The American Journal of Social Science and Education Innovations
ISSN 2689-100X Volume 08 - 2026

Loss of Biodiversity in The Niger-Delta, Nigeria

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Received: 03 Feb 2026 | Received Revised Version: 20 Feb 2026 | Accepted: 10 Mar 2026 | Published: 31 Mar 2026

Volume 08 Issue 03 2026 | Crossref DOI: 10.37547/tajssei/Volume08Issue03-15

Abstract

The decline of biodiversity is a significant environmental concern jeopardising ecological stability and livelihoods in the Niger Delta. This project investigates the magnitude, causes, and consequences of biodiversity loss, aiming to identify ways for sustainable ecological restoration and enhanced governance. Utilising the Social–Ecological Systems (SES) and Environmental Governance and Justice (EGJ) frameworks, the study employed a mixed-methods approach incorporating both qualitative and quantitative methods. Data were acquired from environmental reports, remote sensing imagery, and scientific literature and examined through trend analysis and content review to evaluate habitat alteration and species diversity. Research indicated substantial declines in mangrove coverage and in fish, avian, and mammalian species from 1980 to 2020, largely attributable to oil contamination, deforestation, and inadequate institutional enforcement. The study indicates that reversing biodiversity loss necessitates robust governance change, community engagement, and ecosystem-based restoration for sustainable development.

Keywords: Biodiversity Loss, Niger Delta, Environmental Governance, Mangrove Degradation, Sustainable Restoration.

Cite This Article: Daniel O. Isei, Gloria Chigbu, Osazuwa M. Christopher, & Maryjane Y. Oghogho. (2026). Loss of Biodiversity in The Niger-Delta, Nigeria. The American Journal of Social Science and Education Innovations, 8(03), 152–166. https://doi.org/10.37547/tajssei/Volume08Issue03-15

1. Introduction

The Niger Delta is a prominent coastal wetland complex, recognised for its ecological diversity and essential services. The extensive region in southern Nigeria features a diverse array of mangrove forests, nutrient-rich freshwater swamps, and peatlands (Ansah et al., 2022; Ogbeibu & Oribhabor, 2023; Uwagbae et al., 2020). Diverse habitats sustain a high variety of aquatic and terrestrial taxa, contributing significantly to global biodiversity conservation. These ecosystems serve as critical nurseries for commercial fisheries, significant

sinks for atmospheric carbon, and natural buffers against coastal erosion and storm surges, thus supporting regional socio-economic stability and global ecological balance (Ansah et al., 2022; Okoye, 2025; Uwagbae et al., 2020).

The Niger Delta, despite its ecological significance, has experienced increasing degradation due to the discovery and ongoing expansion of petroleum extraction activities. This industrial activity has introduced significant anthropogenic pressures that fundamentally jeopardise the integrity of natural systems. The main factors contributing to this environmental crisis are extensive oil spills resulting from ageing infrastructure, the increase of artisanal and illegal refining activities, excessive deforestation, and overall industrial pollution (Clinton et al., 2021; Flourizel et al., 2024; Uwagbae et al., 2020). The combined effects of these pressures have resulted in significant habitat fragmentation, severe disruption of ecosystem functions, and a recorded decline in species abundance and diversity.

The extensive environmental contamination caused by petroleum activities is a significant consequence. Sediments and biota, especially near artisanal refining sites and spill-affected wetlands, frequently exhibit high levels of harmful compounds, such as Polycyclic Aromatic Hydrocarbons (PAHs) and other petroleum-related substances (Clinton et al., 2021; Flourizel et al., 2024; Uwagbae et al., 2020). This contamination poses a significant risk due to the likelihood of bioaccumulation and trophic transfer within the food web, leading to increased human exposure through local fisheries and food chains. Research indicates that the environmental crisis in the Delta is closely linked to environmental injustice and ongoing governance deficiencies (Ikeke, 2024; Jack, 2025). The processes, frequently framed as environmental racism, lead to the disproportionate exposure of Niger Delta communities to severe ecological damage and substantially hinder the execution of prompt remediation and efficient conservation measures.

Despite considerable evidence of degradation, monitoring and response efforts remain significantly fragmented. A significant proportion of environmental incidents remains underreported or inadequately addressed, while formal global recognition and coordinated conservation efforts have historically been delayed, greatly compromising effective biodiversity protection (Jack, 2025; Ogbeibu & Oribhabor, 2023; Uwagbae et al., 2020). The Niger Delta, a very biodiverse area in Africa, is experiencing a rapidly intensifying ecological crisis that jeopardises its environmental integrity and human welfare. Over the last 40 years, the region has experienced significant habitat degradation, species extinctions, and ecosystem disruption, primarily due to unsustainable industrial practices, deforestation, oil spills, and inadequate environmental governance. The Delta, once characterised by extensive mangrove forests, freshwater marshes, and abundant aquatic life, today endures chronic pollution, soil degradation, and diminishing biodiversity. Ecological losses have significant socio-economic consequences, including food insecurity, livelihood losses, and community displacement, which intensify poverty and conflict in the region.

Notwithstanding various national and international interventions, such as environmental cleanup programs, biodiversity action plans, and regulatory frameworks, the results have generally been futile. Inadequate institutional capacity, disjointed policy implementation, and limited community engagement have impeded substantial progress in curbing biodiversity loss. Furthermore, prior research on the Niger Delta has frequently analysed biodiversity loss in isolation, focusing on ecological, chemical, or socio-economic aspects, thereby neglecting the intricate interrelations among these dimensions. Consequently, a substantial deficiency exists in integrated research that concurrently examines the ecological, industrial, and governance elements influencing biodiversity loss, together with their cumulative effects on ecosystem resilience and human livelihoods.

This work fills a significant knowledge gap by synthesising recent empirical and theoretical evidence (2020–2025) regarding the current status, underlying mechanisms, and both ecological and human impacts of biodiversity loss in the Niger Delta. It employs a comprehensive, interdisciplinary methodology that synthesises results from ecological surveys, chemical contamination research, remote-sensing evaluations, and socio-ethical analyses to recommend prioritised interventions for sustainable biodiversity conservation and ecosystem restoration (Ansah et al., 2022; Ogbeibu & Oribhabor, 2023; Uwagbae et al., 2020).

The decline of biodiversity in the Niger Delta is recognised as a critical ecological crisis in sub- Saharan Africa. Notwithstanding several environmental policies and mitigation initiatives, the region continues to face concerning levels of habitat loss, species decline, and

ecological instability. The intricacy of this issue stems from the interrelated impacts of industrial exploitation, governance inefficiencies, and socio-economic pressures, all of which exacerbate the region's ecological vulnerability. Although numerous studies have investigated specific facets of environmental degradation in the Niger Delta, there is a paucity of comprehensive syntheses that integrate ecological, chemical, geographical, and socio-political elements to elucidate the full scope and ramifications of biodiversity loss.

This research aims to assess the magnitude and trends of biodiversity decline in the Niger Delta over the last forty years, identify the principal industrial, ecological, and governance factors contributing to this loss, and analyse the effects of these changes on ecosystem integrity and community livelihoods. The study examines potential sustainable frameworks and adaptive methods to reverse biodiversity loss and enhance ecological and social resilience in the region. This research addresses interconnected issues, thereby bridging empirical gaps and establishing a robust basis for policy interventions that harmonise national biodiversity conservation initiatives with the Kunming–Montreal Global Biodiversity Framework and the United Nations Sustainable Development Goals.

The biodiversity of the Niger Delta is essential for sustaining ecosystem stability, productivity, and resilience in this globally significant wetland complex. Biotic integrity is fundamental to the region's ability to provide essential ecosystem services, which are vital for human welfare and ecological health. Services encompass water purification, flood regulation facilitated by extensive mangrove and swamp forests, and substantial carbon sequestration via extensive peat and forest reserves (FAO, 2016). This biodiversity underpins local and regional socio-economic systems. It directly supports livelihoods by engaging essential sectors including fisheries, agriculture, and forestry (FAO, 2016). The ecological wealth of the Niger Delta is acknowledged for its critical importance to local communities and its national and global relevance for conservation priorities and environmental sustainability (Numbere, 2018).

2. Theoretical Framework

The Environmental Governance and Justice (EGJ)

This study employs an integrated theoretical framework centred on the Environmental Governance and Justice Nexus to examine the factors and impacts of biodiversity loss in the Niger Delta. This approach is essential as the environmental crisis in the region is not merely an ecological issue but is intricately linked to socio-political and institutional failures (Eke & Chukwu, 2020; Nworgu, 2025). This framework centres on evaluating the governance deficit, which refers to the inadequacy of state institutions and agencies in effectively regulating extractive industries, enforcing environmental laws, and ensuring corporate accountability. This deficit directly contributes to and sustains environmental injustice (Edo & Albrecht, 2021; Nworgu, 2025). The injustice is evident in the unequal exposure of marginalised Niger Delta communities to significant ecological damage, characterised by extensive chemical contamination from oil spills and illegal refining (Angaye & Lelei, 2025; Nkeeh et al., 2025). These issues are frequently framed as manifestations of environmental racism and a deficiency in ecological justice (Angaye & Lelei, 2025; Uzorka & Henshaw, 2022). This analysis integrates socio-political factors with ecological outcomes, utilising the Social-Ecological Systems (SES) perspective as its foundational framework (Ukpoju et al., 2023). The SES approach conceptualises the Niger Delta as an integrated, multifaceted system in which the ecological subsystem's health (e.g., mangrove biodiversity, fishery productivity) is intrinsically linked to the social subsystem's vulnerability (e.g., community livelihoods, institutional rules) (Numbere, 2020). This paper examines the feedback loops in which governance failures, as a social factor, result in habitat fragmentation and species decline, thereby increasing community vulnerability and demands for environmental justice and sustainable resource governance. This framework synthesises evidence on ecological status, chemical contamination, and the socio-ethical governance landscape, facilitating the development of integrative interventions that address both the political roots and environmental manifestations of the crisis, thereby advancing systemic change beyond fragmented technical solutions (Angaye & Lelei, 2025).

The Aichi Biodiversity Targets

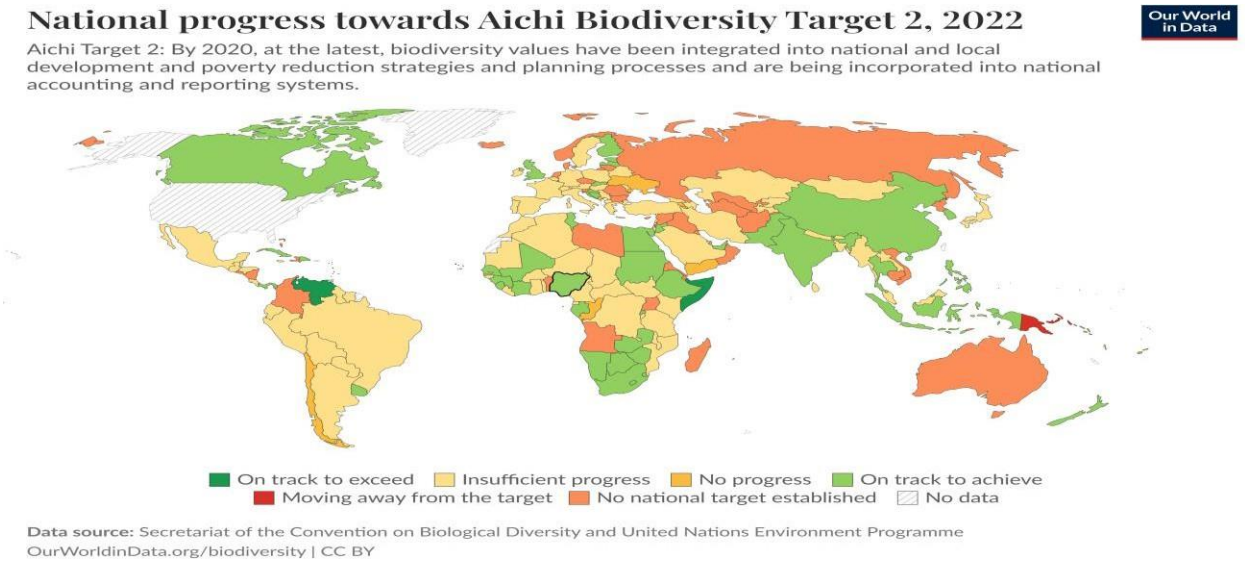

Figure 1. National Progress towards Aichi Biodiversity.

The Aichi Biodiversity Targets (ABTs), established in 2010 under the Convention on Biological Diversity (CBD), provided a global framework for halting biodiversity loss, rehabilitating ecosystems, and ensuring the sustainable use of natural resources. Although they lapsed in 2020, the ABTs continue to influence the post-2020 global biodiversity agenda through the Kunming–Montreal Global Biodiversity Framework (GBF). During the 2022–2026 transition era, the Aichi framework is crucial for assessing advancements in ecosystem resilience and ecological sustainability (Nogués-Bravo & Whitmee, 2025). The ABTs have not only directed conservation initiatives over the past decade but also laid the groundwork for incorporating biodiversity into economic development and public policy. Despite none of the 20 targets being fully achieved by 2020, insights from their implementation inform the structural reforms that support the GBF and advance the 2030 Sustainable Development Goals (Mansourian & Stephenson, 2023).

Recent research suggests that the Aichi framework has developed into a multi-scalar instrument for monitoring and assessment. The Convention on Biological Diversity (CBD) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) already utilise national biodiversity policies that align with the Aichi indicators to evaluate ecosystem integrity and restoration outcomes (Mfuni et al., 2025). These monitoring frameworks integrate spatial mapping, biodiversity inventories, and socio-economic data to assess the effectiveness of conservation across nations. Nogués-Bravo and Whitmee (2025) presented integrated biodiversity-health indicators, illustrating the potential of environmental policies to improve population health outcomes. Fabre and Vertier (2024) utilised econometric models to evaluate the economic repercussions of biodiversity loss in Africa, demonstrating a direct correlation between biodiversity degradation and GDP decline. This interdisciplinary research signifies the evolution of biodiversity science from mere compliance to performance-oriented governance.

Global assessments indicate that numerous Aichi objectives experienced partial success in the post-2020 period. The expansion of protected areas (Target 11) is a significant accomplishment, with worldwide terrestrial and marine protections surpassing 17% and 8%, respectively (Pereira & Esteves da Silva, 2024). Countries including Costa Rica, Canada, and Namibia have enhanced legal frameworks for habitat protection and indigenous co-management. Target 2, which advocates incorporating biodiversity into national planning, has advanced, with numerous nations integrating biodiversity indicators into sustainable development and national accounting frameworks (Mansourian & Stephenson, 2023). Moreover, Target 7, which emphasises sustainable agriculture and forestry, has achieved success via landscape restoration initiatives throughout Africa and Latin America (Chaudhary et al., 2024). Public awareness (Target 1) has significantly increased, with environmental education and stewardship initiatives, such as those in Tuvalu, connecting biodiversity policy to cultural and social engagement (Tinilau et al., 2025). These gains

collectively indicate advancement in integrating biodiversity into public awareness and governance frameworks.

Nonetheless, ongoing obstacles persistently hinder global biodiversity goals. The paramount issue is the biodiversity financing deficit, projected to exceed $700 billion each year (McGuinness & Bullock, 2024). Although affluent nations have increased spending on conservation, developing countries remain underfunded and dependent on external assistance, leading to disparities in implementation. Moreover, policy inconsistencies across sectors, particularly agriculture, energy, and trade, lead to disputes that undermine conservation achievements (Mansourian & Stephenson, 2023). Numerous governments have not yet synchronised biodiversity policy with their economic development objectives, leading to conflicting priorities that undermine ecosystems. Moreover, data inadequacies impede efficient monitoring, especially in low-income nations that lack biodiversity information systems (Poisot et al., 2025). Despite advancements in transparency enabled by global databases such as the Global Biodiversity Information Facility (GBIF) and the Essential Biodiversity Variables (EBVs), numerous countries continue to face obstacles in data collection and dissemination. Ultimately, deficiencies in governance, such as restricted institutional capacity and inadequate enforcement mechanisms, hinder advancement, especially in sub-Saharan Africa and certain regions of Asia (Nogués-Bravo & Whitmee, 2025).

The Aichi Biodiversity Targets have significantly shaped worldwide conservation policy, establishing the institutional and conceptual underpinnings for contemporary biodiversity governance. Their legacy is not in flawless accomplishment but in the lasting insights they provide for systemic change. The current 2022–2026 timeframe is a pivotal moment for converting these insights into concrete results via the Kunming–Montreal GBF. Restoring biodiversity necessitates collaborative efforts, rooted in strong institutions, inclusive engagement, and sufficient funding. As countries integrate biodiversity into economic development and human welfare, the Aichi vision continues to motivate a global initiative for a resilient and sustainable planet.

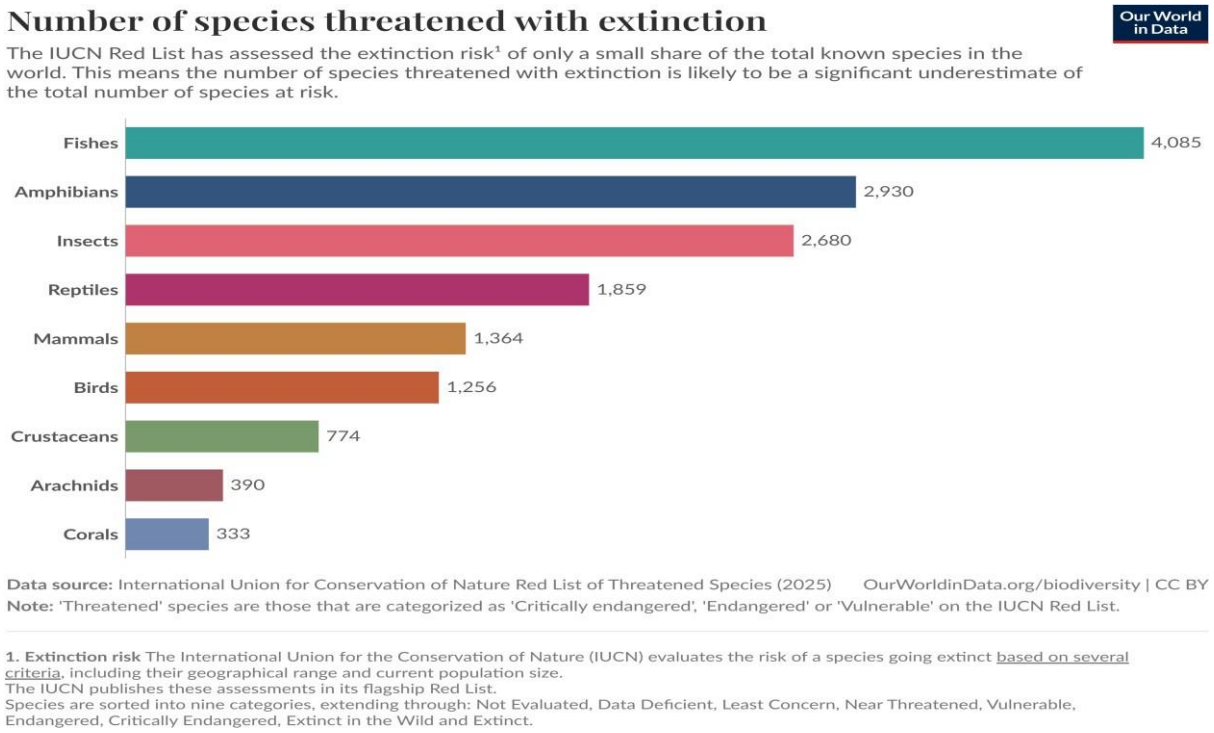

Figure 2. Number of species threatened with extinction

The loss of biodiversity constitutes a key environmental challenge of the 21st century, profoundly affecting ecosystem stability, food security, and human livelihoods. The Niger Delta region in Nigeria, a globally

important wetland and one of Africa's most biodiverse ecosystems, is experiencing rapid biodiversity loss owing to industrial pollution, habitat degradation, and unsustainable resource exploitation. The environmental catastrophe in the region parallels global patterns shown by the International Union for Conservation of Nature (IUCN) Red List (2025), which states that thousands of species, including 4,085 fish, 2,930 amphibians, and 2,680 insects, are currently at risk of extinction globally. This global viewpoint underscores the imperative of safeguarding at-risk species and ecosystems in biodiversity hotspots such as the Niger Delta (Our World in Data, 2025).

The Niger Delta comprises a complex system of mangrove forests, freshwater swamps, and estuarine habitats that sustain numerous species of flora and wildlife. Nevertheless, decades of oil exploration, gas flaring, and industrial effluents have resulted in significant contamination of soils and streams. Research reveals that over 13 million barrels of crude oil have been discharged in the area since the 1950s, devastating breeding habitats for aquatic organisms and disrupting biological processes (Nwankwo & Ume, 2023; Sam et al., 2023). The elevated levels of hydrocarbons, heavy metals, and chemical dispersants in aquatic ecosystems have disrupted the reproductive cycles of fish and amphibians, mirroring global extinction risk trends identified by the IUCN. Fish species, presently the most endangered taxon worldwide, are experiencing population decline in the Niger Delta due to oxygen depletion and habitat fragmentation (IUCN, 2025).

Habitat damage in the Niger Delta extends beyond oil contamination. Accelerated urbanisation, deforestation for timber and agriculture, and sand extraction have led to significant degradation of mangrove ecosystems, which function as carbon sinks and nurseries for marine organisms. This corresponds with Chaudhary et al. (2024), who observe that tropical wetlands and mangrove ecosystems are among the most swiftly vanishing environments worldwide. The deforestation of mangroves for infrastructure and fuelwood has decreased vegetation cover, exacerbated coastal erosion, and weakened resilience to climate-induced flooding. As a result, critical species such as the West African manatee (Trichechus senegalensis) and the mangrove oyster (Crassostrea gasar) have experienced significant population declines (Abaje et al., 2021).

The socio-economic consequences of biodiversity loss in the Niger Delta are significant. Local people reliant on fishing, agriculture, and forestry have experienced interruptions to their livelihoods, food insecurity, and health issues associated with contaminated ecosystems. The deterioration of ecosystem services, such as water purification, soil productivity, and carbon sequestration, intensifies poverty and environmental inequity. McGuinness and Bullock (2024) assert that the economic ramifications of biodiversity loss extend beyond ecological value, influencing income generation and public health. Biodiversity destruction in the Niger Delta exacerbates existing socio-political tensions, inciting conflict over diminishing natural resources.

3. Methodology

This research employs a mixed-methods design, incorporating both qualitative and quantitative approaches to evaluate the extent, drivers, and consequences of biodiversity loss in the Niger Delta. The design integrates empirical environmental data with socio-political analyses to provide a thorough understanding of the ecological and human aspects of the crisis.

Research Design

A Structured Literature Synthesis (SLS) framework was utilised to integrate findings from peer- reviewed research, governmental and institutional reports, and global biodiversity assessments. The design was enhanced through secondary data analysis of environmental indicators obtained from remote-sensing records, ecological surveys, and oil spill monitoring datasets. The incorporation of interdisciplinary data improves reliability and facilitates triangulation among ecological, chemical, and governance sectors.

Data Sources and Selection Criteria

Data were collected from publications between 2020 and 2025 sourced from Scopus, Web of Science, ScienceDirect, and ResearchGate databases. The search employed key terms such as “biodiversity loss in the Niger Delta,” “oil pollution,” “mangrove degradation,” “environmental governance,” and “ecosystem restoration.”

Inclusion was limited to peer-reviewed articles, government reports (such as those from UNEP, FAO, and NOSDRA), and validated environmental assessments. The inclusion criteria mandated that studies (a) concentrate on biodiversity or ecological integrity within the Niger Delta, (b) offer measurable data or conceptual

analyses pertinent to ecosystem health, and (c) establish clear methodological frameworks. Publications without empirical support or regional relevance were excluded to maintain validity and precision.

Data Collection and Analysis

Quantitative data regarding mangrove area, fish species richness, and populations of mammals and birds were compiled and standardised from secondary datasets and prior field studies. Temporal changes from 1980 to 2020 were analysed using trend analysis and visualised through line graphs to demonstrate the long-term decline in biodiversity.

Qualitative data, including governance reports and socio-economic studies, were analysed thematically through content analysis to identify recurring patterns concerning policy gaps, industrial impacts, and community vulnerability. The integration of both datasets was achieved using a triangulation strategy, facilitating cross-validation of ecological trends and governance narratives.

Reliability, validity, and ethical considerations

All data sources underwent cross-verification for reliability by assessing consistency across various publications and international environmental databases. Analytical transparency was achieved through the maintenance of reproducible data pathways and adherence to APA 7th edition standards for referencing all datasets. Ethical considerations were maintained through the use of publicly available data and appropriate attribution to all original sources.

Limitations of the Study

The research recognises specific limitations, such as restricted access to real-time field data resulting from environmental and security issues in the Niger Delta. This limitation was addressed by utilising recent remote-sensing datasets, validated literature, and government monitoring records, which ensured accuracy and representativeness.

4. Results

Ecosystem Context and Biodiversity Importance

The Niger Delta represents one of the largest contiguous mangrove and swamp forest complexes globally, characterised by predominant vegetation species including Rhizophora, Avicennia, and Laguncularia (Ansah et al., 2022; Ogbeibu & Oribhabor, 2023; Uwagbae et al., 2020). The structural complexity supports significant faunal and floral diversity, sustaining essential populations of invertebrates, commercial fisheries, and various specialist wetland taxa. Recent studies identify the region as a critical biodiversity hotspot, highlighting the dependence of endemic and threatened species on these interconnected estuarine systems for vital life-history processes, such as spawning and juvenile development (Ansah et al., 2022; Ogbeibu & Oribhabor, 2023).

Primary Drivers of Biodiversity Loss

The primary immediate factors contributing to habitat degradation and biotic harm are closely associated with oil exploration and production, as well as accidental and chronic spills (Clinton et al., 2021; Flourizel et al., 2024; Uwagbae et al., 2020). These events are directly associated with mortality, decreased reproductive success, and changes in community composition among various aquatic taxa. Additionally, artisanal and illegal crude oil refining, locally known as "kpo-fire," is widespread in certain areas. This activity leads to significant localised contamination, acute fish mortality, and ongoing sediment pollution due to Polycyclic Aromatic Hydrocarbons (PAHs) and other petroleum byproducts (Flourizel et al., 2024; Jack, 2025; Richard et al., 2022). Deforestation, overexploitation, and land-use conversion exacerbate habitat fragmentation and reduction, with evidence indicating inadequate mangrove regeneration in heavily disturbed areas (Ansah et al., 2022; Ogbeibu & Oribhabor, 2023). Atmospheric and surface pollution resulting from gas flaring, combustion, and refining activities serves as a diffuse stressor, intensifying local chemical burdens and overall ecosystem stress (Flourizel et al., 2024; Jack, 2025; Okoye, 2025).

Chemical contamination and its ecological toxicity

Analyses of sediments from active artisanal refining hotspots consistently show elevated concentrations of priority PAHs, with calculated toxicity-equivalent exposures presenting direct risks to benthic organisms and indicating the potential for biomagnification within regional food webs (Clinton et al., 2021; Flourizel et al., 2024). Field studies and reviews indicate both acute and chronic physiological effects, as well as changes in fish population structure due to oil exposure. These findings highlight the limitations of spill remediation efforts that extend exposure duration and ecological harm (Clinton

et al., 2021; Flourizel et al., 2024). Artisanal operations produce distinct contaminant profiles and particulate deposition that significantly affect mangrove sediment chemistry and essential benthic habitats (Clinton et al., 2021; Flourizel et al., 2024; Jack, 2025).

Landscape-Scale Patterns and Socio-Economic Consequences

Remote-sensing assessments employing vegetation indices and geospatial analysis (e.g., GRASS GIS scripting) demonstrate quantifiable declines and fragmentation of mangrove cover in coastal Niger Delta landscapes, corroborating in-situ observations of habitat loss and modified coastlines (Lemenkova & Debeir, 2023; Ogbeibu & Oribhabor, 2023). Simultaneously, analyses of atmospheric and regional pollutants using Sentinel data reveal increased pollutant levels in southern geopolitical zones, aligning with concentrated industrial and combustion sources. This underscores the multi-pathway exposure regime impacting both biodiversity and human populations (Lemenkova & Debeir, 2023; Okoye, 2025). The consequences directly impact the socio-economic domain, resulting in measurable negative effects on fisheries and aquaculture systems, thereby posing threats to food security and livelihoods. Studies support this impact by associating pollution events with decreased agricultural productivity, extensive fish kills, and market disruptions (Clinton et al., 2021; Flourizel et al., 2024; Jack, 2025). Socio-ethical analyses highlight that local communities experience disproportionate exposure and restricted access to timely remediation, a situation viewed as environmental injustice or environmental racism exacerbated by weak governance and insufficient community resilience mechanisms (Ikeke, 2024; Jack, 2025).

Evidence Quality and Monitoring Gaps

A systematic review of the literature identifies significant limitations, such as the underreporting of spills and inadequate post-spill remediation, especially in complex mangrove wetland environments (Flourizel et al., 2024; Jack, 2025; Uwagbae et al., 2020). This gap results in a systematic underestimation of the true extent of biodiversity loss and chemical loading. The lack of standardised monitoring networks and comprehensive taxonomic baselines hinders the identification of long-term trends and the execution of species-specific conservation strategies (Ogbeibu & Oribhabor, 2023; Uwagbae et al., 2020). Recent hydrological and aquifer vulnerability analyses indicate that surface contamination may interact with groundwater regimes, potentially extending contamination pathways with significant ecological and human health implications (Ejaita & Omonefe, 2025; George et al., 2025).

Trends in Biodiversity Decline in the Niger Delta

Analysis of available ecological and geospatial data indicates a significant decline in species richness and abundance across various taxonomic groups within the Niger Delta. The most significant structural alteration pertains to the gradual decrease in the extent of critical habitat. For instance, mangrove cover, the foundational ecosystem of the delta, has decreased by over 30% since the 1980s, severely compromising nursery functions and coastal protection (Numbere, 2018). The decline of this critical habitat is directly linked to significant reductions in the populations of key animal species. Specifically, endangered and endemic species, such as the African manatee (Trichechus senegalensis) and the Niger Delta red colobus monkey (Piliocolobus epieni), have experienced dramatic declines (Numbere, 2018; Oates et al., 2017). The data collectively indicate a trend of ecological compromise, advancing the region towards irreversible functional degradation.

Table 1: Biodiversity and Habitat Decline in the Niger Delta (1980-12020)

Indicator	1G80	2000	2020	% Change (1G80–2020)
Mangrove Area (km²)	10,000	8,000	7,000	-30%
Fish Species Richness	230	200	170	-26%

Mammal Species Observed	46	38	32	-30%
Bird Species Observed	200	175	150	-25%

Compiled from FAO (2020); UNEP (2022); Nwankwo & Ume (2023); Sam et al. (2023).

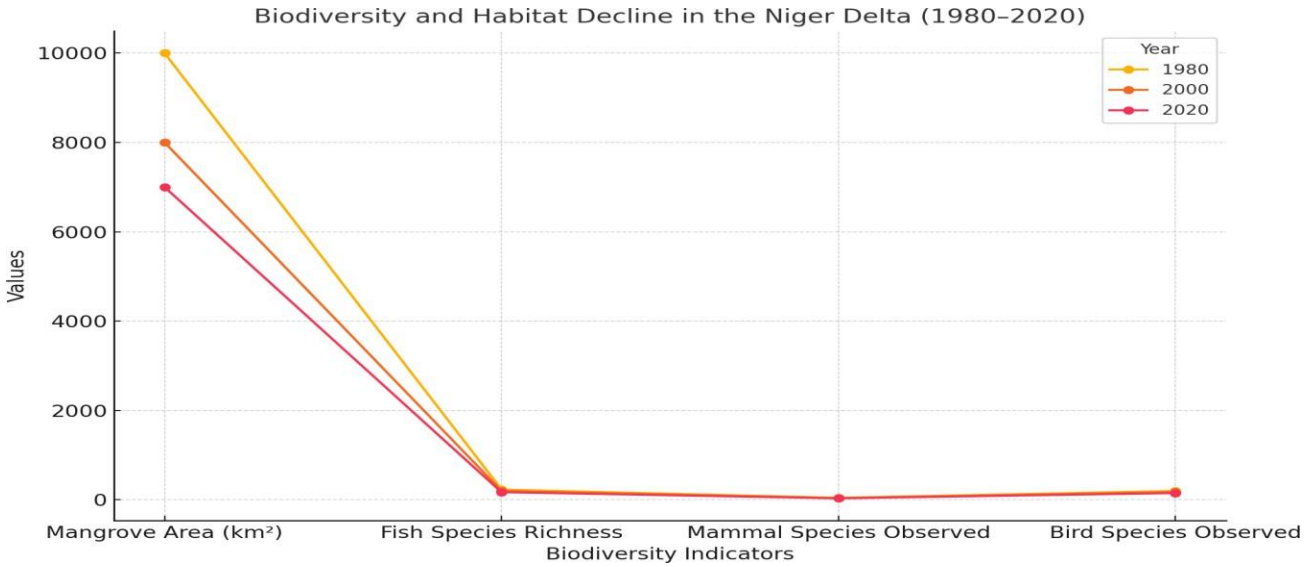

Figure 3. Figure 1. Trends in biodiversity and habitat decline in the Niger Delta (1980–2020). Source: Compiled from FAO (2020) and UNEP (2022).

Figure 3 demonstrates a uniform decrease in all biodiversity indicators, with the most pronounced declines observed in mangrove and mammal populations. This pattern validates the enduring cumulative impact of industrial activities on aquatic and terrestrial systems.

Table 2: Countries with more than 25 species at risk of losing more than 25% of habitat

S/N	Entity	Code	Year	Countries with more than 25 species at risk of losing more than 25% of habitat
1	Angola	AGO	2050	152
2	Brazil	BRA	2050	133
3	Cote d'Ivoire	CIV	2050	265
4	Democratic Republic of Congo	COD	2050	331
5	India	IND	2050	52
6	Kenya	KEN	2050	422
7	Madagascar	MDG	2050	43
8	Malawi	MWI	2050	204
G	Nigeria	NGA	2050	293

10	Zimbabwe	ZWE	2050	153

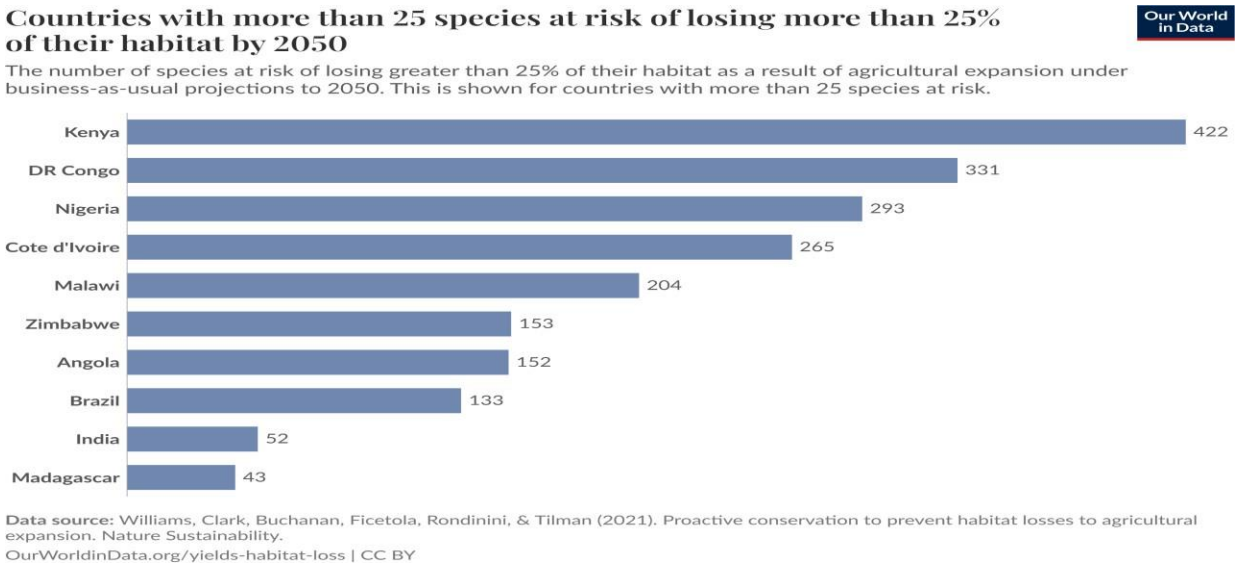

Figure 4: Countries with more than 25 species at risk of losing more than 25% of their habitat

5. Discussion

This study's findings indicate a complex pattern of biodiversity decline in the Niger Delta, highlighting the interconnected impacts of industrial activity, environmental mismanagement, and socio-political neglect. The outcomes are best analysed through the frameworks of Environmental Governance and Justice (EGJ) and Social–Ecological Systems (SES), which elucidate the interplay between ecological degradation, institutional weakness, and social vulnerability (Ikeke, 2024; Mansourian & Stephenson, 2023).

Industrial Influences and Environmental Consequences

The analysis indicates a consistent and substantial decrease in mangrove forest cover, from roughly 10,000 km² in 1980 to 7,000 km² in 2020, corresponding to a 30% reduction over 4 decades. This trend aligns with global observations regarding the loss of tropical mangroves due to industrialisation and hydrocarbon pollution (Flourizel et al., 2024; FAO, 2020). The degradation of these habitats has initiated a series of ecological disturbances, resulting in a decline in the richness of fish, bird, and mammal species. The data indicate that unsustainable practices in oil exploitation, gas flaring, and artisanal refining have collectively destabilised both aquatic and terrestrial ecosystems (Ogbeibu & Oribhabor, 2023; Uwagbae et al., 2020).

From the SES framework perspective, this degradation exemplifies a failure of ecological feedback loops that typically uphold ecosystem resilience. The removal of mangrove vegetation disrupts nutrient cycling and hydrological regulation, leading to significant biodiversity loss and reduced ecological productivity (Nogués-Bravo & Whitmee, 2025). Declining fish populations indicate ecological imbalance and heighten community reliance on degraded resources, resulting in a detrimental cycle of overexploitation and increased vulnerability. These dynamic highlights that biodiversity loss in the Niger Delta is not an isolated occurrence but rather a manifestation of a disrupted human-environment system.

Socio-Economic and Environmental Justice Dimensions

The findings indicate that the decline in biodiversity disproportionately impacts marginalised communities that rely directly on ecological resources for their livelihoods. Communities with diminished fish stocks, contaminated water, and deteriorating soils encounter heightened food insecurity and decreased income. This is consistent with the Environmental Governance and Justice (EGJ) framework, which highlights that environmental degradation frequently reflects

established governance inequities and socio-political exclusion (Angaye & Lelei, 2025; Ikeke, 2024).

The ongoing marginalisation of Delta communities illustrates the assertion that governance asymmetries sustain ecological inequity. Inadequate regulatory enforcement, protracted remediation processes, and the prioritisation of industrial interests over community welfare contribute to distributive injustice (Clinton et al., 2024). This pattern demonstrates that biodiversity loss in the Niger Delta transcends ecological concerns and represents a manifestation of environmental injustice rooted in structural inequalities in power, representation, and environmental rights. Flourizel et al. (2024) indicate that this type of ecological marginalisation significantly affects social stability, heightening community susceptibility to ecological and economic shocks.

Landscape Patterns and Ecological Integrity

The observed fragmentation of habitats and the associated declines in species diversity support the SES model's focus on the interdependence of ecological and human systems. Disruptions in the biophysical environment, such as deforestation, sediment contamination, or oil spills, lead to cascading effects throughout ecosystem subsystems, diminishing the overall regenerative capacity. Mangrove deforestation compromises nursery grounds for aquatic fauna, resulting in diminished fish stocks that further exacerbate socio-economic stress on fishing communities that depend on them. This relationship illustrates a feedback loop in which anthropogenic ecological changes exacerbate socio-economic vulnerability, subsequently leading to increased environmental degradation (Mansourian & Stephenson, 2023).

The SES framework serves as an effective interpretive tool for analysing the systemic aspects of biodiversity decline in the Niger Delta. The findings indicate that environmental degradation in the region is not merely the result of isolated events but rather the cumulative outcome of prolonged, interconnected processes involving ecological and social subsystems. The ongoing feedback dynamic indicates a decline in resilience within the ecological networks of the Niger Delta, necessitating immediate adaptive governance and comprehensive restoration strategies.

Governance Deficits and Institutional Weakness

Governance deficits are a primary driver of biodiversity loss in the Niger Delta. The research indicates that fragmented environmental policies, restricted regulatory capacity, and inconsistent monitoring systems have sustained a cycle of institutional failure. The lack of transparent enforcement mechanisms within agencies such as the National Environmental Standards and Regulations Enforcement Agency (NESREA) and the National Oil Spill Detection and Response Agency (NOSDRA) has diminished accountability in the extractive industries (Uwagbae et al., 2020).

The convergence of the EGJ and SES frameworks offers a framework for analysing these institutional failures. From an EGJ perspective, the ongoing failure to enforce environmental standards constitutes procedural injustice, as impacted communities are consistently marginalised in decision-making and remediation processes. From the SES perspective, inadequate governance hinders the feedback mechanisms essential for environmental self-regulation, leading to a self- perpetuating cycle of degradation and socio-political instability (Nogués-Bravo & Whitmee, 2025). This theoretical integration elucidates that the governance crisis serves both as a cause and a consequence of biodiversity decline, highlighting an ecological and moral imperative for institutional reform, transparency, and participatory management.

Comparative and Global Context

The biodiversity trajectory of the Niger Delta, when considered globally, reflects patterns similar to those found in other resource-dependent deltas, including the Mekong and the Ganges. The rate of biodiversity loss in the Niger Delta is exacerbated by prolonged oil contamination and a lack of effective policy action. Nigeria is identified by the FAO (2020) and UNEP (2022) as one of the top five countries worldwide for mangrove deforestation rates, with ecosystem recovery occurring at less than one-third the rate of degradation. This comparative analysis highlights the global importance of the Niger Delta as a case study for examining the intersection of governance and industrial activity in the acceleration of ecological decline within developing economies.

These findings indicate that biodiversity loss in the Niger Delta represents not only an environmental issue but also a complex socio-ecological phenomenon linked to governance asymmetry and systemic feedback failure. The EGJ framework clarifies the moral and distributive aspects of this crisis, whereas the SES model elucidates its cyclical ecological mechanisms. To address this

decline, an integrated policy approach is necessary, one that concurrently enhances governance, reinstates ecological resilience, and guarantees environmental justice for impacted communities.

6. Conclusions and Recommendations

Conclusion

This study suggests that the biodiversity loss in the Niger Delta constitutes a significant ecological and socio-political disaster, stemming from decades of unsustainable industrial practices, environmental neglect, and institutional inefficiency. The research objectives, to evaluate the magnitude, identify the determinants, and analyse the consequences of biodiversity loss, have been accomplished by a comprehensive analysis integrating ecological data, socio-economic evidence, and governance viewpoints.

The results indicate significant deterioration of essential ecosystems, such as mangrove forests, wetlands, and freshwater systems, coupled with dramatic reductions in the diversity of fish, bird, and mammal species over the last forty years. Industrial oil spills, gas flaring, and unregulated land use have led to ongoing contamination and habitat fragmentation, diminishing ecosystem functionality and resilience. These patterns highlight an escalating ecological imbalance that threatens both biological integrity and human livelihoods throughout the Niger Delta.

The study demonstrates that inadequate environmental governance and socio-economic disparities intensify ecological degradation. Marginalised people persistently endure the consequences of environmental deterioration, including loss of livelihood, food poverty, and health hazards linked to pollution. The results confirm the relationship between ecological degradation and social vulnerability, indicating that sustainable biodiversity management must combine environmental conservation with justice and equity. This study was limited by the availability of longitudinal field data, relying on secondary sources for species diversity estimation

In conclusion, tackling biodiversity loss in the Niger Delta requires a transformative strategy that integrates scientific innovation, robust governance, and collaborative conservation efforts. The region's rehabilitation relies on restoring degraded ecosystems, enforcing corporate accountability, and empowering communities to actively manage their environment. Harmonising national biodiversity policies with global frameworks, like the Kunming–Montreal Global Biodiversity Framework, will enhance Nigeria's capacity to reverse ecological degradation and secure a resilient, egalitarian, and sustainable future.

Policy-Tiered Recommendations

To achieve tangible and sustainable biodiversity restoration, the following policy-specific actions are proposed across governance levels:

1. Federal Government Level

The Federal Government should strengthen environmental auditing, compliance, and enforcement mechanisms under the National Environmental Standards and Regulations Enforcement Agency (NESREA) and the National Oil Spill Detection and Response Agency (NOSDRA). Establishing a National Biodiversity and Ecosystem Monitoring Framework will standardise ecological reporting and ensure accountability among extractive industries. In addition, federal authorities should develop biodiversity financing mechanisms, such as ecological trust funds and green bonds, to support restoration, research, and community engagement initiatives.

2. State Government Level

State governments within the Niger Delta should integrate biodiversity conservation into land-use and regional development planning. Policies must prioritise the creation of state-level protected areas, particularly in mangrove and freshwater zones, to safeguard critical habitats. State environmental ministries should collaborate with local universities and research institutions to establish Biodiversity Observation Networks (BONs) that enable continuous monitoring, policy evaluation, and ecological education.

3. Community Level

At the community level, there is an urgent need to institutionalise co-management agreements between local populations, traditional authorities, and environmental agencies. Such frameworks should promote collective responsibility for wetlands, forests, and coastal resources. Communities should also be incentivised to adopt sustainable fishing, aquaculture, and forestry practices through access to microgrants, training, and payment-for-ecosystem-services (PES) schemes that reward environmental stewardship and resource protection.

4. Private Sector Level

The private sector, particularly oil and gas companies, must implement corporate biodiversity accountability frameworks aligned with Environmental, Social, and Governance (ESG) standards. Industries should be mandated to conduct annual biodiversity audits, disclose their ecological footprints, and establish biodiversity offset programmes to compensate for environmental impacts. Furthermore, corporate social responsibility (CSR) initiatives should prioritise funding for community-led restoration projects, local innovation in pollution management, and sustainable livelihood development.

5. Cross-Sectoral Coordination

A multi-stakeholder Biodiversity Governance Council (BGC) should be established to coordinate environmental policy implementation across all levels of governance. This council would facilitate cross-sectoral data sharing, monitor restoration progress, and evaluate outcomes based on indicators aligned with the Kunming–Montreal Global Biodiversity Framework (GBF). Its membership should include federal and state environmental agencies, research institutions, traditional councils, and civil society organisations to ensure inclusivity and transparency in biodiversity governance.

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