

# DEFORESTATION AND DEGRADATION OF MANGROVES IN THE NIGER DELTA REGION OF NIGERIA: IMPLICATIONS IN A CHANGING CLIMATE

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## Abstract

The mangrove forest ecosystem in addition to acting as a buffer to extreme weather events, contributes immensely to the socio-economic wellbeing of the coastal communities. However, this important ecosystem is fast diminishing in the Niger Delta Region of Nigeria due to factors which are mainly anthropogenic. This study investigated the factors responsible for mangrove deforestation and degradation in this region, and x-rayed the consequences in a rapidly changing climate. It was observed that land reclamation for building of settlements, fish farming, road construction, electricity projects, timber/fuel-wood gathering, oil exploration/exploitation and related activities, refuse dumping, and *Nypa fruticans* invasion, are among the causes of mangrove deforestation and degradation in the region. The paper posits that climate change impact will be more severe in the region, as the ecological, socio-economic, and adaptive roles of the mangroves are lost through deforestation and degradation. Strict protection of the remaining mangrove forests and the regeneration of deforested and degraded mangroves are recommended, for the sustenance and enhancement of their roles in climate change mitigation and adaptation, and the socio-economic wellbeing of the coastal communities.

**Keywords:** Niger Delta, mangrove, deforestation, climate change, impact, adaptation.

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## Introduction

The mangrove forest is typically a tropical group of salt tolerant plants that occupy the inter-tidal zone of sheltered coasts around estuaries and lagoons. The mangrove forests are known to serve various socio-economic and ecological functions especially in the coastal communities. For instance, they provide breeding grounds for fish species and provide numerous non-wood products that contribute to rural livelihoods.

However, the African mangroves have suffered much pressure in the recent past with enormous losses. The loss, destruction and degradation of the mangrove forests have been attributed to many factors including urbanization, quarrying, salt and sand extraction; pollution from industries, agro-industrial chemicals, petroleum and gas exploitation; absence of appropriate legislation; deforestation for fish smoking (Ajonina and Usongo, 2001; Ajonina *et al*, 2005).

The Nigerian mangrove forest belt, besides contributing to the socio-economic wellbeing of the rural coastal communities, has the potential to protect them against extreme weather events orchestrated by climate change. Rising sea level is envisaged to increase flooding in low lying coastal areas, which will in turn increase the physical and socio-economic vulnerability of coastal cities. Nigeria has been recognised as one of the most vulnerable African countries to climate change and the impacts are already being felt in different parts of the country.

Nigeria has over 2,000 industrial establishments with about 80% of these concentrated in the coastal zone especially urban centres, mainly in Lagos, Port Harcourt, and their environs. Industries located in the Nigerian coastal zone include: oil and gas, petrochemical, iron and steel, fertilizer plant, aluminum smelting plant and manufacturing industries such as textiles, food, plastics, pharmaceuticals, cement, soaps and detergents, paints, brewing, and wood pulp and paper (FEPA, 1997).

With the majority of Nigeria's total industrial establishments in the coastal States and more people living and working in climate change-prone areas in the country, the consequences of mangrove deforestation and degradation cannot be underestimated. This paper therefore investigated the causes of mangrove deforestation and degradation in the Niger Delta Region of Nigeria, and examined the implications in a rapidly changing climate.

### **Methodology**

Field trips spanning coastal communities in purposively selected States – Rivers, Bayelsa, and Ondo, within the Niger Delta Region of Nigeria, were embarked upon in 2010 and 2015, to ascertain the causes and consequences of mangrove deforestation and degradation in the study area. In addition, information available from relevant scientific literature on the subject matter was used.

### **Distribution and Extent of the Mangrove Forest in Nigeria**

The distribution of mangroves is affected by climatic factors like temperature and moisture (Duke 1992; Saenger and Snedaker 1993), and other coastal processes like tidal mixing and coastal currents, which affect the dispersal of propagules (De Lange and De Lange 1994). Agrawala *et al.* (2003), noted that the richest mangrove communities occur in areas with water temperature in the warmest month greater than 24°C; while Aizpuru *et al.* (2000) observed that most are found within latitude 25° north and south of the equator, covering approximately 17 million ha in 112 countries and territories in Asia, Africa, Australia, and the Americas.

Approximately 75 per cent of mangroves are concentrated in just 15 countries; with close to half of mangrove coverage occurring in five countries – Indonesia, Australia, Brazil,

Nigeria and Mexico. Nigeria’s mangrove forest which covers an area of about 105,000 hectares is known to be the largest in Africa and the third largest in the world (World Bank, 1995 and Ndukwu and Edwin-Wosu, 2007). The Nigerian coastline which is approximately 853km long stretches from the western border with the Republic of Benin to the eastern border with Cameroon, with mangroves and estuaries extending from 10-150 km inland (USAID, 2008). Mangroves are found in all the coastal states of Nigeria namely – Akwa-Ibom, Bayelsa, Cross River, Delta, Edo, Lagos, Ogun, Ondo, and Rivers States (Figure 1). However, the extent of mangroves in these states varies with Rivers/Bayelsa having the largest area of mangroves (Table 1).

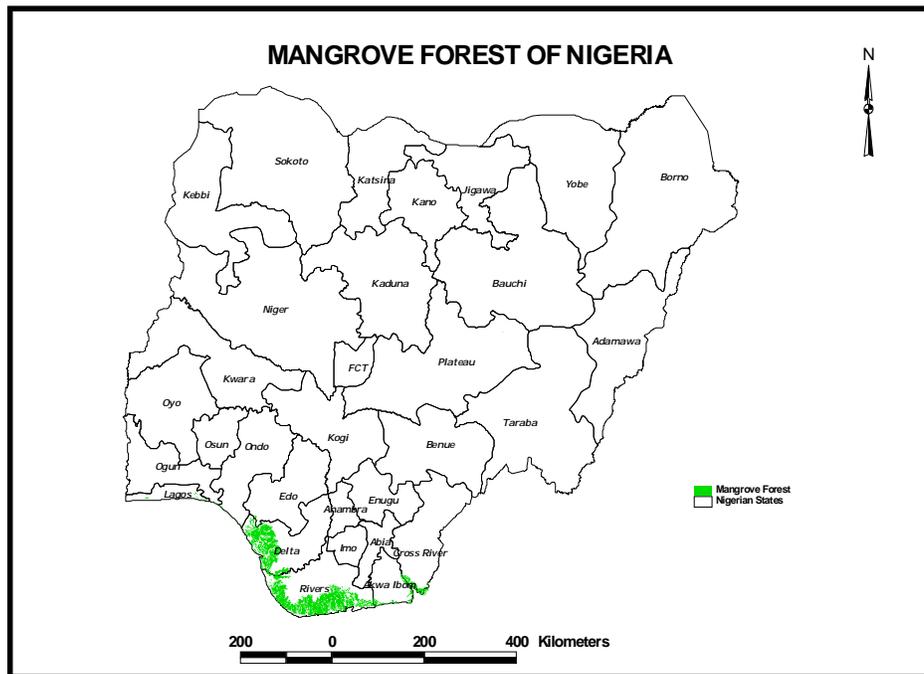


Figure 1: Map of Nigeria showing the distribution of the mangrove forest

**Table1: Distribution of Mangrove Forest in the Nigerian Coastal Area**

State	Area of Mangrove (Km <sup>2</sup> )	Mangrove in Forest Reserves	
		Area (Km <sup>2</sup> )	% of total
Lagos	42.20	3.13	7.42
Ogun	12.18	-	-
Ondo	40.62	-	-
Edo/Delta	3,470.32	143.75	4.14
Rivers /Bayelsa	5,435.96	90.62	1.67
Cross	721.86	67.19	9.31
River/Akwa Ibom			
<b>TOTAL</b>	<b>9,723.14</b>	<b>304.69</b>	<b>-</b>

Source: Adapted from (NEST, 1991)

The Nigerian mangrove is dominated by the red mangroves (Rhizophoraceae), in association with white mangroves (Avicenneaceae). The red mangrove – *Rhizophora racemosa*, is the most common species, covering over 90% of the area and can grow to a height of 45 m under favourable conditions. It is the pioneer species, and is followed by *R. harrisonii* and *R. mangle* as the land gets drier and salinity decreases. *Avicennia* species, a smaller tree than *Rhizophora* species, grows singly on firm land.

As confirmed by Figure 1 and Table 1, much of the Nigeria's mangrove forest is found in the Niger Delta region, and the mangrove in this area, has been reported to be the most exploited in the world (FAO, 2007). The pressure on the mangrove ecosystem, which was minimal, during the pre-colonial era due to low population densities and subsistence agriculture (Bisong, 2001), has been exacerbated by the burgeoning human population and the concomitant activities, including oil exploration and exploitation (Mmom, 2007). The major factors responsible for the destruction of the Nigerian mangroves are discussed in detail in the subsequent section.

#### **Causes of Mangrove Deforestation and Degradation in the Niger Delta Region**

Several factors are responsible for the deforestation and degradation of the mangrove forest in the Niger Delta Region of Nigeria. These include land reclamation for building of settlements, fish farming, road construction, electricity, logging for timber, fuelwood gathering, oil exploration/exploitation and related activities, refuse dumping, and *Nypa fruticans* invasion.

#### **Development of Infrastructure**

This is a major cause of mangrove deforestation in the Niger Delta Region of Nigeria. In recent times especially with the creation of the Niger Delta Development Commission (NDDC) following so many years of struggle and campaign against marginalization of

the people of the Niger Delta Region (where Nigeria's crude oil is mainly found), some efforts have been made to develop infrastructure, and these sometimes result to the destruction of the mangroves. Plates 1 and 2 respectively show the destruction of mangrove forest and subsequent sand-filling as the Ogbia-Nembe road was being constructed in Bayelsa State. These activities sometimes introduce and encourage the growth of some species alien to the mangrove environment around it (see Plate 3).



**Plate 1: Destruction of the mangrove for the construction of Ogbia-Nembe road, Bayelsa State**

*Source:* Field survey, 2010.



**Plate 2: Sand-filling of destroyed mangrove area, Ogbia-Nembe road construction, Bayelsa State**

*Source:* Field survey, 2010.



**Plate 3: *Musanga cecropioides* growing on topsoil deposited in a mangrove swamp forest by the grader near Agip Canal during the construction of Ogbia-Nembe road, Bayelsa State.**

*Source:* Field survey, 2010.

Land reclamation for building of settlements and public facilities is also another major threat to the mangrove ecosystem in the Niger Delta region of Nigeria. In many parts of the region, the mangrove forest is being cleared to build residences (Plate 4) and other public facilities like schools (Plate 5), especially in mangrove areas that are close to access roads.



**Plate 4: Mangrove deforestation to reclaim land for residential buildings, Buguma, Rivers State**

*Source:* Field survey, 2015.



**Plate 5: Land reclamation from mangroves for the construction of a model secondary school in Buguma, Rivers State.**

*Source:* Field survey, 2015.

Electricity Projects sometimes result to the destruction of the mangrove forest (Plate 6). Laying of high-tension wires for electricity projects in mangrove areas leads to mangrove deforestation and degradation in some cases.



**Plate 6: Mangrove destruction for electricity projects, Buguma, Rivers State**

*Source:* Field survey, 2015.

### **Fish Farming**

Large scale fish farming is one of the factors responsible for mangrove deforestation and degradation in the Niger Delta region of Nigeria. A very good example is seen in Buguma, Rivers State (Plate 7) where ONIDA – an Israeli company is involved in large-scale fish farming. The construction of the fish farm (with over forty ponds) led to the destruction and sand-filling of a large expanse of the mangrove forest on which rural livelihood depends to some reasonable extent. The major interest in siting the farm near the mangrove is constant provision of brackish water required to grow the fish species of interest – Barramundi (Plate 8), which is bred and imported from Australia. One wonders what the contributions of such a venture are, especially to the rural economy, as virtually everything used in the farm including fish feed, is being imported from either Israel or Australia.



**Plate 7: Mangrove deforestation for large scale fish farming in Buguma, Rivers State**

*Source:* Field survey, 2015.



**Plate 8: Barramundi – an exotic fish species reared by an Israeli company – ONIDA, in Buguma, Rivers State**

*Source:* Field Survey, 2015

### **Timber and Fuel Wood Gathering**

The mangrove forest is a source of timber. The mangrove species are widely used as fuel for firing small scale industrial boilers due to its high thermal capacity. The red mangrove – *Rhizophora racemosa*, is the most exploited species and is used for firewood, poles and timber. The destruction of the mangrove for fuelwood gathering (Plate 9) is on the increase in many parts of the Niger Delta to meet household energy needs and for income generation.

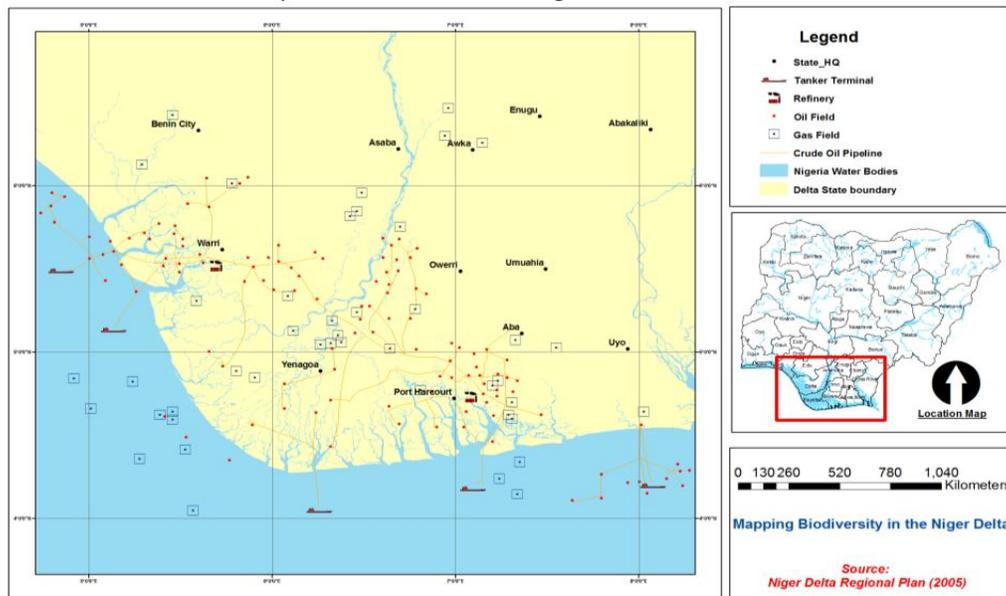


**Plate 9: Destruction/degradation of mangroves via fuel-wood gathering**

Source: Field survey, 2015.

### **Oil Exploration/Exploitation and related Activities**

Activities of the oil and gas industry in the mangrove forests of the Niger Delta (Figure 2) are to a large extent responsible for mangrove fragmentation, deforestation and degradation. Oil drilling and spillage, dredging of canals, and construction of residential quarters for oil workers, constitute huge threat to the survival and proper functioning of the mangrove ecosystem in the Niger Delta region. O’Neil (2007) observed that oil spills and leakages have destroyed much of the Nigeria’s mangrove areas including the fishing economy and water quality.



**Figure 2: Crude oil pipeline network in the Niger Delta Region**

Source: Niger Delta Regional Plan 2005.

### The Menace of Nipa palm

*Nypa fruticans* (Nipa palm) – an invasive alien species (Plate 10), is another major threat to the mangrove ecosystem in the Niger Delta Region. The species which was introduced in Nigeria for the control of river bank erosion has become a big menace to the mangrove ecosystem. The deforestation and degradation of the mangroves for firewood gathering, the construction of navigational canals, villages, and the activities of oil companies, encourage their replacement by this fast colonizer (*Nypa fruticans*) which does not provide the enormous ecological services provided by mangroves (USAID, 2008). Tackling the menace of Nipa palm invasion of the mangrove ecosystem requires a holistic approach that will discourage mangrove deforestation and degradation, complete removal of the species in invaded areas, and massive regeneration of degraded mangroves. SCBD (2001) observed that restoration of degraded habitats in addition to re-introduction of native species can enhance biological diversity and also enhance the resilience of ecosystems against future invasions. Efforts should also be made towards discovering other uses of the Nipa palm that will be beneficial to man.



**Plate 10: *Nypa fruticans* (Nipa palm) – a fast colonizer that threatens the mangrove ecosystem**

*Source:* Field survey, 2015.

#### **Other Factors**

Defecation, refuse dumping, and unsustainable exploitation of non-wood resources, are also among the factors responsible for mangrove degradation in the Niger Delta region. The construction of public toilets that empty directly into the mangroves and the dumping of refuse in and near the mangroves (Plate 11) are now common in the region. Unsustainable exploitation of non-wood resources like fish, periwinkle, crab, etc. is also worrisome.



**Plate 11: Public toilets and refuse dumping in mangroves**

*Source:* Field survey, 2015.

Another factor that encourages the loss and degradation of the mangrove forests in the Niger Delta is the palpable weakness in the implementation of the Environmental Impact Assessment (EIA) decree. Sometimes projects are executed before EIA is done, and in some cases where they are done prior to the execution of the project, the process is usually replete with irregularities that are allowed by the representatives of relevant agencies that should ensure due process and maintain standards. In some cases, clearance is given for projects with huge potential negative impacts on the environment. Here in the Niger Delta Region, multinational oil companies get away with pollution and spillage in many places including the marine and coastal ecosystems unlike in most developed countries. There is need for strict adherence to and compliance with the provisions of the EIA decree if sustainable development is to be guaranteed.

#### **Implications of Mangrove Deforestation and Degradation in a Changing Climate**

The implications of mangrove deforestation and degradation in the Niger Delta Region of Nigeria are quite grave especially in the light of the vulnerability of the region to climate change. In this paper, these implications are considered in respect of climate change mitigation and adaptation, and the socio-economic consequences of extreme weather events orchestrated by climate change.

#### **Implications for Climate Change Mitigation**

The role of mangrove forests in climate change mitigation has been acknowledged the world over. The mangrove forests are among the most carbon-rich tropical forests

(Donato *et al.*, 2011), due to high levels of plant production in addition to high levels of sedimentation from rivers and tidal inputs (Kristensen *et al.*, 2008). Annual mean carbon sequestration rate of the mangrove has been known to exceed those of the terrestrial forest ecosystems like the tropical rain forest, the temperate rain forest and the boreal forests (McLeod *et al.*, 2011). Unlike in most terrestrial ecosystems, the mangrove ecosystems store about 50 – 90 % of their carbon below ground where it can remain for very long periods, with the remainder equally stored for long periods of time in the wood (Pan *et al.* 2011; Pendleton *et al.*, 2012). As a result, more carbon is released to the atmosphere and the ocean when mangroves are degraded or converted to other land uses compared with the terrestrial ecosystems. Donato *et al.* (2011) estimated that mangrove deforestation generates emissions of 0.02-0.12 Pg carbon per year – as much as around 10% of emissions from deforestation globally, despite accounting for just 0.7% of tropical forest area. Thus, as the mangrove forests are destroyed in the Niger Delta Region, they not only release the carbon they hold but also lose their potential to sequester more carbon in the future.

### **Implications for Climate Change Adaptation**

It has been documented that climate change will have considerable impacts in coastal regions (Bardsley, 2006; Caton, 2007), which will probably include beach and dune erosion due to the effects of rising sea levels, extreme events, changes to run-off patterns, and flooding (Caton, 2007). Many coastal communities in different parts of the world have already started experiencing some of these impacts with their concomitant colossal damages and losses.

However, the mangrove forests and other marine and coastal ecosystems like sea-grass meadows, mangroves, and tidal marshes, provide services that aid adaptation to climate change impacts along the coast. These services include prevention of shoreline erosion, protection from storms and sea level rise, regulation of coastal water quality, and food security for many coastal communities around the world. They also protect adjacent marine ecosystems (often coral reefs) from terrestrial inputs, and provide habitat for diverse fish and invertebrates, some of which are commercially important (Rützler and Feller 1996; Mumby *et al.* 2004).

Therefore the current rate of mangrove deforestation and degradation in the Niger Delta Region without any attempt at regeneration will definitely increase the vulnerability of coastal communities in the area, to extreme weather events. There are clear evidences in several parts of the world to buttress this assertion. Evidences from the countries affected by the 2004 Tsunami confirmed that mangrove forests played crucial roles in saving lives and property, and that the waves penetrated far inland where mangroves and other coastal ecosystems had been destroyed, resulting to flooding of farms, destruction of homes and means of livelihood (EJF, 2006). The four countries – Indonesia, Sri Lanka, India and

Thailand, that were worst hit by the impacts of the 2004 Tsunami lost 28% of their mangrove forests between 1980 and 2000 (EJF, 2006). It is also widely acknowledged that the destruction of mangroves and reefs exacerbated the damages done by the 2005 Hurricane Katrina to the US coastal States.

### **Socio-Economic Implications**

The socio-economic consequences of mangrove deforestation and degradation are quite enormous. Although there are no particular estimates or figures for Nigeria, UNEP (2014) reported that the variety of goods and services provided by mangrove forests worth an estimated US\$33-57,000 per hectare per year to the national economies of developing countries with mangroves; and that over 100 million people that live within 10 kilometres of large mangrove forest benefit from them. In addition, emissions resulting from mangrove losses make up nearly one fifth of global emissions from deforestation, resulting in economic damages of US\$6–42 billion annually (UNEP, 2014). Other socio-economic implications may include effects on public health, employment and income generation, changes in population and ethnic patterns, and needs for resettlement of families affected by extreme weather events.

Although there are no studies that have quantified the monetary contributions of the mangroves (in terms of the goods and services provided) to the Nigerian economy, mangroves provide tangible goods like fuel-wood, crabs, shrimps, honey, medicine, dyes, thatch, salt and periwinkles, which support rural livelihoods and serve as vital sources of income to the rural dwellers especially in coastal communities. In addition to the above tangible goods, the mangroves provide intangible services by buffering the coastal communities and providing breeding grounds for fishes.

The economic implications of mangrove deforestation and degradation in the Niger Delta Region cannot be overemphasized, given the fact that the oil companies which contribute immensely to the wealth of the Nigerian nation is located mostly in this region. Lubeck *et al.* (2007) reported that there are over 600 oil fields, 5,284 on- and- off shore oil wells, 10 export terminals, 275 flow stations, 4 refineries and an LNG project, in the Niger Delta Region. In addition to these are other subsidiary companies and investments, and the teeming human population in the region. Therefore, with current high spate of mangrove destruction, extreme weather events orchestrated by climate change, are bound to cause colossal and monumental economic damages.

### **What Should be Done?**

The importance of mangrove ecosystems in climate change mitigation and adaptation (especially in coastal areas) cannot be overemphasized. Hence, the need for the Nigerian Government to come up with appropriate laws and policies that will halt the current high spate of mangrove degradation and conversion, conserve the remaining mangroves, and

ensure massive regeneration of degraded areas. These will help to improve the resistance of mangrove ecosystems to climate change so that they can continue to deliver ecosystem services, and provide alternative livelihood options in the face of climate change. Mant *et al.* (2014) observed that the conservation, restoration and sustainable management of ecosystems can help reduce vulnerability to climatic hazards such as hurricanes, rising sea levels, floods and droughts.

It is imperative to ensure that EIAs are thoroughly done for developmental projects in the Niger Delta region to mitigate the high spate of destruction and degradation of very important ecosystems like the mangrove forest. In addition, environmental impacts of industries sited in coastal regions can be mitigated by ensuring that their wastes are treated to specified and acceptable standard before they are discharged into the sea.

In addition, Nigeria should emulate other countries like Indonesia, Philippines, Bangladesh, and Sri Lanka, where mangrove regeneration has become a very serious business. Apart from direct planting of mangrove species, efforts to conserve the mangroves in these countries include environmental education of the coastal communities on the need for sustainable use.

### **Conclusion and Recommendation**

Mangrove forests in the Niger Delta region of Nigeria have been deforested and degraded to a large extent due mainly to anthropogenic pressures. There is need for mapping and strict protection of the remaining mangrove forests in the region. Massive regeneration of deforested and degraded mangrove areas should be carried out urgently, for enhanced ecological roles, socio-economic wellbeing of the people, and climate change adaptation/mitigation. There appears to be paucity of information from the available literature concerning the ecology of mangrove ecosystems in Nigeria, their carbon sequestration capabilities/potential, economic values, and current status. There is a dire need for empirical studies to fill these gaps.

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