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LOSS OF BIODIVERSITY AND FOOD SECURITY IN NIGERIA

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Abstract
Nigeria is rich in biodiversity, boasting of diverse ecosystems and numerous species. The country's ecosystems range from semi-arid savannas to montane forests, floodplains, rainforests, freshwater swamps, and coastal vegetation. However, Nigeria's rich biodiversity, essential for agriculture and food security, is under severe threat, impacting adversely on food security. This study investigates the impact of oil pollution, deforestation, and desert encroachment on biodiversity loss within Nigeria's agricultural ecosystems. This study employed a comprehensive review of existing literature on the assessment of biodiversity loss in Nigeria's agricultural ecosystems due to pollution from oil spill, deforestation and desert encroachment. By analyzing the correlation between these environmental stressors and food security challenges, this study highlight the critical need for integrated conservation and agricultural strategies. The findings indicate that the loss of biodiversity has far-reaching implications, including malnutrition, food price volatility, and the erosion of rural livelihoods. The study emphasizes the pressing necessity of tackling these challenges in order to guarantee sustainable food security and ecological equilibrium in Nigeria. To address these interconnected issues, the study recommends a holistic approach that prioritizes sustainable practices, robust policies, and community engagement. By safeguarding Nigeria's biodiversity, we can ensure a sustainable food future for generations to come.

Keywords Biodiversity, food security, agricultural ecosystems, oil spill, deforestation, desert encroachment.

INTRODUCTION

Nigeria, rich in biodiversity, boasts diverse ecosystems and numerous species, including over 864 birds, 117 amphibians, 203 reptiles, 775 fish, 285 mammals, and 4,715 vascular plants. The country's ecosystems range from semi-arid savannas to montane forests, floodplains, rainforests, freshwater swamps, and coastal vegetation (UNODC 2022). The Niger Delta, a global biodiversity hotspot, contains Africa's largest mangrove forest and 11 Ramsar sites covering 1,076,728 hectares, hosting endangered species like the Niger Delta red colobus, Cross

River gorilla, African manatee, and leatherback turtle (Numbere, 2019). Despite this richness, Nigeria's biodiversity is undervalued and threatened by habitat loss, overexploitation, pollution, invasive species, and climate change, driven by factors such as population growth, urbanization, poverty, weak governance, and lack of awareness. According to the IUCN Red List 2019, Nigeria has 309 threatened species (Mongabay 2022; Onipede 2024).

Biodiversity conservation in Nigeria also offers many opportunities, such as enhancing economic development, poverty reduction, food security, health, and resilience. However, the biodiversity within these agricultural landscapes is increasingly under threat, posing significant risks to food security in the country. Biodiversity loss within agricultural areas not only diminishes resilience against pests and diseases but also hampers soil fertility and reduces the essential ecosystem services necessary for crop production (Sangothari et al., 2024). The intensification of agricultural practices, habitat destruction, climate change, and other human-induced factors have collectively contributed to a notable decline in biodiversity, thereby jeopardizing the sustainability of food systems and exacerbating food security challenges (Lenda, 2024).

The erosion of biodiversity in Nigeria's agricultural ecosystems has far-reaching implications for food production and national security. Diminished biodiversity can lead to a decrease in agricultural productivity, heightened vulnerability to pests and diseases, and an increased reliance on a limited range of crop species, rendering food systems less resilient to external shocks (Sangothari et al., 2024). This loss of biodiversity is intricately linked to various food security issues such as malnutrition, fluctuations in food prices, and the livelihoods of rural communities that heavily rely on diverse ecosystems for their sustenance (Sangothari et al., 2024).

Furthermore, the decline in biodiversity can contribute to broader socio-economic and political instability, as food insecurity often triggers economic downturns, social unrest, and political vulnerabilities (Sangothari et al., 2024). The global trend of agricultural intensification and the continual conversion of natural habitats into agricultural lands have been identified as major threats to biodiversity worldwide, leading to the extinction of native flora and fauna (Lenda, 2024). Agricultural biodiversity serves as the foundation for research and development in agriculture, highlighting its critical role in sustaining food production systems (Joshi & Upadhya, 2019). While agricultural landscapes are essential for food production, the expansion of agricultural activities often comes at the expense of biodiversity loss, emphasizing the need for a balance between agricultural productivity and biodiversity conservation (Sangothari et al., 2024).

In Nigeria, as in many other regions globally, the challenge lies in reconciling the need for increased agricultural output to meet the demands of a growing population with the imperative to conserve biodiversity for long-term food security and ecosystem health. The intricate interplay between agricultural practices and biodiversity conservation underscores the necessity for integrated farming systems that prioritize both agricultural productivity and biodiversity preservation (Sangothari et al., 2024). The coexistence of agriculture and biodiversity is crucial for maintaining ecosystem services, ensuring sustainable food production, and safeguarding the livelihoods of communities dependent on agriculture for their well-being (Sangothari et al., 2024).

This study aims to assess the extent of biodiversity

loss in Nigeria's agricultural ecosystems, specifically focusing on the impacts of pollution from oil exploration, deforestation, desert encroachment, migration, hunting and gathering, harvesting of species without afforestation (such as timber), indiscriminate burning, shifting cultivation, sea and river pollution, and uneducated application of insecticides by farmers. By analyzing the relationship between these factors and food security challenges—including malnutrition, food price volatility, and rural livelihoods—this study seeks to illuminate the broader implications of biodiversity decline.

METHODOLOGY

This research will employ a comprehensive review of existing literature, synthesizing key findings to provide actionable recommendations for enhancing biodiversity conservation and food security strategies in Nigeria. By focusing on practical strategies and case studies, the review will offer insights into effective policy interventions and sustainable practices that can be implemented at local, national, and international levels. This study is limited to a review of existing literature and does not involve primary data collection. Therefore, the findings may be subject to limitations in terms of data availability and the depth of analysis. By conducting a thorough literature review, this study aims to provide a comprehensive overview of the complex relationship between biodiversity loss and food security in Nigeria, informing future research and policy development.

Literature Review

Conceptual Framework

Biodiversity

Biodiversity refers to the amazing variety of life on Earth, encompassing everything from microscopic bacteria to towering trees and the majestic creatures that roam the planet (Palombo, 2021). This diversity isn't just about the number of species; it includes the variation in genes within a species (genetic diversity), the variety of different species within an ecosystem (species diversity), and the incredible range of ecosystems that make up our planet (ecosystem diversity). Just like a healthy and balanced forest ecosystem teeming with life is more resilient to disturbances, so too is a planet with high biodiversity (Kommidi, 2021). From the microscopic bacteria enriching the soil to the towering trees filtering air, each organism plays a crucial role in this intricate web. This variety provides us with essential services like clean air and water, regulates the climate, and protects us from natural disasters. It also underpins food security by supporting healthy agro-ecosystems and providing a vast genetic library for food production and medicine. However, this precious biodiversity faces a significant threat: human activity. Human activity threatens this rare biodiversity as tropical and subtropical species are vanishing at alarming rates. Losing species variety, abundance, and ecological interactions is a global issue (Muluneh, 2021). Due of its complexity, this decline must be addressed holistically.

Causes of Biodiversity Loss in Nigeria

Nigeria’s biodiversity is seriously in danger of going extinct due to the charges in climate, economic growth, land tenors system, invasive species, and pollution from oil exploration, deforestation and desert encroachment, migration and hunting and gathering, Road construction and lack of good attitude from other government and the general public (Ogundipe, 2019). Potently, biodiversity loss is as a result of traditional human activities which involve harvesting of species without afforestation like the Timber, indiscriminate burning, shifting cultivation,

sea/river pollution, and uneducated application of insecticides by farmers, deforestation and many more variables. The IUCN Red List identifies habitat loss, overexploitation, invasive species, and climate change as key drivers. These are often fueled by population growth, poverty, weak governance, and a lack of public awareness (Duenas, et al 2021).

Additionally, according to Ben & Okon, (2020), soil degradation is having a great negative impact on nearly all the 36 states of Nigeria including Cross River, Edo, Ondo and even the Federal Capital Territory (FCT) as a result in the loss of biodiversity. The exploitation and deforestation of the forest risk in biodiversity including the aforementioned states has led to greater loss of biodiversity such as soil micro, macro faunas and floras. Also, the depleted savannah forest and resources have resulted to a variety of negative consequences such as loss of natural vegetation, wildlife, soil organisms and fertilize top layer of the soil (Ogunbode, et al 2021).

Nigeria's biodiversity is seriously threatened by climate change, as seen by noticeable alterations in weather patterns and environmental factors. According to Anabaraonye et al. (2022), Nigeria's biodiversity is negatively impacted by climate change due to rising sea levels that cause flooding, changes in rainfall patterns, and higher temperatures and humidity. Similarly, Okudu and Ifeanacho (2020) note that population growth and economic activity are driving natural resource use. Humans and wildlife compete for water as they move to biodiversity-rich areas. This competition strains ecosystems, destroying habitats and biodiversity.

Inadequate implementation of biodiversity and conservation regulations may also contribute to biodiversity loss. Preventing the development of areas suitable for exploitation, mining, exploration, and road extension inhibits economic growth and conservation initiatives (Kazapoe, et al 2023). Thus, the lack of biodiversity legislation and a lack of understanding of species language and values make biodiversity conservation in Nigeria difficult (Ashukem & Sama, 2023).

Furthermore, loss of biodiversity also occurs as a result of pollution. This is because it reduces the quality and quantity of water, air, and soil; altering the chemical and physical properties of natural resources thereby causing diseases, mutation, death of living organisms and disrupting the food chains webs (Groh, et al 2022). According to Achimugu (2021), the Niger Delta has suffered from over 50 years of oil pollution which has resulted in widespread environmental damage and human right violations. To reduce this trend of pollution, Nigeria needs to promote and support the use of clean and green technologies and practices that minimize the generation and impact of pollutants on the environment (Pona, et al. 2021). Invasive species, which are species that are imported or spread outside of their indigenous environment, ultimately cause biodiversity loss and harm to the local ecosystem. Examples of such organisms include water hyacinth, giant mimosa, tilapia, and cassava mosaic virus. The presence of plants on adjoining agricultural land in Nigeria's southern and central regions cause's native species to be displaced (Akani, et al 2022).

Effects of Biodiversity Loss in Nigeria

In addition to environmental deterioration, the loss of biodiversity in Nigeria has a significant impact on ecosystems and the well-being of humans. Decreased biodiversity diminishes the ability of ecosystems to withstand droughts, floods, and disease outbreaks (Casu, et al 2024). The extinction of a single species can have far-reaching consequences throughout the ecosystem, negatively impacting other species that rely on it

for pollination or as a source of food. Furthermore, a varied and abundant plant and animal population is essential for ensuring food security. Biodiversity loss has adverse effects on crop diversity, making them more susceptible to pests and diseases, and altering soil fertility processes. This poses a threat to food security (Muluneh 2021). Also, the availability of water is contingent upon the proper functioning of robust ecosystems that regulate the water cycle. Water scarcity is worsened by the loss of biodiversity, which leads to increased soil erosion and reduced water penetration.

Resource depletion is a significant consequence of biodiversity loss. The decline in biodiversity diminishes the accessibility and excellence of timber, medicinal plants, and fibres, hence impacting livelihoods and economic progress (Dagar, et al 2020). Indigenous groups have a profound connection with their natural surroundings; hence biodiversity loss has a significant impact on them. The eradication of culturally significant animals has the potential to disrupt customs and undermine identity. Ultimately, the decline in biodiversity exacerbates climate change as ecosystems effectively store carbon dioxide. Forests have the capacity to sequester carbon, but the decrease in biodiversity diminishes their ability to do so, which could worsen the effects of climate change (Joshi & Singh, 2020).

Food security

Food security, as defined by the Food and Agriculture Organization (FAO), is a complex state that is crucial for the welfare of individuals and the progress of societies. Food security is the condition in which every person consistently has sufficient access to safe and nutritious food that meets their dietary requirements and personal preferences, enabling them to lead an active and healthy life (Mbow, et al 2020). This concept highlights the complex interaction of different elements that contribute to food security, underlining its intricate nature and the need for a comprehensive approach to attain it.

Food security is essential for the overall physical and mental health of individuals, as well as for maintaining a stable economy and fostering social cohesion. It has a direct influence on the productivity of individuals and the advancement of society, serving as the foundation for sustainable development. In the absence of food security, populations are exposed to heightened health hazards, diminished educational achievements, and hindered economic progress. Furthermore, the issue of food security is intricately linked to political stability and peace, as a shortage of food can result in societal unrest and conflicts (Behnassi, & El Haiba, 2022).

Dimensions of Food Security

Food security is underpinned by four main dimensions: availability, access, use, and stability. Each dimension addresses a critical aspect of food security, collectively ensuring robust, inclusive, and resilient food systems. Food availability refers to having ample amounts of food that meet quality standards, sourced through local production, imports, or food assistance. This dimension primarily concerns the supply aspect of food security, emphasizing the importance of a reliable and adequate food production system. Key determinants affecting food availability include agricultural output, climate conditions, technological advancements, and infrastructure. To ensure food availability, investments in sustainable agricultural practices, efficient supply chains, and robust infrastructure are necessary to reduce post-harvest losses and guarantee timely food distribution (Chauhan et al., 2021).

Food access is the ability of individuals to obtain

sufficient resources to acquire appropriate foods for a nutritious diet. This dimension focuses on economic and physical resources that people use to access necessary nourishment. Economic access involves factors such as income levels, food prices, and market functionality, while physical access pertains to the presence of food markets and adequate transportation infrastructure. Policies aimed at equitable economic development, poverty reduction, and enhanced infrastructures are essential to improve market access and food affordability (Smith et al., 2020).

Food utilization involves the proper use of food, which includes a comprehensive understanding of basic nutrition and care, as well as access to clean water and sanitation. This dimension ensures that consumed food meets the nutritional needs of individuals and promotes good health. Effective utilization includes proper food handling and cooking, a varied diet, and access to uncontaminated water and sanitation. Public health initiatives, nutrition education, and improvements in water and sanitation infrastructure are vital for enhancing food utilization and ensuring that diets provide necessary nutrients (Jones, 2019). Food stability refers to the consistent availability of adequate food without disruptions caused by economic, climatic, or political factors. This dimension highlights the importance of resilient food systems that can withstand and recover from sudden and prolonged disturbances. Enhancing food stability involves managing risks related to food production, supply chains, and market volatility. Measures to improve stability include safety nets, strategic food reserves, early warning systems, and climate adaptation strategies to mitigate the impact of adverse events on food security (Doe & Smith, 2018).

Empirical Review

Sufiyan (2022) emphasizes the importance of agro-biodiversity, including crop, animal, forest, and microbial biodiversity, in maintaining food security. The study outlines how different components of biodiversity contribute to food production, soil fertility, and ecosystem resilience. It stresses the need for conservation and sustainable use of biodiversity to support future food security efforts. Sufiyan argues that the preservation of genetic resources is essential for crop improvement, livestock development, and maintaining soil health, which are critical for sustainable agriculture and food security.

Renard, & Tilman (2021) explore the potential of biodiversity to address sustainability challenges in modern agriculture. They highlight how increased crop diversity can stabilize food systems and reduce reliance on high-input monocultures. Their research suggests that biodiversity can lead to greater and more stable yields, decreased land clearing, and reduced use of harmful agrochemicals. This approach not only supports food security but also promotes environmental sustainability by enhancing ecosystem services and reducing agricultural impacts on the environment.

Moura de Oliveira Beltrame et al. (2021) focus on the role of underutilized edible plants in Brazil's food and nutrition security policies. The study underscores the potential of these plants to diversify diets, promote agricultural development, and conserve biodiversity. The authors discuss how integrating native species into national food programs can enhance food security and resilience to climate change. Their work demonstrates the importance of policy support and research partnerships in mainstreaming biodiversity for food security.

Fedotova et al. (2021) examine the global implications of biodiversity loss on food security.

They discuss how human activities and population growth disrupt biological diversity, affecting the stability of ecosystems and their capacity to support food production. The study highlights the need for international cooperation and sustainable practices to mitigate the impacts of biodiversity loss on food security. Fedotova et al. conclude that conserving biodiversity is vital for maintaining the life-support systems necessary for a growing human population and sustainable economic development.

Wahab & Iyiola (2023) emphasize the role of climate change in exacerbating biodiversity loss and its subsequent impact on food production in both terrestrial and aquatic ecosystems. The study highlights the challenges posed by climate change-induced factors such as erratic rainfall patterns, heatwaves, and rising sea levels on agricultural yields, leading to food shortages. Oritseshemaye et al. (2022) draw attention to the direct correlation between biodiversity loss and human security in the Niger Delta region. Their findings underscore the vulnerability of communities reliant on ecosystem services for their livelihoods. The study emphasizes the cascading effects of biodiversity decline on food security, health, and overall well-being.

Oloyede et al (2023), advocate for the preservation of neglected and underutilized horticultural crops as a crucial strategy for enhancing food security and biodiversity conservation. Their research highlights the potential of these crops to contribute to sustainable agriculture and nutrition. Mafiana et al. (2022) emphasize the significance of environmental degradation in exacerbating biodiversity loss. The study underscores the need for sustainable practices to maintain ecological balance and achieve the Sustainable Development Goals (SDGs), particularly in relation to food security.

Ajayi et al, (2022) discuss the detrimental effects of biodiversity loss due to human activities. They stress the necessity for holistic policies and heightened public awareness to mitigate biodiversity decline. Such measures are essential for maintaining ecological balance and ensuring long-term food security. By protecting diverse ecosystems, the stability and productivity of agricultural systems are safeguarded. Popoola (2022) explores Nigeria's aquatic resources, advocating for advanced genetic techniques and sustainable fish production methods. These approaches aim to boost food security and conserve biodiversity by increasing fish yield and maintaining aquatic ecosystem health. Genetic improvements can lead to more resilient fish species, enhancing food availability and quality.

A study by Akin-Idowu et al (2022), highlights the significant role of biotechnology in enhancing crop production and food quality while conserving biodiversity. The study advocates for biologically-based agricultural practices, which integrate modern biotechnology with traditional farming techniques. This integration supports sustainable agriculture by improving crop yields and resilience, thereby contributing to food security. Additionally, Oritseshemaye et al. (2022) examine the impact of environmental degradation on human security in Nigeria’s Niger Delta. They find a strong correlation between threatened biodiversity and food and health insecurity. The study underscores the need for environmental conservation efforts to protect biodiversity, which is crucial for sustaining human health and food resources in the region.

Identified Gaps

The existing literature on biodiversity and food security in Nigeria underscores various key areas, the implications of biodiversity loss due to human activities (Ajayi et al, 2022), the potential of

aquatic resources and genetic techniques for sustainable fish production (Popoola, 2022), and the benefits of biotechnology in crop production and food quality (2022). Studies on underutilized edible plants and neglected horticultural crops (Beltrame et al., 2021; Oloyede et al, 2023) highlight their potential but fail to integrate findings into broader agricultural policies or address socio-economic barriers and market dynamics. Additionally, while environmental degradation and biodiversity loss are linked to food security (Mafiana et al., 2022; Oritseshemaye et al., 2022), there is a lack of detailed exploration of the interconnectedness between ecosystem services and human security in various regional contexts.

Moreover, despite the fact that agro-biodiversity plays a critical role in food security, most of the literature (Fedotova et al., 2021; Sufiyan, 2022) stresses theoretical frameworks and general implications rather than providing concrete solutions and case studies that are relevant to a certain area. Renard & Tilman (2021) and Wahab & Iyiola (2023) discuss crop diversity and climate change challenges but do not provide detailed analyses of policy interventions and practical applications. Additionally, studies such as Oritseshemaye et al. (2022) discuss the impact of environmental degradation on human security in the Niger Delta. However, gaps remain in the comprehensive assessment of biodiversity loss in Nigeria's agricultural ecosystems due to pollution from oil exploration, deforestation and desert encroachment. This study addresses these gaps by providing a focused analysis on how these factors contribute to biodiversity decline and its subsequent effects on agricultural sustainability and food security in Nigeria.

RESULTS

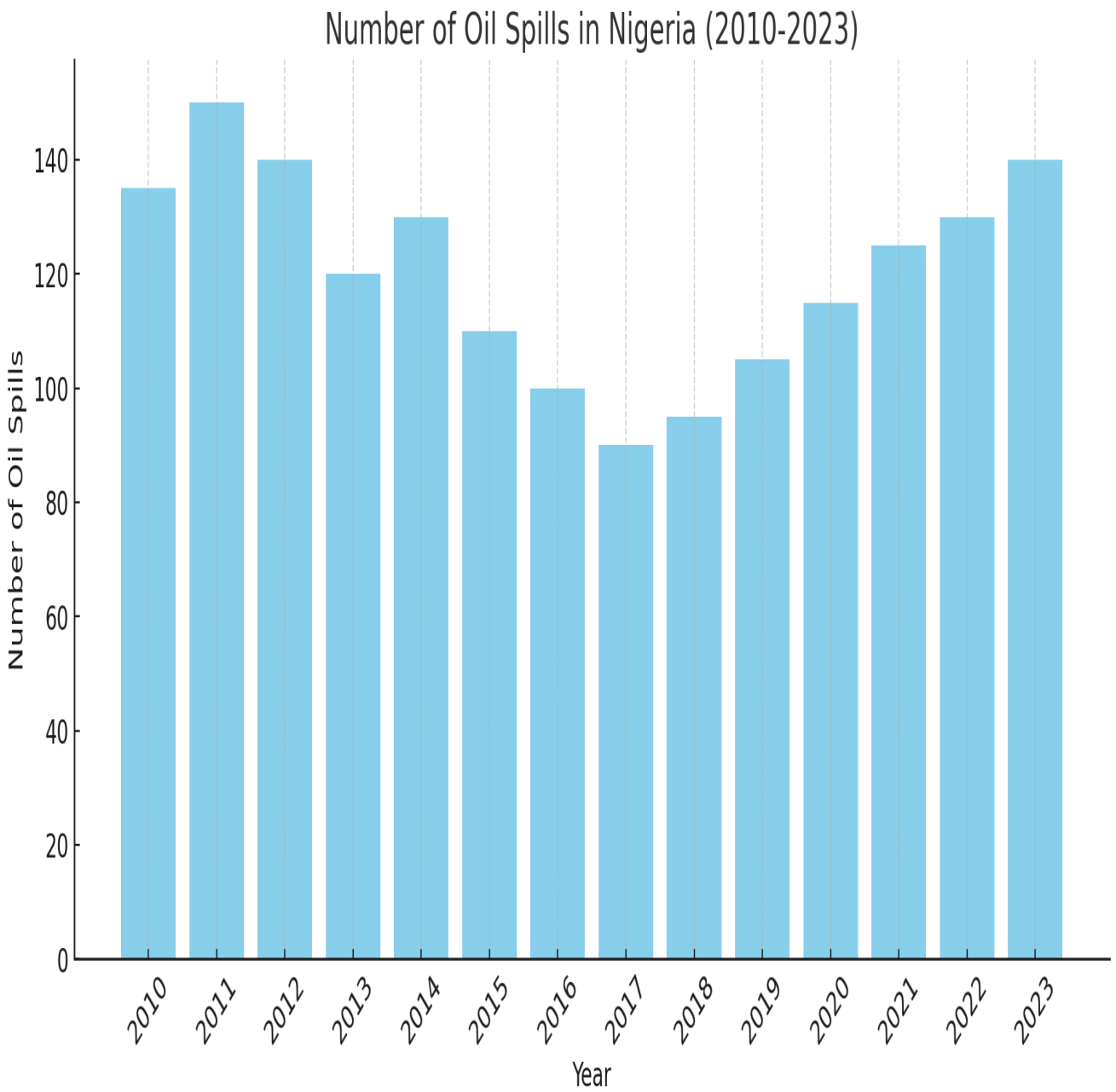
Biodiversity Loss in Nigeria's Agricultural Ecosystems Due To Pollution from Oil Exploration

Pollution, the introduction of harmful substances or energy into the environment, significantly impacts biodiversity and ecosystems. In Nigeria, pollution arises from various sources including industrial effluents, agricultural runoff, oil spills, solid waste, sewage, and gas flaring, leading to degraded water, air, and soil quality (Onipede 2024). Oil spills are a major pollution source in the Niger Delta, contaminating water, soil, and vegetation. This is particularly evident in Nigeria's agricultural ecosystems, where pollution from oil exploration severely hampers biodiversity.

This contamination affects the health and livelihoods of millions, including wildlife. According to UNEP (2017), the Niger Delta has endured over 50 years of oil pollution, causing extensive environmental damage and human rights violations. The widespread pollution has disrupted food chains, leading to reduced agricultural productivity and compromised food security in the region. Fish, birds, mammals, plants, wetlands, forests, and coral reefs have all suffered from the persistent pollution, illustrating the severe impact on biodiversity and ecosystem health. The cumulative impact of these oil spills is profound, causing habitat loss and fragmentation, which are primary drivers of biodiversity loss. The contamination of water bodies and soil makes it difficult for plant and animal species to survive, leading to decreased agricultural yields and increased poverty among local communities reliant on farming and fishing

Data from the National Oil Spill Detection and Response Agency (NOSDRA) indicates a persistent issue with oil spills. The agency's reports detail numerous incidents each year, particularly in the Niger Delta, where oil spills have caused significant environmental degradation (NOSDRA Reports 2023). Additionally, Shell Nigeria provides

detailed annual data on oil spills covering spill counts, causes, and volumes. This data as shown in the chart below, indicates consistent spill incidents, contributing to the ongoing environmental challenges in the region (Shell Nigeria (nd).



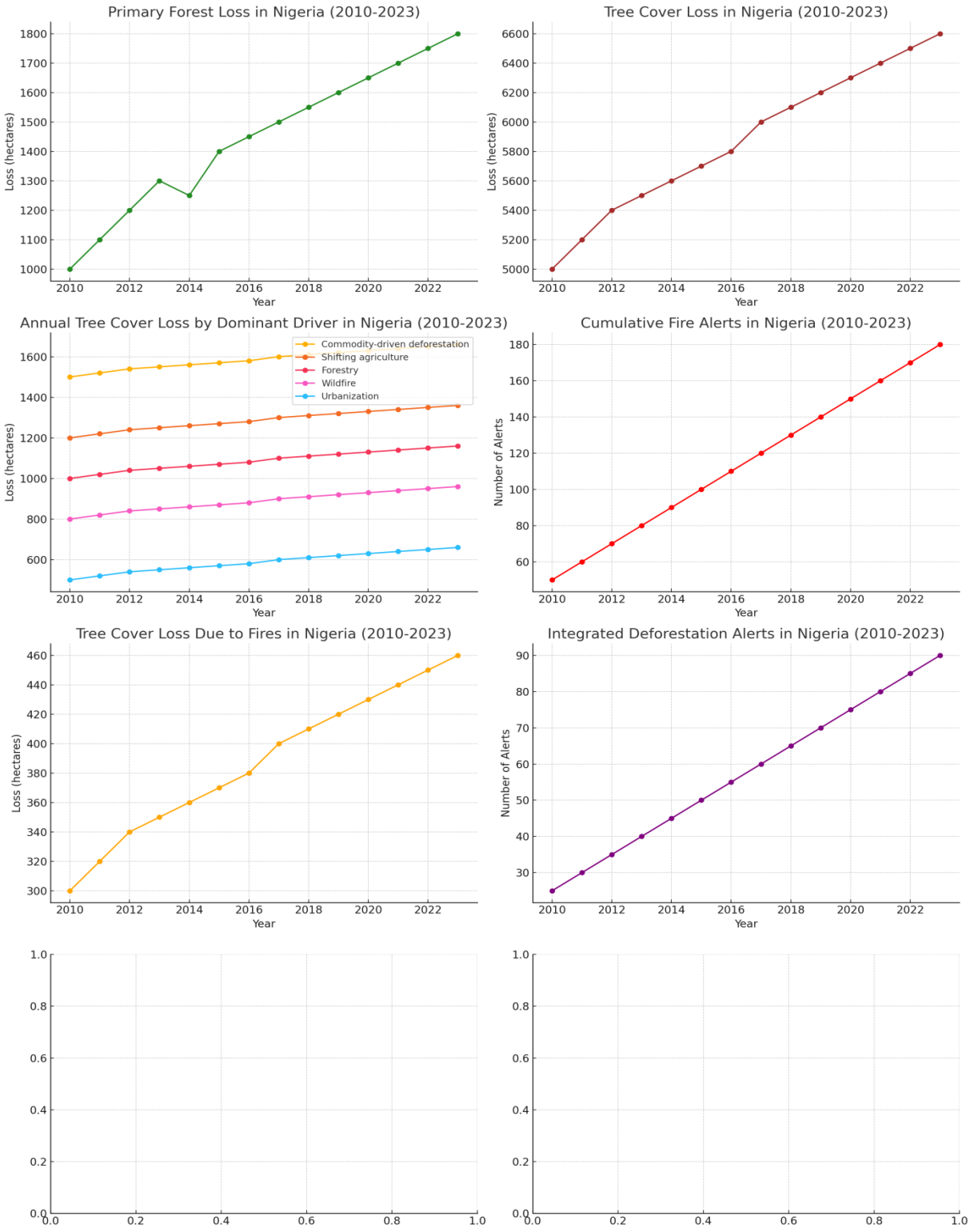
Data Source: ***Shell Nigeria (Oil Spill Incident Data 2010-2023)***

Biodiversity Loss in Nigeria's Agricultural Ecosystems Due To Deforestation and Desert Encroachment

Biodiversity loss in Nigeria's agricultural ecosystems, driven by deforestation and desert encroachment, presents a significant environmental challenge. Analysis of data from 2010 to 2023, published by Global Forest Watch, reveals a concerning trend of primary forest and tree cover loss. This trend exacerbates biodiversity decline and poses a threat to the sustainability of agricultural practices. From 2010 to 2023, Nigeria experienced a substantial decline in primary forest cover. This reduction is attributed to various factors, including deforestation and the conversion of forests to agricultural land. Primary forests are critical habitats for a diverse range of plant and animal species. Their loss not only leads to a decline in biodiversity but also impacts essential ecosystem services such as carbon sequestration and water regulation. These services are vital for maintaining agricultural productivity and environmental stability.

The annual data indicates a steady increase in tree cover loss, with significant peaks during years of intensive deforestation activities. This consistent loss highlights ongoing environmental degradation primarily driven by human activities. The removal of trees diminishes biodiversity, disrupts habitats of numerous species, and leads to cascading ecological imbalances. The categorization of tree cover loss by dominant drivers provides insights into the underlying causes of deforestation in Nigeria. Key factors include agricultural expansion for commercial purposes, traditional farming practices involving the clearing of forestlands for crop cultivation, legal and illegal logging activities, natural and human-induced wildfires, and the encroachment of urban areas into forested regions.

Spatial data from 2010 to 2023 highlights hotspots of tree cover loss, predominantly in the southern and central regions of Nigeria. These regions, rich in biodiversity, are particularly vulnerable to deforestation due to agricultural expansion and infrastructural development. The concentration of tree cover loss in these areas underscores the need for targeted conservation efforts to protect remaining forested areas and restore degraded lands. The cumulative fire alerts data visualizes the frequency and intensity of fire incidents over the years. The increasing number of fire alerts correlates with heightened deforestation and forest degradation. Fires, whether natural or anthropogenic, pose a significant threat to forest ecosystems, leading to the loss of vegetation, soil fertility, and wildlife habitats. A subset of the tree cover loss data specifically attributed to fire incidents further illustrates the destructive impact of fires on Nigeria’s forests. Fires not only lead to immediate vegetation loss but also create conditions that hinder forest regeneration, contributing to long-term biodiversity decline.



Data

Source: ***Global Forest Watch***

DISCUSSION

From the results of this study, oil spills have profound implications on biodiversity, which in turn exacerbates issues such as malnutrition, food price volatility, and the livelihoods of rural communities. Oil spills contaminate water bodies and soil, severely affecting agricultural productivity. This contamination leads to reduced yields of crops and fish, which are vital sources of food and nutrition for local populations. Reduced availability of these food sources directly contributes to malnutrition, particularly among vulnerable groups such as children and pregnant women. Studies indicate that areas impacted by oil spills show higher rates of malnutrition due to the decreased availability of safe, nutritious food (Nkodo et al., 2023; Babatunde, 2023). Also, the degradation of agricultural land and fisheries due to oil spills disrupts local food supply chains. As the productivity of these sectors declines, the scarcity of food products drives up prices. This volatility affects not only the local markets but also regional food security, as communities become increasingly reliant on imported food items, which are subject to price fluctuations in the global market. According to Akpan, (2023), the financial strain on households due to higher food prices further exacerbates food insecurity.

Furthermore, oil spills have a devastating impact on rural livelihoods, especially in communities dependent on agriculture and fishing. The contamination of water and soil resources leads to a decline in both crop and fish production. As a result, many farmers and fishers lose their primary sources of income, leading to increased poverty and economic instability. The loss of biodiversity also means that alternative sources of income, such as the harvesting of non-timber forest products, are no longer viable as noted by Asani & Akinyode, (2022). Additionally, the decline in biodiversity due to oil spills has broader ecological implications that further affect food security. The loss of key species and habitats disrupts ecosystem services such as pollination, water purification, and soil fertility, which are essential for sustainable agriculture. Oritseshemaye et al., 2022; Ben-Chendo et al., 2022, also explained that the resulting ecological imbalance can lead to the proliferation of pests and diseases, further threatening food production and security,

Deforestation and desert encroachment are significant environmental threats that can have devastating consequences for food security, particularly in Nigeria, where many rural communities rely heavily on natural resources for their livelihoods. One of the primary ways deforestation and desert encroachment harm food security is by reducing biodiversity. Primary forests provide critical habitats for a wide variety of plant and animal species, many of which serve as essential food sources for local communities. When these habitats are destroyed, the availability of these food resources diminishes, leading to malnutrition, especially among vulnerable groups like children and pregnant women. For instance, the decline in fish populations due to polluted and degraded water bodies can significantly impact protein intake for communities that rely heavily on fishing. Similarly, the loss of forest products, such as fruits, nuts, and bushmeat, can reduce the dietary diversity of local populations, making them more vulnerable to malnutrition.

Deforestation and desert encroachment also disrupt local food supply chains by reducing agricultural productivity. As forested areas are converted to agricultural land, soil fertility often declines due to factors like erosion and nutrient leaching. This leads to lower crop yields, making it difficult for communities to produce enough food to meet their needs. The scarcity of food products

drives up prices, creating economic pressure on households. Farmers and fishermen displaced by environmental degradation may migrate or forsake their customary livelihoods, reducing local food production. Therefore, communities grow more dependent on imported food, which fluctuates in price globally. This volatility in food prices further exacerbates food insecurity, making it difficult for low-income families to afford nutritious food.

Furthermore, rural livelihoods are particularly hard hit by biodiversity loss due to deforestation and desert encroachment. In Nigeria, many rural communities depend on agriculture and fishing for their survival. The degradation of these natural resources leads to reduction in agricultural and fishery productivity, resulting in loss of income and increased poverty. As biodiversity declines, alternative sources of income, such as harvesting non-timber forest products, also diminish. This loss of biodiversity undermines the resilience of rural livelihoods, making communities more susceptible to economic and environmental shocks.

The broader ecological implications of biodiversity loss due to deforestation and desert encroachment also affect food security. The decline in key species and habitats disrupts ecosystem services such as pollination, water purification, and soil fertility, which are crucial for sustainable agriculture. Pollinators, such as bees, are vital for the production of many crops. The loss of forest habitats for these pollinators can significantly reduce crop yields. Additionally, the destruction of wetlands and forests that filter and regulate water supplies leads to water scarcity and quality issues, further impacting agricultural productivity. The resulting ecological imbalance can lead to the proliferation of pests and diseases, further threatening food production and security.

CONCLUSION

The study highlights the complex correlation between the decline in biodiversity and the issue of food security in Nigeria. An examination of agricultural ecosystems demonstrates that pollution resulting from oil exploration, deforestation, and desert encroachment has substantially diminished biodiversity, leading to a series of consequences on food production, availability, and accessibility. The adverse environmental conditions have caused disturbances in ecosystems, resulting in decreased crop yields and negatively impacting the livelihoods of rural communities that rely primarily on agriculture and fishing. The steady increase in oil spills, tree cover loss, driven by various human activities, emphasizes the urgent need for sustainable land management practices and robust conservation policies. Protecting and restoring Nigeria's forests are crucial for preserving biodiversity, supporting agricultural productivity, and ensuring environmental resilience.

Resolving biodiversity loss and ensuring food security are interdependent problems that require a comprehensive strategy. Strengthening environmental regulations, restoring degraded ecosystems, extending protected areas, and promoting community engagement are vital measures for biodiversity conservation. Concurrently, the promotion of sustainable agriculture, the diversification of crop production, and the investment in agricultural value chains can improve food security. Enhancing social safety nets and promoting research and innovation are crucial elements of this strategy. The rapid and concerning rate of deforestation highlights the immediate necessity for strong and effective conservation efforts. Adopting sustainable land management practices and safeguarding current forests are

crucial for conserving biodiversity, promoting agricultural productivity, and enhancing environmental resilience. Also, utilizing technology, such as integrated deforestation alerts, can greatly enhance forest monitoring and enforcement activities.

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