

STATE OF THE ENVIRONMENT IN THE NIGER DELTA AREA OF ONDO STATE

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Abstract:

The geomorphological agents at work in the coastal zone are winds, the astronomically-generated tides, the wind-generated waves, and various forms of current flow. These generate specific geomorphic processes and interact to produce an energy input which shapes and modifies the coast. Through feedback mechanisms, the developing morphology influences geomorphological processes, thereby becoming a factor influencing subsequent coastal evolution. Man, through his activities, is also a variable in this geomorphological equation.

Within the last three decades, accelerated coastal erosion, sea incursion and flooding have surfaced and reached alarming dimensions in some other parts of the niger Delta, notably along the transgressive mud coast in Ondo state. This paper examines the state of the environment in the Western Niger Delta area of Ondo State. It identifies the environmental problems in the area and also at the environmental and socio-economic impacts of these problems. Possible and practicable recommendations were proffered in an attempt to reduce or check the trend and scenario of these problems in the area.

Key Words: Environment, Niger delta, Ondo State

Introduction

Studies on coastal landforms, processes and change are becoming more and more relevant as human intervention (at scales ranging from sandmining on a single beach to global warming) increases (Viles, 1990). It is very apparent that coastal zone is of great importance to every maritime nation of the world. Data derived from United Nations Population Division (1993) revealed that many of the leading megacities in the world are located on the coast. Consequently, the coastal zone of most countries of the world represents areas of many activities; for example communication, food production, settlement, recreation, mining, harbor making and so on. In addition to human activities or moderation on the coast, the coast itself, is a zone of intense energy input naturally, this energy transported by waves arrives at the coast and is available for work. Therefore, the coast represents a zone of complex and dynamic process naturally which shape and re-shape the configuration of the zone continuously. Geomorphologically, the zone can best be referred to as the most restless part of the continent.

Obvious advantages of the coastal zone to maritime nations make it expedient that deliberate, systematic studies of the areas be carried out for the purpose of proper coastal management and planning. Failure to study and manage each coastline properly with regard to ongoing natural and human activities in this area poses a great hazard and threat of lives and investment in the future. The entire coastal zone of Nigeria and elsewhere represent a challenging environment for applied geomorphological research where a continuum of relationship is observable.

Coastal Erosion

Coastal geomorphologists are becoming increasingly concerned with applied studies for a variety of reasons, including economic considerations (Viles, 1991). Dees and Davis (2001) described erosion as the means of wearing away of a shore of a body of water covered by sand, gravel or larger rock fragments by an instance or product of erosive action. The problem of coastal erosion and coastal stabilization is attracting greater attention from recent studies. Coastal erosion is not confined to Nigeria or West Africa coastline alone. It is a global phenomenon creating problems in virtually all the continents, such as United States of America, South America, France, Japan, Australia

and Africa. The coastal characteristics vary a lot from one coast to another on a regional basis, even along the same country like Nigeria, but the fundamental processes of wave's tides, and current actions at the coast remain the same everywhere.

Studies by Davies (1986) have shown that in the United States of America, the coastline is eroding at an average of more than one metre per year on the Pacific West coast and exceeding thirty metres per year in parts of Louisiana's coast on the Atlantic side. The magnitude of coastal erosion and coastal recession varies from place to place over time. Erosional rates along the Spain is said to vary from thirteen metres to more than thirty metres per year according to measurement. In Japan, problem of coastal erosion is so acute along the coastline that presently Japan has witnessed perhaps the world's most concentrated to arrest coastline erosion (Ibe, 1990; Nordstorm, 1994).

In Miami Beach, for example, despite the provision of a great number of steel groynes and vertical seawall, for millions of dollars, erosion still continues. The same story is at Florida beach, after the dredging of the inlet, the jetties that were built in 1918-1925 had blocked the southward littoral drift almost completely. The consequence was heavy erosion on the southern side of the inlet. Over many years now, attempts were made to combat erosion by construction of a great number of groynes, but this has not been very successful (Steers, 1971).

Coastal erosion is of course not limited to lowlying coast like in a stretch of depositional coast such as forms a larger part of Nigerian coastline. It also affects rocky coasts with cliffs and wavecut platforms (Faniran, 1986). For example, in the studies by Valentine (1971), along the Romans coastline of the Northsea between Flamborough head and Kilmsea, the low hills of Holderness reach the coast and form cliffs. As reported by Valentine (1971), along 61.5 kilometre of the Holderness coast, 307 points were selected at which to measure the retreat of the land between 1852 and 1952. on average, the cliffs receded by 120 metres in that period, approximately 720 hectares of land were lost and hence about 100 million cubic metres of materials were carried away. It was noticed that erosion was most severe at the south-east than north. Also, the most general cause of erosion was attributed to the energy of the sea. For future coastal protection, it was suggested that severest points of erosions should be considered first.

The Nigerian coast is richly endowed with a variety of natural resources, especially forests and mangroves, fisheries, touristic resources and mineral resources such as crude oil and gas which account for over 90% of Nigeria's foreign exchange earnings. Geomorphologically, the Nigerian coastline can be divided into four main physiographic zones: the Barrier-Lagoon complex, the Transgressive Mud beach or Mahin Mud coast, the Niger Delta and the Strand Coast. These different sections of the Nigerian coastline are associated with differing erosive activities; a result of combination of natural and anthropogenic factors.

The Niger delta geomorphic region in its entirety that is including the flanks is extensive, composite and multifaceted. The erosion rates in this section of the Nigerian coastline varies, ranging from between 18-24 m annually at Ugborodo/Esravos station, 20-22m annually at Forcados station, 16-19m annually at Brass station, 15-20m annually at Kulama station and 20-24m annually at Bonny station and 10-14m annually at Opobo (Ibe, 1988). The strand coast is about 85km long lying between Imo River and the Nigerian border with Cameroon in the east. The Strand coast is fronted by flat beaches which change into a beach ridge plain behind with a few small swamp systems. An average of between 10-13m erosion rates were recorded at Ibeno-Eket station (Ibe, 1988).

The perception of the deleterious effects of human activities on the coastal environment system in Nigeria dates back to 1910 when the construction of moles to halt the movement of sand into Lagos Harbour began to induce progressive accretion of Lighthouse Beach behind the west mole and the retrogradation of Victoria Beach east of the mole (Webb,1960; Uzoroh, 1971). Similar changes have also taken place at Ogborodo (Esravos estuary) as a result of the construction of moles which interfere with the natural movement of sand along the coast and have altered, therefore, the age long pattern of erosion and deposition in the area. These man- induced accelerated processes are still very active in these coastal areas.

Within the last three decades, accelerated coastal erosion, sea incursion and flooding have surfaced and reached alarming dimensions in some other parts of the Niger Delta, notably along the transgressive mud coast in Ondo State; Patani, Bomadi, Burutu and Ogulaha along Forcados River in Delta State; Oron, James Town and Mkpong Utong along Cross River; Utaiwa along Jaja creek; and

Brass and Ibeno-Eket in Akwa Ibom State (CREMS, 2000). In fact, Asangwe (1993) identified more than fifty erosional sites along the national coastline.

Coastal erosion is a normal geomorphological process worldwide. However, the acceleration of coastal erosion is largely attributed to direct and indirect interference by man with the normal hydrodynamics along the coast. With the exception of Victoria Beach, Awoye area and Ogborodo (Escravos), the causes of accelerated erosion along the Nigerian coast are still unknown (CREMS, 2000). The alarming ecological and socio-economic impacts of these processes, however, have prompted individual environmental scientists, research institutions and governmental agencies to proffer and implement "lasting" solutions to these problems. Invariably, these solutions are not products of detailed long-term studies of the hydrodynamics of coastal processes, accelerated erosion and flooding in the affected areas. Also importantly, environmental issues were not taken into consideration in the decision and implementation of the coastal protection works. Consequently, many have failed woefully to solve the problems. In fact, in most cases, they have further undermined the stability of the coastal environment. All these underscore the need for research and database for coastline protection, coastal zone planning and management. This is particularly desirable in respect of the Ondo State coast owing to its uniqueness which makes it unwise to transfer to the area solution which has worked in other but dissimilar areas.

The Study Area

The area lies east of the West African lagoon system and on the western or Benin Flank of the Niger Delta Basin. The numerous lagoons in the coastal area have all disappeared due to silting and spread of aquatic weeds; the only survivor is the Mahin Lagoon. All the creeks and rivers in the area drain into Benin River. It is only here that the sandy beach materials of the Nigerian coastal plain are replaced by mud and lacustrine deposits. The general stratigraphy of Ondo State coast, therefore, differs from that of the Niger Delta by having about 60m mud overlying the Benin sands. The location of its eastern part in an unstable fault zone on the Benin Flank of the Niger Delta has important implications for geomorphological processes in this environmentally sensitive region. Unlike in other coastal states where wide wave beaten barrier beaches are backed inland by a sequence of equally extensive raised beaches and lagoons or mangrove swamps, the coastal plain in Ondo State is not only narrow (less than 700 metres wide) but it is backed by 30km-60km wide freshwater marshes and freshwater swamps with an intricate network of interconnected creeks swamp and lacustrine marshes. The narrow coastal plain constitutes, therefore, a fragile buffer zone between the tranquil waters of the swamps and the menacing waves of the Atlantic Ocean. Extensive breaching of this narrow coastal plain will result in massive incursion of the sea into the inland swamps with serious implications for national security and economy.

Soil and vegetation follow closely the geomorphological pattern. The main types of vegetation are:

- i. Mangrove forest and coastal
- ii. Vegetation.
- iii. Freshwater swamp forest.
- iv. Savanna and stunted rain forests of the sand ridges and mainland margin.

The mangrove forest on the coastal plain has been extensively cleared by the people for use as fuelwood, especially around the settlements where they have been replaced by coarse salt-resistant grass. Striking feature of vegetation in the area is the dessication of about 10,000 hectares of freshwater swamp forest in the Awoye area. It is attributed to salinization induced by salt water intrusion.

The soils are hydromorphic. The older sand ridge complexes develop brown and orange sand soils while the more recent one near the coast bear light grey sand soils. Where there are depressions on the ridge complexes, the soils can be described as poorly drained light grey sands. The swamps flats are characterized by swampy 'organic' soils which in the major part consist of decomposed and partly decomposed matter, while areas affected by tides bear saline soils.

Coastline Recession

Coastline recession in the Western Niger Delta area of Ondo State is principally by wave attack on the unconsolidated sediments of the clay ridge since the coast is not under the influence of longshore currents and the nearshore littoral Guinea current is very weak. In the absence of the protection offered by mangroves, the energy of waves and tides is concentrated on the bare surface of

the clay ridge exposed to the direct impacts of waves. As the waves overrun the plain during high tide, a network of rills develops on the plain by the backwash of the waves. These rills are progressively deepened and widened by subsequent uprush and backwash currents to form deep U-shaped gullies with vertical heads. The bigger gullies have terraced walls, the terrace being on the same level as the sub-tidal platform. These gullies become avenues for penetration of waves into the coastal plain as the gully heads advance at a very rapid rate into the plain. The measured rates of gully head retreat vary from 5.7m to 15.8m per annum (Ebisemiju, 1987). Most of the gully heads are now less than 50m from the town. Some gullies develop tributaries. Opposing tributaries of adjoining gullies cut deeply into their common interfluvies and eventually meet. In this way, a block of the plain is detached from the 'mainland'. As this block is attacked from all sides by waves, its total destruction is very rapid and a sub-tidal platform is produced. The platform grows as other detached blocks are eroded. The landward limit of effective wave action is marked by a mud scarp less than 1m high. The retreat of this scarp face is through the collapse of chunks of clay which first accumulate at the base of the scarp until they are broken into smaller fractions and transported seaward by backwash or carried into the coastal plain during high tide. Thus during low tide, the backshore area is highly indented by gullies and the sub-tidal platform is dissected into blocks of varying sizes. During high tide, the platform is submerged. The sea inlets dug by fishermen also serve as zones of rapid coastal erosion.

During high tides and the infrequent storm surges, the low coastal plain is overtopped by waves and tides. These initiate a sheetwash process and an imperceptible but widespread removal of surface sediments and their transportation into the inland creeks and swamps. In this way, the coastal plain is progressively lowered. Surface lowering by sheetwash also takes place during rainstorms.

The accumulation of ocean water in depressions on the coastal plain aids both coastline recession and ground surface lowering. These flood pools have the effect of making the water content of the soils higher and thereby weakening the physio-chemical interparticle bonds, reducing the coherence of the unconsolidated soil, and rendering the flood pool area more vulnerable to sheetwash erosion by the energy uprush and backwash currents of the waves and tides. The depressions are thereby deepened and widened until adjacent ones coalesce and become incorporated into the growing sub-tidal platform and plays a major role, therefore, in its expansion and subsequent destruction of the coastal plain.

Probable Causes Of Coastline Recession

The Niger Delta has been growing seaward by the accumulation of sediments brought down by the River Niger itself. At the same time, erosion phenomenon has been very aggressive and persistent in some parts of the Delta. The Niger Delta has also been experiencing regional subsidence arising from isostatic response to loading of the Delta and its margins with sediments from the Niger/Benue drainage system (Allen, 1964, 1965; Allen and Wells, 1962; Burke, 1972; Mascle, et al, 1976). Ebisemiju (1985, 1987) postulated that this regional subsidence process had probably been accelerated by the withdrawal of oil and gas from the Agbada Formations which underlie the unconsolidated deposits of silt and clay materials in the area.

It is also significant that the local people link the incidence of accelerated coastal erosion in the area with the commencement in the 1970s of crude oil and gas exploration in the area. A particularly striking feature of the mud coast of the desiccation off the swamp forest. The central and lateral bounds of the stressed forest area closely match those of the zone of accelerated coastline recession. The area appears to be expanding outward, especially westward, from a central point some 5km inland from the coast.

Seismic investigations by oil prospecting companies also could have induced local subsidence. Seismic investigations have involved the detonation of explosive charges at or below the ocean floor in the nearshore zone. Local people, especially at Aiyetoro, claimed in a memorandum to the NNPC in 1981 that seismic investigations conducted in the area generated shock waves which caused extensive damages to the King's concrete palace and other structures in the town; this claim was refuted by the Corporation. It is well known that, however, that the force of such explosion could cause liquefaction of surficial sediments and consolidation of the subsurface sediments, resulting in a potential increase in sediment erodibility and water depth. The potential disturbance of the nearshore bottom induced by such activities is consistent with the conditions necessary to promote coastal erosion. Increased water depth within the nearshore zone would enable larger waves to penetrate

further inland than otherwise experienced. This would result in coastal erosion and inundation of inland forests by sea water.

The association of space and time of accelerated marine erosion and dessication of forests would imply that the transgression of the sea which induced these major ecological disasters were indeed triggered by a single geomorphic process, viz, localised accelerated of land subsidence. The high concentration of oil wells within the affected area further supports this theory since it defines a possible mechanism for the consolidation of subsurface host and overburden materials causing land subsidence. Seismic shaking of the southern parts of Nigeria in 1985 indicate that the continental shelf here may not be so stable after all. It is, however, not unlikely that the seismicity was triggered by subsidence associated with hydrocarbon extraction in Awoye area, as has been reported from other parts of the world (Yerkes and Castle, 1976).

Overtopping of the coastal plain by waves and tidal floods, also could have been further accelerated by rise in sea level in response to global warming. It has been predicted that temperature will rise by between 2^oC and 3^oC and sea level will rise by 0.5m to 1m by the year 2100. the resulting deepening of the continental shelf will result in increase in effective wave height and other changes in wave and tidal dynamics. These will further increase the rates of coastal erosion, flooding and salt water intrusion along low-lying coasts like the mud coast of Ondo State.

The Environmental And Socio-Economic Impacts Of Coastal Erosion

The coastline in Awoye has receded by about 3.31km between 1974 and 1996 at annual rates which varied from 31m to 19m. by 1981, coastline recession in Awoye area had caused the incorporation of 487 hectares of the coastline plain into the Atlantic Ocean within a period of eighteen years: 1973 to 1991 (Ebisemiju, 2001). By 1996, the cumulative losses had risen astronomically to 3415 hectares. During this period, the coastal plain was reduced in width by about 62% and breached in four places at Jirinwo, Odofado, Awoye and Ago Nati. This has resulted in the loss of scarce land for settlement and animal husbandry on the narrow coastal plain. At Aiyetoro, the coastline has receded by about 0.57km between 1974 and 1999 resulting in the incorporation of about 300 hectares of the coastal plain into the Atlantic Ocean. The present rate of coastline recession is 35m a year. At this rate, the coastal plain which is only about 50m wide here will be breached. Other areas experiencing very rapid rates of coastline recession are Ori-Oke Iwamimo to Ogororo and Abereke.

The coastal processes have also adversely affected the fishing economy of the people. Fishing in both the freshwater creeks, lagoons and swamps and in the nearshore zone of the Atlantic Ocean has always been the main source of revenue for the local people. The turbidity of ocean waters in the nearshore zone is high. The waters of the nearshore zone, therefore, constitute an unfavourable ecological environment for marine fishes which have consequently deserted the zone forcing fishermen to travel far into the sea. Unfortunately, they are unable to finance the additional investments which deep sea fishing entails.

The major direct impacts of the erosion menace, obvious even to the least discerning observer, is the large scale destruction of buildings, canals and mangrove forest especially in Awoye area. Evidence abounds both around the present coastline, within the inter-tidal platform and in the nearshore zone to indicate previous settlement sites; there are in the form of ironwood stakes of abandoned houses.

Accelerated coastline recession and tidal floods have forced people to abandon their houses and move inland to relatively safe locations. On the average, settlements are moved from one location to other every four years. Today, the original site of Awoye is in the Atlantic Ocean at a distance of 3km from the present shoreline. This semi-nomadic movement of the people does not allow erection of permanent structures but those that can be easily dismantled whenever they are being threatened by tidal floods and coastal erosion. This periodic relocation of settlements inland, therefore, is a significant economic social and cultural disruption to the people. The massive breaching of the coastal plain in Aiyetoro area will undoubtedly produce a catastrophic event that will wipe out all the settlements in this heartbeat of Ilaje coast, with the impacts felt throughout the freshwater swamps to the north.

The deleterious effects of accelerated coastal erosion and sedimentation on the environment, economy and social life of the communities in the Awoye/Imoluma area are pervasive and most of the people have resigned themselves to a situation beyond their control. Indeed, the continuing threat to life and property by coastal erosion and tidal floods, the cost of rebuilding houses every two to four

years, the hazards and high costs of deep sea fishing, the loss of the rich nearshore and freshwater fishing grounds and the lack of alternative gainful employment opportunities have forced the young and middle-aged men and women to emigrate to other riverine states in Nigeria and also to neighbouring West Africa countries, especially the Cameroon Republic, Gabon, Congo and Ghana where they engage primarily in fishing and remit part of their earnings for the upkeep of the older folks who remain behind.

Erosion Control Measures

Two categories of coastal erosion are distinguishable: long-term (chronic) and short-term (storm-induced) coastal erosion. Generally, chronic erosion is more difficult to address than storm-induced erosion (PACE, 2003). Generally, because of the dynamic nature of coastal areas, various methods for protecting the coastline from the consequences of coastal erosion problems exist; some structural and others non-structural. The structural measures have been described as 'hard' measures, which has to do with the constructions of various engineering devices, which are physical and concrete, meant to protect or reduce subsequent occurrences of a given hazard events. Some of the hard coastline defense works that have been used in managing coastal erosion and retreat include groins, jetties, breakwaters, sea-walls, wave-return walls and tetrapods (Charlier, et al., 1989a, Charlier, et al., 1989b). The non-structural responses include the use of satellite forecasting or telecommunications for issuing warnings (Anderson, 1994).

Sand replenishment, revetment and other structures such as groins and jetties which are structural measure and designed to retard littoral drift of materials are not relevant to the resolution of the coastal erosion crisis in the area since littoral drift is virtually non-existent along the entire length of the mud coast. Rather, the searchlight should be focused on those structures which prevent incoming waves from breaking close to the coastline, and at the same time dampen their ferocity. The control works capable of achieving these are sea walls (dykes) and breakwaters.

A widely canvassed engineering solution to coastal erosion in the area is the construction of a dyke to follow the edge of the high waterline, and high enough to prevent over-topping by tidal waves, with the seaward toe protected with some form of armour layer, and the construction of revetment on this side to reduce the action of waves and currents on the dyke.

Suggestions For Effective Management Of Coastal Erosion Along The Nigerian Coast

Coastal erosion, as a natural occurrence and process may not entirely be stopped, but can be properly managed in such a manner as to maximize the gains associated with its occupation and physical development while reducing the risk in such human occupation. Two categories of coastal erosion have been distinguished- long-term (chronic) and short-term (storm-induced) coastal erosion. Generally, chronic erosion is more difficult to address than storm-induced erosion (Dees, et al., 2001). A combination of methods has been recognized in the management of coastal erosion in the world. Charlier et al. (1989a, 1989b) has divided the methods into 'hard' and 'soft' methods. However, despite the use of the hard and soft or a combination of the hard and soft methods of coastal erosion management, it has been found that three quarter's of the world's beaches are in retreat, some at a rate of a year. Thus, in this paper, Integrated Coastal Zone Management (ICZM) is been recommended for the Nigerian coastal area.

ICZM is defined as a dynamic process in which a coordinated strategy is developed and implemented for the allocation of environmental, socio-cultural and institutional resources to achieve the conservation and sustainable use of the coastal area (Nwilo, 2004). ICZM has been described as a process for decision-making: it should be continuous, iterative and should recognize the contributions of stakeholders and the natural dynamism, both physical and ecological, of the coastal environment (Smith, et al., 2004). A primary goal of ICZM is to overcome the compartmentalized approach to managing coastal resources by harmonizing the decisions of diverse jurisdictions and levels of government. For instance, EU has recently recommended the promotion of participatory planning in coastal management and encouragement to develop systems that allow the monitoring and dissemination of coastal zone information (Jude, et al., 2004). In particular, ICZM aims to bridge the traditional divide between management of the land and the water. ICZM, therefore, is also about building institutions that facilitate this integration and is also founded on the principles of sustainable development, recognizing that the coastline is the fount of resources of great value to human communities and that these resources should be managed in ways that conserve their value for future generations (Jude, et al., 2004).

However, some of the challenges facing the successful implementation of an ICZM in Nigeria for the management of the Nigerian coastal erosion can be broadly grouped into political, socio-economic and manpower factors. These challenges must be properly addressed as part of the concerted efforts aimed at avoiding adverse effects of coastal erosion phenomenon.

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