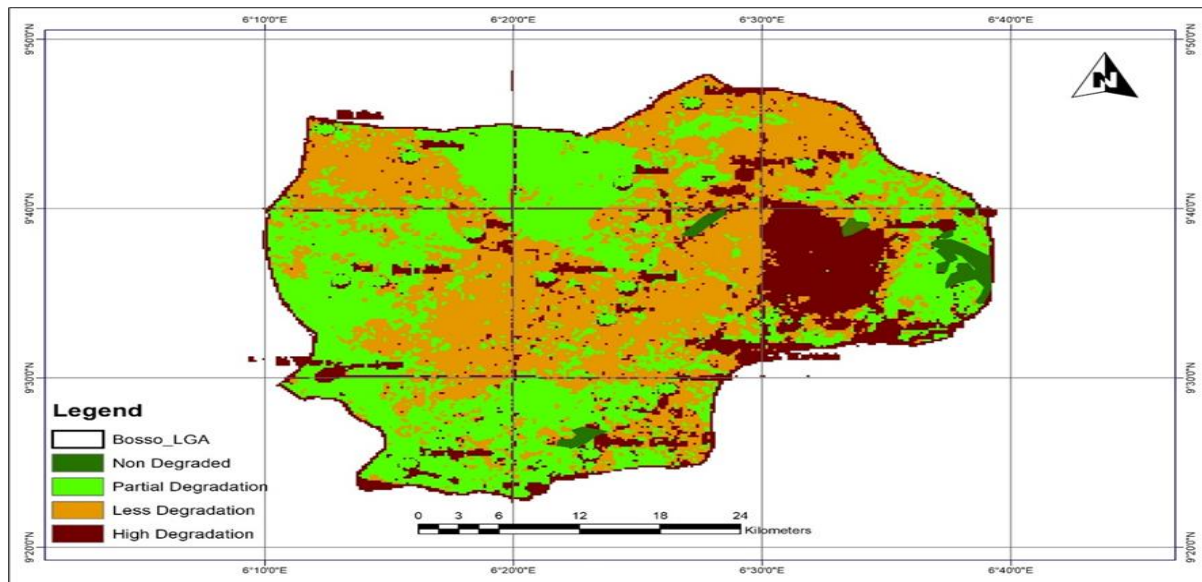


Figure 5: Land Degradation Map of Bosso LGA, Niger State in 2014

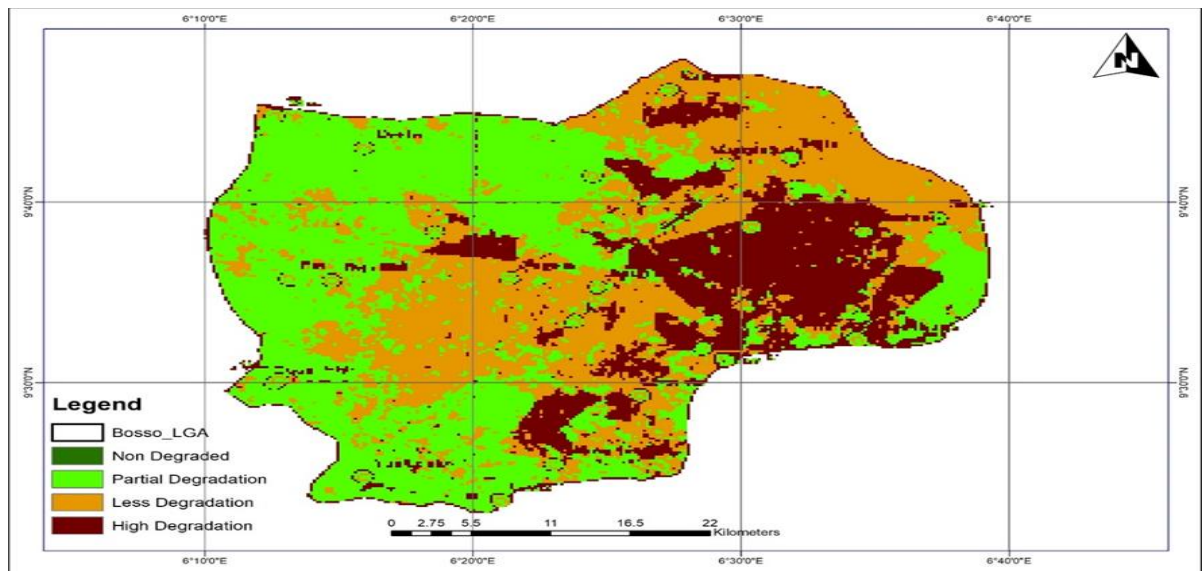


Figure 6: Land Degradation Map of Bosso LGA, Niger State in 202

Table 4: NDVI Vegetation Cover Change Statistics for Bosso LGA, 2004–2024

Vegetation Class	2004 (km ²)	2014 (km ²)	2024 (km ²)	Change (%)	% of LGA (2024)
Dense Vegetation (NDVI > 0.5)	442.3	282.5	145.7	−67.1	9.2
Moderate Vegetation (0.3–0.5)	655.8	571.5	497.3	−24.2	31.4
Sparse Vegetation (0.1–0.3)	363.1	471.7	608.5	+67.6	38.4
Bare/Degraded (NDVI < 0.1)	124.0	259.5	333.7	+169.1	21.1
Total Study Area	1,585.3	1,585.3	1,585.3	—	100.0

Source: Supervised classification of Landsat 8 OLI imagery (2004, 2014, 2024); field verification (2024); NDVI thresholds adapted from Symeonakis and Drake (2004)

4.6 Challenges Faced by Local Communities in Implementing Sustainable Land Management Practices

Figure 7 demonstrates that barriers to SLM practice are widespread across the sample, with six of seven barriers affecting more than half of all respondents. Barriers to SLM practices are widespread, led by tool/input shortages (91.9%), financial constraints (77.8%), general conflict/insecurity (74.7%), tenure insecurity (72.7%), limited extension access (70.7%), labour scarcity (66.7%), and market access constraints (49.5%).

The multi-layered constraints identified by the communities reveal that the adoption of SLM is not merely a technical choice but is tightly constrained by institutional, economic, and geopolitical factors. The near-universal shortage of tools and inputs (91.9%) and lack of funds (77.8%) highlight the severe poverty constraints that prevent smallholders from investing in modern conservation inputs. Furthermore, the high prevalence of conflict and insecurity (74.7%) alongside tenure insecurity (72.7%) creates an environment of short-term survival. As Elmahal (2026) establishes, institutional friction and geopolitical instability undermine long-term capital investments in land preservation. Farmers will not invest labour or capital into constructing erosion barriers or planting permanent agroforestry trees if they lack legal certainty over long-term tenure or face immediate displacement due to regional conflicts. Additionally, weak agricultural extension delivery (70.7%) leaves a critical information gap, cutting rural communities off from modern, climate-resilient agricultural practices and spatial resource planning frameworks.

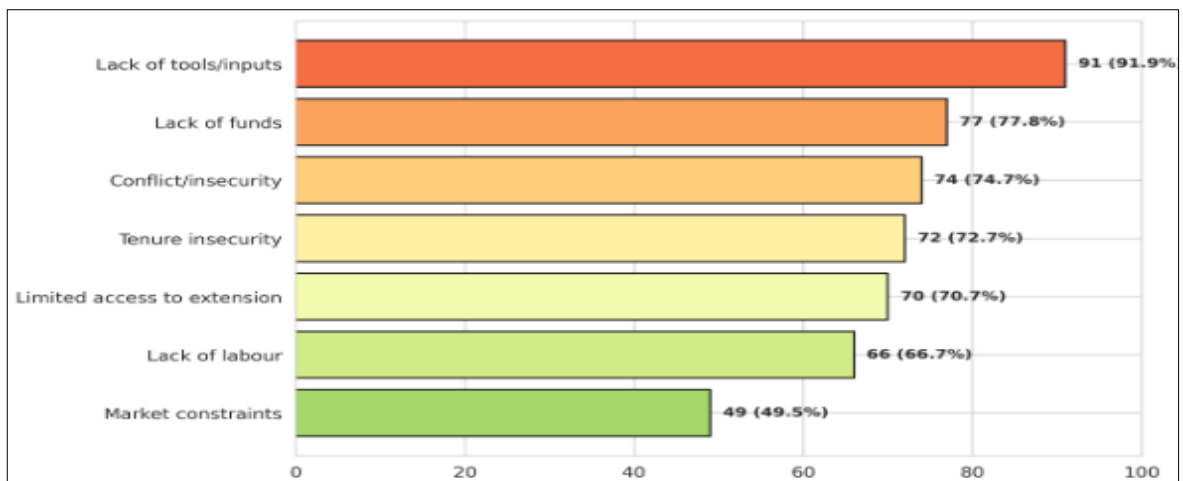


Figure 7: Challenges of Sustainable Land Management Practices

5.1 Conclusion

This study assessed the nature and extent of land degradation in Bosso Local Government Area (LGA), Niger State, Nigeria. The findings confirm that land degradation in Bosso LGA is both extensive and accelerating, characterized by a 53.2% decline in mean NDVI and a 169.1% expansion of bare and degraded surfaces. While community-based approaches enjoy wide acceptance, their execution is bounded by severe resource, security, institutional, and land tenure constraints. To ensure sustainable land management, policy interventions must shift toward providing targeted agricultural inputs, establishing institutional tenure security, improving extension support, and utilizing regular remote sensing tools for dynamic environmental monitoring.

References

- Ademola, A. A. (2022). Land Degradation and Its Impacts on Ecosystem Services in the Nigerian Guinea Savannah: Implications for Sustainable Land Management. Doctoral Inaugural dissertation Submitted to the Faculty of Science, University of Bern.
- Ahmed, A., Usman, L., & Bello, R. (2021). Challenges of community participation in sustainable land management: A Nigerian perspective. *Environmental Policy Review*, 18(3), 56-72.
- Anucha, J. A. (2026). Multi-Index satellite-based assessment of soil surface dynamics in the Niger Delta (Nigeria). *Frontiers in Earth Science*, 14(1), 1834748.
- Baba, M. (2025). Monitoring desertification and its environmental effects in Sokoto State. *Bayero Journal of Engineering and Technology*, 20(2), 45-58.
- Burkart, S., & Mwendia, S. (2024). Transforming livestock through forages: Opportunities, barriers, and strategic priorities in sub-Saharan Africa. *CGSpace Literature Review*, 4(2), 1-15.
- Elmahal, A. (2026). *Integrated Land-Use Strategies for Flood, Drought, and Water Table Management in Arid and Semi-Arid Regions*. IntechOpen, London. <https://doi.org/10.5772/intechopen.1227650>
- Eswaran, H., Lal, R., & Reich, P. F. (2001) Land degradation: an overview. *Responses to Land degradation* 10: 20-35.
- Ezeh, C. I., Ojimgba, O., Nmerengwa. J. K. (2023). Consequences of Land Degradation on Livelihood and Food Security of Rural Farmers in South-East, Nigeria: A Comparative Analysis. *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, 23(3), 289-298.
- Gibbs, H. K., & Salmon, J. M. (2020). Mapping the world's degraded lands. *Applied Geography*, 101, 102191.
- Hamdy A, Aly A (2014) Land degradation, agriculture productivity and food security. In Fifth International Scientific Agricultural Symposium. Presented at the Agrosym.
- Hudson, S. (2023). Community building. The Vital Role of Community Engagement: Building Stronger Connections. Retrieved 17th April 2024 from: <https://www.disciplemedia.com/building-your-community/importance-of-community-engagement/>
- Ijeomah, H. M., & Aiyelaja, A. A. (2020). Indigenous knowledge systems and biodiversity conservation in Nigeria. *Journal of Environmental Management*, 261(1), 110213. <https://doi.org/10.1016/j.jenvman.2020.110213>
- International Union for Conservation of Nature (IUCN) (2024). Land degradation and climate change. Retrieved from: <https://www.iucn.org/resources/issues-brief/land-degradation-and-climate-change>
- Meinzen-Dick, R., Quisumbing, A. R., & Doss, C. (2022). Gender and land restoration: Inclusive strategies for sustainable impact. *World Development*, 147(1), 105652.
- Muhammad, A. B., & Adamu, M. (2025). A Comprehensive Review of the Environmental Impacts of Gully Erosion in the Semi-Arid Zone of Northeastern Nigeria: Implications for Sustainable Land Management. *Journal of Built Environment and Geological Research*, 11(2), 89-104.



- Oladipo, S., Adeyemi, K., & Nwankwo, C. (2022). Deforestation and land degradation in Niger State: The role of community-based approaches. *Nigerian Environmental Research Journal*, 27(4), 112-128.
- Olaniyi, A. A., & Adewole, T. O. (2021). Environmental degradation and rural community disintegration in Nigeria. *Development in Practice*, 31(4), 529-541. <https://doi.org/10.1080/09614524.2021.1889493>.
- Olumba, C. N., Garrod, G., & Areal, F. (2024). Analysis of the enabling environment for delivering land degradation neutrality in Nigeria: perspectives from the sub-national to local level. *Journal of Environmental Planning and Management*, 67(1), 1-22. <https://doi.org/10.1080/09640568.2024.2312446>
- Pact (2023). Community-based natural resource management: A lynchpin in the fight against climate change and environmental degradation. Retrieved from: <https://www.pactworld.org/blog/community-based-natural-resource-management-lynchpin-fight-against-climate-change-and-environmental-degradation>
- Slayi, M., Zhou, L., Dzvene, A. R., & Mpanyaro, Z. (2024). Drivers and Consequences of Land Degradation on Livestock Productivity in Sub-Saharan Africa: A Systematic Literature Review. *Land*, 13(9), 1402. <https://doi.org/10.3390/land13091402>.
- Stringer, L., Akhtar-Schuster, M., & Thomas, R. (2021). Community participation in land restoration: Lessons from Africa. *Journal of Sustainable Development*, 30(2), 21-38.
- UNESCO (2024). Widespread soil degradation alarms UNESCO. Retrieved from: <https://www.unesco.org/en/articles/unesco-raises-global-alarm-rapid-degradation-soils>