Research Article

Land Degradation Neutrality for Africa – A Case of Niger Republic

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Abstract

Land Degradation Neutrality (LDN), which promotes a dynamic balance between land rehabilitation and deterioration, has emerged as a key idea in environmental sustainability. This guarantees that productive land resources do not experience a net loss. Land degradation is one of the primary issues that Sub-Saharan African (SSA) nations are dealing with. Many animals, habitats, and locations in the Sahelian areas have suffered due to this act of land degradation (LD). The Sahel is among the most climate-sensitive regions in the world because of changes in land use and land cover (LULC). The Niger Republic is in the middle of the Sahel. This nation has faced several challenges in accomplishing the primary Sustainable Development Goals (SDGs). This study's main objective is to give readers a comprehensive understanding of the causes, effects, and techniques for evaluating the effectiveness of different mitigation initiatives to assist the Niger Republic in meeting its LDN and SDG objectives. This investigation used the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) methodology. Through the use of the search engines Scopus, Academic.edu, ResearchGate, and Google Scholar, we thoroughly examined, screened, and assessed published publications from 2008 to 2024. According to the historical assessment, salinization, overgrazing, deforestation, drought, and soil erosion are the primary causes of LD. On the other hand, it has been demonstrated that socioeconomic determinants include poverty, land tenure rights, population pressure, and economic instability. These variables affect natural biodiversity, the human population, and climate change. Lastly, the research evaluates mitigation techniques and discusses institutional policies for sustainable land management (SLM) and suitable farming practices.

Keywords

Ecosystem Biodiversity, Land Degradation Neutrality, Great Green Wall, Sahel Regions, Sustainable Land Management, PRISMA

1. Introduction

For studies of sustainable development and global environmental change, LDN, one of the SDGs of the United Nations Convention to Combat Desertification (UNCCD), has become essential (Feng et al., 2022). Widely acknowledged as the primary factor in reducing the rates of land degradation and averting desertification, LDN has emerged as a concept in environmental sustainability (Haregeweyn et al., 2023). Due to increased susceptibility brought on by climate change and population expansion, many dryland regions are at risk of desertification, LD, and the conflict that results between humans and land (Nkiaka et al., 2024). Many dryland regions are undertaking significant afforestation and reforestation to achieve LDN, one of the SDGs, and enhance carbon sequestration (Nkiaka et al., 2024). Due to the region's vulnerability to LD and desertification, the Sahel is currently undergoing widespread regeneration under the Great Green Wall Initiative (GGWI) (Nkiaka et al., 2024). Many scholars and stakeholders have attempted, but failed, to develop different SLM approaches in the past and the present. On the other hand, there is no thorough analysis of the geographical trends, opportunities, and difficulties of SLM research and application (Haregeweyn et al., 2023).

The Great Green Wall (GGW) initiative, which aims to

restore 100 million hectares of degraded land, trap 250 million tons of carbon, and create 10 million green jobs by 2030, is particularly vulnerable to desertification in the Sahel regions of SSA due to LD (Nebie and West, 2024). Climate change patterns are among the many environmental issues that the Sahel areas have recently had to deal with. This urgent issue is caused by both human and natural sources (Tefera et al., 2024). LD has a detrimental effect on ecosystem biodiversity and livelihoods in around 40% of the world's landmass (Kesavan et al., 2022; Feng et al., 2022). Managing LD has become difficult in recent years and necessitates a deep understanding of the complex interactions between land systems and human civilizations (Okpara et al., 2018; Chasek et al., 2019).

Desertification and soil erosion may result from the land's gradual degradation. Current mechanical agricultural practices, industrialization, and the fast growth of cities are key indicators of LD (Gunawardena et al., 2024). The main sources of income for a large number of people in the SSA nations are agriculture, animal husbandry, and natural resources. Their situation makes them vulnerable to LD (Adenle et al., 2022). With significant losses in agricultural output and a decline in biomass, the Niger Republic has one of the highest rates of LD in the Sahel. This is because there is limited access to fertile land. After all, degraded laterites comprise almost 50% of the country's land area (Singbo et al., 2023). 6.12 million acres of land in the Niger Republic were lost as a result of LD, according to Moussa et al. (2016). Furthermore, it was estimated that the cost of LD-related land rehabilitation was almost US $0.71 billion (Moussa et al., 2016). As a result, researchers are paying close attention to the management of the country's livestock, natural resources, and Agri-ecological zones.

According to Adamou et al. (2021), the population is affected by a 3.8% annual rate of population increase, poor infrastructure, a lack of natural resources, and unfavourable impacts from climate variability. Additionally, it lowers the rate of economic growth in the nation (Adamou et al., 2021). 80% of people rely on rainfed agriculture, while 77% of the landmass receives less than 150 mm of precipitation per year (Adamou et al., 2021).

Abdou (2013) claims that the Niger Republic's 17 million residents suffer from health issues as a result of poor sanitation, which is made worse by the country's growing demands on its limited water supplies. A medium-term action plan (MTAP) and a national action plan (NAP) are being used to address the nation's other problems, which include desertification and food insecurity brought on by resource overexploitation and climate change. Significant efforts have also been made to slow down environmental degradation and restore natural resources during the past three decades. These activities have escalated since 1984, particularly in the past five years with the involvement of high officials. The MTAP, the outcome of the Environment and Desertification Control effort, is in line with the strategy to reduce poverty (SRP) and strategy for rural development (SRD) orientations in the context of environmental and desertification mitigation, and it serves as a guide for Niger's strategies against desertification (Abdou, 2013).

The unsustainable use of land as a means of subsistence is mostly brought on by population pressures in rural regions and is made worse by climate variability linked to global climate change, such as protracted droughts and erratic rainfall patterns. Urgent action is needed to stop permanent biodiversity loss and diminish soil fertility, which threaten food security, agricultural production, and the social stability of local communities. Both affected communities and national governance face significant obstacles as a result of this persistent tendency.

According to the complex nature and wide-ranging effects of LD in the Sahel, a thorough analysis of the study is necessary to fully grasp the phenomenon's holistic aspects. Though it could have certain drawbacks, doing a thorough examination of the socioeconomic, environmental, climatic, and demographic characteristics of specific locations within the SSA countries has the potential to provide important insights. The specificities of the research location usually limit this approach, making it difficult to extrapolate findings throughout the diverse terrain of SSA. On the other hand, a thorough analysis of the body of current research enables a broader assessment that may incorporate results from a variety of settings, approaches, and periods. A systematic review provides a more thorough knowledge of the causes and consequences of LD in the region by combining the results of several research.

Additionally, this analytical approach identifies patterns, gaps in knowledge, and practical mitigation techniques that might not be seen in single case studies. Moreover, systematic reviews have great value in assessing the effectiveness of treatments in a range of settings, producing evidence-based suggestions that may be adjusted to different socioeconomic and environmental situations. Our decision to do a systematic review in this work rather than a localized inquiry allows us to make use of a wider range of data and experiences, which will provide us with a more complete understanding of how LD affects land production in SSA.

This approach is particularly helpful in guiding future research and treatments aimed at mitigating the effects of LD on human populations and their ecosystems, as well as in forming policy. The goal of this systematic review is to compile the body of evidence currently available about the causes and consequences of LD in SSA. It specifically seeks to address the following research questions:

➢ Which biophysical and socioeconomic factors are the main causes of land degradation on the African continent?
➢ What effects does land degradation have on mortality rates, production levels, and human health?
➢ What are the consequences of reduced food security and rural livelihoods?
➢ Additionally, which measures have been implemented to mitigate these effects, and how successful are they?

This study used the Niger Republic as a focal point for investigation to examine the phenomena of LDN in the African environment. Our investigation aligns with the broader global goals to achieve SDGs and tackle urgent

global issues, including those concerning climate change, biodiversity preservation, and LD. In the Sahelian regions, where LD has had a significant influence on human populations, natural resources, and livelihoods, this question is especially important. In particular, this study focuses on the state of LDN in SSA and the Niger Republic, investigates the root causes of LD in the study area, and finally aims to extract knowledge relevant to SLM and efficient governance in the assigned territory.

2. Materials and Methods
2.1. Study Area
The coordinates of latitude (15°00'N to 25°00'N) and longitude (0°00'W to 15°00'E) define the research region (Fig. 1), which is situated in West Africa. The Republic of Chad borders the Niger Republic on the east, Mali and Burkina Faso on the west, Libya and Algeria on the north, and Nigeria on the south. Around 18 million people are living in

the study region, which has a total land area of about 1.27 million square kilometers (Moussa et al., 2016; Adamou et al., 2021). Agadez, Diffa, Zinder, Maradi, Tahoua, Dosso, Tillaberi, and Niamey are the eight main administrative areas that make up the country (Adamou et al., 2021). The study region is acknowledged as one of the world's least populous nations. The Sahara Desert, which makes up around 77% of the whole geographical area, has an average annual precipitation of about 150 mm. The southern portion of the land, which makes up the remaining 23% of the total area, is home to a sizable population. Rainfed agriculture provides a living for a significant 87% of the population (Moussa et al., 2016). Laterite soils dominate the research area's land surface, limiting access to agricultural land (Singbo et al., 2023). The thermal conditions within the regions are noted to remain elevated throughout the year, with temperatures ranging from (20 °C to 48 °C) during the dry periods and (28 °C to 33 °C) in the wet seasons (Adamou et al., 2021).
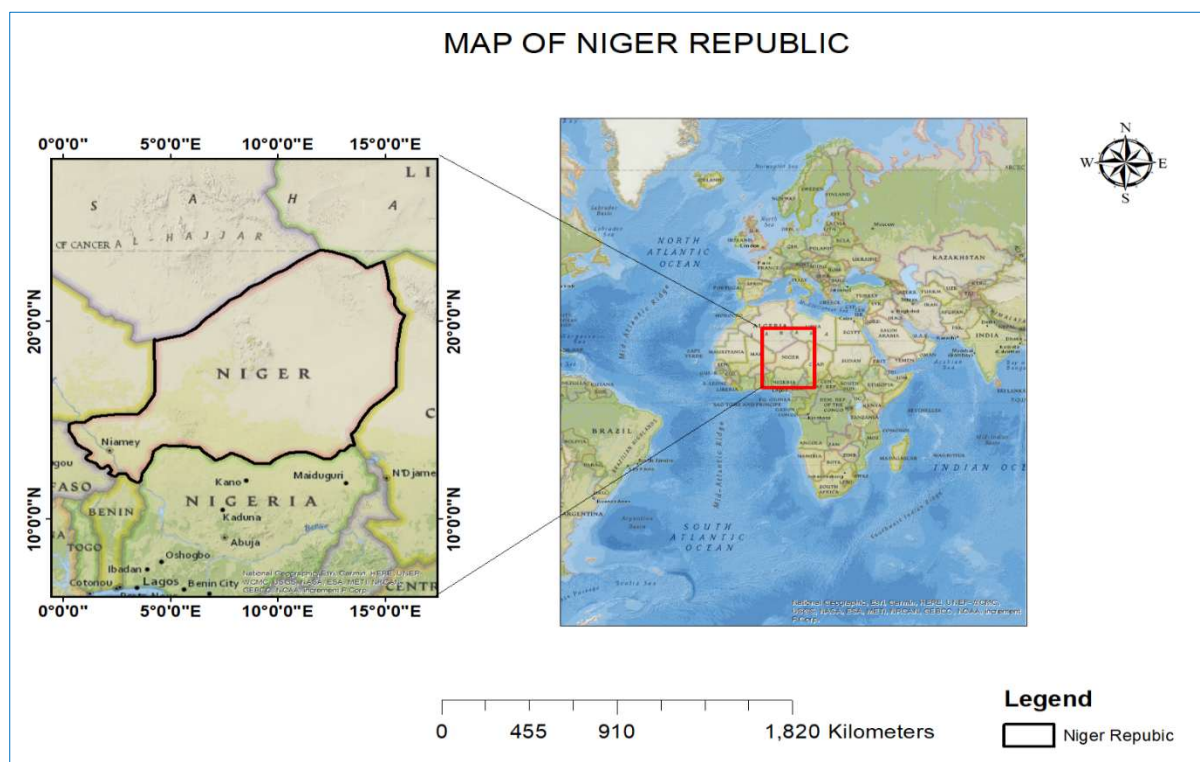

Fig. 1. Map of the study area

2.2. Theoretical Framework
It is commonly known that human-caused causes of LD lead to socio-economic interactions. In this study, the conceptual framework developed by Shackleton et al. (2019), based on the factors proposed by Adenle et al. (2022), was used to explain how people perceive LD in the African context. The authors reviewed six major factors that influence people's perceptions of LD, including:

➢ Individual: Human perception is a cognitive construct that changes over time and in different spatial contexts. According to Shackleton et al. (2019), basic demographic identity factors, experience contexts, and value systems are the main factors that impact people's perceptions.

➢ The extent of LD in the Niger Republic is determined by the environment of the research region and its distinguishing features, which include the rate of LD. The degradation of land can occur in different intensities and geographical areas, especially in small and large areas. This variation results from the fact that opinions about deterioration might differ depending on the kind of LD, its historical location, and how long it has been occurring.

➢ Effects of LD: Changes to the socio-ecological system (SES) or its parts are referred to as consequences of LD, depending on how severe LD is (Adenle et al., 2022).

➢ Sociocultural setting: The socio-cultural context described here has to do with three geopolitical zones, which are [A-B-C] and represent the socio-cultural

structure that governs human relations (Adenle et al., 2022).

➢ The agroecological zone is the subject of the landscape context. According to this concept, characteristics including ecosystem type, land use, land cover, and many more are recognized as important drivers affecting how people perceive LD.

➢ Context of governance and institutional policies: Land management practices, which over time have a reciprocal effect on the socio-ecological system in question, are one way that institutional and governmental policies greatly influence people's perceptions by forming values, social relationships, attitudes, and behaviours (Adenle et al., 2022).

2.3. Study Design

This study's systematic review was based on the PRISMA guidelines as recommended by Slayi et al. (2024). To clarify the study selection process, a PRISMA framework was included, and a completed PRISMA checklist was used to ensure a comprehensive and transparent review process.

While the review was not listed in a publicly available database, we made an effort to adhere to the highest standards of systematic review methodology, which significantly improves the research process's clarity, accuracy, and repeatability (Slayi et al., 2024). To ensure a thorough review and lay the groundwork for future research endeavours to replicate and build upon the findings, the review was conducted in two main phases: the methodical identification and selection of relevant literature and the careful management and analysis of the data extracted from the selected studies (Fig. 2 is the flowchart of the research methodology).
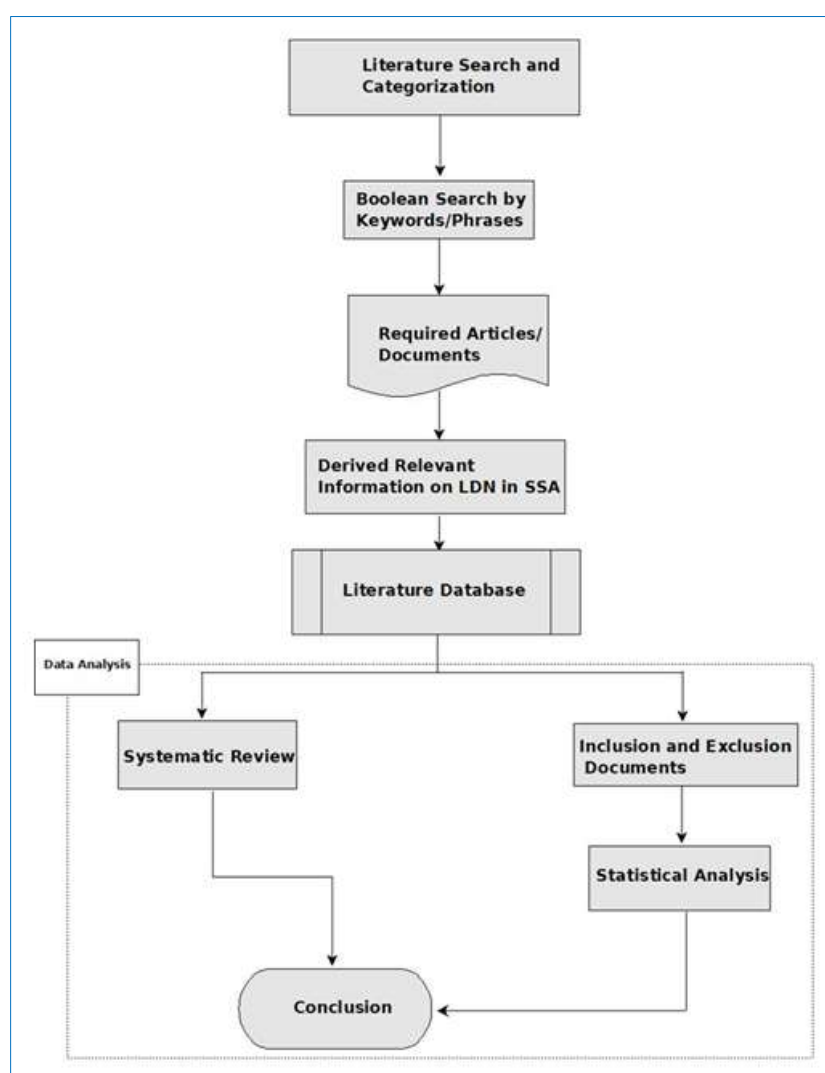

Fig. 2. Literature review building, article categorization, and data analysis were adopted in this study

2.4. Relevance and Current State of the Investigated Topic

This review aimed to find studies that fit the Population, Exposure, and Outcomes (PEO) elements of the research questions, following the methodology described by Bettany-Saltikov (2010). This initial step was crucial in determining

the topic's applicability and in revealing the current status of research in this area. We developed eligibility criteria to guarantee the inclusion of highly relevant studies, and this review focused on studies on LD in SSA, which is crucial for comprehending the effects of LD in areas where human

populations, ecosystems, and livestock are crucial to local economies and food security. Critical causes of LD, such as soil erosion, drought, overgrazing, poverty, and difficulties with land tenure, were the focus of the exposure criterion.

Additionally, the papers that were chosen for evaluation had to include results related to how LD affects land productivity, including how it affects livestock health, grazing capacity, and the livelihoods of populations who depend on these ecosystems. By excluding studies that did not fit these requirements—such as those that were solely focused on crop agriculture or those that were located outside of the SSA context, this rigorous selection procedure ensured that the evaluation was focused and pertinent. This approach not only makes review more pertinent, but it also makes it easier to understand the present level of knowledge on the causes and effects of LD in SSA countries.

2.5. Historical Literature Search

The historical literature review for this systematic review was conducted using the Scopus and Google Scholar search engines, as well as the comprehensive multidisciplinary databases Academia.edu and ResearchGate, to find academic publications that focus on the causes and effects of LD in SSA. In all, 31 papers were used in this investigation. Using the PEO paradigm, a search method was developed. "Land degradation neutrality," "land degradation in Africa," and "land degradation neutrality in Niger Republic" were the main search terms. To guarantee a comprehensive examination of the topic, these phrases were combined. To further refine the search results, filters were applied to select only peer-reviewed journal articles, conference proceedings, book chapters, and review papers published in English, focused on fields relevant to Environmental Science, Agricultural and Biological Sciences, and the Social Sciences, and limited to publications published between 2008 and 2024 to include the most recent research findings.

The search process involved exporting the results to Mendeley reference management software (v1.19.8) for further screening, first examining titles and abstracts against predetermined inclusion and exclusion criteria's, eliminating studies that did not meet these standards, and then assessing the full texts of the remaining articles for relevance. Our evaluation focused on studies that specifically looked at how LD affects ecosystem biodiversity in SSA and the Niger Republic. We next extracted and assessed the quality of the data from the chosen studies to make sure the final literature compilation was reliable and relevant to the study question.

According to the search study, anthropogenic causes of LD in SSA include deforestation, overexploitation of vegetation, shifting cultivation, soil desurfacing, overgrazing, careless use of agrochemicals, a lack of soil conservation practices, and excessive groundwater extraction (Osman, 2014; Adenle et al., 2022; Feng et al., 2022). Improving land tenure rights, offering alternative livelihoods, eradicating poverty and raising awareness, nature-based initiatives and smart agricultural practices are some of the mitigation strategies that have been suggested by multiple researchers based on the search history (Adenle et al., 2022; Slayi et al., 2024; Dimobe et al., 2022; Oyama, 2014).

Fig. 3 shows the line and bar graph representation of published peer-reviewed articles in recent years concerning LDN across various regions in SSA.
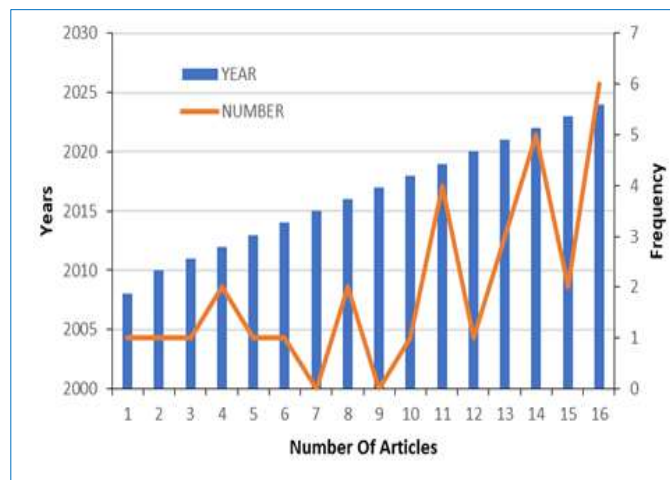

Fig. 3. Number of included articles between 2008 and 2024. The bar chart represents the number of articles reviewed per year and the line plot depicts the cumulative sum of all articles over the years

2.6. Inclusion and Exclusion Criteria

To ensure the quality and relevance of the research reviewed, we carefully defined the inclusion and exclusion criteria for the selection of review articles, as shown in Table 1. To improve readability and guarantee alignment with the researchers' language competency, we limited our inclusion to English-language articles. Geographically, the review focused only on SSA-related literature, purposefully leaving out studies from other areas to maintain the systematic review's focus. There were some restrictions because the articles used in this research study had to be completely available for download. Although access restrictions did constrain our capacity to include several potentially pertinent studies, we recognize that numerous references are accessible through various online platform catalogues. Furthermore, these databases' abstracts and keywords might also provide insightful information. We recommend that a broader range of international sources be examined in future research projects to enhance the typology of the subjects examined. Only studies that examined the causes and effects of LD in the setting of SSA countries were included in the analysis. Works that did not interact with LDN and only focused on crops were not included. Only peer-reviewed journal papers, conference proceedings, book chapters, and review articles were included; reports and these were not included since they did not provide significant empirical evidence to support and confirm the study's integrity.

2.7. Data Analysis

To identify recurrent themes and patterns in the chosen papers, the data analysis used a thematic technique. This method made it easier to evaluate the main causes of LD, how they affect land production, and how effective different mitigation techniques are. Furthermore, using the terminology taken from the abstracts, a co-occurrence network and link analysis were developed to look at the connections between different knowledge fields (Slayi et al., 2024). The size of the label and circle that represented a

phrase in this analysis depended on their importance, which was shown by how frequently it appeared in the articles. Relationships between knowledge areas are indicated by the links between terms; stronger linkages are indicated by terms that are located closer together.

3. Results and Discussion
3.1. Primary Drivers of Land Degradation in Sub-Saharan African Countries

Population growth, human activity, poor governance, wars, limited resources, and climate variability are all considered in the comprehensive analysis of the main causes of LD in SSA nations. The study clarifies the complex interactions between biophysical and socioeconomic factors in different geographical areas, each of which has unique difficulties and

conditions. The research contained within this study encompasses a large geographic reach, including Nigeria, Burkina Faso, Kenya, Tanzania, and Niger Republic, which serves as the main point of our investigation. The search history of LDN studies in SSA is summarized in Table 2.

The wide range of environmental and social circumstances that contribute to deterioration is highlighted by this widespread dispersion. Field surveys, remote sensing, geospatial data analysis, and dynamic vegetation modelling are just a few of the methods used in the examined research. Researchers like Oyama (2012) and Oyama (2014) have used field surveys and participatory rural assessments to capture the traditional knowledge of the affected communities and provide thorough insights into local perspectives.

Table 1. Inclusion and Exclusion Criteria for the Review Articles in the Order of Selection

Criteria	Included	Excluded	Justification
Language use	English	All other languages	To enhance readability and due to author preference
Country or Location of Study	Sub-Saharan related studies	Non-Sub-Saharan African studies	To be in line with the objective of the study
Article availability	Fully available articles using the Google Scholar search engine, Academia.edu, and Researchgate platforms	Article not accessible	To cite the authors correctly
Date of publication	Articles published between the years (2008-2024)	2007 and below	To have the current contemporary perspective on LDN in Africa
Research Focus	Studies that included LDN	Studies focusing on solely agriculture and livestock	To be in line with the focus of the study
Type of Article	Peer-reviewed research journal articles, conference papers, book chapters, and review papers	Gray literature, including reports and thesis, unless they provided substantial information about the subject matter	To increase the validity of the research investigations

Table 2. Summary of Historical Review of LDN Studies in SSA

Year of published	Source (Example)	SSA Region	Socio-economic factors for LD	Biophysical factors for LD
2011, 2019, 2020, 2022	Adenle and Speranza, 2020; Speranza et al., 2019; Akinnagbe and Umukoro, 2011; Ibrahim et al., 2022	Nigeria	Conflicts, Population pressure, Economic Factors, Policy and Governance	Desertification, Soil Erosion, Land use changes, Overgrazing, Over-cultivation, Mining, Deforestation/logging
2022	Dimobe et al., 2022	Burkina Faso	Population pressure, Economic factors, Policy and Governance	Deforestation/logging, Over-cultivation, Climatic factors
2019	Gichenje et al., 2019	Kenya	Population pressure, Economic factors, Policy and	Climatic factors, Chemical fertilizer applications, Overgrazing, Over-cultivation, Deforestation/logging, Land use changes
2021	Reith et al., 2021	Tanzania	Population pressure, Economic factors, Policy and	Land use changes, Deforestation, Over-cultivation
2008, 2012, 2013, 2014, 2016, 2021, 2023, 2024	Abasse et al., 2008; Grolle, 2012; Oyama, 2012; Abdou, 2013; Oyama, 2014; Moussa et al., 2016; Adamou et al., 2021; Singbo et al., 2023; Nkiaka et al., 2024	Niger Republic	Conflicts, Population pressure, Economic Factors, Policy and Governance	Drought, Overgrazing, Climatic factors, Deforestation, Chemical fertilizer applications, Improper waste disposal, Soil erosion

According to the author's research, the growing human population has led to several anthropogenic activities, which has resulted in the severe consequences of LD in the Sahelian countries. Understanding the sociocultural aspects of LD and developing culturally relevant therapies need the use of these qualitative approaches. As demonstrated by Dimobe et al. (2022), Gichenje et al. (2019), Reith et al. (2021) and Adenle

et al. (2022). On the other hand, remote sensing and statistical studies provide quantitative information about vegetation and LD changes across large geographical and temporal scales. This data is extremely important for spotting prevailing patterns and trends. The review's main findings clarify that LD is largely caused by biophysical factors such as soil erosion, overgrazing, forest encroachment, and

rainfall variability, and socioeconomic factors such as poverty, land tenure concerns, and market accessibility. For example, local populations in SSA countries see drought as the primary driver of resource depletion, which is exacerbated by poverty and inadequate land tenure systems (King-Okumu et al., 2021).

Overgrazing is a significant factor in the degradation of the Niger Republic's land, leading to decreased plant cover, increased soil erosion, and decreased land productivity (Oyama, 2014). These elements worsen food insecurity in pastoralist communities and have a negative impact on animal output (Slayi et al., 2024). In areas with high gradients and little plant cover, soil erosion is more severe. However, certain soil conservation strategies, such as terracing and tree replanting, show promise in mitigating these adverse effects. Degradation is made worse by the effects of climate change, which show up as higher temperatures and different precipitation patterns.
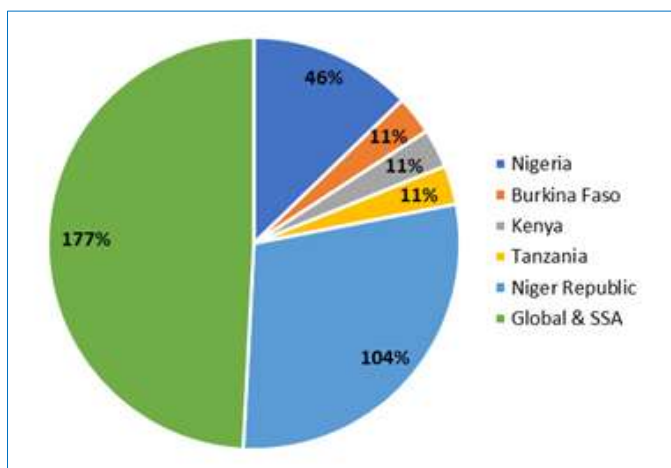

Fig. 4. Percentage share of publications per SSA country and Global studies

As a result, there is less fodder available and higher cattle death rates. Deforestation brought on by fuelwood harvesting and agricultural growth further exacerbates LD by causing soil erosion and fertility loss (Dimobe et al., 2022). While insecure land tenure inhibits sustainable land management and results in overgrazing and soil erosion, stable land tenure promotes improved land conditions and improved land management practices (Slayi et al., 2024).

In order to survive immediately, communities that face economic instability often overuse land resources, which leads to serious degradation. The diversification of income sources and the implementation of community-based natural resource management strategies are imperative to mitigate this concern (Adenle et al., 2022). The rising strain from population expansion also incites overgrazing and the alteration of lands for agricultural uses, which leads to severe soil erosion and the loss of vegetation (Oyama, 2014). However, there are significant gaps in the literature about the long-term effects of soil conservation strategies, the effectiveness of climate adaptation strategies, and the complexities of socioeconomic factors influencing land management practices.
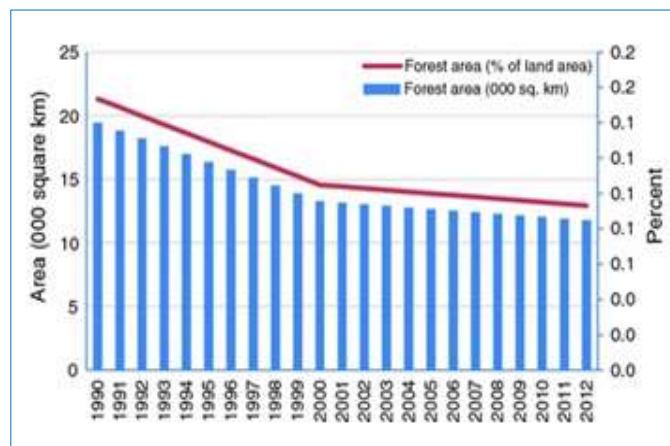

Fig. 5. Niger Republic Forest area trend (Moussa et al., 2016)

The development of effective interventions targeted at sustainable land management and the improvement of agricultural output requires further research into community involvement, technological developments, and the implementation of policy initiatives (Adenle et al., 2022).

However, challenges still exist, especially in ensuring sustainable implementation and ongoing oversight. To handle the complex issues brought about by LD and climate change, studies like those conducted by Moussa et al. (2016) and Singbo et al. (2023) highlight the need for an integrated approach to land management that combines traditional knowledge, modern scientific methods, and adaptive strategies. There are clear gaps in the literature, especially about the need for more long-term studies that combine socioeconomic and biophysical data to provide a thorough understanding of the dynamics of land degradation.
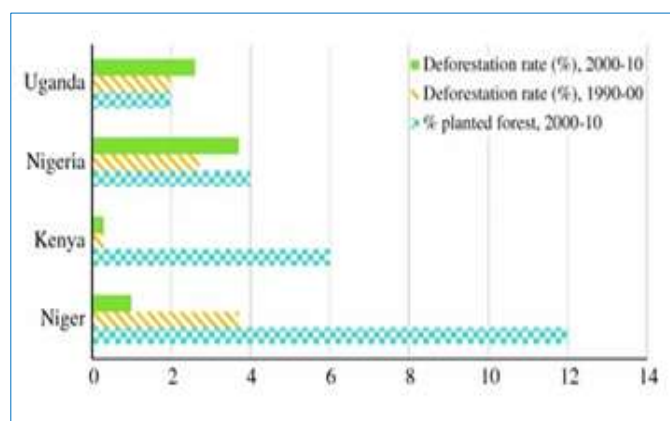

Fig. 6. Deforestation rate and planted forest as share of total forest area in selected countries (Moussa et al., 2016)

Future research should focus on these areas as well as the development of policies that support local livelihoods, strengthen institutional capabilities, and promote sustainable farming practices that are adapted to specific regional circumstances. To promote resilience and guarantee the survival of rangelands in the SSA area, such measures are essential. The proportional share of publications by SSA and global studies from 2008 to 2024 is displayed in Fig. 4.

3.2. Impact of Land Degradation on the Niger Republic and Other Sub-Saharan African Countries

The research's conclusions highlight the severe and varied effects of land degradation in the Niger Republic and other parts of African nations. Mousaa et al. (2016) found a clear correlation between LD and changes in forest cover in the Niger Republic. This implies that environmental deterioration directly affects a country's economic production in addition to endangering human health. Similarly, Singbo et al. (2023) showed that in the Niger Republic, access to arable land is limited due to degraded areas. As a result, this adds to the high rates of poverty that are seen in the country. These results underscore the critical importance of LD, emphasizing its vulnerability to environmental changes. Speranza et al. (2019) found that the two main markers of LDN in the Nigerian setting are gully erosion and land pollution. The authors also clarified that there are inconsistencies in the way that LDN rules are implemented within the current institutional structures.

According to Dimobe et al. (2022), LD is the primary cause of poverty among people living in rural areas of Burkina Faso, and they suggest improving lives through a variety of strategic options. Gichenje et al. (2019) provided more proof of the detrimental effects of LD on browning and greening patterns in Kenya, which are important markers of terrestrial life and economic growth. Last but not least, Nkonya et al. (2016) highlighted how LD in SSA countries has had a significant impact on the livelihoods of those living in poverty, whose main sources of income are mostly dependent on natural resources.

This study is important because it shows how deteriorated habitats have long-lasting effects on the ability of people, land, and cattle to survive, especially throughout critical life stages. When taken as a whole, these analyses provide a compelling picture of how LD negatively impacts cattle health, production, mortality, human health, and land integrity across SSA. The data clearly shows that sustainable land management techniques are urgently needed to mitigate these negative effects and increase the resilience of land restoration projects in communities across Africa. The land use land cover (LULC) of the Niger Republic and other SSA nations, as well as the degradation of the country's forests, are depicted in bar graph form in Figs. 5-7.

The Niger Republic's forest cover decreased as a result of changes in LULC, as seen in Figs. 5-6. Fig. 7 shows that similar discoveries were made in other SSA nations. It is evident from Fig. 8 that the water bodies, forests, and short Sahelian grass have been impacted by over-cultivation and urbanization. As seen in Fig. 9, the nation had to spend millions of dollars to restore the deteriorated land.

3.3. Socio-Economic Consequences of Reduced Land Productivity

The substantial socioeconomic effects of lower land productivity in several SSA regions highlight the ripple effects of LD on livelihoods and food security. For instance, the clear correlation between lower household income and decreasing land production in the Niger Republic highlights the economic instability that local populations face (Singbo et al., 2023; Oyama, 2014).
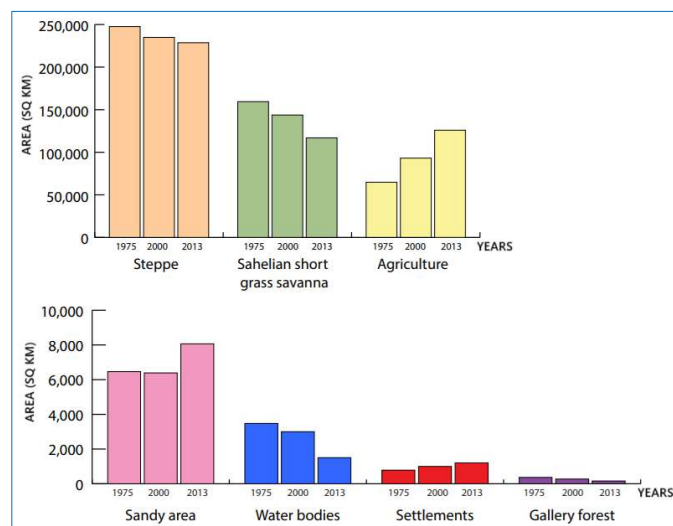

Fig. 7. Evolution of the different land cover types in Niger Republic (Adamou et al., 2021)
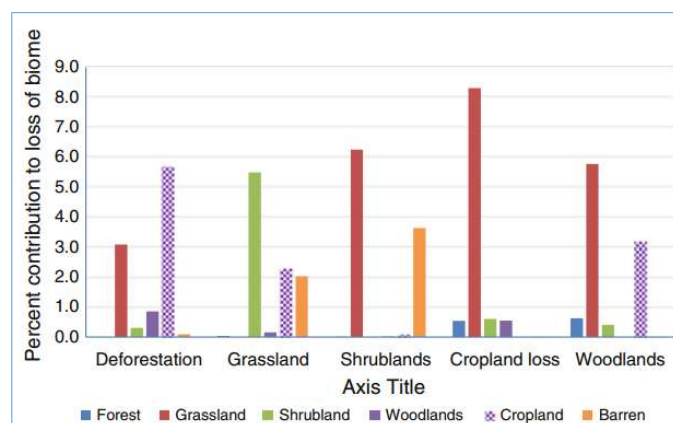

Fig. 8. Source of Loss of Biome Extent and Destination Biome in the LULC of Niger Republic (Moussa et al., 2016)
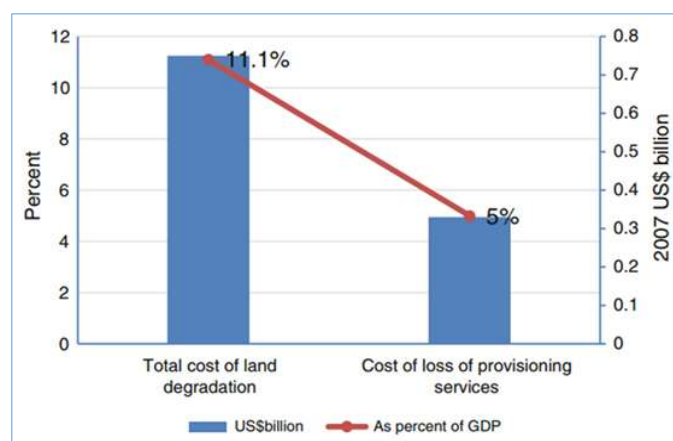

Fig. 9. Cost of LD due to LULC of Niger Republic (Moussa et al., 2016)

Food insecurity is made worse by such income declines because households lose purchasing power and have less access to essential food supplies. Similarly, in Burkina Faso, there is a clear correlation between declining land production and rising rates of poverty (Dimobe et al., 2022).

Communities are becoming more and more dependent on food aid as a result of this economic strain, which indicates a loss in their ability to withstand environmental hardships and become self-sufficient. Gichenje et al. (2019) explain the situation in Kenya, where declining agricultural yields spur rural-to-urban migration, as another example of the socioeconomic effects. As families look for other sources of income in metropolitan areas, this movement frequently acts as a survival strategy. However, this shift comes with increased nutritional deficiencies, which are a result of decreasing access to varied and nutrient-dense foods that animals have historically supplied (Slayi et al., 2024).

According to Singbo et al. (2023) research in the Niger Republic, families headed by women are disproportionately affected by LD, highlighting the gender-specific consequences of the condition. Particularly during dry seasons when animal output is at its lowest, these households face more food insecurity. Although this adaptation is meant to be a coping strategy, because subsistence farming is fundamentally less dependable than livelihoods built around animals, it increases vulnerability to hunger during crop failures. In conclusion, our findings highlight the complex connections between food availability, economic sustainability, and environmental deterioration in SSA. To save livelihoods and increase resilience against potential shocks, they highlight the urgent need for measures that simultaneously address the ecological and socioeconomic aspects of LD.

3.4. Effectiveness of Mitigation and Adaptation Strategies

The results of the study showed that different adaptation and mitigation strategies employed in many African countries to address LD and its impact on cattle productivity had varying degrees of effectiveness. For instance, the significant increases in cattle production and land health suggest that rotational grazing is quite advantageous (Slayi et al., 2024). This method allows pastures to recover while reducing overgrazing, a primary contributor to soil deterioration. However, there has been limited success with agroforestry approaches (Adenle et al., 2022). Even though these techniques effectively reduced soil erosion and improved feed quality, their efficacy was contingent upon several factors, such as local ecological conditions and community engagement. This implies that, despite its benefits, agroforestry may not be equally applicable or suitable everywhere. Similarly, terracing and mulching are excellent soil conservation techniques that reduce LD and increase cattle output (Slayi et al., 2024).

These methods were shown to enhance soil moisture retention through farmer surveys and field testing, which is crucial for sustaining animal feed and pasture development during dry seasons and halting soil erosion (Slayi et al., 2024). Taken together, these findings demonstrate the importance of context-specific strategies tailored to the unique economic, social, and environmental conditions of SSA countries. The effectiveness of these approaches offers promise for improving land productivity and sustainability in the face of LD, provided that local conditions are properly considered, and that ongoing community participation and education are offered.

3.5. Recommendations for Policy Makers in Charge of These Problems and Future Research Directions

Although our knowledge of how LD impacts SSA's agricultural output and rural lives has advanced significantly, there are still some gaps that need to be addressed. One major gap in the development of sustainable land management strategies is the insufficient integration of modern scientific methodologies with ancient knowledge systems. Traditional agricultural methods in the varied communities provide priceless insights into land management and animal care, even though their expertise is occasionally underutilized in policy and intervention approaches. Future studies should focus on bridging this gap by incorporating indigenous knowledge into livestock management and land restoration strategies to increase the resilience and durability of these interventions. Another gap is the ignorance of the long-term socioeconomic impacts of LD on different demographic groups, particularly women and youth. LD and lower livestock output can have gendered impacts, limiting opportunities for youth in rural areas and disproportionately hurting female-headed households. More gender-sensitive and youth-focused research is required to fully understand the unique possibilities and challenges that these groups face in the context of cattle production and LD in SSA.

Women are crucial to the effective administration of livestock and land production since they are usually in charge of tasks like feeding, watering, and maintaining the grounds and animals. Despite their crucial contributions, their perspectives and viewpoints are typically underrepresented in land management decision-making processes. Therefore, studies that highlight the special demands, constraints, and contributions of women may lead to more inclusive and effective approaches to sustainable land management. Similarly, youth comprise a significant share of the population in many rural communities, but they often face barriers such as limited access to resources, land, and knowledge. Targeted research and capacity-building initiatives are necessary to ensure the long-term resilience of land resources and to promote youth involvement in sustainable practices. By teaching young people about issues related to LD, we can empower them to become active change agents in their communities. Such research is necessary to develop inclusive and equitable solutions that successfully mitigate land degradation while meeting the diverse needs of all parties. Furthermore, more comprehensive evaluations that include the sustainability and scalability of these interventions across a range of ecological and socioeconomic contexts are needed, even though several studies have demonstrated the effectiveness of various mitigation and adaptation strategies. While taking into consideration local environmental conditions, cultural norms, and budgetary constraints, future research should search for best practices that may be adjusted for application in other SSA regions.

Climate change continues to be the primary driver of LD, but little is known about how it interacts with other factors including land use changes, political actions, and socioeconomic alterations. Future studies should use an integrated strategy that examines the cumulative impacts of climate change in addition to other variables that contribute

to land degradation in order to give a more thorough knowledge of the possibilities and challenges for sustainable land management. Lastly, to provide current information on LD and its impact on land productivity, improved data collection and monitoring techniques are needed. By enabling faster and more effective responses to emerging hazards, the development and implementation of such systems will support adaptive management and policymaking. In conclusion, addressing these gaps through interdisciplinary and participatory research approaches would be crucial to developing policies that successfully halt land degradation and enhance livestock sustainability in SSA.

3.6. Potential Limitations

This systematic review provides useful information regarding LDN in Africa using the Niger Republic as a case study in SSA. Numerous potential disadvantages were identified. First of all, the review was unavoidably constrained by the availability and accessibility of published papers. Because the inclusion criteria restricted the selection to English-language papers, pertinent research published in other languages could have been left out. This language bias may restrict the comprehensiveness of the findings, particularly in fields where a significant amount of research has been conducted in languages other than English. Gray literature, which includes government records, reports, and theses and may offer insightful information, may also be obscured by the focus on official publishing and peer-reviewed journal articles. Ignoring Gray literature might result in a more constrained grasp of the topic, even though peer-reviewed research is typically more reliable. Furthermore, there are significant differences in the research designs, methodologies, and geographic coverage of the included studies. This variety may make it challenging to combine the findings and draw broad implications. It might be difficult to extend results to different contexts when reported outcomes vary due to variations in study design, sample sizes, and data collection methods.

On the other hand, because research with notable or positive findings is more likely to be published than those with null or negative findings, the review's reliance on published studies may introduce a publication bias. This bias has the potential to skew the review's conclusions by overemphasizing the relationship between land degradation and land production. Another limitation is the period of the included study. Many studies do not account for recent changes in the climate, regulations, and land management practices, which could affect the degree of land degradation that exists now. Because environmental and socioeconomic elements in SSA are always changing, results from previous studies could not fully reflect the situation today.

Finally, the review may be constrained by the lack of long-term research that tracks the effects of LD and mitigation efforts over extended periods. Short-term studies may not adequately reflect the long-term consequences of LD on livestock and livelihoods or the full effects of interventions. Despite these limitations, the study provides a helpful overview of existing knowledge and highlights significant areas for more research. Addressing these limitations via more comprehensive, inclusive, and longitudinal research will be crucial to enhancing our understanding of the complex links between cattle productivity and LD in SSA.

4. Conclusions and Recommendations

The significant and varied effects of LDN in SSA are highlighted in this systematic study. Millions of people in this area depend on the land for their livelihood and food security. According to the data given, LD, which is caused by a combination of biophysical and socioeconomic causes, seriously jeopardizes land health, production, and survival, making poverty and food insecurity among rural people who depend on agricultural cultivation even worse. According to the research, several factors contribute to land degradation, including soil erosion, climate change, and unsustainable land management techniques. The interconnection of the ecological and socioeconomic systems in the area is highlighted by the cascade repercussions, which include decreased food production, poverty, drought rates, desertification, and increased mortality. Rotational grazing, agroforestry, and soil conservation are examples of mitigation and adaptation practices that have demonstrated promise in improving land productivity and repairing degraded areas. However, community engagement, favorable policy frameworks, and local socioeconomic conditions are frequently necessary for these tactics to be successful. There are still a lot of unanswered questions about the management and comprehension of LD and its effects on lands in SSA, despite the notable advancements. Prioritizing long-term research that integrates gray literature and examines the efficacy of integrated methods that include ecological restoration and socioeconomic development might be beneficial for future research. To create sustainable land management techniques that preserve land productivity and improve the resilience and general well-being of the communities who rely on them, these gaps must be filled.

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