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A Review on the Role of Swamps and Wetlands in the Conservation of Aquatic Biodiversity in the Niger Delta Region of Nigeria.

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ABSTRACT

This research highlights the critical role played by swamps and wetlands in preserving aquatic biodiversity in the Niger Delta region of Nigeria. Swamps and wetlands ecosystems serve as essential habitats for breeding, spawning, and nurturing various aquatic species, ensuring the sustainability of diverse aquatic organisms. Swamps and wetlands also contribute to nutrient cycling, water purification, and the stabilization of aquatic ecosystems. Despite their ecological significance, wetlands in the Niger Delta are under threat from pollution, oil exploration, and habitat degradation, leading to biodiversity loss and reduced fishery productivity. The research emphasizes the importance of protecting these ecosystems through conservation strategies such as sustainable fishing practices, wetland restoration and pollution control to maintain their ecological and economic benefits for the region.

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Introduction

Wetlands and swamps have long been recognized as crucial ecosystems, yet their ecological importance has not always been fully appreciated. In the past, these areas were often viewed as wastelands that needed draining and conversion into farmland or urban development (Turner *et al.,* 2000; Acreman *et al.,* 2020), leading to extensive wetland degradation worldwide, including in the Niger Delta, where large sections of mangrove swamps were cleared to accommodate urban growth and oil exploration (Nwilo & Badejo, 2005). By the mid-20th century, global awareness of the importance of wetlands grew significantly. A key milestone was the 1971 Ramsar Convention, which provided a framework for the conservation and sustainable utilization of wetlands. This international treaty highlighted wetlands' critical roles in maintaining biodiversity, regulating water cycles, and mitigating climate change (Ramsar Convention Secretariat, 2013). In the Niger Delta, wetlands and swamps have historically been vital to local communities, providing food, water, and raw materials for traditional livelihoods, and holding cultural and spiritual significance (Akpan & Bassey, 2020). However, rapid industrialization and oil extraction over time have severely disrupted these ecosystems, resulting in habitat destruction and loss of aquatic species (Numbere, 2020).

In recent years, recognizing the importance of protecting these wetlands to conserve aquatic biodiversity, various local and international conservation initiatives—such as mangrove restoration projects and sustainable development programs—have been undertaken to repair the damage caused by decades of exploitation. The goal is to ensure these ecosystems can continue supporting both human communities and aquatic life (Chidumeje *et al.,* 2014). Wetlands and swamps are vital for maintaining ecological balance, offering habitats, food sources, and breeding grounds for diverse species—whether permanent or seasonal (Mitsch *et al.,* 2015; Alikhani et al., 2023). The Niger Delta hosts one of the world's largest wetland systems, a biodiversity hotspot characterized by its extensive network of rivers, creeks, and mangrove forests that shelter rare species unique to the region (Uluocha & Okeke, 2004). These ecosystems play a crucial role in ecological stability by supporting wildlife and human livelihoods, regulating water quality, and functioning as natural carbon sinks. Despite their importance, wetlands in the Niger Delta face increasing threats from urbanization, deforestation, and oil pollution, which jeopardize their capacity to sustain aquatic life (Loveline, 2015; Numbere, 2020; Alongi, 201). Recognizing these challenges underscores the urgent need for their protection and sustainable management. This study examines the role of swamps and wetlands in preserving aquatic biodiversity in the Niger Delta, emphasizing their ecological significance, the threats they face, and potential conservation strategies (Edo & Albrecht, 2021).

About The Niger Delta.

Located on the Atlantic coast of Southern Nigeria, the Niger Delta lies within the lower reaches of the Niger river, extending between latitudes 05°19′34″N 06°28′15″E and 5.32611°N 6.47083°E (Ayanlade & Drake, 2016; Asuka & Hyginus, 2023). The average monthly temperature of the region is 27°C, and an annual rainfall ranging from 3000 to 4500 mm. There are two distinct seasons with the wet season occurring from July to September and the dry season from December to February (World Bank, 1995). The Niger Delta is made up of nine states and home to some 30 million people, approximately 22% of the country's population (2006 census). These states include: Abia State, Akwa Ibom State, Bayelsa State, Cross River State, Delta State, Edo State, Imo State, Ondo State, Rivers State. The Niger Delta region is one of the most prominent regions in Nigeria, endowed with several water bodies that are distributed as freshwater like rivers, stream, creeks, lakes and estuaries (which interphase fresh and salt water) and marine water (Izah, 2018). The region is made of nine states: Abia, Akwa Ibom, Bayelsa, Cross River, Delta, Edo, Imo, Ondo and Rivers states. The region covers approximately 2370 Square kilometers of mainly flowing fresh waters and 8600 square km of stagnant swamps (Okonkwo *et al.,* 2015). The Niger Delta aquatic ecosystem is greatly blessed with variety of fish species, both fin and shellfishes. Many of the fish species are endangered due to constant pollution of the Niger Delta regional coastal environment by the petroleum and allied industries (Uluocha and Okeke, 2004).

Wetlands

Wetlands are ecosystems characterized by the presence of water, either permanently or seasonally, which significantly influences the soil and supports vegetation adapted to water-saturated conditions. They serve as transitional zones between terrestrial and aquatic environments, encompassing a wide variety of habitats such as swamps, marshes, bogs, and fens (Mitsch *et al.,* 2015). Wetlands can be freshwater or saltwater systems, occurring in diverse climates and geographic locations. Wetlands are ecologically significant due to their role in supporting biodiversity and maintaining environmental balance. They provide critical habitats for plants and animals, including fish, amphibians, birds, and invertebrates, many of which are specially adapted to these environments. Additionally, wetlands offer numerous ecosystem services, including water purification, flood control, carbon sequestration, and groundwater recharge (Ramsar Convention Secretariat, 2013).

Types of Wetlands

Wetlands are varied ecosystems categorized by their water conditions, plant life, and geographical position. The main types of wetlands are:

i. Swamps

Swamps are wetlands characterized by the dominance of woody vegetation, such as trees and shrubs, and are typically found in areas with poor drainage. They can be freshwater or saltwater ecosystems, depending on their location and water source. Freshwater swamps often occur in floodplains and lowlands, where rivers or streams provide a constant water supply. Vegetation includes species like cypress, willows, and swamp oaks. Saltwater swamps, on the other hand, are typically mangrove-dominated, with species such as red, black, and white mangroves thriving in saline conditions (Mitsch *et al.,* 2015). Ecologically, swamps play an essential role in water filtration, flood regulation, and habitat provision. They support a variety of species, including amphibians, reptiles, and waterfowl. Swamps also act as carbon sinks, storing large amounts of organic matter in their waterlogged soils. Notable examples include the freshwater swamps of the Niger Delta and the mangrove forests of the Sundarbans in South Asia.

ii. Marshes

Marshes are wetlands dominated by herbaceous (non-woody) plants such as grasses, sedges, and reeds. These wetlands are nutrient-rich and are typically found along the edges of rivers, lakes, and estuaries. Marshes can be freshwater, often found inland, or saltwater, located along coastlines. Their vegetation thrives in waterlogged soils and shallow water, making them important breeding and feeding grounds for aquatic and bird species (Zedler & Kercher, 2005). Freshwater marshes regulate water flow, filter pollutants, and provide critical habitats for species such as frogs, fish, and waterfowl. Salt marshes, often found in estuarine environments, play a role in protecting coastlines from storm surges and are important nurseries for marine life. Examples of marsh ecosystems include the Okavango Delta in Botswana and the salt marshes along the Gulf of Guinea coastline.

iii. Bogs

Bogs are unique wetlands that form in areas with poor drainage, primarily fed by precipitation rather than groundwater or surface water. As a result, bogs are nutrient-poor and highly acidic, which limits the types of vegetation that can thrive. These wetlands are dominated by sphagnum moss, along with some shrubs and stunted trees. The accumulation of organic matter in bogs occurs slowly, leading to the formation of peat over time (Joosten *et al.,* 2012). Bogs are significant carbon storage systems, as their acidic and waterlogged conditions slow down the decomposition of organic material, trapping carbon for centuries. They also support unique plant species such as carnivorous plants and provide habitats for specialized fauna. Examples include the peat bogs of northern Europe and Canada.

iv. Fens

Fens are wetlands similar to bogs but differ in that they receive water not only from precipitation but also from groundwater or surface runoff. This additional water source makes fens less acidic and more nutrient-rich, allowing for a greater diversity of plant life. Vegetation in fens includes grasses, sedges, wildflowers, and some woody plants (Charman, 2002). Fens support diverse ecosystems and play a role in water filtration and carbon sequestration. They are particularly important in maintaining hydrological balance and preventing downstream flooding. Examples of fens include those found in the European Alps and North America's Great Lakes region.

v. Mangroves

Mangroves are coastal wetlands found in tropical and subtropical regions. These wetlands are dominated by salt-tolerant trees and shrubs, such as red, black, and white mangroves, which thrive in saline and waterlogged conditions. Mangroves are often located in intertidal zones where saltwater and freshwater mix, creating brackish environments (Nababa *et al.,* 2020). Their extensive root systems stabilize coastlines, prevent soil erosion, and dissipate wave energy, providing a natural defense against storm surges (Spalding *et al.,* 2010). Ecologically, mangroves are vital breeding and nursery grounds for marine species, including fish, crustaceans, and mollusks. They also play a significant role in carbon sequestration, storing large amounts of carbon in their biomass and soils. Examples include the mangrove forests of the Niger Delta and the Sundarbans, the world’s largest mangrove forest, located in India and Bangladesh.

vi. Tidal Flats

Tidal flats, also known as mudflats, are coastal wetlands found in intertidal areas where the tides periodically submerge and expose the land. These wetlands are typically devoid of large vegetation but are rich in organic matter and nutrients. Tidal flats provide critical habitats for shellfish, crabs, and worms, which in turn support migratory bird populations that rely on these areas for feeding (Murray *et al.,* 2019). Tidal flats act as natural buffers against coastal erosion, reducing wave energy and sediment transport. They also play a role in nutrient cycling, as tidal action continuously replenishes nutrients and oxygenates sediments. Examples include the Wadden Sea in Europe and tidal flats along the Niger Delta.

vii. Vernal Pools

Vernal pools are seasonal wetlands that form in shallow depressions during rainy seasons and dry out during warmer months. These wetlands are often freshwater systems, with water levels fluctuating significantly based on rainfall. Vernal pools are typically devoid of fish, making them ideal breeding grounds for amphibians and insects (Colburn, 2006). Despite their

temporary nature, vernal pools are biodiversity hotspots. They support species uniquely adapted to their seasonal cycles, such as fairy shrimp and certain amphibians. Vernal pools are commonly found in Mediterranean climates, such as parts of California and South Africa.

viii. Peatlands

Peatlands are a type of wetland where the accumulation of partially decayed organic matter (peat) dominates. These wetlands can overlap with bogs and fens but are distinguished by their high carbon content and slow decomposition rates. Peatlands are found globally, ranging from tropical peat swamps in Southeast Asia to northern peatlands in Canada and Russia (Joosten *et al.,* 2012). Peatlands are critical carbon sinks, storing more carbon than all the world's forests combined. They also regulate water flow and prevent flooding by retaining water during wet periods. However, peatlands are highly susceptible to degradation through drainage, agriculture, and peat harvesting.

ix. Playa Lakes

Playa lakes are temporary wetlands found in arid and semi-arid regions. These shallow depressions fill with water during periods of heavy rainfall and evaporate during dry seasons. Playa lakes are typically alkaline due to the accumulation of salts from evaporation, and their vegetation is often sparse (Smith, 2003). Despite their ephemeral nature, playa lakes provide important habitats for migratory birds and serve as water sources for wildlife in dry landscapes. They also contribute to groundwater recharge and support unique microbial communities. Examples of playa lakes are found in the High Plains of the United States and parts of Australia.

Types of Swamps

Swamps are diverse ecosystems classified based on their hydrology, vegetation, and geographic location. The major types of swamps are:

Freshwater Swamps

Freshwater swamps are wetlands primarily fed by rivers, streams, or rainfall. These swamps are typically found inland, often in low-lying areas, floodplains, or along riverbanks. The water in freshwater swamps is low in salinity, creating ideal conditions for certain plant species. Vegetation in these swamps includes water-tolerant trees such as cypress, swamp oaks, and willows, along with shrubs and aquatic plants like ferns and reeds (Mitsch *et al.,* 2015). Freshwater swamps provide critical habitats for a variety of species, including fish, amphibians, reptiles, and birds. These ecosystems also act as natural flood control systems, absorbing excess water during heavy rains and reducing the risk of flooding in surrounding areas. Additionally, they play a role in nutrient cycling and water purification by filtering sediments and pollutants from surface water (Numbere, 2020). Examples include the Okavango Delta in Botswana and the freshwater swamps of the Niger Delta, which support diverse flora and fauna vital to local and global ecosystems.

i. **Forested Swamps:** These are dominated by trees, often deciduous like red maple, tupelo, and bald cypress. They provide habitat for a diverse range of wildlife, including birds, mammals, reptiles, and amphibians.

ii. **Shrub Swamps:** These are characterized by shrubs like buttonbush and willow. They are often found along the edges of lakes and rivers.

Saltwater (Coastal) Swamps

Saltwater swamps, also known as coastal or tidal swamps, are located along coastlines and are influenced by tidal flows and saline water from the sea. These swamps often overlap with mangrove ecosystems in tropical and subtropical regions. The vegetation is dominated by salt-tolerant species, such as red, black, and white mangroves, which thrive in waterlogged and saline soils (Spalding *et al.,* 2010). Ecologically, saltwater swamps are critical for protecting coastlines from erosion and storm surges. The intricate root systems of mangroves stabilize the soil and reduce the impact of waves, acting as natural barriers against extreme weather events. They also serve as breeding and nursery grounds for many marine species, including fish, crustaceans, and mollusks, which are vital for local fisheries and global food security. Furthermore, saltwater swamps play a significant role in carbon sequestration, storing large amounts of carbon in their biomass and soils. Notable examples include the mangrove swamps of the Niger Delta, one of the largest mangrove forests in the world, and the Sundarbans mangrove forest in India and Bangladesh.

iii. **Mangrove Swamps:** These are found in tropical and subtropical coastal areas. Mangrove trees are salt-tolerant and play a vital role in protecting coastlines from erosion and storms.

Importance of Swamps

Swamps are a type of wetland ecosystem characterized by waterlogged soils and the presence of woody vegetation, such as trees and shrubs. These ecosystems are often found in low-lying areas and can be classified into freshwater swamps, which are fed by rivers or rainfall, and saltwater swamps, which are influenced by tidal flows and seawater (Mitsch *et al.,* 2015). Swamps are distinct from other wetlands due to their dominance of forested landscapes and the unique biodiversity they support. Swamps serve as critical habitats for many plant and animal species, playing a significant role in the maintenance of biodiversity. Freshwater swamps are home to species such as amphibians, fish, and reptiles, while saltwater swamps, particularly mangroves, support crustaceans, mollusks, and a variety of fish species (Beare *et al.,* 1995). These ecosystems also act as natural water filters, trapping sediments and pollutants, and regulating water flow, which helps prevent flooding in adjacent areas.

Biodiversity

Biodiversity is the variety of life on Earth from genes and species to ecosystems and the valuable functions they perform. For at least 3.8 billion years, a complex web of life has been evolving on Earth. Millions of species inhabit land, freshwater, and ocean ecosystems. All species, including human beings, are intricately linked by their interactions with each other and the environments they live in (Chiarucci *et al.,* 2010). Biodiversity, short for biological diversity is the variety of all living things and their interactions. Biodiversity changes over time as extinction occurs and new species evolve. Scientists often speak of three levels of diversity: species, genetic, and ecosystem diversity. In fact, these levels cannot be separated. Each is important, interacting with and influencing others. Changes at one level can cause changes at other levels (Ahmed *et al.,* 2022).

Components of Biodiversity

There are 3 major components of biodiversity, they are: Genetic diversity, Species diversity and Ecosystem Diversity.

i. Genetic Diversity

Every individual plant or animal has a distinct combination of genes. The variety of genes within a given population or species is known as genetic diversity. Genetic diversity refers to the variety of genes within a species. It is crucial for the adaptability and survival of species, allowing populations to withstand changes in environmental conditions and resist diseases (Roe *et al.,* 2014).

ii. Species Diversity

This aspect of biodiversity pertains to the variety of species within a particular ecosystem or on Earth as a whole. Species diversity measures the number of different species found in a given territory Ecosystems with high species diversity tend to be more resilient and productive, supporting complex food webs and ecological processes. For instance, coral reefs, which are among the most biodiverse ecosystems, support numerous marine species (Schweiger *et al.,* 2018).

iii. Ecosystem Diversity

Ecosystem diversity refers to the variety of habitats, communities, and ecological processes within a region. Examples include forests, wetlands, grasslands, and marine ecosystems. Each ecosystem provides unique services, such as carbon storage in forests or water filtration in wetlands. It relates to variety of habitats, biotic communities and ecological processes in the biosphere, and is considered as complex level of diversity (Schweiger *et al.,* 2018).

Importance of Biodiversity

Biodiversity plays a critical role in maintaining ecosystem functionality and supporting human well-being.

i. Diverse ecosystems are more resilient to disturbances such as climate change, pests, and diseases. The interactions among species ensure the continuity of ecological processes, such as pollination and nutrient cycling (Bernhardt & O'Connor, 2021).
ii. Biodiversity underpins ecosystem services that sustain life on Earth. These include provisioning services (e.g., food, water, and medicine), regulating services (e.g., climate regulation and flood control), cultural services (e.g., recreation and spiritual value), and supporting services (e.g., soil formation and nutrient cycling) (Balvanera *et al.,* 2017).
iii. Biodiversity contributes significantly to economies worldwide. Industries such as agriculture, pharmaceuticals, and tourism rely heavily on biological resources (Hanley & Perrings, 2019).
iv. Biodiversity provides opportunities for research, helping scientists understand ecological relationships and discover solutions to global challenges such as climate change and disease outbreaks (Dudgeon *et al.,* 2006).

Aquatic Biodiversity

Aquatic biodiversity can be defined as the variety of life and the ecosystems that make up the freshwater, tidal, and marine regions of the World and their interactions. Aquatic biodiversity encompasses freshwater ecosystems, including lakes, ponds, reservoirs, rivers, streams, groundwater, and wetlands (Bernhardt & O'Connor, 2021). It also consists of marine ecosystems, including oceans, estuaries, salt marshes, sea grass beds, coral reefs, kelp beds, and mangrove forests. Aquatic biodiversity includes all unique species, their habitats and interaction between them (Hickman *et al.,* 2006). It consists of phytoplankton, zooplankton, aquatic plants, insects, fish, birds, mammals, and others. Aquatic biodiversity refers to the variety of life forms found in water-based ecosystems, including oceans, rivers, lakes, wetlands, and estuaries. It encompasses the genetic, species, and ecosystem diversity within these habitats, from microscopic plankton to large marine mammals like whales. Aquatic biodiversity is vital for the functioning of ecosystems and provides numerous ecological, economic, and social benefits (Dudgeon *et al.,* 2006).

Importance of Aquatic Biodiversity

Aquatic biodiversity, the variety of life found in water bodies, is essential for the health of our planet and human well-being (Alho, 2008).

Ecosystem Services:

i. Aquatic organisms like bacteria and algae help filter water, removing pollutants and improving water quality.
ii. They play a crucial role in recycling nutrients, ensuring the availability of essential elements for plant growth.
iii. Marine ecosystems absorb carbon dioxide from the atmosphere, helping to mitigate climate change.
iv. Mangrove forests and coral reefs act as natural barriers, protecting coastlines from erosion and storm surges.

Economic/ health Benefits:

i. Aquatic resources provide food and livelihoods for millions of people worldwide.
ii. Diverse marine ecosystems attract tourists, boosting local economies.
iii. Marine organisms are a source of valuable compounds used in medicine.
iv. Aquatic resources are a major source of protein for many populations.

Threats to Aquatic Biodiversity in the Niger Delta

Aquatic biodiversity faces numerous threats from human activities and environmental changes:

i. Pollution from agricultural runoff, industrial waste, and plastic debris degrades aquatic habitats. Eutrophication caused by nutrient pollution leads to dead zones, where oxygen levels are too low to support most marine life (Diaz & Rosenberg, 2008; Onyena & Sam, 2020).
ii. Rising sea temperatures, ocean acidification, and melting glaciers threaten marine and freshwater species. Coral bleaching events, for example, are linked to increased ocean temperatures, resulting in the loss of critical habitats (Roberto *et al.,* 2023).
iii. Overexploitation of marine resources and destructive fishing practices, such as bottom trawling, severely impact aquatic biodiversity. Similarly, the destruction of habitats like mangroves and wetlands for urbanization and agriculture reduces breeding and feeding grounds (Kamleshbhai *et al.,* 2022).
iv. Non-native species introduced into aquatic ecosystems can outcompete native species, leading to declines in biodiversity. For instance, the introduction of zebra mussels in North American freshwater systems has caused significant ecological disruptions (Havel *et al.,* 2015).

Conservation of Aquatic Biodiversity

Efforts to conserve aquatic biodiversity include some key strategies like:

i. Establishing marine protected areas (MPAs) and freshwater reserves to conserve critical habitats and species. For example, the Great Barrier Reef Marine Park is a well-known conservation success story (Acreman *et al.,* 2020).
ii. Promoting sustainable fisheries and aquaculture practices, reducing bycatch, and implementing stricter regulations on overfishing (Ward *et al.,* 2022).
iii. Reducing pollution through better waste management, stricter industrial regulations, and minimizing plastic use (Ahmed *et al.,* 2022).
iv. Restoring degraded habitats, such as replanting mangroves and rehabilitating coral reefs, to support ecosystem recovery (Piczak *et al.,* 2023).

Types of Aquatic Biodiversity in Niger Delta.

The freshwater resources of the Niger Delta are home to a variety of fish species and many other aquatic plant resources, many of which are of significant economic importance. The region's rivers and streams support species from various fishes. These fish are vital for local fisheries and contribute to the livelihoods of many communities (Meye and Ikomi, 2009).

i. ***Clarias gariepinus*** **(African Catfish):** Found throughout Africa and Middle-East. Freshwater lakes, rivers and swamps are their preferred habitat.

ii. ***Pseudotolitus elongatus*** **(Croaker):** They are primarily marine, but are also found mostly seasonally in brackish waters over sandy or muddy bottoms in coastal area with large river run-offs.

iii. ***Penaeous notialis*** **(Brown Shrimp**): Preferred habitat is Estuarine biome and usually patches among rocks. Marine; juvenile estuarine. Found in most rivers in the Niger delta.

iv. ***Tympanotonus fuscatus*** **(Periwinkle):** It is found all along the coast of Niger Delta. It is also found in the river mouths along west African countries. This species is found in brackish water. They are bottom dweller

v. ***Pila ovate*** **(Water Snail):** Can be found all states of the Niger Delta, its habitat is fresh water.

vi. ***Anas sparsa*** **(African Black Duck):** The African Black Duck is also known as the Black River Duck, found in Africa and the Niger Delta region of Nigeria. The black duck's habitat are rivers and streams.

vii. ***Pistia stratiotes*** **(Water lettuce);** Its often called water cabbage, it can be found in ponds, rivers and lakes across the Niger delta and some parts of Africa.

viii. ***Nymphaea lotus*** **(white lotus):** It is also called the water lily, found in quiet areas around rivers, lakes and ponds.

Role of Swamps and Wetlands in Aquatic Biodiversity Conservation in Niger Delta.

Swamps and wetlands are among the most biologically productive ecosystems on Earth, serving as critical habitats for a diverse array of plant and animal species. These ecosystems provide unique environments that support biodiversity conservation by offering breeding grounds, feeding habitats, and shelter for various terrestrial and aquatic organisms. Their ecological functions contribute significantly to sustaining life forms while delivering essential ecosystem services (Mitsch *et al.,* 2015).

Habitat Provision: Wetlands and swamps in the Niger Delta region serve as essential habitats for a variety of aquatic species, because they are essential to the preservation of aquatic biodiversity. These environments give fish, amphibians, crustaceans, and aquatic plants the vital support they need to complete their life cycles. In addition to numerous insects and waterfowl, they support species including tilapia, catfish, and the West African manatee, acting as breeding, nursery, and feeding grounds. Wetlands maintain these processes, which guarantee aquatic ecosystems' resilience and production, both of which are essential for preserving biodiversity. (Sam *et al.,* 2023).

Water Filtration: Due to their innate ability to filter water, wetlands and swamps in the Niger Delta are vital to the preservation of aquatic species. Prior to pollution, sediments, and excess nutrients reaching open water bodies, these ecosystems serve as vital buffers. Wetlands maintain water quality by filtering out contaminants including oil residues, heavy metals, and agricultural runoff. (Bassey & Akpan, 2020) In an area where industrial pollution, particularly from oil and gas operations, is a major problem, this purification procedure helps aquatic animals by establishing a more stable and less hazardous habitat. (Azuka *et al.,* 2023). The wetlands' capacity to reduce pollution also includes maintaining aquatic vegetation that is essential to the food chain and safeguarding species that live in sediment. The loss of species and habitats is one of the major hazards to biodiversity posed by the deterioration of these ecosystems, which is frequently caused by oil spills and untreated industrial effluent (Nababa *et al.,* 2020). Wetlands protect biodiversity and increase the local ecosystems' resistance to human-induced stressors like industrial waste and agricultural chemicals by naturally eliminating pollutants. Therefore, in the Nigerian Niger Delta, their preservation and restoration are essential to sustainable ecosystem management. (Onyena & Sam, 2020; *Ward et al.,* 2022).

Flood Control: In the Niger Delta region of Nigeria, wetlands and swamps are essential for flood control, which in turn preserves aquatic biodiversity. In order to avoid sudden spikes in water levels, these ecosystems function as natural sponges, absorbing surplus water during periods of intense rainfall and releasing it gradually. By giving aquatic organisms stable habitats and lowering the possibility of sudden habitat loss, this approach helps reduce the dangers of devastating floods. Additionally, by reducing water flow and maintaining water levels, wetlands' distinctive structure including their plant and soil composition contributes to their ability to act as a buffer against floods downstream. (Alikhani *et al.,* 2023).

Beyond their ecological advantages, wetlands play an important part in flood regulation. Because they lessen the effects of catastrophic weather events like hurricanes and increasing sea levels, these places are essential for climate resilience. In the Niger Delta, where issues like pollution, oil exploitation, and urbanization are problems, preserving wetlands not only saves biodiversity but also makes communities more resilient to environmental threats. Restoring hydrological links and minimizing wetland degradation are two examples of sustainable management and restoration projects that are crucial to preserving these ecosystems' capacity to regulate flooding. (Loveline, 2015). These efforts underscore the necessity of integrating wetland conservation into broader environmental and climate adaptation strategies to safeguard both ecosystems and human livelihoods.

Carbon Sequestration: The Niger Delta, a complex network of rivers, creeks, and swamps, is a global biodiversity hotspot. One of its most critical roles in aquatic biodiversity conservation is its capacity for carbon sequestration. This process, where carbon dioxide is absorbed from the atmosphere and stored in plant biomass and soils, is a vital tool in mitigating climate change (Alongi, 2021). The Niger Delta's wetlands play a vital role in carbon sequestration by absorbing and retaining atmospheric carbon dioxide (CO_2) in soil and vegetation. Because of their thick biomass and special anaerobic soil conditions, which inhibit the breakdown of organic matter, mangrove forests the largest in Africa act as essential carbon sinks. Through lowering temperature swings and providing a buffer against sea level rise, this strategy not only slows down climate change but also stabilizes aquatic ecosystems (Sam *et al.,* 2023). These advantages are crucial for preserving the delicate aquatic habitat balance and shielding species from the damaging consequences of climate change, like habitat loss and rising salinity (Barenblitt *et al.,* 2024).

Furthermore, fisheries and other aquatic resources that are essential to local lives are indirectly supported by wetlands' role in halting climate change. Additionally, mangroves improve ecological resilience by defending against catastrophic weather events and stabilizing coasts.

Fishery Sustenance: Fisheries, which are essential to the region's food security, economic stability, and biodiversity conservation, depend on the Niger Delta's wetlands. Numerous fish species, including commercially significant ones like tilapia and catfish, use these wetlands as breeding, nidification, and feeding grounds. Fish survival and growth are improved by the nutrient-rich waters and protected habitats that swamps offer, resulting in an ideal ecology for fisheries to flourish. Both commercial and artisanal fishing, which

are essential to the local residents' lives, are supported by this biodiversity. While commercial fisheries profit from the high productivity of these habitats and make a substantial contribution to Nigeria's total fish supply, artisanal fishermen mostly rely on traditional wetland expertise (StoryMaps, 2023).
Moreover, wetlands help regulate fish populations by offering refuge areas that allow for stock replenishment, especially when fishing pressure is high in open waters.

Conclusion

Wetlands and swamps are crucial ecosystems that play a vital role in conserving aquatic biodiversity both in the Niger Delta and worldwide. In Nigeria's Niger Delta, these habitats support a diverse array of species by providing essential resources such as breeding sites, feeding areas, and refuges. They are especially important for aquatic organisms like fish, amphibians, and invertebrates that depend on the unique conditions these environments offer. However, despite their significance, these ecosystems face increasing threats from habitat destruction, pollution, climate change, and unsustainable land-use practices. To address these challenges, both global and local conservation efforts such as restoration projects, sustainable management strategies, and the enforcement of protective legislation are urgently needed.

Recommendation

i. Governments should strengthen and enforce environmental laws and policies that safeguard swamps and wetlands, including designating these ecosystems as protected areas.
ii. Encourage sustainable land-use practices that minimize habitat destruction, such as controlled agricultural expansion and eco-friendly urban development near wetland areas.
iii. Involve local communities in conservation initiatives by providing education, resources, and incentives for sustainable practices that protect wetlands.
iv. Implement restoration projects for degraded swamps and wetlands, including replanting native vegetation, restoring natural water flow, and removing invasive species.
v. Strengthen regulations on industrial and agricultural runoff, reduce plastic waste, and improve wastewater treatment to prevent wetland pollution.
vi. Invest in scientific research and monitoring programs to understand wetland dynamics, assess biodiversity, and track the impacts of human activities on these ecosystems.
vii. Increase public awareness about the ecological importance of swamps and wetlands through campaigns, education programs, and partnerships with media organizations.

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