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MANGROVE FORESTS IN NIGERIA: WHY THEIR RESTORATION, REHABILITATION AND CONSERVATION MATTERS

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ABSTRACT: *Mangrove forests, those specialised group of plants that have adapted to living in the fringe of land between the sea and the land, along coasts and riverbanks where fresh and saltwater meet are found in only tropical and sub-tropical nations and territories. These forests representing less than 1% of all tropical forests and less than 0.4% of the total global forest estate, are among the most productive and biologically diverse ecosystems on the planet. They provide numerous goods and environmental services, including many of the resources upon which coastal communities depend for their survival and livelihood. Although Nigeria has a sizeable contiguous mangrove forest ecosystem - the largest in Africa and the third-largest in the world – but this forest is presently facing a severe threat of decimation. Lack of awareness and understanding regarding the functions performed by an intact mangrove forest ecosystem by Nigerians is majorly responsible. As a way of arousing Nigerians' consciousness to the vital need for mangrove forest conservation, this paper tried to highlight the crucial functions performed by an intact mangrove forest ecosystem. Nigerians will only be able to tap from the immense values inherent in the mangrove forest ecosystem with the restoration, rehabilitation and conservation of mangrove forests in the country.*

KEYWORDS: Mangrove Forest, Restoration, Rehabilitation, Conservation, Nigeria

INTRODUCTION

Mangroves are a type of forests that grow where saltwater meets the shore in tropical and subtropical regions. Doing so serves as an interface between terrestrial, freshwater and marine ecosystems. In other words, Mangroves are a transition between the terrestrial and marine ecosystems, with connectivity between the seagrass and the coral reef, which allows the flow of species living among these two environments. They are, in essence, a specialised group of plants that have adapted to living in the fringe of land between the sea and the land, along coasts and riverbanks where fresh and saltwater meets. In these areas, only a few other plants can survive the harsh environmental conditions. These plants have adaptations that enable them to accommodate daily flooding by seawater when the tide is high, and exposure to the tropical sun's hot rays when the tide flows out. Besides, Mangroves frequently have to survive freshwater flooding when streams overflow during the rainy season. The trees making up the

mangrove have aerial roots in the form of stilts, allowing them to anchor in waterlogged soil of salt or freshwater.

Globally, Mangrove forests are rare and cover an area of only around 240,000 square kilometres (WRI/IIED, 1986) in 123 tropical and sub-tropical nations and territories; this represents less than 1% of all tropical forests worldwide and less than 0.4% of the total global forest estate (FAO, 2006; Van, 2012). Mangrove forests reach their greatest extent along the coasts of South and South-east Asia, Africa and South America. Four countries (Indonesia, Brazil, Australia, and Mexico) account for more than 40% of the total global mangrove coverage, with Indonesia having the highest with more than 20% (Van, 2012).

Mangrove forests used to be seen as wastelands that needed to be cleared to create room for other developmental activities such as agricultural and urban development. Today, however, scientists, development planners and coastal dwellers have come to value mangroves for what they are – extremely productive ecosystems that provide numerous good and services both to the marine environment and people. Not only are they among the most productive and biologically diverse ecosystems on the planet, but they also deliver incredible ecosystem services that play a critical role in supporting human well-being. These ecosystem services include climate regulation, disaster risk reduction, food security and poverty reduction etc. In Nigeria, however, the mangrove forest is still relatively undervalued, underappreciated and underutilised. And this explains the reason why its destruction is of no concern to Nigerians. Nigeria's mangrove forest is today facing a severe onslaught and is being decimated at an alarming rate. As of now, no conscious effort is being put in place to ensure the preservation of this precious gift of nature. The main reason behind this is the complete lack of awareness and understanding regarding the various functions performed by an intact mangrove forest ecosystem. As a means of arousing the consciousness of policymakers, development planners and indeed the generality of Nigerians to the urgent need for the restoration, rehabilitation and conservation of mangrove forests in the country, this paper tried to bring to the fore the crucial functions performed by an intact mangrove forest. It also took a cursory look at the mangrove forests in Nigeria and how these forests are being threatened at present.

Functions of Mangrove Forests

Marine Fisheries

Mangrove forests are home to a large variety of fish, crab, shrimp, shellfish and mollusc species which form an essential source of food for thousands of coastal communities worldwide. According to Environment Australia (2000) report, more than 3000 fish species are found in mangrove ecosystems. Mangrove forests also serve as a valuable nursery area for shrimps, crustaceans, molluscs and many fish species, including coral reef fish. According to (Lal 1990), these species sustain the local abundance of fish and shellfish populations. A study undertaken on the Mesoamerican reef, for example, showed that there are as many as 25 times more fish of some species on reefs close to mangrove areas than in areas where mangroves have been destroyed. This makes mangrove forests vitally important to coral reef and commercial fisheries (https://wwf.panda.org/our_work/oceans/coasts/mangroves/mangrove_importance/). In Selangor, Malaysia, 119 species were recorded to be associated with mangrove ecosystems while 83 species were recorded in Kenya, 133 species in Queensland Australia, 59 species in Puerto Rico and 128 from the Philippines https://en.wikipedia.org/wiki/Ecological_values_of_mangroves.

Mangroves also provide a safe nursery and ideal breeding grounds for young marine life before they are ready to move further out to sea or populate coral reefs. Studies have revealed that many fish species find shelter among the mangrove roots as juveniles, head out to forage in the sea-grass beds as they grow, and move into the open ocean as adults. In Queensland, Australia, an estimated seventy-five per cent of the commercially caught prawns and fish depend on mangroves for part of their life cycles and nutrients exported from the mangroves to other ecosystems (Horst, 1998). In Figi, roughly half of commercial and artisanal fisheries species' catch depends on mangrove areas during at least one critical stage of their life cycle. In Eastern Australia, 67 per cent of the commercial catch comprises species dependent on mangrove communities (WRI/IIED, 1986). Overall, an estimated 80 per cent of the global fish catch relies on mangrove forests directly or indirectly (Ellison, 2008).

The role of Mangrove Forests in Food Security provision and Livelihoods

In 2017, the UN Ocean Conference estimated that nearly 2.4 billion people live within 100 km of the coast (Wood, 2019). Mangrove forests provide many of the resources upon which these coastal communities depend for their survival and livelihood. Economically, mangroves offer livelihood opportunities for coastal communities through fisheries and ecotourism. The fish, shellfish, and other food sources obtained from them play a vital role in neighbouring communities' food security. At low tide, people can walk across the tidal flats to collect clams, shellfish, and shrimp, while at high tide, fish that move in to feed among the protection of mangrove roots turns the marshy land into a very rich fishing ground (American Museum of Natural History updated). With an estimated 80% of global fish catches directly or indirectly dependent on mangroves coastal populations, these forests help ensure food security for local communities and contribute significantly to local livelihoods, employing coastal populations (Ellison, 2008; Pidgeon, 2010).

Mangrove forests also provide a wide variety of plant species with multiple economic uses. Their tree species are highly prized and serve as a reliable source of wood for building houses, boats and pilings because of their hardy resistance to rot and insects. The tree species also yield very useful industrial timber, fuelwood and charcoal of high calorific value. Most of the tree and shrub species also serve as sources of non-timber forest resources such as edible fruits and leaves, indigenous medicines, tannin, seed, fatty oils, thatching materials and sedges, fencing materials, fodder, honey and manure http://www.andelfire.com/ma/Minor.

The role of Mangroves as a Natural Coastal Defense

Mangrove forests serve as nature's buffer between land and sea. They play a vital role in coastal ecology and in sustaining and securing coastal communities. The sturdy root systems of mangrove trees help form a natural barrier against violent storm surges and floods. River and land sediment is trapped by the roots, which protects coastline areas and slows erosion. This filtering process also prevents harmful sediment from reaching coral reefs and seagrass meadows https://wwf.panda.org/our_work/oceans/coasts/mangroves/mangrove_importance/ (Wood, 2009). Research by the United Nations Environment Programme (UNEP) has demonstrated that mangrove's robust build efficiently reduces storms' total destructive capability and wind surges by 70 to 90 per cent. According to Lotfinasabasl, (undated), mangroves also help protect the health and overall biodiversity of surrounding ecosystems by acting as a water filter. Filtration is enabled by the mangrove's capability to absorb and store

heavy metals that would otherwise result in the release of metal pollution into nearshore water bodies.

Mangrove forests remain one of the most cost-effective methods of managing disaster risk along coastlines. Coastal damage from hurricanes and typhoons is much more severe in areas where mangroves have been cleared. Damage assessments from the 2004 Indian Ocean tsunami concluded that there was significantly more damage to human lives and livelihoods where ecosystems had been disturbed, especially dunes, mangroves, beach forests and coral reefs (Danielsen et al. 2005). When Philippines Super Typhoon Yolanda struck Philippines areas, mangrove forests suffered significantly less damage as the trees acted as a shield from the strong winds and waves.

Detailed reviews of all the existing research into mangroves' role in coastal protection were undertaken by the Mapping Ocean Wealth (MOW) team. Publication resulting from this describes how a 100-meter-wide belt of mangroves can reduce wave heights between 13 and 66 per cent and up to 100 per cent where mangroves reach 500 meters or more in width. If mangrove forests are sufficiently large, they can reduce storm surge peak water levels between 4 and 48 centimetres per kilometre of mangrove. It is estimated that even such relatively small reductions in peak water levels can reduce flooding and prevent property damage in low-lying areas. The Report, and its accompanying Policy Brief, provides a social and economic valuation of the flood protection benefits from mangroves in the Philippines. Other MOW-linked studies compared the costs of natural versus engineered sea defences, and their findings showed that restoring mangroves can be two-to five-times cheaper than building a concrete breakwater to provide the same degree of protection (MOW, undated)

Mangroves and Coastal Water Quality Improvement

Mangroves are essential to water quality maintenance. Mangrove forests protect both the saltwater and freshwater ecosystems. Mangroves maintain coastal water quality by abiotic and biotic retention, removal, cycling of nutrients, pollutants, particulate matter from land-based sources, filtering these materials from the water before reaching seaward coral reef sea-grass habitats. They filter and trap sediments, heavy metals, and other pollutants with their dense network of trees and vegetation (https://ecoviva.org/7-reasons-mangroves-matter/:). The root systems of mangrove trees slow water flow, facilitating the deposition of sediment. This ability to retain sediments flowing from upstream prevents contamination of downstream waterways and protects sensitive habitat like coral reefs and sea-grass beds below. In comparison with the expense of constructing wastewater treatment plants, mangroves are commonly selected as receiving areas of effluent. 2-5 hectares of mangrove may treat the affluence of one hectare of aquaculture (Environment Australia, 2000). Many countries are increasingly adopting the notion of explicitly constructing mangrove wetlands for the primary purpose of using it for the treatment of aquaculture and sewage effluents. (Saenger, 2013)

Mangroves as Biodiversity Hotspot

Lying at the interface between coastal and terrestrial ecosystems, mangrove ecosystems comprise a wide array of unique habitats and support diverse terrestrial, estuarine, and marine species. Mangrove forests can indeed be regarded as a biodiversity hotspot. They provide a habitat for thousands of species at all levels of marine and forest food webs, from bacteria to barnacles to tigers. By filtering coastal waters, mangroves form a nutrient-rich breeding ground

for numerous species that thrive above and below the waterline. Mangrove ecosystems support a range of wildlife species, including crocodiles, birds, tigers, deers, monkey and honeybees (Saenger, 2013). According to UNEP (1995), mangrove ecosystems are unique because they include structural niches and refugia for numerous animal species. For example, crabs, mainly represented by two families – Grapsidae (63 mangrove species) and Ocypodidae (over 80 species) – are considered keystone species. The crabs positively influence tree productivity and reproduction, presumably by aerating the soil through their burrowing activities (Smith, Boto, Frusher & Giddins, 1991). Animals find shelter either in the roots or branches of mangrove forest trees. Mangroves forests also serve as nesting and resting sites for coastal birds such as brown pelicans and roseate spoonbills. Many shorebirds and migratory bird species, including kingfishers, herons, and egrets, depend on mangroves for part of their seasonal migrations. An estimated two million migratory shorebirds of the East Asian-Australasian Flyway annually migrate from the Arctic Circle through South-East Asia to Australia and New Zealand and back, stop to forage at numerous wetlands along this Flyway, including the wetlands of Oceania (Environment Australia, 2000). Thus, the clearing of mangrove forest leads to the loss of valuable habitat, threatening myriad species' survival. Mangrove forests are also a potential source of undiscovered biological materials that could benefit humankind, such as antibacterial compounds and pest-resistant genes. https://www.floridamuseum.ufl.edu/southflorida/habitats/mangroves/importance-mangroves/

Mangroves and Eco-tourism Potential

Mangrove ecosystem holds great potential for ecotourism development. Given the diversity of life inhabiting mangrove systems and their proximity in many cases to other tourist attractions such as coral reefs and sandy beaches, mangrove forests provide a rich environment for activities like sports fishing, bird-watching, hiking, kayaking, boat tours and other recreational activities. More importantly, sustainable tourism offers a stimulus to preserve existing mangrove areas, with the potential to generate income for local inhabitants https://www.weforum.org/agenda/2019/02/5-reasons-to-protect-mangrove-forests-for-the-future/and. If held at sustainable levels, ecotourism could provide the perfect motivation to protect mangroves instead of clearance for mass tourism developments. Whereas unregulated development threatens mangroves – like mega tourism projects in Mexico, polluting industries in India and Vietnam or large-scale shrimp aquaculture in many parts of the world threaten mangroves, locally-led community development can offer economic growth without compromising coastal ecosystems. Despite its great promise for revenue generation and economic development, today, only a few countries have started to tap into their mangrove forests' tourism potential. Several mangrove sites from the USA, Japan, Vietnam, India, and Malaysia attract hundreds of thousands of visitors annually.

Mangrove Forests and Climate Mitigation

Mangroves make a critical contribution to climate regulation through carbon capture as they store a lot of carbon. While only occupying 13.8 million hectares of tropical coastlines per hectare basis, mangroves are among the world's most carbon-rich forests. They have high carbon stocks, containing on average 1,023 metric tons of carbon per hectare (Donato et al., 2011). Per-year, mangroves can store 42 million tons of carbon/hectare (Discover Magazine, undated). Similar to terrestrial forests, mangroves capture carbon from the atmosphere via photosynthesis. However, unlike terrestrial forests, which store most of their carbon in the trunk and branches, mangroves store most carbon in their root systems and neighbouring soil

with more than 90% of the carbon they capture stored in the soils beneath them, where, undisturbed, the carbon can remain stable for centuries or more. When the roots, branches and leaves of mangrove tree die, they are usually covered by soil, which is then submerged under tidal water. This oxygen poor-environment causes a prolonged break down of the plant material resulting in significant carbon storage. Thus, the soil acts as carbon 'sinks', locking it away for generations (Wood, 2019). Also, the fire risk that might lead to the loss of stored carbon is very minimal.

Research has shown that coastal mangroves perform more than other forests in their carbon storage capacity. For example, an examination of 25 mangrove forests across the Indo-Pacific region found that per hectare, they sequester carbon at a rate two to four times greater than other mature tropical forests and store three to five times more carbon per equivalent area than tropical forests" such as the Amazon rainforest (Wood, 2019). This means that conserving and restoring mangroves is essential to fighting climate change, https://ecoviva.org/7-reasons-mangroves-matter/:

Mangrove Forests in Nigeria

Nigeria has the largest mangrove forest in Africa and the third-largest in the world after India and Indonesia. Mangrove swamps in Nigeria stretch along the entire coast. They are found in nine of the 36 states, namely Abia, Akwa-Ibom, Bayelsa, Cross River, Delta, Edo, Imo, Ondo, and Rivers States, collectively referred to as the Niger Delta. However, despite this expansive geographic coverage, the Niger Delta mangrove forest has approximately 80% of its vegetation distributed in only three states: Bayelsa, Delta, and River states (James et al., 2013). The largest extent of mangroves is found in the Niger Delta between the Benin River region in the west and Calabar, Rio del Rey estuary in the east. Maximum width of 30 to 40 kilometres of mangroves is found on the flanks of the Niger Delta, which is a highly dynamic system. The lagoons of Lagos and Lekki dominate the coastal systems in the west, with both lagoons fringed by mangroves and backed by swamp forests. In the far east of the country is a second major delta/estuary system associated with the Cross River, which has a considerable mangrove area extending in a belt of 7–8 kilometres on both sides of the estuary and up to 26 kilometres in the deltaic zone at the head of the estuary (Arabomen, Obadimu, Ofordu & Ademola, 2016).

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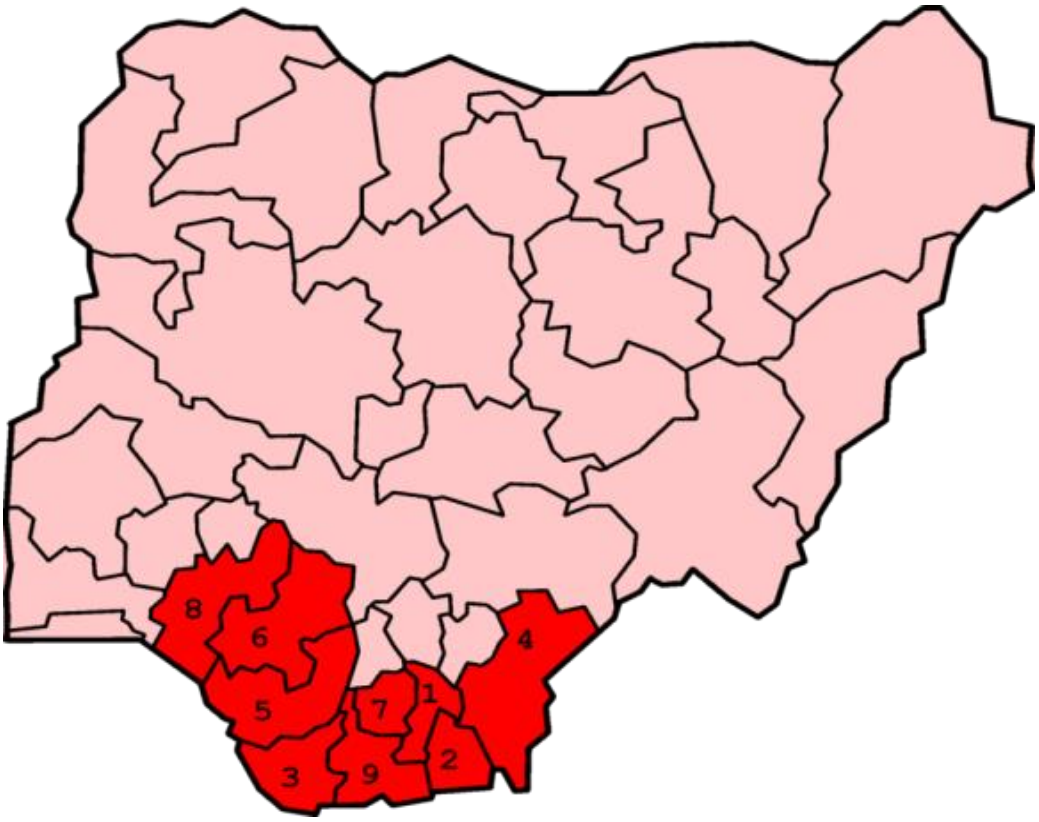

Map of Nigeria numerically showing states typically considered part of the Niger Delta region: 1. Abia, 2. Akwa Ibom, 3. Bayelsa, 4. Cross River, 5. Delta, 6. Edo, 7.Imo, 8. Ondo, 9. Rivers

Source: https://commons.wikimedia.org/wiki/File:NigerDeltaStates.png#/media/ File:NigerDeltaStates.pn

The threat to the Mangrove Ecosystem in Nigeria

Nigeria's mangrove forests have suffered a lot of degradation and destruction. They remain one of the most threatened wetland types in Nigeria today. Many factors are responsible for mangrove forest destruction, but oil exploration and extraction activities remain the most severe threat to Nigeria's mangrove forest ecosystem. Nigeria's Oil Industry is located mostly in the mangrove forest ecosystem. Thee numerous oil exploration companies' activities have led to fragmentation, deforestation, and degradation of the mangrove forest ecosystem. For example, Shell Petroleum Development Company alone has shot over 120,000km of seismic lines and created vast degraded bare areas resulting from dredging activities in the mangrove forest. Impacts of other petroleum development companies such as Mobil, Elf, Agip and Chevron on the Nigerian mangroves are yet to be estimated (Abere & Ekeke, undated). But oil extraction poses the greatest threat to the mangrove forest ecosystem in Nigeria. Comprising over 90 per cent of Nigeria's total exports, the oil-rich Niger Delta produces over two million barrels of crude oil a day, placing Nigeria as the 6th among Oil Producing and Exporting Countries (OPEC) and 9th oil-producing country in the world. Such extensive oil extraction has come at a great environmental and social cost. Since 1958, when oil was discovered in

commercial quantity in the Niger Delta, the Nigerian Federal Ministry of Environment has estimated that 13 million oil barrels have been spilt during extraction processes. These spills are the product of many factors, including unenforced drilling regulations, refinery leaks, pipeline corrosion, vandalism, and human error. The average number of such spills has gradually increased from 250 in 1958 to 500 spills per year at present (Langeveld & Delany, 2014). So not only has the Nigerian Oil Industry deforested mangrove ecological zones for drilling purposes, but it has also deteriorated the health of the surrounding mangrove areas through oil spillages. Oil spills have many harmful effects on the environment. Oil kills plants and animals in the estuarine zone. Oil endangers fish hatcheries in coastal waters and contaminates the flesh of commercially valuable fish. The oil that settles on beaches kills organisms that live there, while those that settle on the ocean floor kill benthic (bottom-dwelling) organisms such as crabs and disrupts major food chains. Oil also covers birds, impairing their flight or reducing the insulated property of their feathers.

Other factors responsible for mangrove degradation in Nigeria include agricultural expansion, urban growth, over-harvesting for timber and fuel, conversion to other uses, and the steady encroachment and spread of the Nypa palm (an invasive mangrove forest plant).

CONCLUSION

Mangrove forests play very important ecological and economic functions and are crucial to coastal communities' survival and sustainable livelihoods. Although Nigeria has a large expanse of the mangrove forest ecosystem, the largest in Africa and third largest globally, its value is yet to be understood and appreciated by the majority of Nigerians hence its continued destruction. Mangrove forests destruction and degradation in Nigeria results mainly from the oil exploration and exploitation activities of numerous oil companies operating in Nigeria's Niger Delta region. For Nigerians to tap from the immense values inherent in mangrove forest ecosystems, their restoration, rehabilitation, and conservation become essential.

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