

## **Benefits, Threats to Mangrove Ecology and Assessment of Current Conservation Programmes in Niger Delta Region, Nigeria**

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### ***Abstract***

*Mangroves are vital coastal ecosystems that provide numerous ecological, economic, and social benefits. They serve as critical habitats for diverse marine and terrestrial species, protect shorelines from erosion, and act as significant carbon sinks, mitigating climate change. However, mangrove ecosystems are under severe threat globally due to human activities such as deforestation, coastal development, pollution, and aquaculture. In the Niger Delta, these threats are exacerbated by oil spills and illegal logging, leading to the degradation and loss of mangrove forests. The decline of mangroves not only undermines biodiversity but also negatively impacts the livelihoods of local communities who depend on these ecosystems for fishing, fuelwood, and other resources. Despite the implementation of various conservation programmes, challenges remain in effectively preserving and restoring mangrove habitats. Therefore, this study investigates the benefits provided by mangroves and examines the effectiveness of current conservation efforts, highlighting the ongoing threats to these crucial ecosystems and the need for enhanced protective measures. The study finds that mangroves offer significant ecological and socio-economic benefits, including habitat provision, coastal protection, and carbon sequestration. However, current conservation programmes face challenges such as insufficient funding, lack of enforcement, and community engagement issues. The research concludes that while existing efforts have had some success, there is a pressing need for more robust, integrated approaches to conservation that involve local communities and address the root causes of mangrove degradation. It is recommended that conservation programmes adopt a more inclusive approach, involving local communities in decision-making processes and providing them with alternative livelihoods to reduce dependence on mangrove resources. Additionally, increased funding and stronger enforcement of environmental regulations are essential to ensure the long-term sustainability of mangrove ecosystems.*

**Keywords:** *Benefits, Threats, Mangrove Ecology, Conservation Programmes*

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## INTRODUCTION

The concept of "environment" has evolved over time to encompass a broad range of elements that affect human life, transcending the traditional understanding of natural surroundings to include social, economic, and cultural aspects (Hart, 2023). According to Giddens (2013), the environment can be viewed as a complex interplay of natural and man-made systems that influence and are influenced by human activity. Similarly, Myers (2002) posits that the environment extends beyond geographical landscapes to involve intricate relationships among various ecological components. Furthermore, as noted by Wilson (2006), the concept now also encapsulates the built environment, reflecting human alterations to the natural world. Thus, the environment is a multi-dimensional construct that serves as a backdrop for the interaction of biological, physical, and social systems, each contributing to the quality and sustainability of human life (Ihemeson, 2023, Ihemeson, 2024).

Environmental conservation programmes constitute a pivotal dimension in the broader discourse on sustainable development and ecological stewardship. These programmes encompass a diverse range of initiatives aimed at preserving natural resources, reducing environmental degradation, and fostering a more harmonious coexistence between humans and the natural world. According to the World Wildlife Fund (WWF), such programmes often involve efforts to protect endangered species, conserve habitats, and combat climate change through various methods such as reforestation, pollution control, and community education (WWF, 2020). Similarly, the United Nations Environment Programme (UNEP) asserts that environmental conservation programmes are crucial for achieving the Sustainable Development Goals (SDGs), particularly those that pertain to life on land and below water (UNEP, 2019). They represent a multi-faceted approach to ecological preservation, involving not just governmental agencies but also non-governmental organisations, community groups, and individual citizens. By integrating scientific research, community participation, and policy advocacy, these programmes seek to create a more sustainable and equitable future for all.

Mangroves are species of forests that germinate where can't water reach the shores in tropical and sub-tropical regions. It serves as an interface between terrestrial, freshwater and marine ecosystems. Mangroves transit from terrestrial and marine ecosystems. There is interconnectedness between sea grass and the coral reef and this allows the movement of species living among the two. There are three Mangrove tree families and 6 species that are found in the Niger Delta namely Red Mangrove (Rhizophoaceae) including *Rhizophora racemosa*, *R.harisonii* and *R Mangle*. The white Mangrove (Combretaceae) known as *Laguncularia racemosa* and The Black Mangrove (Avivenniaceae) represented by *A. germinas*.

Mangrove ecology is an area of study within environmental science that focuses on mangrove forests, unique ecosystems found in coastal regions where saltwater and freshwater intersect. These ecosystems are of critical importance for both biodiversity and human well-being. According to the Food and Agriculture Organization (FAO), mangroves serve as a habitat for a wide array of species, including several that are commercially valuable for fishing industries (FAO, 2007). They also act as natural buffers against coastal erosion, storms, and tsunamis,

thereby playing a protective role for adjacent human settlements (Alongi, 2008). Mangrove trees have unique adaptations, such as pneumatophores, which allow them to thrive in saline conditions that would be inhospitable to most plant species. These ecosystems are highly productive and contribute significantly to carbon sequestration, but they are increasingly under threat from human activities like deforestation, pollution, and climate change. Understanding mangrove ecology is therefore essential for effective conservation strategies and sustainable management of these vital ecosystems.

According to Aberu and Ekeke (2011), “Nigerian mangrove ecosystem is mostly fragmented detail formation located in the River Niger and occasionally what should have been continuous and uniform mangrove forest in the Delta Islands are interrupted by beach Ridge Island forest sandwiched between the coastal beaches and the estuarine mangrove and Island within the forests typically contain lowland rainforest species. Some have large areas of high-quality forests with high concentrations of biodiversity as in the Andoni area. All the major towns and rural mangrove dependent communities such as Abonnema, Bonny, Buguma, Brass Nembe etc in the Niger Delta area are located on such beach ridge forest Islands within the mangrove ecosystem”.

The Sciences Direct (2023) wrote on the benefits thus “Mangrove supply various goods and provide invaluable ecological services to humanity. They serve as a habitat to different spells of fishes provide a variety of plant products, improve water quality, provide fish and shellfish for local communities, ensure coastal stabilization, provide food chain support for near-shore fisheries and undertake carbon sequestration.

### **Statement of the Problem**

The focus on mangrove ecology and conservation programmes in Rivers State, Nigeria, is an urgent matter demanding critical academic scrutiny. The region is bedecked with a myriad of challenges coupled with potential opportunities that require attention. The first issue of concern is environmental degradation, largely attributable to oil and gas activities in the state. Rivers State is a hub of petroleum activities, and the ramifications of these on the local ecology are dire. Frequent oil spills contaminate water, soil, and flora, affecting both the quality and longevity of mangroves (Ihemeson, 2023; Ihemeson, 2024). According to Kuenzer et al. (2011), the ecological integrity of mangrove systems is highly susceptible to such anthropogenic pressures, and the repercussions are both immediate and long-term. The degradation has a ripple effect, affecting local fisheries, biodiversity, and ultimately human livelihoods.

The second issue is the inadequacy of current conservation programmes. Although there are policies and government bodies designated for environmental oversight, the implementation of these programmes leaves much to be desired. Duke et al. (2007) highlights that inadequate funding, poor planning, and a lack of local community involvement are common pitfalls in many conservation efforts. The irony is that while policies may exist on paper, they are seldom enforced, resulting in ongoing degradation of these invaluable ecosystems.

The third issue revolves around community engagement, or the lack thereof, in conservation efforts. Many conservation programmes are developed and rolled out without adequate

consultation with the communities who interact most closely with these ecosystems. Such an approach can breed resentment and non-compliance, undermining the very objectives the programmes aim to achieve. This top-down approach to conservation is an outdated paradigm that has proven ineffective in many instances.

Fourthly, there is the issue of land use conflict. Mangrove areas are often converted for agricultural or industrial purposes, causing habitat loss. Barbier (2016) highlights that mangroves are frequently considered 'wastelands,' and this erroneous perspective has led to land-use policies that favour economic gains over ecological integrity. Such policies disregard the ecological and even economic value that healthy mangroves contribute in terms of fisheries, wood, and tourism.

The fifth issue is the existential threat of climate change. Rising sea levels and increasing temperatures are altering the very fabric of these ecosystems. According to Gilman et al. (2008), climate change poses an additional layer of threat to mangroves, exacerbating existing pressures and possibly pushing these ecosystems beyond the point of natural recovery.

The sixth issue pertains to the lack of scientific research on local mangrove species and ecosystems. Without concrete scientific data, it is difficult to formulate effective conservation strategies. Furthermore, there is often a lack of educational programmes to inform the public and policymakers about the value of mangroves, leading to neglect and harmful activities.

The seventh issue concerns the complex interplay between different governmental bodies responsible for the environment, land use, and economic development. Often, conflicting interests among these entities hinder effective conservation efforts. As a result, holistic and integrated approaches to mangrove conservation are seldom realized. This brings us to several rhetorical questions. How can a balance between economic development and environmental conservation be achieved in Rivers State? Are the current conservation programmes robust enough to withstand the multiplicity of challenges? What role does the local community play in shaping their environmental future?

It is against this backdrop that this study was undertaken to assess the mangrove ecology and conservation programmes in Rivers State: challenges and prospects. The urgency of this study is rooted in the need to tackle the multifaceted challenges plaguing the mangrove ecosystems in Rivers State. With escalating environmental degradation and ineffective conservation strategies, the ecological future of these areas is precarious. The study aims to offer a comprehensive evaluation of the state of mangroves in Niger Delta region, analysing existing conservation programmes and proffering viable solutions for improvement. It is hoped that this investigation will contribute meaningfully to the global discourse on environmental conservation and offer actionable insights for Niger Delta region and similar regions worldwide.

## LITERATURE REVIEW

### Mangrove Ecology

The study of mangrove ecology is a critical focal point within environmental science, particularly in the broader context of coastal ecosystem management, climate change adaptation, and biodiversity conservation. As these ecosystems are often located in areas where saltwater and freshwater intersect, they serve as interfaces between terrestrial and marine environments. Their unique characteristics have been the subject of extensive research by prominent scholars in various fields of study.

Firstly, Norman C. Duke, a renowned ecologist, defines mangrove ecology as the study of "tidal forest ecosystems" found in intertidal zones of tropical and subtropical coasts (Duke, 1992). According to Duke, these ecosystems are highly productive and offer a plethora of services including coastal protection, sediment trapping, and serving as nurseries for various marine species. Duke's work places particular emphasis on the adaptability of mangroves, detailing how these plants have evolved unique physiological adaptations to survive in challenging saline conditions.

Secondly, Dr. Daniel Alongi, another esteemed ecologist, describes mangrove ecology as the scientific investigation of "carbon-rich forests" that play a vital role in global carbon cycles (Alongi, 2002). Alongi focuses on the biogeochemical aspects of mangrove ecosystems, elucidating how they act as carbon sinks and contribute to climate change mitigation. His research has been instrumental in understanding the nutrient cycling and energy flow within these complex systems.

Thirdly, Edward B. Barbier, an economist who has extensively studied mangrove ecosystems, provides a socio-economic dimension to mangrove ecology (Barbier, 2016). According to Barbier, mangrove ecosystems offer a range of valuable ecosystem services that have direct and indirect economic benefits for human societies. From acting as storm buffers to supporting fisheries, Barbier's perspective adds an economic valuation lens to the study of mangrove ecology.

Fourthly, Karen McKee, a researcher specializing in wetland ecology, defines mangrove ecology as the study of "salt-tolerant forested wetlands" found in tropical coasts (McKee, 1995). McKee's work has been influential in understanding the physiological and morphological adaptations of mangroves that allow them to survive in waterlogged, saline conditions. She has conducted comprehensive studies on the root systems of mangroves, particularly their pneumatophores, which allow them to respire in water-saturated soils.

Lastly, Farid Dahdouh-Guebas, an expert in marine ecology and conservation, explains that mangrove ecology encompasses not just the biological and physical aspects, but also the human interactions with these ecosystems (Dahdouh-Guebas et al., 2005). Dahdouh-Guebas has contributed significantly to the socio-ecological dimensions of mangrove conservation, emphasizing the role of local communities in the sustainable management of these ecosystems.

Mangrove ecology can be defined as the interdisciplinary study of complex, salt-tolerant forested ecosystems situated at the confluence of marine and terrestrial environments. This field delves into the biological, physical, chemical, and socio-economic dimensions of mangrove forests, examining not only their unique flora and fauna but also their roles as carbon sinks, protectors against coastal erosion, and nurseries for marine life. Furthermore, mangrove ecology encompasses human interactions with these ecosystems, scrutinising the balance between conservation efforts and economic activities such as fishing and tourism.

### **Environmental Conservation Programmes**

Environmental conservation programmes are fundamental elements in the global endeavour to safeguard natural resources and ensure a sustainable future for both humans and the planet. Given the escalating threats of climate change, biodiversity loss, and environmental degradation, these programmes have gained increasing attention from policymakers, researchers, and activists alike. In light of this, let us consider how some prominent scholars have defined "environmental conservation programmes."

Firstly, Robert Costanza, a pioneering environmental economist, defines environmental conservation programmes as "systematic efforts to maintain essential ecological processes, preserve biodiversity, and sustainably manage natural resources" (Costanza et al., 1997). For Costanza, the focus is on the integration of ecological, economic, and social goals. His work often emphasizes the need for assigning economic value to natural capital and ecosystem services, thereby incorporating them into the broader framework of sustainable development.

Secondly, Vandana Shiva, a globally recognised environmental activist and scholar, defines environmental conservation programmes as "civic-driven initiatives that focus on protecting biodiversity, traditional knowledge, and the rights of local communities" (Shiva, 2005). In her view, conservation is not just an ecological need but also a social justice issue. She argues that indigenous communities have a vital role to play in conservation efforts, and that their rights and traditional knowledge should be central to any conservation programme.

Thirdly, Edward O. Wilson, a leading biologist and conservationist, describes environmental conservation programmes as "structured scientific and policy interventions aimed at preserving biodiversity hotspots, restoring damaged ecosystems, and preventing species extinction" (Wilson, 2002). Wilson often highlights the importance of biodiversity for the planet's health and human well-being, advocating for large-scale conservation efforts backed by rigorous scientific research.

Drawing upon these definitions, it becomes evident that environmental conservation programmes are multi-faceted efforts involving a blend of science, policy, and community engagement. They are not merely about preserving what remains of the natural world, but also about restoring what has been lost and ensuring that natural resources are used in a sustainable manner. For instance, they can involve everything from reforestation projects and wildlife protection schemes to community-based natural resource management and environmental education programmes (Pretty et al., 2009).



Furthermore, the success of these programmes often depends on cross-sectoral collaboration involving various stakeholders, including government agencies, non-governmental organisations, private sector entities, and local communities. Such partnerships are vital for pooling resources, sharing knowledge, and building a collective vision for conservation (Leisher et al., 2012).

It is also crucial to note the evolving nature of environmental conservation programmes. With advancements in technology and increasing scientific knowledge, new forms of conservation strategies, such as conservation biotechnology and geo-engineering solutions, are emerging. These new paradigms are reshaping the contours of conservation science and policy, offering both opportunities and challenges (Minteer & Collins, 2010).

Thus, the environmental conservation programmes are complex, multidisciplinary efforts aimed at protecting and sustaining the earth's natural resources and biological diversity. They encapsulate a variety of approaches, methodologies, and stakeholder involvements, all geared towards achieving ecological, social, and economic sustainability. In an era marked by unprecedented environmental challenges, the need for robust, effective, and inclusive environmental conservation programmes has never been more critical.

### **Theoretical Framework**

The study is anchored on the Social-Ecological Systems (SES). The Social-Ecological Systems (SES) framework is a pivotal theoretical construct that seeks to understand the intricate relationships between social systems and ecological systems. It was conceptualised by Elinor Ostrom, a political economist, who initially applied it to the study of common-pool resources. Ostrom's groundbreaking work, which culminated in her receiving the Nobel Prize in Economic Sciences in 2009, began around the late 20th century and evolved over several years. The framework is detailed in her work, particularly in the paper "A General Framework for Analyzing Sustainability of Social-Ecological Systems," published in 2009 (Ostrom, 2009).

The SES framework provides a multidimensional lens to examine the complex interactions between human communities and their surrounding ecosystems. At its core, the framework identifies key variables and sub-systems that influence the sustainability of social-ecological systems, including resource systems, resource units, governance systems, and actors. The framework also considers external factors such as market forces, policies, and technology, which can have both direct and indirect impacts on the system (Ostrom, 2009).

In the context of "An Assessment of Mangrove Ecology and Conservation Programmes in Niger Delta region: Benefits and Threats," the SES framework offers immense utility and relevance. Niger Delta region, rich in mangrove forests, faces challenges ranging from industrial pollution to climate change, impacting both the ecology and local communities dependent on these ecosystems. The SES framework allows for an integrated assessment that considers not just the ecological status of mangrove forests but also the social, economic, and cultural dimensions that are inherently linked with them. For instance, it can help researchers understand how local governance mechanisms and community practices contribute to or detract from conservation efforts. Moreover, the framework can be instrumental in identifying key stakeholders, from local fishing

communities to government agencies and NGOs, thereby providing a holistic view of the governance landscape (Lebel et al., 2006).

The SES framework is particularly adept at highlighting the concept of resilience, crucial for mangrove ecosystems. Resilience in this context refers to the ability of the social-ecological system to absorb shocks and disturbances while maintaining its fundamental functions and structures (Folke et al., 2010). In Niger Delta region, where mangroves face threats from oil spills to overfishing, understanding resilience factors can guide conservation strategies. It can inform policymakers on how to build adaptive capacity in both human communities and ecological systems, ensuring the long-term sustainability of conservation efforts.

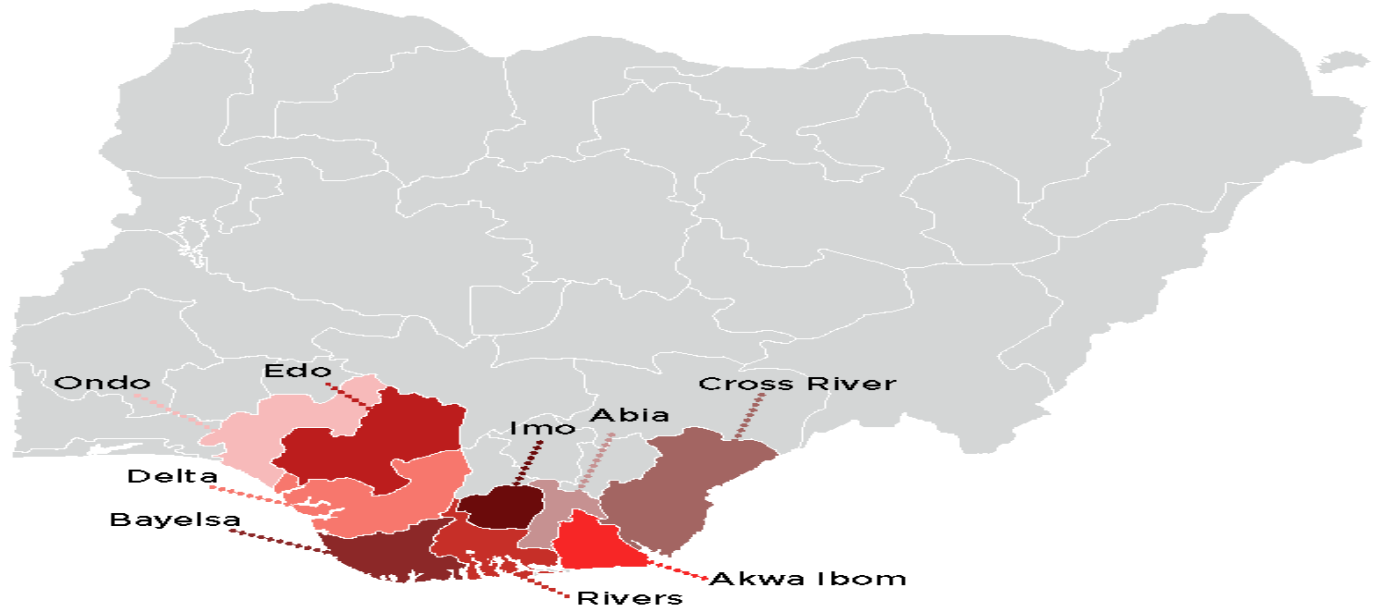
Finally, the SES framework can also inform the economic valuation of mangrove ecosystems. By recognising the multi-faceted benefits that these ecosystems provide, from storm protection to fish nurseries, an economic value can be assigned to them. This can be a powerful tool for advocacy and policy formulation, making a compelling case for the allocation of resources for conservation (Turner et al., 2014).

Thus, the Social-Ecological Systems framework, developed by Elinor Ostrom, provides an invaluable tool for comprehensively assessing the complex challenges and opportunities facing mangrove ecology and conservation programmes in Niger Delta region. Its multidisciplinary approach enables a nuanced understanding that considers ecological, social, economic, and governance dimensions. By adopting the SES framework, policymakers, researchers, and conservationists can develop more effective, equitable, and sustainable strategies to protect the invaluable mangrove ecosystems of Niger Delta region.



## NIGER DELTA REGION

### Map of Niger Delta Region



Source:

[https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.stakeholderdemocracy.org%2Fthe-niger-delta%2F&psig=AOvVaw0tdu8Dy9jL\\_NmsvuXcojsR&ust=1697127942157000&source=image&cd=vfe&ved=0CBEQjRxqFwoTCLC6ysG07oEDFQAAAAAdAAAAABAE](https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.stakeholderdemocracy.org%2Fthe-niger-delta%2F&psig=AOvVaw0tdu8Dy9jL_NmsvuXcojsR&ust=1697127942157000&source=image&cd=vfe&ved=0CBEQjRxqFwoTCLC6ysG07oEDFQAAAAAdAAAAABAE)

The Niger Delta region, situated in the southern part of Nigeria, is one of the most resource-rich yet paradoxically underdeveloped regions in the world. Spanning over 20,000 square kilometres, it comprises nine states and is inhabited by a mosaic of ethnic communities. Despite its abundant oil reserves, which contribute significantly to Nigeria's economy, the region grapples with severe socio-economic and environmental challenges. According to Watts (2004), the Niger Delta is a classic example of the "resource curse," where natural wealth has not translated into improved living conditions for the local populace but has instead exacerbated inequality and conflict.

The discovery of oil in commercial quantities in the 1950s transformed the Niger Delta into an economic powerhouse. It accounts for about 90% of Nigeria's foreign exchange earnings and 80% of the government's revenue (Ibaba, 2005). However, this oil wealth has not trickled down to the local communities. The region is plagued by high rates of poverty, unemployment, and lack of basic amenities such as clean water, healthcare, and education. Okonta and Douglas (2003) contend that the benefits of oil extraction have been siphoned off by political elites and multinational corporations, leaving the local communities impoverished and disenfranchised. This has led to growing discontent and given rise to various forms of social unrest, including militant groups demanding a fair share of the oil wealth.

One of the most pressing issues in the Niger Delta is environmental degradation caused primarily by oil and gas activities. Frequent oil spills, gas flaring, and deforestation have led to soil and water pollution, adversely affecting the local ecology and livelihoods. According to Nriagu et al. (2016), the Niger Delta is one of the most severely oil-impacted ecosystems in the world. This environmental degradation has had catastrophic consequences for the local communities, most of whom rely on fishing and agriculture. Mangrove forests, which are vital for fish breeding, have been destroyed, leading to declining fish stocks and loss of income for fishermen. Similarly, farmlands have become infertile due to soil pollution, affecting agricultural productivity.

The governance and policy framework in the Niger Delta has largely been ineffective in addressing these complex challenges. Several initiatives, such as the Niger Delta Development Commission (NDDC) and the Amnesty Programme for militants, have been launched by the government, but they have not yielded significant results. Ukiwo (2007) argues that these initiatives have been marred by corruption, lack of transparency, and inadequate community participation. There is a glaring disconnect between policy formulation and implementation, leading to a trust deficit between the government and the local communities. This has further complicated the efforts to bring about sustainable development in the region.

In conclusion, the Niger Delta is a region replete with contradictions. It is rich in natural resources but poor in human development indicators. Its abundant oil wealth has not benefited the local communities but has instead led to environmental degradation, social unrest, and economic disparity. A multi-pronged approach that addresses the ecological, social, and governance aspects is crucial for the sustainable development of the Niger Delta. The stakes are high, not just for the region but for Nigeria as a whole, as the Niger Delta remains the economic backbone of the country.

### **Economic Benefits of Mangrove Ecology**

According to Elijah A Leh, during the 1999 Forest Conservation Society's Ecosystem workshop at Hotel Presidential, Port Harcourt, the following are the economic benefits of Mangrove.

- a. **Pulp manufacture:** The morphological properties of mangrove wood made it unsuitable for use in the manufacture of paper as it exhibited poor strength quality.
- b. **Cutch:** Cutch is the crude tannin extract from mangrove bark used in the tanning of hides for the manufacture of leather and for centuries in some tropical countries for the preservation of fishing nets. In Nigeria, local fishermen preserved their cotton nets by soaking them in boiled cutch extracted from mangrove bark. However such treatment of nets has become unnecessary as Dylon nets have virtually replaced cotton ones.
- c. **Charcoal:** Mangroves have been found to make excellent charcoal whereas in South East Asia they are produced in clay kilns. Laboratory tests have shown that it is possible to recover up to 27.2kg of tar from a ton of mangrove wood.
- d. **Fuelwood (Firewood):** Firewood is the most important product of the mangrove in Nigeria.

Its advantage is that it burns when partially dry with an even heat and has a high calorific value producing less smoke. It therefore becomes a valuable fuelwood for not only domestic purposes but also the commercial production of smoke-dried fish and bread-making.

- e. Pitprops: It is estimated that about 20,000 cubic metres of mangrove wood pit-props were used during the active coal mining years at Enugu. Most of this wood came from the mangrove forests around Port Harcourt making the area devoid of the tail mangroves commonly seen in the Brass area. Mangrove pit props are said to be suitable for this purpose on account of their strength.
- f. Timber: A small unquantified demand for mangrove-sawn timber exists and is being used in areas requiring heavy-duty construction and for railway sleepers. The difficulty in its extraction is the limiting factor for a more extensive use of mangrove timber.
- g. Poles, foundation piles and other uses: Because of their high resistance to fungi attack mangrove poles have been extensively used for communication lines, they served as foundation piles for the construction of local bridges and are used for the erection of signposts.

Locally, mangrove poles are used for mud and thatch house construction. In other areas, it is used for staking yams. Other species of woody plants existing within the mangrove ecosystem are useful in various forms including fish trap construction and firewood. The wood of *Avicenna* sp is being used for tools and boat construction; the ashes are for washing clothes and in the Far East an ointment from the seeds is used in the treatment of ulcers.

Other crustaceans of food interest are those that follow the tide especially the juveniles or post-larval stages of the pink shrimp. The mangrove oyster is another seafood item that is much cherished by the Niger Delta people living within the marine environment. The Syster, *Ostrea taulipa* is found on mangrove prop roots between the mean high and mean low water marks and is immersed and exposed twice within 24 hours. The Syster is harvested by cutting the prop roots, These are taken home where the shells are pried open to remove their soft edible content.

Other edible species of molluscs exist within the mangrove ecosystem but the most common ones are the periwinkles found in the creeks and drain channels. These migrate to the mudflats at high tide where at ebb tide they are picked for processing as a food item. The bivalve molluscs such as cockles also form an important food item that is of special interest to the people of the mangrove ecosystem. The mud-skipper, *Periophthalmus* is another characteristic edible small fish commonly found within the mangrove ecosystem. As an adult, it is amphibious and could be easily seen on land using its pectoral fins to skip across muddy flats or climb dead wood and trees, particularly *Avicenna* sp. Mud skipper which feeds mainly on land is insectivorous, its eye structure is well suited to sharp visualization of small prey such as mosquitoes.

## **Culturing Fish Within the Mangrove Ecosystem**

The productive capability of the mangrove ecosystem in terms of its use for culture fishery could multiply several times the benefit derivable from it. Brackish water fish culture in ponds built in mangrove swamps is a widespread practice in the East, especially the Philippines, and this is now spreading to other parts of the world.

The Buguma experimental fish pond started in 1963, the tidal fish ponds in Ikoyi, Lagos and the brackish water fish ponds at Ikot Abasi, Akwa Ibom State are yet to be of any significance in terms of offish culture development in Nigeria. Even though the culture of shrimps is a highly profitable venture in many countries, the mangrove ecosystem, which provides the natural environment, is not being seriously utilized for that purpose. Other culturable seafood species include crabs as is done in Taiwan and Systems as practised by Malaysians.

### **Biodiversity of the Mangrove Ecosystem**

It is not just the saline flora and fauna that are of benefit to mankind in the mangrove ecosystem. Animals of terrestrial origin also inhabit the mangrove swamps and these may include insects, reptiles, birds, and small and large animals such as hogs, crocodiles, antelopes, monkeys, hippopotami, elephants, etc. Compared with forests and woodland, mangroves do not contain many species since every animal has to adapt to the wet swampy environment. Unfortunately, these animals are being hunted to near extinction.

### **Some Intangible Benefits of the Mangrove Ecosystem**

Mangroves are able to support its many consumers because of their relatively high natural fertility or productivity which has been estimated to be more than twenty times that of open ocean waters and compares favourably with certain terrestrial ecosystems (Lear & Turner, 1977). The Nigerian mangrove ecosystem has well-developed Rhizophora zones exposed to tidal action and high levels of nutrients which could be as much as 2500 - 3000 grams of dry organic matter produced in each square metre per year.

In the mangrove swamp producers of organic matter include not only the trees themselves but also the epiphytes, algae, roots and plankton in the surrounding water. Although a few leaves are eaten directly by herbivores and some insects and crabs, a greater part of the debris available to consumers in the inshore marine food chain are subject to breakdown by bacteria and fungi. Thus the action of microorganisms increases the food values of mangrove leaves. The value of mangroves is not restricted to their contribution to coastal fisheries. In their way, they also have a certain aesthetic beauty. The anastomosing creeks cutting off pockets of dark green mangrove vegetation with their distinctive prop roots dropping from branches five metres high is a beautiful scenery to watch.

The mangrove ecosystem in Nigeria especially in the Niger Delta region is subject to activities of oil prospecting companies prominent amongst which is gas flaring. The volumes of carbon dioxide

released into the air are silently absorbed by the luxuriant green vegetation of the mangrove ecosystem.

Other pollutants that the mangrove swamp battle with to purify our environment are the industrial pollutants from organic wastes, toxic minerals and organic chemicals, suspended floating substances and bacteria and viruses. Some of these pollutants are broken down into harmless substances and accumulate within the organisms (Imevbore & Odu in Wilcox & Powell, ed; 1985). The intense chemicals and biological activity in mangroves involving the living and non-living components of the ecosystem cause them to act as sinks which concentrate pollutants. The benefits derivable from the mangrove ecosystem are immeasurable. The potential of the Nigerian mangrove ecosystem as a protein food source is very high.

The mangrove ecology is relatively very fragile and once destroyed it takes many years to recover. Mangrove coastal resources are rare to come by and their utilization is essential for the desirable development of the people. The benefits obtained from this huge nature reserve should be sustainably managed. States like Rivers, Bayelsa and Delta with huge mangrove forest areas should reserve some hectares for conservation and management.

At the rate man is exploiting the natural mangrove swamp forests, the benefit we now enjoy will soon disappear if deliberate efforts are not made to keep some parts of this special natural endowment.

### **B. Threats to Mangrove Ecology**

To be able to proffer adequate protection and conservation measures and programmes for a highly sensitive ecology such as mangroves, it is necessary to identify the various mangroves, it is also necessary to identify the various threats, sources of pollution and destruction of this environment that sustain over 40 per cent of the rural population of the State.

- i) Top on the list of mangrove destruction is oil and gas exploration through seismic operations, numerous and often uncleaned oil spills, gas flares, and companies' operational routes and canalisation projects.
- ii) The second threat to mangrove ecology is faulty and reckless socio-economic projects that often lack adequate planning and execution without the slightest Environmental Impact Assessment (EIA) studies. Such projects include road construction, reclamation, bridge and canalisation projects as well as industrialisation. Among these, road and canalisation projects are shoulders higher as destroyers of the mangroves because of the havoc they have done in the past to the mangrove ecosystem. Road and canalisation projects not only cause fragmentation of mangrove ecosystems but also open them for more indiscriminate exploitation. Similarly, blocking and landfilling of swamps, Creek courses and other mangrove ecology with poor drainage facilities (like culverts) had on several occasions and

in many places caused the extermination and withering of mangrove forest covering several hectares, communities and localities.

- iii) Thirdly, the mangrove ecosystem has come to bear the brunt of abject poverty as experienced in both rural and urban centres. This is because the resources of the mangrove ecology are being increasingly exploited for both home use and commercial transactions. Organised firewood business has come to stay in the state and mangroves from the bulk of the wood are being traded upon by both natives and strangers.
- iv) The fourth threat to mangroves is closely linked with the last source and this has to do with the population explosion that in turn exposed the mangrove environment to unhealthy competitive and uncontrolled exploitation, fast degradation and abuse by both natives and visitors. The situation becomes even more precarious when the bulk of the population depends on the mangrove for firewood since they cannot afford alternative petroleum products which have become the exclusive privilege for a limited urban elite due to their exorbitant prices and prolonged scarcity.
- v) Finally, it is worthy of mentioning the water weed infestation of the mangrove ecology where water hyacinths and Nipa palm are clear leaders. The displacement of mangroves in many localities by Nipa palm may not be unconnected with the pollution of the mangrove environment that changes the BOD (Biological Oxidation Demand) of the ecology that favours the growth of other vegetation at the expense of the mangroves and its resources.

**C. Assessment of current environmental and Conservation programmes affecting mangrove Ecology in Niger Delta region**

The Importance of mangroves and its resources to the people and communities of the Niger Delta is as old as the history of the region. Mangrove provides shelter, food and power to the people. Mangrove resources are rich sources of protein (oysters, crabs, molluscs, etc.) and have come to form part of the daily menu of many families throughout the country. The traditional occupations of Niger Delta communities are also controlled and determined by mangrove ecology, and their security and protection from natural forces (flood, erosion, etc) to some extent depend on this highly valued but sensitive ecology.

Despite this unarguable importance of the mangrove ecology to the survival of individuals and the economy of the region, no concrete step has ever been taken, to protect the exploitation of the mangrove or to boost its conservation. What seems to be the first mangrove conservation programme was abandoned halfway by the inglorious Niger Delta Basin Development Authority (NDBDA) when the Authority failed to map out mangrove conservation centres on sanctuaries as announced in the early years of establishment in the early 1960s.



The second and most recent was the 1987 mangrove revegetation plans for Abel Kiri in Abonnema. This effort saw about 40 mangrove forest Plantations, under the management of the State's Forestry Department. As usual, the programme was abandoned halfway for lack of funds.

- i) It will, therefore, not be an exaggeration and overstatement to observe that Government conservation programmes over the years tended to sideline mangrove ecology.
- ii) The enacted laws and edicts regarding the exploitation and use of mangroves have not been enforced. The regulating agencies have not been adequately funded, staffed and equipped for proper monitoring and enforcement of relevant laws, particularly the forest laws (CAP. 55) 1463, which tend to favour the state forest resources.
- iii) There has been a lack of control and harmonisation in most government resource conservation programmes and this tended to give room for non-continuation and failure to many well-intended programmes concerning environmental protection.
- iv) The poor monitoring of mangrove ecology by the government, and rural communities coupled with the operations of oil companies, industries and other developmental agencies have brought serious negative impacts on the mangrove ecosystem to the extent that the same has come to be treated as a no man's resources.
- v) The recent mangrove rehabilitation programmes of oil-polluted sites and seismic lines embarked upon by oil firms are a welcome development although they lack government and communities' contributions and involvement. This can in future become a source of conflict in many communities because such programmes without local involvement is bound to favour some communities/families/localities at the expense of others. Moreover, the sustainability and continuity of such programmes cannot be guaranteed because currently the project is seen by the natives as an "imported project" because they lack inputs from the host communities.
- vi) There has been a conflict of interests and duplication of functions by agencies charged with the responsibility to monitor and manage the mangrove ecosystem to the extent that polluters and destroyers have capitalised on this to escape the wrath of the law. Closely related to this is the fact that adequate compensation has not been paid in the event of pollution and destruction of the mangrove ecology by oil firms and industries. This may be due to inadequate monitoring, weak laws and low compensation rates. Currently, a paltry sum of N1,500 (One thousand five hundred Naira ) is offered for a hectare of polluted mangrove ecology by oil firms. This is indeed unrealistic.

## **D CONCLUSION**

The protection and conservation of the mangrove ecosystem throughout Niger Delta region with about 40 per cent of the country's mangroves cannot be over-emphasised. As efforts are made to put the whole country on the path of sustainable development, correct past developmental discrepancies and promote national unity and overall balanced development, it is the strong desire of MFCSN that the mangrove ecosystem should be at the heart of such a programme considering its sensitivity and Importance to both local and national economy/ interests.

The mangrove ecology has over the years undergone remarkable changes which have not been noticed by the authorities, and if noticed, have not been accorded appropriate recognition by planners and developers. This has greatly denied the region of adequate attention.

For instance, the mangrove ecology can no longer be said to be sparsely populated by only the indigenous population where very limited fishing, lumbering and other primary activities only go on as was formerly the case. Rather over the years, clusters of human population and serious environmental threatening activities have emerged in many localities. Oil exploration and exploitation activities and the level of industrialisation in mangrove-dominated localities have come to overwhelmingly dominate traditional fishing and other activities.

Strangers and foreigners have also penetrated the region than must have been predicted and known years ago. The impact of the increased human population and the upswing in high technology cannot be over looked when planning for the sustainability of mangrove ecology, quick development and transformation of rural areas, this is what Vision 2010 should be able to address.

We hope that the already identified problems and the suggested solutions will help members of this highly respected committee to fashion out appropriate developmental policies and strategies for the sustainable exploitation and development of the mangrove ecology in the State.

Apart from the already listed problems, the Mangrove ecology is in dire need of other equally important related programmes such as soil conservation, ecological control projects (erosion, flood, water weeds menace, and upstream dam effect), demographic changes, environmental awareness as well as economic empowerment of rural people and rural transformation.

### **Recommendation**

Based on the identified findings, the following recommendations were offered:

- i) There is a need to harmonize environmental and forestry laws, functions and operations of relevant agencies affecting the exploitation, protection and conservation of mangrove ecology at both state and Federal levels. That is, there should be adequate harmonization of functions and operations of the Federal Environmental Protection Agency (FEPA), Department of Petroleum Resources (DPR), Niger Delta region Petroleum Environmental Protection Authority (RSPEPA) and the Forestry Department (FOR DEPT) of Niger Delta region Ministry of Agriculture and Natural Resources.
- ii) There is need for the federal government to adequately fund the regulatory agencies instead of relying on the regulated to fund the regulator.

- iii) There is need for the government to development the political Will to protect the environment through the establishment of an equitable parity between oil revenue for development projects and degradation of the environment
- iv) The Multinational oil coopertations should adopted the best practice in the process of exploring these resources in order to minimize the destruction of the eco-system.
- v) There is need for economic empowerment of the host community to reduce their dependent on fuelwood which contributed deforestation.

## References

- Alongi, D. M. (2002). Present state and future of the world's mangrove forests. *Environmental Conservation*, 29(3), 331-349. doi:10.1017/S0376892902000231
- Alongi, D. M. (2008). Mangrove forests: Resilience, protection from tsunamis, and responses to global climate change. *Estuarine, Coastal and Shelf Science*, 76(1), 1-13. doi:10.1016/j.ecss.2007.08.024
- Barbier, E. B. (2016). The protective service of mangrove ecosystems: A review of valuation methods. *Marine Pollution Bulletin*, 109(2), 676-681. doi:10.1016/j.marpolbul.2016.01.033
- Beuschel, G. (1976) "Report On The Utilization, Exploitation And Regeneration Of Mangrove Swamp Forests In Nigeria". Federal Department Of Forestry, Ibadan.
- Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., ... & van den Belt, M. (1997). The value of the world's ecosystem services and natural capital. *Nature*, 387(6630), 253-260. doi:10.1038/387253a0
- Dahdouh-Guebas, F., Jayatissa, L. P., Di Nitto, D., Bosire, J. O., Lo Seen, D., & Koedam, N. (2005). How effective were mangroves as a defence against the recent tsunami? *Current Biology*, 15(12), R443-R447. doi:10.1016/j.cub.2005.06.008
- Duke, N. C. (1992). Mangrove floristics and biogeography. In A. I. Robertson & D. M. Alongi (Eds.), *Tropical Mangrove Ecosystems* (pp. 63-100). Washington, DC: American Geophysical Union.
- Duke, N. C., Meynecke, J. O., Dittmann, S., Ellison, A. M., Anger, K., Berger, U., ... & Dahdouh-Guebas, F. (2007). A World Without Mangroves? *Science*, 317(5834), 41-42. doi:10.1126/science.317.5834.41b
- FAO. (2007). *The world's mangroves 1980-2005: A thematic study prepared in the framework of the Global Forest Resources Assessment 2005*. Rome: FAO Forestry Paper 153. Retrieved from <http://www.fao.org/docrep/010/a1427e/a1427e00.htm>
- Fenco (1976): "A Study Of The Industrial Uses Of The Mangroves". Rivers State Ministry Of Economic Development And Reconstruction, Port Harcourt.

- Folke, C., Carpenter, S., Walker, B., Scheffer, M., Chapin, T., & Rockström, J. (2010). Resilience Thinking: Integrating Resilience, Adaptability and Transformability. *Ecology and Society*, 15(4), 20. doi:10.5751/ES-03610-150420
- Giddens, A. (2013). *Sociology* (7th ed.). Polity Press.
- Gilman, E. L., Ellison, J., Duke, N. C., & Field, C. (2008). Threats to Mangroves from Climate Change and Adaptation Options: A Review. *Aquatic Botany*, 89(2), 237-250. doi:10.1016/j.aquabot.2007.12.009
- Hart, A.O. (2023). *Assessment of water quality around oil facilities in Bonny, Rs, Nigeria*. Lap Lambert Academic Publishing
- Ihemeson, O. C. (2023), The roles of developed and developing countries in curbing fossil emission for sustainable development: Implications for policies making. *American Journal of Social and Humanitarian Research*, 4(11), 116-139. <https://globalresearchnetwork.us/index.php/ajshr/article/view/2737/2438>
- Ihemeson, O. C. (2024), An Assessment of UN Policies on Fossil Emission and Climate Change: Implications on the National Security of US, 2010-2023. *Journal of Integrity in Ecosystems and Environment*, 2(5), 8-23. <https://journals.proindex.uz/index.php/JIEE/article/view/1108/941>
- Ihemeson, O. C. (2023). *Environmental laws and sustainable development in Niger Delta region, Nigeria*. Lap Lamber Academic Publishing
- Ibaba, S. I. (2005). Understanding the Niger Delta Crisis. *Research Journal of International Studies*, 8, 79-91.
- Keay, K. W. J. (1965): *Outline Of Nigerian Vegetation*, Govt. Printer, Lagos,
- Kuenzer, C., Bluemel, A., Gebhardt, S., Quoc, T. V., & Dech, S. (2011). Remote Sensing of Mangrove Ecosystems: A Review. *Remote Sensing*, 3(5), 878-928. doi:10.3390/rs3050878
- Lear, R. & Turner, T. (1977), *Mangroves Of Australia*, University Of Queensland, Press St. Lucia.
- Lebel, L., Anderies, J. M., Campbell, B., Folke, C., Hatfield-Dodds, S., Hughes, T. P., & Wilson, J. (2006). Governance and the Capacity to Manage Resilience in Regional Social-Ecological Systems. *Ecology and Society*, 11(1). doi:10.5751/ES-01606-110119
- Leh, E. A. (1977): "The Development Potential Of The Niger Delta "Ministry Of Agriculture And Natural Resources, Port Harcourt.
- Leisher, C., Van Beukering, P., & Scherl, L. M. (2012). *Nature's Investment Bank: How Marine Protected Areas Contribute to Poverty Reduction*. The Nature Conservancy.
- McKee, K. L. (1995). Mangrove species distribution and propagule predation in Belize: An exception to the dominance-predation hypothesis. *Oecologia*, 101(4), 477-485. doi:10.1007/BF00329427

- Minteer, B. A., & Collins, J. P. (2010). Move it or lose it? The ecological ethics of relocating species under climate change. *Ecological Applications*, 20(7), 1801-1804. doi:10.1890/09-2397.1
- Myers, N. (2002). *Environmental issues and sustainable futures: a critical guide*. Rowman & Littlefield.
- N.D.D.B. (1964 - 66): Annual Reports Of The Niger Delta Development Board, Port Harcourt.
- Nriagu, J., Udofia, E. A., Ekong, I., & Ebuk, G. (2016). Health Risks Associated with Oil Pollution in the Niger Delta, Nigeria. *International Journal of Environmental Research and Public Health*, 13(3), 346. doi:10.3390/ijerph13030346
- Okonta, I., & Douglas, O. (2003). *Where vultures feast: Shell, human rights, and oil in the Niger Delta*. Sierra Club Books.
- Ostrom, E. (2009). A General Framework for Analyzing Sustainability of Social-Ecological Systems. *Science*, 325(5939), 419-422. doi:10.1126/science.1172133
- Powell, C. D. (1993): "A Report Of Recommendation To The Natural Resources Conservation Council" Rivers State University Of Science And Technology, Port Harcourt.
- Pretty, J., Adams, B., Berkes, F., Ferreira de Athayde, S., Dudley, N., Hunn, E., ... & Robson, J. (2009). The intersections of biological diversity and cultural diversity: Towards integration. *Conservation and Society*, 7(2), 100. doi:10.4103/0972-4923.58642
- S. A. Abere and B. A. Ekeke (2011) *Mediterranean journal of social sciences* Vol. 2 (7) December 2011
- Science Direct (2020) A review of the threat of oil exploitation to mangrove ecosystem. In sights from Niger Delta
- Shiva, V. (2005). *Earth Democracy; Justice, Sustainability, and Peace*. South End Press.
- Skoup & Company Ltd. (1980): "Feasibility Study Of The Development And Management Of Mangrove/Swamp Forest". Fedfor, Lagos.
- Berja, P. Campbell G.K. Hockett. B. L And N. W Pammenter, in the mangroves of southern Africa: Wildlife Society of Southern Africa.
- Turner, R. K., Georgiou, S., Clark, R., Brouwer, R., & Burke, J. (2014). Economic valuation of water resources in agriculture: From the sectoral to a functional perspective of natural resource management. *FAO Water Reports*. Rome: FAO.
- Ukiwo, U. (2007). From "Pirates" to "Militants": A Historical Perspective on Anti-State and Anti-Oil Company Mobilization among the Ijaw of Warri, Western Niger Delta. *African Affairs*, 106(425), 587-610. doi:10.1093/afraf/adm057
- UNEP. (2019). *Environment Under Review: Global Environmental Conservation Programmes*. Retrieved from <https://www.unep.org/resources/report/environment-under-review-global-environmental-conservation-programmes>

Watts, M. (2004). Resource curse? governmentality, oil and power in the Niger Delta, Nigeria. *Geopolitics*, 9(1), 50-80. doi:10.1080/14650040412331307832

Wilson, E. O. (2002). *The future of life*. Knopf.

Wilson, E. O. (2006). *The creation: An appeal to save life on Earth*. W. W. Norton & Company

World Bank (1992): "Forestry Sector Review", Report No. 10744 -Uni.

WWF. (2020). *Our Work: Conservation Programmes*. Retrieved from <https://www.worldwildlife.org/initiatives>