

THE EFFECT OF CLIMATE CHANGE ON THE NIGERIAN COASTLINE A CASE STUDY OF THE NIGER DELTA

Asimiea, O. Amina

Department of Crop and Soil Science,
Faculty of Agriculture, University of Port Harcourt, Nigeria

ABSTRACT

The Niger Delta is characterized by semi-diurnal tidal regimes. The intertidal zone serves as a breeding ground for the rich assemblage of flora and fauna and the nutrient processing zone of the brackish water ecosystem. As oil spills, it is carried by incoming tidal water into the intertidal zone. On its path it coats the pneumatophores of the mangrove plants, starving the plants of the much needed oxygen, scorching the roots and other sedentary fauna. The extent of deforestation and fauna loss due to oil spill is directly proportional to the spread of the incoming tide and the width of the intertidal zone. Rising sea levels due to global warming, initiate storm surge and the expansion of the intertidal zone. Flooding from runoff also increases upstream; this complicates life in the coastal communities. As the intertidal zone extends landwards, aquatic species move landwards and terrestrial forms in newly flooded areas are wiped out. Consequently, there is loss of biodiversity and resources of the Niger Delta people. Deforestation, Excavation, dredging and slot cutting for pipeline routes deprives the Niger Delta environment of its carbon storage capacity, fauna habitat and breeding grounds. It inhibits forest regeneration and prevent run-off from getting to the open waters. Re-vegetation should be supervised to ensure higher survival rate of transplanted mangrove seedlings. To minimize pipe damage, pipe of higher tensile strength and hardness that cannot be cut with conventional cutting equipment is suggested for replacement of old pipes and for the construction of new lines. Also Nigerian National Petroleum Corporation should reactivate and coordinate oil spill response outfit, CLEAN NIGERIA. Finally, NNPC should coordinate the joint ownership of pipeline routes between oil companies and redefine the concept of Right Of Way (ROW) in order to reduce the area deforested for pipe line by individual oil companies.

Keywords: Climate Change, Nigerian Coastline, Niger Delta

Introduction

The Nigeria coastline is approximately 859 km, and lies within the coordinate of Latitude 4° 10'N and 6° 20'N and Longitude 2° 45' and 8° 32' in the eastern section of the Gulf of Guinea. The coastline is divided into four sections (from East to West) as:

1. The stranded coast /estuary complex (about 100 km, which extends from the Imo River estuary to the boundary between Nigeria and Cameroon, terminating at the Bakassi Peninsula
2. The Niger Delta distributary system (about 450 Km, starting at the Benin River estuary and extends to the Imo River estuary)

3. The transgressive mud coast and associated intertidal flats (about 100 km East of Lagos) it is contiguous with the barrier beach lagoon complex, stretching for a distance of 83km to the Benin River estuary)

4. The barrier beach lagoon complex (about 220Km Eastwards from the border of Benin Republic with Nigeria)

The Niger Delta

The Niger Delta covers about 50% of the total length of the Nigerian coastline and generally influences the ecology of other sections of the Nigerian coastline, with tidally inundated mangrove vegetation, brackish and fresh water ecosystems encountered in each of the other

coastal belts of the Nigerian coastline. The Niger Delta can be divided into the Western Delta Complex, The Arcuate Delta and the Eastern Flank. There are 21 major River channels from Benin River to Imo River. These are: Benin, Escravos, Forcados, Ramos, Dodo, Pennington, Digatoru, Bengatoru, Kulama, Fishtown, Sangana, Nun, Brass, St. Nicholas, Santa Barbra, St. Bartholomew, Sombriero, New Calabar, Bonny, Andoni and Imo River. All these rivers open to the Atlantic Ocean. Generally, the Niger Delta is characterized by a sandy shoreline backed by extensive mangrove swamp and barrier island separated by tidal channels. This section of the Nigerian coastline has the longest barrier island of about 35Km (Ramos –Dodo Island) and the widest is Focados-Ramos Island which is 10km wide. Towards the eastern flank the barrier islands are narrower and appear as remnants of beach ridges, reduced by wave actions and tidal erosion in and around the network of creeks.

The region is characterized by semi–diurnal tidal regimes with tidal amplitude of about 1.2 meters high and ebb flow reaching higher velocities than flood flow. Generally, ebb flow velocity that exceeds flood flow by 5000m³/sec. are recorded for Bonny River and tidal flows control drainage patterns in the mangrove marshes (NEDECO, 1961). These phenomena regulate the environmental conditions under which flora and fauna of the Niger Delta thrive.

The vegetation in the area is basically mangrove with pockets of barrier islands with typical forest species especially at the southern fringe. Seven species of mangrove distributed in five families, known to inhabit the West African coastal waters are all represented within the Niger Delta. These are *Rizophora racemosa*, *Rizophora harrisonii*, and *Rizophora mangle* (the Red mangroves). Others are *Avicennia Africana* (white mangrove) and *Laguncularia racemosa* (the black mangrove). *Conocarpus erectus* is the only described species of a monotypic genus, endemic to West Africa; it occurs along the Bonny River. *Nypa fruticans* is another monotypic genus, which is

spreading fast in the Niger delta and fast replacing *Rizophora* [1]. This species was introduced into Calabar Nigeria in 1906 [2]. The mangrove vegetation is punctuated at various points by beach ridges on which fishing settlements and communities are developed by the inhabitants. At some portions, *Acrostichum* and *Phoenix species* occur in the intertidal range.

The Niger Delta is rich in biodiversity, one common and unique feature of the Niger Delta distributary system being the intertidal mud flat. The intertidal zone is defined as the space between the lowest water mark at low tide and the highest water mark at high tide. A zone of transmission between the aquatic and terrestrial zone, often inundated during the spring tide is referred to as the supra-intertidal zone. Most of the assemblage of flora and fauna (Clams, crustaceans, crabs, mollusc, burrowing worms, fish fry and juveniles, shrimp larvae etc.) are found in the intertidal zone. The intertidal zone is the breeding ground of most aquatic forms and it is the nutrient processing zone of the brackish water ecosystem [3-4], this is responsible for the relatively high environmental sensitivity index in most parts of the Niger Delta. The organisms that inhabit this zone are well adapted to the semi–diurnal tidal regimes, water current and wave action that prevail in this zone. However rising sea levels with the associated changes in hydrodynamics alter the ecological setting of these organisms [5].

The Effect of Oil Exploitation Activities in the Niger Delta

Environmental degradation or pollution associated with petroleum oil and gas exploration and exploitation activities in the Niger Delta is the most discussed contemporary issue in Nigeria. Ironically, the extent and dynamics of degradation is sparingly understood. As oil spills it is carried by incoming tidal water into the intertidal zone. On its path it coats the pneumatophores or breathing roots of the mangrove plants, starving

the plants of the much needed oxygen. Also the direct effect of the toxic components of crude oil is the outright scorching of the affected roots. The plants die within a period of 6-10 weeks starting from the shoreline inwards to the supra-intertidal zone, a phenomenon referred to as *Die-Back* [10]. Ordinarily, the extent of die-back is directly proportional to the spread of the incoming tide and the width of the intertidal zone. Similarly, as the oily water recedes at the turn of the tide the intertidal zone is smeared by the stranded oil slick, coating the surfaces of the intertidal mud flats and vital substrates of the intertidal communities. In this process virtually all the sedentary forms in the area are killed and some of the mobile forms barely escape [6-7]. From the foregoing any factor that increases the expanse of the intertidal zone by increasing the volume of water coming into the estuary naturally aggravates the impact of oil spill as more of the vegetation and associated fauna die.

Effect of Global Warming on the Niger Delta Coastline

As global temperature increase, glaciers and ice sheets and even the surface layer of the ocean warms as well, expanding in volume thus raising sea level. The Sea level rose 10 to 25 cm during the 20th century. Sea level is projected to rise another 28 to 58 cm if greenhouse gas emissions continue to increase significantly by the end of the 21st century. These projections do not incorporate possible large-scale melting of the Greenland or Antarctic ice sheets, which could begin in the 21st century with warming of a few degrees Celsius [8].

Rising sea level resulting in storm surges, in which winds locally pile up water and raise the sea, will become more frequent and damaging. This will complicate life in many barrier islands of the Niger Delta and coastal communities. Erosion of beach ridges and barrier Islands will increase. As the sea invades the mouths of rivers, flooding from runoff will also increase upstream. The current environmental situation in the Niger delta is

further complicated by rising sea levels and with increase in the volume of water coming into the creeks, the intertidal zone extends landwards. These create new areas of aquatic influence bring in aquatic species thus wiping out terrestrial forms. There is, by this means, loss in biodiversity in the Niger Delta.

With increase in the width of the intertidal zone oil spills are carried beyond the usual limits of the intertidal zone destroying more vegetation and animal lives [9]. The human communities living on the barrier Islands depend on the flora and fauna in these impacted areas and as these resources are lost to the process, the people are forced to turn to other undesirable means of livelihood.

In many parts of the Niger Delta there is loss of soil fertility and change in land use such as housing developments, oil and gas pipe line establishment and flow station development. As trees are burned to clear land, they release stored carbon back into the atmosphere as carbon dioxide. Also, hundreds of thousands of kilometres of pipe lines with average width of 15 meters run across the Niger delta swamps. As these pipelines Right of Ways (ROW) are deforested, the Niger Delta environment is robbed of its carbon storage capacity, fauna habitat and breeding grounds.

Four of the five oil export terminals in Nigeria are located in the Niger Delta. These terminals evacuate oil and gas from oil fields in and out of the Niger Delta. In most cases, at some distance, as the pipes approach the terminals they run alongside each other. In such cases instead of the usual 15 meter width, 30 meters or even 45 meters width is deforested because each oil company acquires its own ROW.

The process of laying oil pipes entail the excavation of the swamp to a depth of three meters at which the pipes are laid. This process brings soil at the depth of 3m to the surface. Beyond the first one meter, the chikkoko mud of the mangrove swamp is generally acidic and of low fertility. Therefore excavation, dredging and slot cutting in the Niger Delta drastically reduce the chances of the regeneration of

vegetation and other biotic form. Shore lines at places spared of oil spill where excavation activities are undertaken are physically altered. Heaps of dredge spoils restrict incoming tidal waters and limit the expanse of the intertidal zone. Erratic rainfall is associated with global warming resulting in higher volumes of run-offs from the lands. Dredge spoil prevents run-off from getting to the open waters, resulting in the formation of back swamps. Under such conditions nutrients generated from leaves and other biotic forms are concentrated within the back swamp creating anoxic conditions due to massive biodegradation. This further wipes out desirable species leaving obnoxious ones in the back swamps.

Mitigation Measures

One way to keep carbon dioxide emissions from reaching the atmosphere is to preserve existing vegetation and plant more trees. Trees, especially young and fast-growing ones, soak up a great deal of carbon dioxide from the atmosphere and store carbon atoms in new wood. The following measures can prevent oil spill and ameliorate the loss of vegetation associated with oil spill.

Re-vegetation of the mangrove swamp is one measure that is included in the environmental management plan of most pipeline construction projects. To the extent that it is properly carried out, this is useful in the marginal replacement of lost vegetation on pipeline ROW.

Deliberate efforts should be made to reduce the total hectare deforested for oil and gas pipeline activities. The national Petroleum Cooperation (NNPC) can coordinate the joint ownership of ROW between oil companies. In this way the width of ROWs can be compromised for pipelines of two oil companies to be laid within a space of 20 meters instead of 30 meter. Also existing ROW with established coordinates of pipeline locations can be expanded to accommodate new pipelines instead of clearing vegetation for new line.

The seasoned reasons advanced by the communities that oil spill, as a result of equipment failure and aging oil pipes and the

counter argument by the oil companies that oil spills as a result of sabotage from community youths is stale and should be replaced by proactive efforts on the part of the oil companies. One way out of this argument, is to use pipes with higher tensile strength and hardness that cannot be cut with conventional cutting equipment. Detailed investigation on such pipes and the possibility of using them to replace obsolete pipes are needed.

Most companies have established oil spill response procedures, which are either not practiced in the event of an oil spill or is not efficient enough to contain the spread of spilled oil. Often time, hydrodynamics of the location and the technical input employed at the time of spill could limit the extent of coverage of the spill and so reduce the magnitude of impact of the spill. This was the reason for the formation of CLEAN NIGERIA, an organisation of oil companies operating in Nigeria at that time. The mandate of the organisation is to pull resources that will be deployed to contain oil spilled by member companies. In its earlier years the organisation was effective but over the years it lost steam as rhetoric and the politics of cause of spill between the companies and the communities gained prominence over spill control and impact mitigation. CLEAN NIGERIA should be revived with clearer objectives and regulation for NNPC.

Oil companies can take advantage of the technology of transverse drilling to site oil facilities at locations where they can be better monitored to prevent wilful damage by irate youths.

Political will on the part of various levels of government is needed to create employment and divert the attention of the youths of Niger Delta from vandalizing oil facilities

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