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The Effects of Human Activities in the Mangrove Ecosystem in Nigeria (Review)

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Abstract

This paper looks at the mangrove ecosystem in Nigeria, using secondary sources to discover some human activities that affect the natural environment and the resultant effects of these activities. Some human activities affecting the study area were briefly studied which includes pollution of coastal waters, gas flaring, land reclamation, overfishing etcetera. The study concludes majority of the local population are fishers or are engaged in trade that services fishers. Collapse of these fisheries and other resources will inevitably lead to loss of livelihood by an already impoverished segment of the population. loss of livelihood implies loss of employment, loss of income, loss of pleasure, satisfaction and food. In a nutshell, loss of this ecosystem will lead to more poverty in the land. On the other hand, re-forestation and sustainable management of mangroves will lead to improved ecosystem health as well as all the services it provides for mankind and biological diversity. Finally the study recommends among others that sustainable agriculture should be introduced, which is based on the idea that if communities are given more knowledge and tools to grow better crops on their land that command higher prices and also points out that alternative livelihoods are a further refinement of sustainable

agriculture, which strives to give people other ways to make money that will limit their time and inclination to over-extract from the wild

Keywords: *Mangrove, Ecosystem, Human activities, Coastal Waters, Gas Flaring, Land Reclamation*

Introduction

The term "mangrove" refers to an assemblage of tropical trees and shrubs that grow in the Intertidal zone. Mangroves include approximately 16 families and 40 to 50 species (depending on classification). According to Tomlinson (1986), the following criteria are required for a specie to be designated as "true or strict mangrove": Complete fidelity to the mangrove environment, plays a major role in the structure of the community and has the ability to form pure stands, morphological specialization for adaptation to the habitat, physiological specialization for adaptation to their habitat, taxonomic isolation from terrestrial relatives. Thus, Mangroves are salt-tolerant characteristic complex plant communities occurring in sheltered coast line areas in the tropical and sub-tropical inter-tidal regions of the world such as bays, estuaries, lagoons and creeks. The plant community of a mangrove swamp is most commonly termed "mangal", a forest with a dense canopy, also known as mangrove swamp forest or, simply, mangrove. The mangrove forest of Nigeria is the larges in Africa and third largest in the world after India and Indonesia (Macintosh and Ashton, 2003). Nigeria contains the most extensive mangrove ecosystems, which comprise nearly 35 per cent of the total cover for West Africa (UNEP-WCWC, 2006). The total mangroves covers in Nigeria is about 7 386 km^2 which is 22 percent in Africa (UNEP-WCWC, 2006b) Mangrove swamps in Nigeria stretch along the entire coast and are found in nine of the thirty six states. The largest extent of mangroves is found in the Niger Delta between the region of Benin River in the west and the Calabar, Rio del Rey estuary in the west. The lagoons of Lagos and Lekki dominate the coastal systems in the west. Both Lagoons are fringed by mangroves and backed by swamp forests (FAO, 1992). Several threats like population growth and economic

development, petroleum and gas exploration and production, deforestation, invasive species and commercial fish farming are the major problems confronting mangrove ecosystem, This study is aimed to provide details on (i). Show the man-environment interface, (ii). The type of environmental problems arising from the human activities and the question of sustainability in general. (iii). How the situation may be resolved towards realizing sustainable use of the environment.

The Study Area

Mangroves are found to some extent in all the nine coastal states of Nigeria (Lagos, Ogun, Ondo, Edo, Delta, Bayelsa, Rivers, Akwa Ibom and Cross River). The major concentrations however are in the key Niger Delta states of Delta, Bayelsa and Rivers. The widest reach of mangroves is in the edge s of the Niger delta and specifically Delta and Rivers states. The Lekki and Lagos lagoons have the largest component of mangroves in the western axis. The Cross River has a secondary delta associated with the branching of the river into an estuary. This reaches 7-8km in width and stretches inland into the estuary for about 26kilometre (FAO,1992). Edo state though not on the Atlantic coast has a tiny mangrove section along the Gwato creek. A further amount is along the boundary line with delta state as the Ossiomo enters the Benin River. Mangrove is a distinct sub-set of the Nigerian rainforest and estimated to cover about a tenth of the forest and wooded area of 31.59 million hectares (Ibianga, 1985). It is found on the coast and stretch into the rivers and its complex lagoons in several places and estimates the Nigerian mangrove to be about 10,500km^2.

Over 20 million people live along Nigeria's coastal zone. The mangrove ecosystem has some of the fastest growing population centres in Nigeria. These include Lagos, Nigeria's economic capital, Port Harcourt and Warri with huge investments of oil and gas. Others are Calabar, Onne, Koko, Forcados and Bonny which serve various export and import terminals. More recently, fresh additions to LNG 'trains' are taking place in the mangroves as exemplified by the Brass plant. This fast development is exerting pressure on coastal natural resources. Rural-urban migration has heightened poverty in rural areas.

Climate

The Nigerian coastal area is dominated by the equatorial hot and humid climate. The annual temperature range is between 26^{0}C and 34^{0}C with the highest temperatures occurring during the dry season (November - March). Gas flaring

in the oil producing areas has introduced local highs in temperature that were hitherto uncommon in these areas. Temperatures of the order of 35^0 -36^0C could be experienced in the hot season while average temperatures of 32^0C are not uncommon. Hot spots include Port Harcourt, Warri, Bonny, Escravos, Forcados and their surroundings. The flaring of gases, apart from increasing the local temperatures also creates serious environmental pollution (Nwilo & Onuoha, 1993, Nwilo, 1995).

The total annual rainfall averages 350 - 600cm. More than 80 percent of the rains fall in the rainy season (April - October) when the tropical storm conditions are frequent. Rainfall is usually heavy and occasionally may last well over 24 hours. Rainfall of say 50mm per hour between July and August is common and results in floods which destabilize soil and enhance erosion.

The predominant wind is the rain bearing south west trade winds from the Atlantic Ocean. During the short dry season period, the dust laden north east trade wind from the Sahara Desert reaches the coastal area producing hazy weather conditions (Ibe et al 1985). Two rainfall periods exist in the coastal areas of Nigeria. The first is between March and July, when the inter tropical zone is moving northwards, followed by the south westerly monsoon wind which brings rainfall to the areas it blows over. Then, there is a short dry period in August, when the inter tropical zone is at its most northerly position, after which it starts moving southwards. Again, all the areas under the influence of the monsoon winds experience rainfall between the months of September and November.

Topography

The Niger Delta is composed of a chain of sandy beach ridge barrier islands about 20 in number, backed by brackish mangrove swamps. Behind the swamps is an extensive flood plain that starts from around Onitsha at a height of about 20m above sea level (Allen, 1965). The barrier islands rim the sub aerial Niger Delta from the vicinity of the Benin River on the north western flank of the delta to the Opobo River in the east. Their lengths range from 5 to 37 kilometers and average 18 kilometres while their widths vary from a few hundred metres to 12 kilometres. The Delta is underlain by deltaic deposits of the tertiary age up to 12,000m thick in some places. It is still building even though accelerated erosion and flooding are taking place in many places.

The base of the sedimentary fill in the Niger Delta consists of unfossiliferrous sand stones and gravel weathered from underlying pre-cambrian basement (Akpati, 1989). Above the course materials are marine shales, sandstones and limestones of Santonian age, whose deposition was ended in parts of the Nigerian basin by folding, faulting, and basic igneous intrusion during the Santonian age. The next cycle of deposition began with the transgression that lasted into the Maestrichtian. The present Niger delta was initiated during regression that began in early Eocene

The soils underlying the Niger delta are generally characterized as soft, highly compressible, organic and inorganic silt clays overlying fine sands at great depths (Nig. Coastal Erosion and Subsidence (Tech. Report no.1, 1991). These soil characteristics make the Niger delta highly susceptible to subsidence. Although no conclusive studies or research have been carried out to determine the degree of subsidence, increased flooding and inundation of the barrier islands and swamps seem to indicate that the rate of subsidence is appreciable. A preloading survey of the liquefied natural gas site in Bonny tends to support the idea that the delta is still undergoing natural subsidence. Allen (1965) sees the Delta as an area of long continued subsidence which has attracted stream drainage over millions of years and represents an interplay between the powerful, sediment laden Niger and almost equally powerful forces of the Atlantic Ocean into which it empties. Other forces such as damming, oil, gas and water extraction have also recently come into play in the determination of the physical configuration of the Delta. For example, the construction of dams across the River Niger and its tributaries has led to a reduction in the volume of sediment getting to the coast. This reduction has invariably led to increased erosion problems along the coastline (Nwilo, 1995).

Drainage System

The Nigerian coast comprises four distinct geomorphic zones. On the western side is the barrier bar lagoon complex that changes about 100 km eastwards of Lagos into mud beaches. The mud beaches then grade into the Niger delta that consists of a chain of sandy beach ridge barrier islands backed by an extensive mangrove swamp. The barrier islands rim the sub-aerial Niger delta from the Benin River on the northwest flank of the delta to the Opobo River in the east. There are more than 20 major beach ridge barrier is lands between the mangrove swamp and the open sea (Allen 1965). Eastward of the Opobo River to the

eastern border with Cameroon is the strand complex coastline. The continental shelf widens from 25-30 km off Lagos to 75 km at the Niger delta. There are 36 estuaries on the coast, which owe their origin to bar-built (such as the Lagos lagoon) drowned river valleys (such as Qua Iboe River) and river delta estuaries. The end of the continental shelf is marked by an often-steep continental slope. The slope is the beginning of what is called the offshore ocean environment (as distinct from what is generally referred to as the near shore coastal ocean).

Most of the physical factors such as winds, waves and tides affecting the coastal zone have their origin in the offshore ocean. This offshore ocean feature, together with the near shore ocean and their drainage basins (the so-called marine catchment basins) constitute the geographical space sometimes referred to as a Large Marine Ecosystem (LME) by Sherman and Alexander (1986).

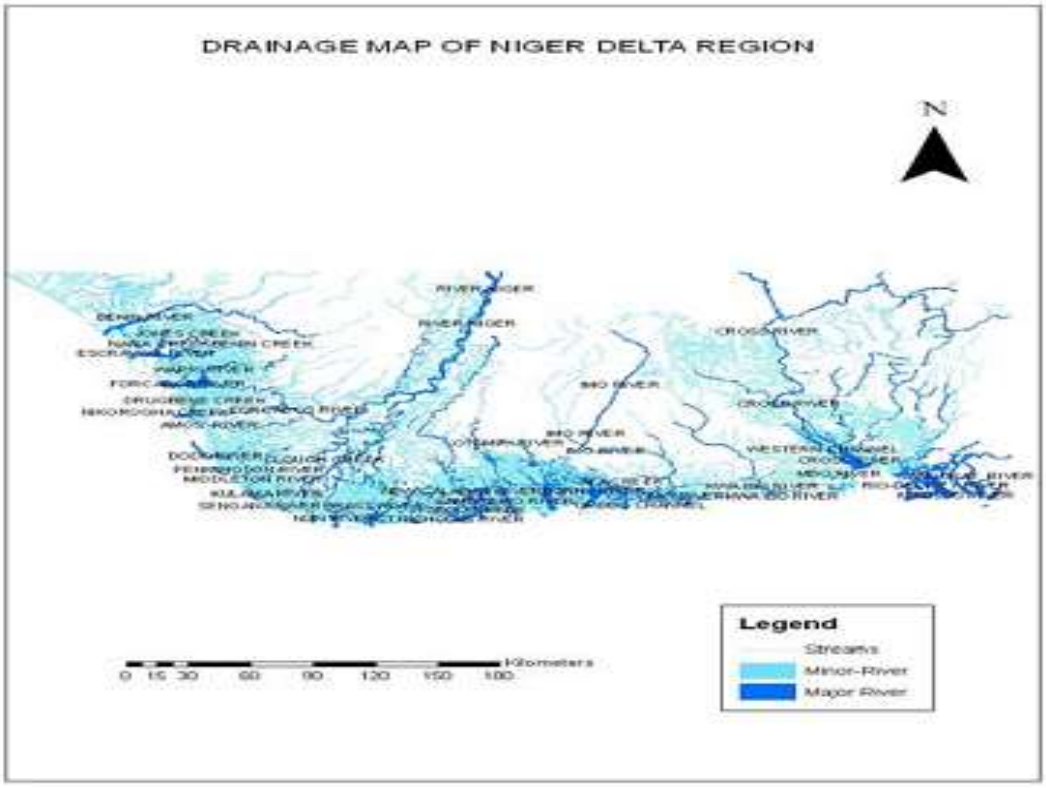

Fig. 1: Map showing the drainage system of the study area.

Fauna

The Nile crocodile, Crocodylus *niloticus*, is found in some estuaries.Turtles are protected species, species occurring in the Nigerian zone include (Caretta *carretta*(Atlantic Loggerhead), Lepidochelys *olivacea* (Pacific riddley turtle),

Eretmochelys *imbricata* (Atlantic Hawksbill turtle) and Demochelys *coriacea* (Leatherback turtle).They nest along the Nigerian beaches and inhabit mainly coastal waters. There is a degree of dependency of the most characteristic mangrove species towards the coastal zone.

A total of 13 bird families, comprising 45 species, have been recorded in the Nigerian coastal zone. Most of these birds are migratory, utilizing the mangrove and mudflat areas of the estuaries for short perio ds each year, while others are resident. The most common palaeartic migrant shorebirds are Charadrinus *hiaticula*, Pluvialis *squat* orola, Tringa *tetanus*, T. *nebularia* and Actitis *hypoleucos* . Among the water birds, the most common large residents are Egretta species (e.g. E. *intermedia*, E. *garzetta* and E. *alba*).

All 45 species have been reported to utilize the mangrove and mudflat areas as foraging grounds and/or roosting sites. Shore and water birds consume large amounts of crustaceans, annelids, molluscs and fish in their diet. The Nigerian coastal zone is a very suitable wintering or staging site for migratory waders. The expansive areas of exposed m u d and sand flats at low tide and the large mangrove systems provide rich nutrient flows in to the intertidal zone, thus providing suitable conditions for visiting water birds. A typology of mangroves in terms of bird composition may reflect the different organizational types of mangrove ecosystems, an essential tool for mangrove study and management.

Fruit bats most likely play an important role in the reproductive biology of most mangrove plants by acting as their pollinator. A large population of tree pangolin (Manis *tracuspis*), Grass cutter (Thryonomys *swinderianus*), Leopa rd (Panthera *capensis*), Otter (Aonyx capensis), Nile crocodile (Crocodylus *niloticus*), short nosed crocodile (Orteolaemis *tetraspis*), Mona monkeys (Cercopithecus *mona*), Putty nose monkey (C. *nictitanus*), Forest genet (Genetta *poensis*), Hippoptamus (Hippopotamus *amphibius*), Red river hog (Potamocherus *porcus*), Buffalo (Syncerus *caffer*), Bushbuck (Tragelaphus *scriptus*), Maxwell duiker (Cephalophus *maxwelli*), Yellow-backed duiker (Cephalophus *sylvicultor*), Blue duiker (C. *monticola*), Brush tailed porcupine (Antherurus *africanus*), Olive colombus (Colobus *verus*), Chimpanzees (Pan *trogloytes*), Pygmy hippopotamus (Hippopotamus *amphibius*), Red river hog (Potamocherus *porcus*), Buffalo (Syncerus *caffer*), Bushbuck (Tragelaphus *scriptus*), all these classified as endangered species of wildlife utilize the coastal zone, occurring in remote and undisturbed mangrove forests, they feed

on leaves and fruits and palm shoots. Some monkeys have a preference for feeding on mangrove leaves.

Flora

They are characterized by three species of *Rhizophora*. The red mangrove, R. *racemosa*, which make up about 90% of the vegetation of the mangrove ecosystem, is the pioneer at the edge of the alluvial salt swamp, R. *harrisonii* is dominant in the middle of the *Rhizophora* zone and R. mangle on the inner edge. Other species, more often found in stunted and shrub form, are R. *Avicennia nitida* and *Laguncularia racemosa*. Associated with the main mangrove formation is strand vegetation with *Conocarpus erectus* and other woody species that grows at the edge of the swamps, mainly near the sea. (Olorode, 1984)

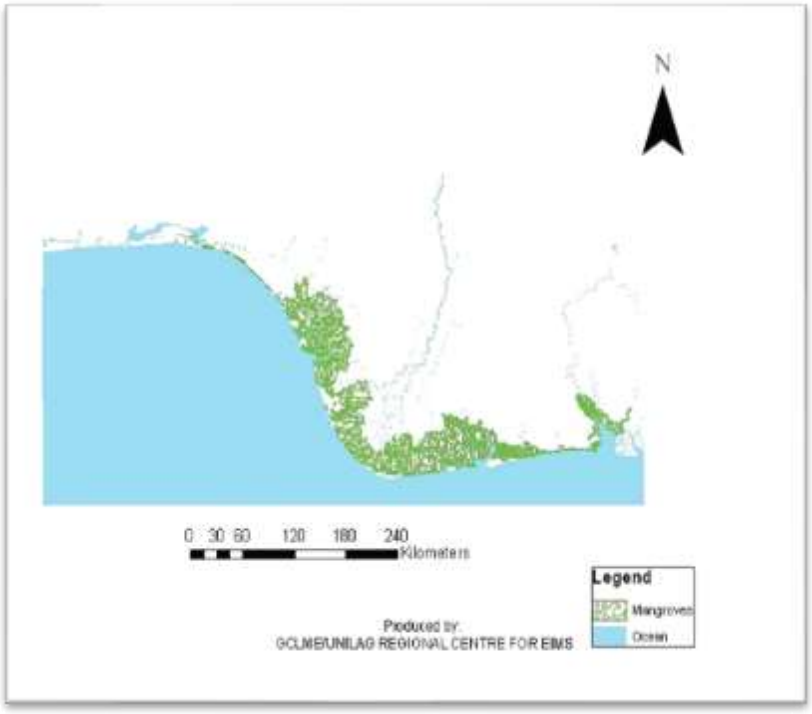

Fig. 2: A map of Nigerian mangroves

Importance of Mangroves

The importance of mangrove generally cannot be over emphasized. This ecosystem is a globally significant interface between the marine and tropical rain forest Mangrove trees remained the most efficient photo synthesizers than

almost any other plant, mangrove forms a life support system for much of the tropical world's coastal marine life

Mangrove forests are also important for the economy, society, and the environment. In economic terms, many different types of mangrove wood are used for construction, furniture making, and the extraction of useful chemicals such as tannin, alcohol, citric acid and wood tar. Mangroves are also a source of fuel, particularly wood from Rhizophora trees, which can be used for firewood and to make high quality charcoal. They also serve as fisheries, breeding grounds, and nursery areas for marine animals. Within the environment, mangroves act as a natural barrier which helps to protect against storms, Tsunami and coastal erosion. They help to protect the environment from toxic substances and their aerating roots can screen out debris carried by the currents, helping to clean water flowing from rivers and streams into the sea. Mangroves cause the deposition of sediment suspended in water, creating mudflats which are suitable for further mangrove colonization. Moreover, mangrove can absorb CO2 and fix C inside its body which led to decrease greenhouse gas. Socially and culturally, mangroves provide livelihoods for communities and are source of food from plants and animals as well as providing a source of medication from plants with medical properties. From the climate change perspective, mangroves are accepted to be good environmental indicators.

Human Activities

Fishing is the main occupation of the coastal communities, with various types of gears being employed. Fishing is conducted in creeks, rivers, estuaries, mudflats, near-shore and offshore. Commercial fishing supports about 440 trawlers, with about three quarters of the fleet targeting the shrimp resources. The mangrove plants and associated halophytic plants are used for building, extraction of tannin; construction works, curing of fish, and other fishing implements. Mineral resources in the coastal and marine waters include petroleum, with an oil reserve of about 21 billion barrels and gas reserve estimated at more than 11 trillion cubic feet. Current production levels are at about 1.9 million barrels of crude oil and 200,000 barrels of gas condensate per day. The current natural gas production is 3,400 million cubic feet per day in the form of associated gas, of which about 340 million is marketed in the

domestic market, 340 million re-injected and 2,7 20 million cubic feet is flared daily.

Sand and gravel are exploited onshore and offshore, in the riverbed, lagoons, estuaries and beaches. Millions of cubic meters of sand are dredged annually during oil exploration and exploitation, as well as for the construction industry. Most of the sand mined is used for reclamation of swampy areas, in the block-making industry and construction work.

The area is generally inhospitable and difficult to develop. The area is inhabited mainly by fishermen/women and small farmers. The human population is in form of a linear pattern. The dense vegetation of mangrove forest found in most of the coastal states have become a dependable source of fuel wood for domestic and small scale food processing as well as income generation. In Nigeria, mangroves and associated mangrove species are used for charcoal, firewood, wood distillation, poles and Nypa products. Species mostly used for charcoal are Rhizophora *spp*, , Avicennia *spp* and Laguncularia spp. Mangrove poles are used for building and flooring of houses, foundation piling, scaffolding and fishing stakes. The leaves are also used for medicinal purposes. Similarly, the fresh water swamp forest vegetation occurring around fresh water creeks and lakes support fishing activities, gathering of sea foods, fuel wood, gin distillation from raffia palm trees (Raphia *vinifera*), collection of African mango seeds, Ogbono, (Irvingia *gabonensis*), snails, weaving of mats and other objects/items from screw pines (Pandus *candelabrum*), rattan palm (Pandus *andelabrum*), and bulrushes etc. The population engages in subsistence farming, depending on availability of land, for their livelihood. In addition, mangrove forests have been of great use, supporting some of Nigeria's highest level of biodiversity and as habitat for numerous endangered plants and animal species.

In recent times, however, the mangrove forest and coral reef of Nigeria's coastal states has become highly degraded and depleted with the result that the ability of the ecosystem to fulfill its numerous functions is threatened.

Environmental Issues in Nigerian Mangroves

The human activities carried out in the mangroves have a long term effect on the environment these activities are threatened by modifications in the Mangrove ecosystem in Nigeria. The coastal areas of Nigeria, which house the Mangrove ecosystem have undergone wide modifications especially in the last

thirty years. Most of the modification had been due to increasing pressures on coastal resources, conflicting exploitation methods, increasing population and other anthropogenic activities these activities include oil pollution, gas flaring, industrialization, soil degradation, heat stress, acid rain, water resource degradation, introduction of alien invasive species and deforestation. Most of the modifications have resulted in loss of biodiversity, reduced ecosystem viability and value of coastal systems.

In many cases for example, mangrove ecosystems have been on the decrease since exploitation for oil and gas commenced in the Niger Delta. Most areas, which had dense mangrove vegetation, have been replaced by new vegetation like grasses and climbers.

The Nigerian marine environment continues to come under various serious threats, usually linked to development pressure. Man-made impacts tend to impair the integrity of the marine environment and negatively influence biodiversity.

Cutting down of mangrove vegetation by local people for building and firewood also result in deforestation of the mangrove vegetation. This has also encouraged the spread of Nypa palm (an exotic species) which is fast displacing mangroves in many disturbed areas. Below are the most prevalent agents responsible for modification of ecosystems (Awosika, 2005)

Pollution of coastal waters

The main sources of pollution include industrial waste, raw/untreated sewage and pesticides. Hydrocarbon production contributes about 95% of the country's Gross National Product (GNP). Oil exploration, exploitation and transportation have a significant effect on the environment. Crude and refined oil spills incident s are very frequent in the coastal and marine environment, especially during periods of very strong ocean currents when it can spread to cover the en tire 853 km coastline. The area where frequent spillages occur is categorized as ecologically sensitive or critical (mangrove ecosystems).

Mangroves roots heavily coated by a thick layer of bituminous material (Bodo West, Bonny LGA)

Gas flaring

Efforts to reduce the flaring of associated gas have not been very successful as low technology does not perm it the exploitation of natural gas. Flaring impacts on the quality of the coastal atmosphere. It also affects coastal vegetation and human habitation. The mixture of flared gas and precipitation causes acid rain, with harmful effects on the mangrove biota and marine organisms. These impacts are yet to be studied and fully understood

Land reclamation

Land reclamation of swamps adjoining the coast for the increasing human population and other development activities destroys the nursery, breeding and feeding grounds of marine organisms. It also restricts the distribution of organism s and leads to considerable loss of biodiversity.

Coastal erosion

Coastline erosion is prevalent in Nigeria and has been closely associated with ocean front constructions such as ports and harbours. Ibe (1989) reported that the Nigerian coastline experiences some of the fastest erosion rates in the world averaging about 20-30 metres per year in some locations.

Over fishing

The coastal and marine resources are either over fished, or fished close to, or beyond their maximum sustainable yield. The heterogeneity of species of different sizes poses a problem in mesh size regulation in the fishery sub-sector.

Deforestation

Deforestation of the coastal mangrove vegetation exposes the coast to storm surges, coastal erosion and loss of land. The mangrove swamp is the spawning, breeding, nursery and feeding ground for fish and shellfish for both brackish and marine organisms.

Construction of canals and channels

Construction of canals/channels contributes to land loss as craft movement generates strong waves that impact on the banks of these waterways.

Mining of sand

Mining activities on the foreshore and seabed are a very common feature in Nigeria and they impact negatively on the bottom communities. Mining of sand affects the environmental sediment balance and has major impacts on the associated bottom dwelling organisms.

Invasive species

Water hyacinth Eichhornia *crassipes* entered Nigeria through the freshwater lagoon system in September 1984. The present distribution in coastal waterways has been estimated at 3,561 km^2. Spreading of the infestation to adjoining lagoons in the Republic of Benin and the Cameroon is estimated at 500 km^2 and 275 km^2 respectively.

The tiger shrimp Penaeus *monodon* entered the Nigerian coastal waters in about 1992 following the escape of captive stocks from a shrimp farm in the Rivers area. These shrimps now occur throughout Nigerian coastal waters less than 20 m deep. They are most abundant in Akwa Ibom, Rivers and Cross River coastal waters and have recently been reported in Lagos lagoons and other estuaries along the coast. The shrimps are caught throughout the year with a peak period in abundance between February and October. Initial trawl landings in 1998-1999 were limited (500-800 kg per trip of 50 days) but by the year 2000 it had become a major fishery for the commercial shrimp trawlers with each vessel landing between 10 and 14 tonnes per annum. By the end of 2001 each vessel

landed an average of 17-21 tonnes per annum (Isebor 2003). The impact of this invasive species on indigenous shrimps is unknown.

Nypa fruticans is gradually replacing Rhizophora sp. due to mangrove deforestation and the lack of a management plan for the coastal zone. Slow natural regeneration of deforested areas leading to the rapid invasion and colonization by Nypa. This invasive plant is a threat to the economically and ecologically important mangrove trees, as well as exacerbating the destabilization and erosion of coastal foreshores. Nypa lacks the necessary prop root system that stabilizes and consolidates the muddy banks.

Nipa palm competing with native mangrove (Imo River, Khana LGA)

Oil spills

The impact of an oil spill depends among other factors on the type of oil, the volume spilled, the nature of the spillage (continuous or intermittent), the nature of the impacted environment and the prevailing meteorological and oceanographic conditions.

In 1970, only one oil spill (of 150 barrels) was reported; in 1971 the number increased to 14 involving 15,110 barrels. By 1974, there were 105 oil spills, increasing to 154 and 241 reported oil spills by 1978 and 19 80 respectively. The number oil spills in 1999 was 319, which was 32 percent higher than the 1998 figure of 242.

Depending on spill circumstances, known and potential impacts include:
• Mass mortality and or tainting of animals as well as other aquatic resources;
• Ground water contamination;
• Abandonment of Fishing ground and associated livelihood pursuits;
• De vegetation and other forms of ecological damages;
• Loss of biodiversity in breeding grounds;
• Loss of drinking and industrial water sources;
• Reduction of land area available for agriculture;
• Loss of recreational facilities and aesthetic values of the environment;
• Increased economic burdens of pollution cleanup, population rehabilitation;
• Impairment of human health; and
• Worsened rural underdevelopment, poverty and heightened community embitterment.`

Solid wastes

Solid waste constitutes a major environmental problem in the coastal areas of Nigeria especially from major coastal cities like Lagos, Warri and Port Harcourt. Due to rapid increase in coastal population, the volume of solid waste generated by residents has quadrupled in recent years. Facilities for disposing of solid waste have been over stretched hence manual clearing of solid wastes have been rendered inadequate. The use of mechanical devices has become inevitable.

The largest generators of solid wastes are the steel, food processing and tanning industries. Estimates of annual generations of municipal solid wastes for Lagos, Calabar, Port Harcourt and Warri are 1,400,000; 190,000; 650,000 and 66,721 tonnes respectively (Lagos Waste Management Authority (LAWMA 1999). Wood-shavings and saw-dust from the wood processing industry which are sometimes located near water-fronts pose peculiar problems which include; BOD imposition, smothering of benthos and alteration of hydrodynamic conditions.

Sewage

In most large Nigerian cities, there is no central sewage treatment plant except in some relatively new estates and factories. In most cases, households are connected to self – contained septic tanks. Therefore, raw human waste

evacuated by dedicated trucks is generally disposed into coastal waters. This practice is very prevalent in Lagos, Warri and Port Harcourt where coastal population is very high.

Global climate change and sea level rise

Probably the main coastal consequence of an increase in global temperature is an accelerated rise in sea level. Latest projections of sea level rise predict a sea level rise of between 65 + 35cm by the end of the 21st Century (Second World Climate Conference, Geneva 1990). The rate of sea level rise along the Nigerian coastline in the past has not been quantified due to paucity of data.

Recommendations

Having fully grasped the human – environment interface in the mangrove and the long term effect of human activities understood, the flowing are steps to be taken in order to sustain the environment for future use.

1. There should be protected areas where both fauna and flora are preserved. More research needs to be done to define the status of the resources that would be in these parks. Especially needed at this time are updated maps and data on the status of all so-called protected areas.
2. Many conservationists believe that the best hope for protecting and conserving natural resources is to involve communities in this work. Communities near protected areas and any other remaining wild areas in Nigeria rely on these resources for their existence. They should be made to know that they are stakeholders and therefore not watch while their means of livelihood depletes and it is to their advantage to conserve them for future use.
3. Sustainable agriculture should be introduced, which is based on the idea that if communities are given more knowledge and tools to grow better crops on their land that command higher prices, they will be less inclined to clear more land and further degrade the environment.
4. Alternative livelihoods are a further refinement of sustainable agriculture, which strives to give people other ways to make money that will limit their time and inclination to over-extract from the wild. For instance engage people in removing invasive species, like Nypa palm, while providing them with uses like training people to use these plants

for crafts products they can sell, much as people do in the Southeast Asian countries where Nypa palm has evolved along with people.

5. The government should also invest in ecotourism as this will provide an alternative subsistence for the local.
6. Also, steps should be taken in the addition of conservation of the environment in junior school curricular, so as to inculcate environmental conservation in young ones.

Conclusion

The importance of mangroves as an ecosystem has been highlighted – biological importance, ecological importance, socio-economic importance. The results of human activities on the resources of this ecosystem have equally been discussed. Now, a balance should be drawn between the need of the mangroves by communities, and resource sustainability. Since the entire ecosystem is dependent on mangrove survival, mangroves should be re-planted. It is a known fact that mangroves are slow-growing plants, so allowing only natural replenishment will further cause mangrove-dependent resource depletion. Majority of the local population are fishers or are engaged in trade that services fishers. Collapse of these fisheries and other resources will inevitably lead to loss of livelihood by an already impoverished segment of the population. Loss of livelihood implies loss of employment (idleness is the mother of most social vices), loss of income, loss of pleasure, satisfaction and food. In summary, loss of this ecosystem will lead to more poverty in the land. On the other hand, re-forestation and sustainable management of mangroves will lead to improved ecosystem health as well as all the services it provides for mankind and biological diversity. In this situation, the rural communities will be empowered toward self and environmental development.

As a step towards sustainable management of mangroves, re-forestation will ensure availability of this resource and the services it provides for future generation

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