Morphology Analysis of Niger Delta Shoreline and Estuaries for Ecotourism Potential in Nigeria

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Abstract

Estuaries provide numerous goods and services needed for human development and socioeconomic sustenance, housing about 60 % of the world's population with highly fragile natural endowment of luxuriant diverse ecological types. A beneficial link through long-term biodiversity conservation with local, social, and economic development in estuaries therefore remains a well-planned ecotourism development. Such development is necessary since disturbance of the dynamic 'steady state' of estuaries may result in total modification of their morphology or losing entire ecosystems. This study examines the shoreline morphology of the Niger Delta and major estuaries for better understanding of the natural forcing within the estuary systems and their potential for ecotourism development planning and management beyond the twenty-first century.

Keywords

Morphology • Shoreline • Estuaries • Ecotourism • Niger delta

Introduction

Natural luxuriant flora and fauna, and the natural resources of estuaries, commonly found on the numerous sedimentary coasts around the world, provide numerous goods and services needed for human development and socioeconomic sustenance, housing about 60 % of the world's population. Estuaries are semi-enclosed coastal bodies of water with free connection to the open sea within which sea water is diluted with freshwater derived from land drainage (Pritchard 1967). These water bodies receive sediments from both fluvial and marine sources and contain facies influenced by tides, waves, and fluvial processes (Dalrymple et al. 1992), stretching from the sea inlet to the upper limit of tidal rise influence within river valleys (Fairbridge 1980). Estuaries link marine waters (subtidal and intertidal), freshwaters, and terrestrial ecosystems and usually contain wetlands formed at the margins of the land and sea features. Thus, an estuary functions as a transient open system in a dynamic 'steady state' through exchanges of energy, water, and sediment with the surrounding systems (catchment and open sea). External environmental inputs and the system constraints therefore change as the estuary develops.

Estuary development involves interplay between its different components as it attains a dynamic steady state, with mixing stratification over space and time scales within the estuary system. The system dynamic pattern therefore depends on the relationship between accretion, water movement, and sediment transport, influenced by long-term average sediment supply transport (from inland or coastal origin), its characteristics (direction and magnitude), and abrupt changes in the estuarine morphology (Milliman 1991; Pethick 1994).

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Hence, estuaries are often characterized by fine sediment deposition (sand and mud) and include extensive intertidal areas (saltmarshes, mudflats, and sand flats), and semidiurnal or diurnal tidal regimes (Plate 1). Pritchard (1967) proposed four classes of estuaries based on their geomorphological status, while Hume and Herdendorf (1988) developed a 16-type classification scheme based on the geomorphology and oceanographic characteristics of the estuary, tides, and the catchment hydrology. The Defra (2002) estuaries classification was based on sediment origins, and Hayes (1975) classified estuaries of tidal ranges of less than 2 m, between 2 and 4 m, and above 4 m into microtidal, mesotidal and macrotidal estuaries, respectively. Dyer (1997) pointed out that when the ratio between river flow and tidal flow is equal to or greater than one, the estuary is highly stratified, at about 0.25 is partially mixed, and well mixed at values less than 0.1, based on the salinity structure involving the mixing process between fresh and salt water (Seminara et al. 2001). Dilution processes within estuaries take place at different mixing levels due to many forcing mechanism like tides, tidal currents, and wave-induced motion. At the mixing point, a salinity gradient is formed and the occurrence of internal waves on the interface generates a density flow gradient which tends to increase flood currents in the deepest parts and decrease flow near the surface and the shallow cross-sectional area of the river channel.

Distortions to the dynamic 'steady state' of an estuary may therefore severely alter the geomorphic and geological characteristics and resilient behavior of the system, with the possibility of total modification of its morphology or losing the entire ecosystem (Pethick 1994; French 2006). Hence, this study examines the shoreline morphology of the Niger Delta shoreline and major estuaries for better understanding of the natural forcing within the estuary systems and their potential for ecotourism development planning and management beyond the twenty-first century.

Ecotourism entails the ability of human beings to utilize the natural resources for the promotion of tourism without being destructive to the ecosystem. It therefore entails benefiting from the enormous provision of the numerable natural resource environment without destroying the livelihood of indigenous communities. It is therefore beneficial not only as a means of conserving the estuary-rich biodiversity and extensive ecosystem environment but also to the economy of the host community (Moelry 1990; Mowforth and Munt 2009). It is a promising means of advancing social, economic, and environmental objectives of sustainable development of the numerable natural resource.

Box 1: Overview of Estuary and Ecotourism

- Estuaries are semi-enclosed coastal bodies of water with free connection to the open sea.
- Estuaries are commonly found on the numerous sedimentary coasts, providing numerous goods and services.
- Estuaries classification can be based on geomorphological and oceanographic characteristics, sediment deposition, and tidal regimes and dilution processes.
- Ecotourism entails the ability of human beings to utilize the natural resources for the promotion of tourism without being destructive to the ecosystem.
- There is need to examine the Niger Delta shoreline morphology and their potential for ecotourism development.

Niger Delta Shoreline Morphology System

The Nigeria coastline region of length approximately 859 km consists of a narrow low-lying topography coastal strip of land and stretches inland for a distance of about 15 km in Lagos to about 150 km in the Niger Delta and about 25 km east of the Niger Delta. This coastline lies within Latitude 4°10′N and 6°20′N and Longitude 2°45′ and 8°32′ in the eastern section (Fig. 1). Tides along the entire Nigerian coast are semidiurnal and from a southwesterly direction with two inequalities. The tidal range increases progressively eastwards from 1 m at Lagos to about 3 m at the Calabar estuary. Though the tidal range is relatively small, the spring tidal range reaches on average 1.8 m across the coastline (Abam 1999). This intense tidal activity can be destructive and significantly modify the coastline morphology characteristics, as evident along the Mahin coast during a spring tidal range of 1.5 m (Nwilo and Onuoha 1993).

Sediments near the shore of the coastline area are composed of coarse to fine sand except off the Mahin mud coast, which is void of sand but with sediment grades varying from fine sand to silt; Nigerian coast are semidiurnal and from a southwesterly direction with two inequalities to mud at the outer shelf, with finer-grained sand beaches occurring along the flanks of the Niger Delta (Plate 2). The coastal region is divided into four main geomorphic zones (from east to west) namely the stranded coast/estuary complex, the Niger Delta, the transgressive Mahin mud coast, and the barrier beach lagoon coast complex (Awosika et al. 2000).

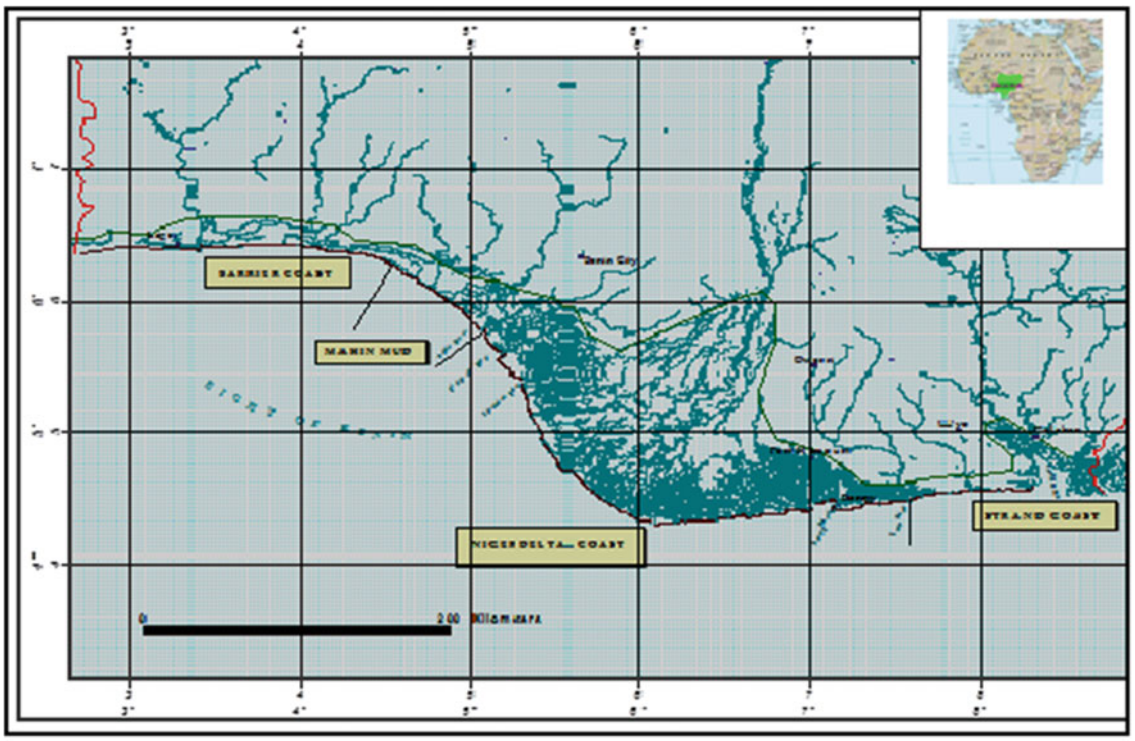

Fig. 1 Nigeria coastal area geomorphologic zones (Awosika et al. 2000)

Box 2: Nigerian Coastal Region

- Nigeria coastline region covers a total length of approximately 859 km.
- Nigerian coastal region is divided into four main geomorphic zones (from east to west) namely the stranded coast/estuary complex, the Niger Delta, the transgressive Mahin mud coast, and the barrier beach lagoon coast complex.
- Nigerian coast is semidiurnal and from a south-westerly direction with two inequalities.

Based on large- and small-scale geomorphic differences and numerous physical characteristics (i.e. beach sediment grain size and coastal processes), the coastline was classified into six geomorphic units (Fig. 2). The Niger Delta consists of the western delta flank, arcuate delta, and eastern flank categories.

The Niger Delta is a vast sedimentary basin with a complex river network and a fragile ecology in which fresh and saline water ecosystems maintain a dynamic equilibrium. The delta covers about 50 % of the total length of the Nigerian coastline, stretching from the Benin River estuary for about 450 km eastward, and terminates at the mouth of the Imo River estuary. The region has a delta flank coast (western and eastern flank) on either side accounting for 115 km of Nigerian coastline and characterized by semidiurnal tidal regimes with tidal amplitude of about 1.2 m and higher ebb flow velocities than flood flow. For example, ebb flow velocity in excess of about 5,000 m^3/sec above flood flow was recorded at the Bonny River (NEDECO 1961). The geomorphic unit has 21 major river mouths/tidal inlets that intersect the coast, breaking it up into a series of barrier islands of which 16 are within the arcuate delta region. This natural delta receives its sediments, which mainly comprise medium to coarse unconsolidated sands, silt, clay, shale, and peat, from the suspended and traction load of the Niger and Benue Rivers and their tributaries.

The Niger Delta is characterized by a sandy shoreline backed by extensive mangrove swamp and Barrier Island separated by tidal channels. This region has the longest barrier island of about 35 km (Ramos–Dodo Island), of which the widest is Focados–Ramos Island which is 10 km wide. In the eastern flank, the barrier islands are narrower and appear as remnants of beach ridges, due to wave action and tidal erosion in and around the associated creek network. The barrier islands on the delta are generally 15–20 km in length and 3–5 km wide and are better developed on the western than on the eastern flank. Based on the shoreline morphology deposition (Fig. 3), the delta region is vulnerable to sandy coast erosion and horizontal recession due to the white beach sand and sandy ridge substrates with grades of fine- to very fine-grained,

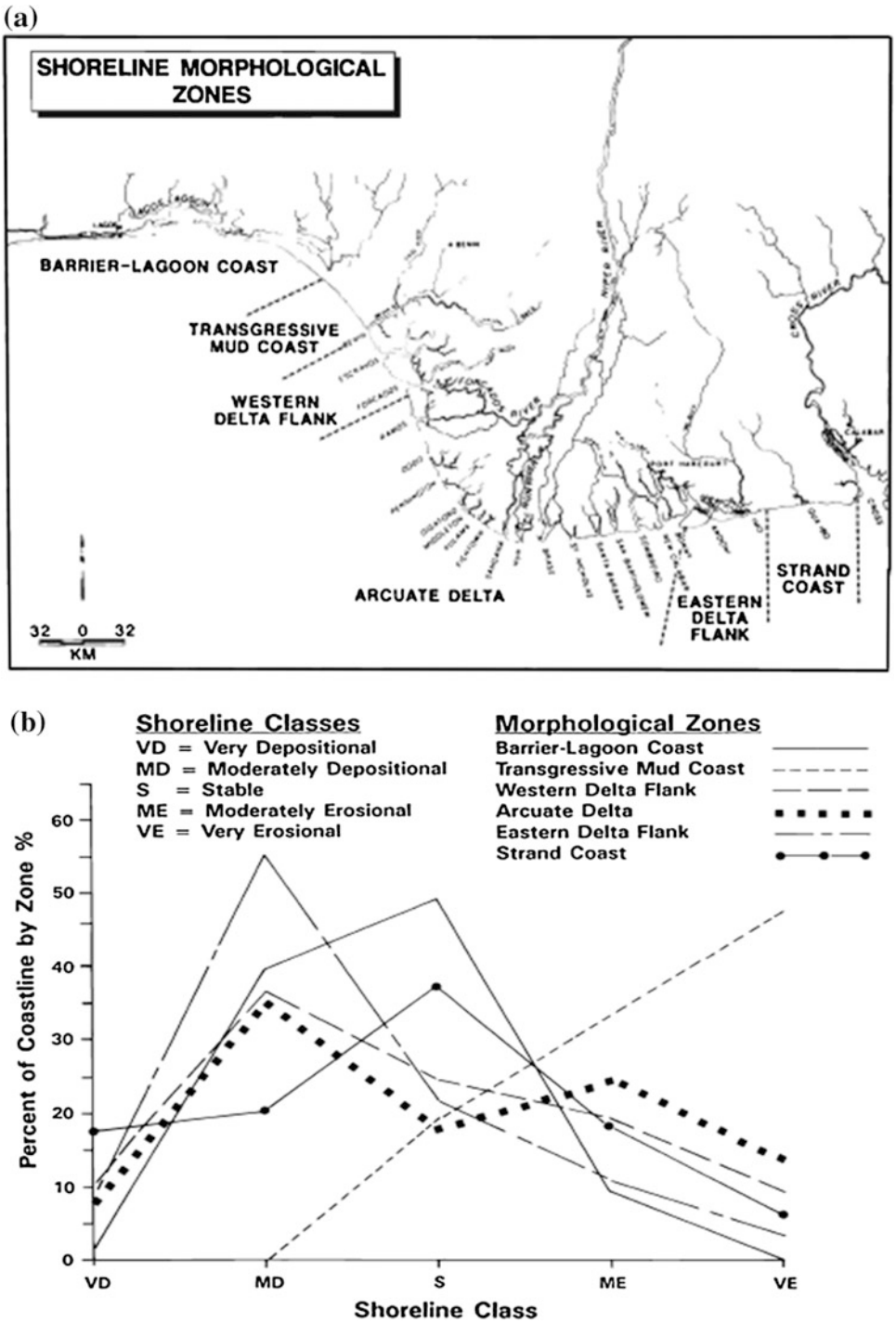

Fig. 2 Nigeria shoreline morphological zones (**a**) and coastal processes (**b**) (Sexton and Murday 1994)

moderately well-sorted sand. While the western flanks are less susceptible to erosion due to the dark and dark brownish organic and peaty clay of high plasticity (Abam 1999), the eastern flank of brown sandy clay soil is more vulnerable. The western delta flank extends from the Benin River to east of the Forcados River estuary, while the eastern delta flank extends from east of the Bonny/New Calabar Estuary entrance to immediately east of the Imo River.

The salinity intrusion within the Niger Delta depends strongly on the spatial extent of the diurnal tidal range within the region, which diminishes inland (Abam 1999), with more inundation in the western and arcuate delta part of the delta with settlements such as Port Harcourt, Bonny,

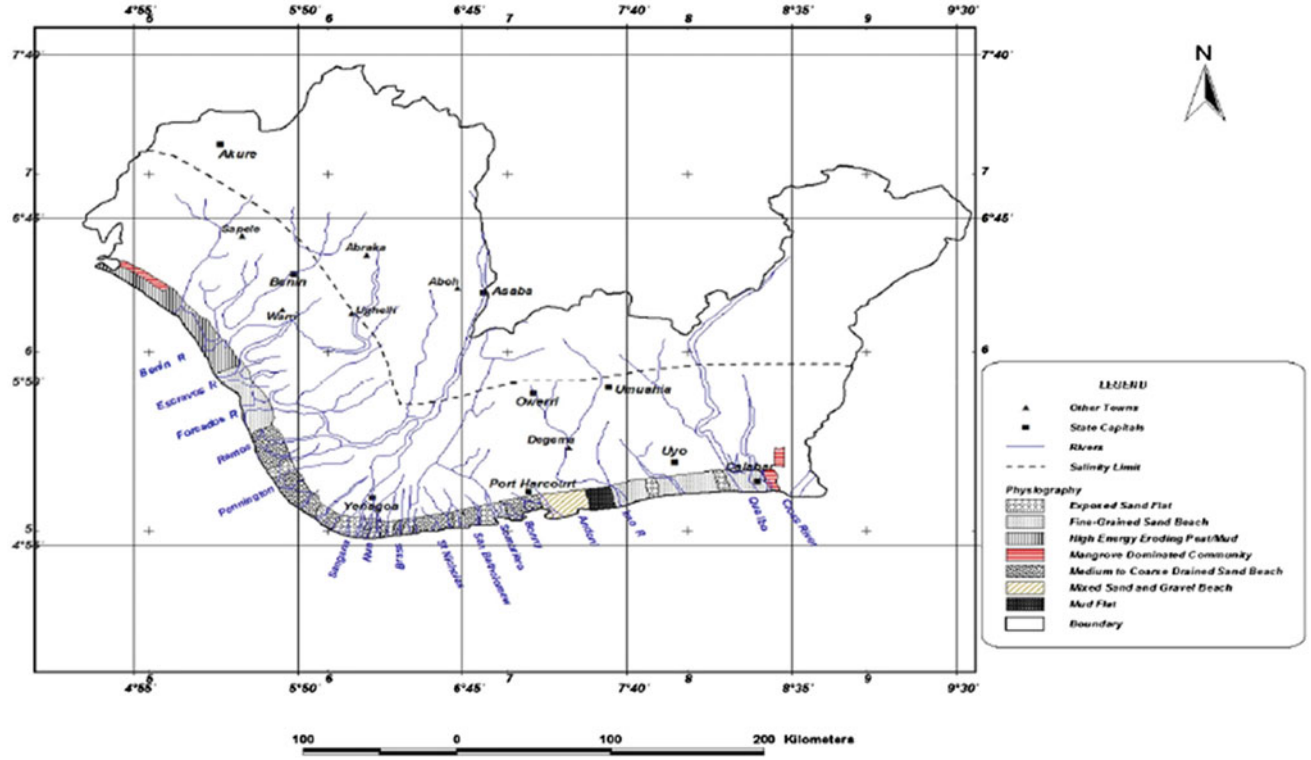

Fig. 3 Niger Delta shoreline morphology (Ogba and Utang 2010)

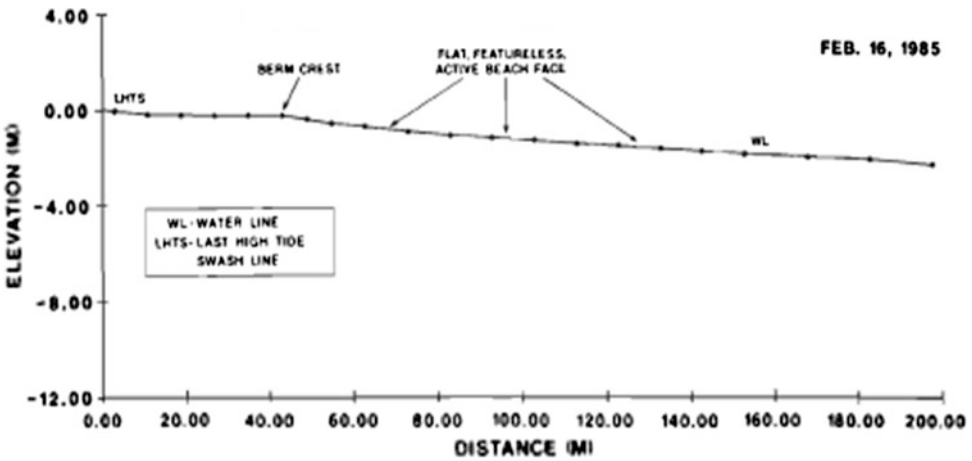

Fig. 4 Typical delta flanks beach profile plot (Sexton and Murday 1994)

Brass, Forcados, Nembe, Opobo, Koko, Degema, Burutu, and southern part of Warri, which are severely under the influence of tides and salinity, but not the entire coastal area (100 km from the coast).

It should be noted that the western side of the delta has significant active freshwater and sediment delivery from the upstream Niger–Benue river system, while the eastern side is influenced primarily by marine processes (waves and tides) (Sexton and Murday 1994). Erosion processes are prominent in the eastern flank of the delta as a result of reworking by marine processes, while the western flank is more constructional or depositional and fluvial dominated due to the active river systems (Sexton and Murday 1994). The post-Kainji dam therefore subjected the region to strong erosional stress due to reduction in water and sediment delivery into the Niger Delta region (Abam 2001).

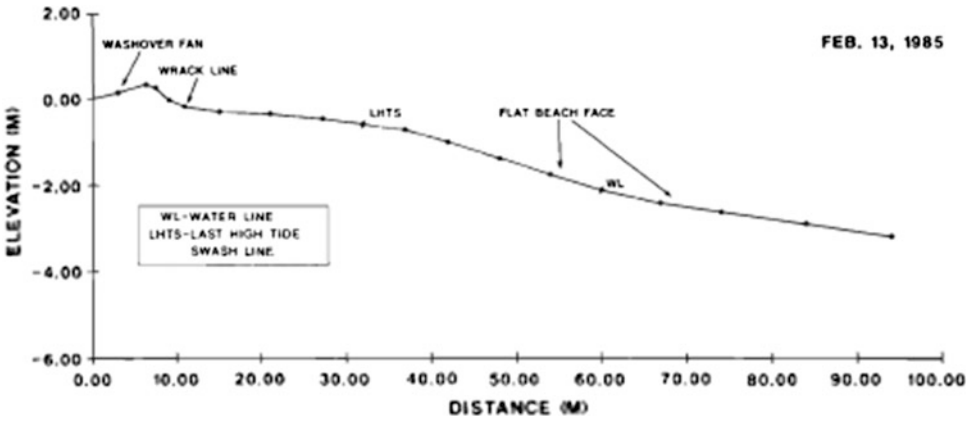

Fig. 5 Typical arcuate delta flanks beach profile plot (Sexton and Murday 1994)

Niger Delta Beach Profile

The Niger Delta flanks (Fig. 4) consist of very fine-grained, mica-rich sand with prominent anti-dunes on active beach faces. These beaches usually have moderate (less than 1 m) wave heights, and the very wide intertidal beach faces heights often greater than 175 m with gentle slope profiles ranging from 1:50 to 1:90. Beaches on the western delta flank are slightly finer grained and flatter, while the tidal amplitudes for the eastern delta and western delta flanks are 2.5 and 1.5 m, respectively.

The Niger arcuate delta (Fig. 5) covers 284 km of Nigeria's coastline (not including the delta flanks) and is composed of fine- to medium-grained, well-sorted sand with barrier island beaches having moderate intertidal beach faces (50 m) with steeper slopes in relation to the delta flanks of 1:15–1:20.

Box 3: Nigerian Coastal Region

- The Niger Delta consists of the western delta flank, arcuate delta, and eastern flank categories.
- The western side of the delta has significant active freshwater and sediment delivery, while the eastern side is influenced primarily by marine processes (waves and tides).

Niger Delta Estuaries

The Niger Delta estuarine waters cover an area of about 680 km^2 (Fig. 6). The Bonny/New Calabar river systems form about 39 % of the total area (Sott 1966). The Niger Delta area is the richest part of Nigeria in terms of natural resources with large deposits of petroleum products (oil and gas) (Braide et al. 2004). The Niger Delta is a tidal river estuary of fluvial erosion origin and a fully developed Holocene environment. Sediments originate from a drowned coastal plain, while the estuaries are meso-tidal having a composite delta development with a landward side (flood-tide delta) and a seaward side (ebb-tide delta) with salt marshes and tidal flats at the boundaries next to strongly meandering upstream reaches partially mixed with seasonal stratification variations. It should be noted that spring tide currents favor turbulent flow exchanges and a lowering of the mixing stratification ratio with a less sharp interface. However, a zone of high salinity gradient is established at about mid-depth, while the surface and bottom layers are quite homogeneous (Hume and Herdendorf 1988; Dyer 1997; Seminara et al. 2001; Defra 2002).

Bonny River Estuary

The Bonny river system has the largest tidal volume within the Niger Delta (NEDECO 1961), composed of an estuarine and highly saline seawater located seaward of the river mouth (typical of the Niger Delta coastal region), and influenced by tide- and wind-driven surface currents. The Bonny River estuary lies in the strand coast, between longitudes 6°58′ and 7°14′ East, and latitudes 4°19′ and 4°34′ North. It has an estimated area of 206 km^2 and extends 7 km offshore to a depth of about 7.5 m (Irving 1962; Scott 1966). It is a partially mixed estuary with a typical tidal water zone and little freshwater input but extensive mangrove swamps and intertidal mud flats, which are being influenced by the semidiurnal tidal regime. In the Bonny River estuary, the salinity fluctuates with the season and tide regime and is influenced by the Atlantic Ocean (Dangana 1985) with a tidal range of about 0.8 m at neap tides and 2.20 m during spring tides (NEDECO 1961). The estuary width is about 3,000 m and narrows down to 200 m upstream with water depth decreasing upstream except in the relatively shallow expanse where the Opobo channel

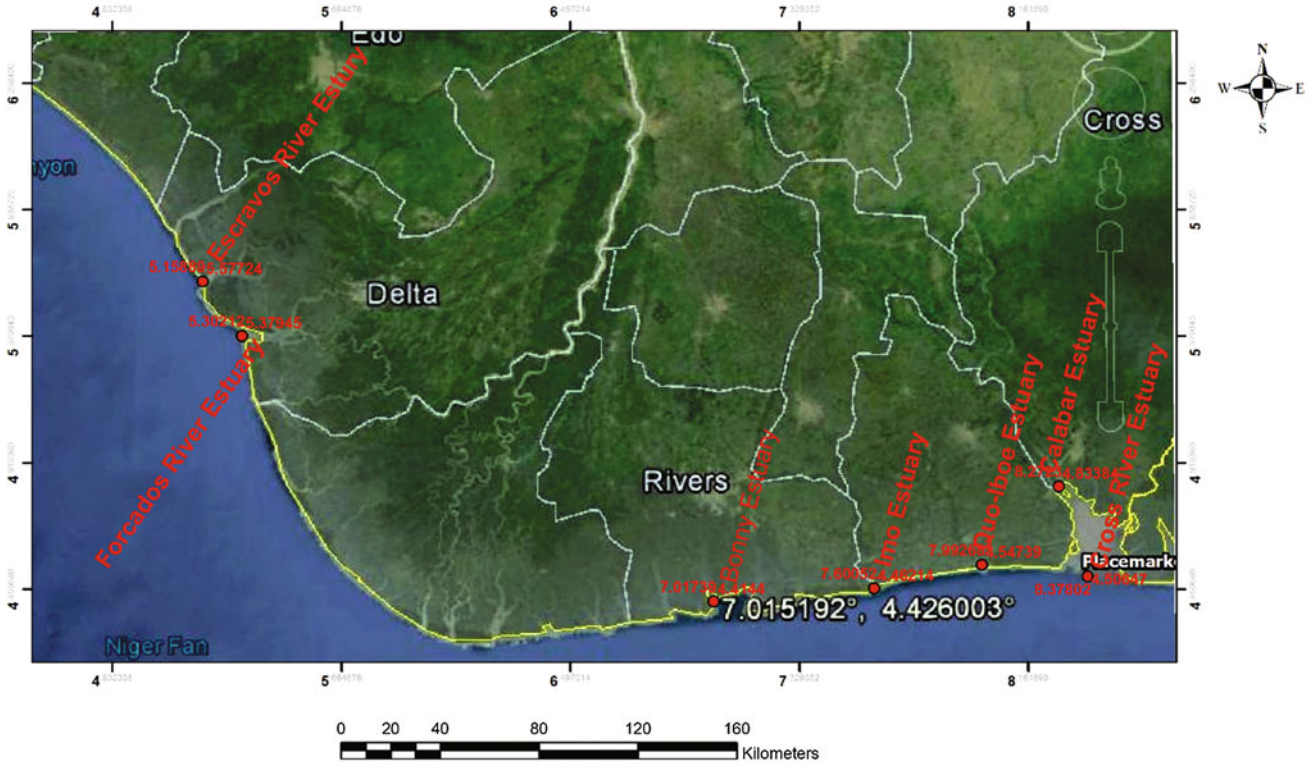

Fig. 6 Niger Delta estuaries

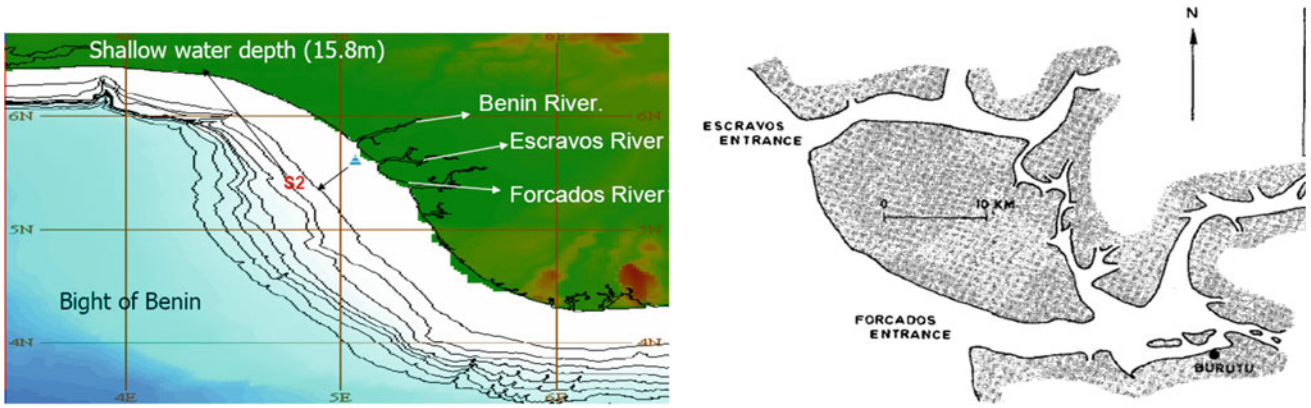

Fig. 7 The Escavos and Forcardos River estuaries

and the Hughes channel branch off. The river is tidal over almost the entire channel, with salt intrusion reaching New Calabar junction, a distance of 70 km. Freshwater discharge into the river system is relatively insignificant. Bonny River tidal range varies from 1.96 m on mean spring tides to 0.91 m on mean neap tides. Peak ebb and flood current velocities are 1.6 and 1.0 m/s, respectively, on spring tides and 1.5 and 0.8 m/s under average tides (Plate 3).

Cross River Estuary

The Cross River Estuary (Plate 4) encompasses rich habitats such as the mangroves, wetlands, lagoons, beaches, and mudflat ecosystems around it, as well as maintaining an exceptionally high level of biological productivity. The strength of the Cross River deltaic sedimentation is derived from the Cameroun Mountain. The Cross River estuary is

Plate 1 Overview of an estuary in Nigeria's coast

the largest in the West African subregion and is approximately 25 km wide at the mouth and more than 440 km long, with a tidal flushing of 1.83 billion cm^3 per day (Enyenihi 1991) and tidal amplitude of 3 m (Asuquo et al. 1998). It is the largest estuary along the Gulf of Guinea (Enyenihi 1991) covering an estimated area of 54,000 km^2 with about 74 % lying in Nigeria with the remaining 26 % in Cameroon (Enyenihi 1991). The estuary has a long coastline with fringing mangrove and a characteristic muddy bottom. Also, the estuary has no sandbar blockage but only a moderate tidal range of 3 m at Calabar. The beaches around the estuary are a potential attraction for tourists and perform numerous functions ranging from species abundance, research, and educational purposes to the protection and stabilization of the coastline.

Calabar Estuary

The Calabar River is a NE–SW-trending tidal river and a major tributary of the Cross River which has the largest estuary in West Africa (Plate 5). The Calabar estuary is mainly formed by the Cross River, but also receives waters from the Calabar and other streams. The Rio del Rey creek at the eastern end of the estuary marks the boundary between Nigeria and Cameroon. The estuary is 10–12 m broad at its mouth and maintains the same breadth for about 30 km. The upper facies of the Calabar River has a thickness of 8 m, while the lower facies is 10 m thick. The grain size distribution reflects that the facies has medium sands and negatively skewed sediments. Also, coarse sands, poorly to moderately sorted, and leptokurtic sediments characterize the upper facies.

Qua Iboe River Estuary

The Qua Iboe River estuary is a meso-tidal estuary with a N–S-trending estuary which opens into the Atlantic Ocean. The deepest part of the channel lies within the central portion and is 10 m deep (Plate 6).

Although sandy beaches are known to develop in some portions of the estuary, most of them are fringed with tidal mudflats and oligotrophic mangrove swamp (Essien et al. 2003). In the Qua Iboe River estuary, the upper facies has a thickness of 5 m, while the lower facies is 10 m thick. Both its upper and lower facies are characterized by moderately sorted, negatively skewed sediments. Very fine-grained, leptokurtic to very leptokurtic sediments typify its upper Facies, and medium sands and mesokurtic sediments typify its lower facies. Table 1, provides the details of tidal current velocities for the Qua Iboe River estuary and Calabar River. Tidal current velocity for other estuaries is not readily available.

Imo River Estuary

The Imo River is located in southeastern Nigeria and flows 150 miles into the Atlantic Ocean. The estuaries of the Imo

Plate 2 Niger Delta landscape

Plate 3 Liquified natural gas terminal within Bonny landscape (www.indypendent.org, 2010)

and Qua Iboe Rivers are underlain by sedimentary formations of Late Tertiary and Holocene ages with deposits of recent alluvium and beach ridge sands occurring along the coast (Plate 6). The Imo estuary is around 40 km wide, and the river has an annual discharge of 4 km^3 with 26,000 hectares of wetland and is characterized by fluvio-lagoonal deposits and littoral sands of the beach ridge complex, including organic silts, clays, and sand. The estuary comprises tidal creeks, small brackish water lagoons, and fringing mangrove swamps. The estuaries are shallow and have tidal amplitudes of about 1.0 m and receive seawater from the Atlantic Ocean (Plate 7).

Escravos and Forcados Estuaries

Escravos and Forcados estuaries (Fig. 7) are river estuaries which are tributaries of the Niger River located in the western Niger Delta flank. The river estuaries are a complex system where seawater is diluted with freshwater and the dilution process takes place at different mixing levels. This results from mixing due to many forcing mechanisms such as tides and tidal currents, waves and tidal waves, and induced motion and runoff (Dyer 1997). The Escravos River is a distributary of the Niger River; it flows through a westerly course and traverses zones of mangrove swamps and coastal sand ridges for 57 km before ending at the Bight of Benin on the Gulf of Guinea, where it flows into the Atlantic Ocean. At the Escravos Bar, the natural passageway is about 4 m deep with the sedimentation being of the order of 2 million m^3 per year in the lee of the breakwaters. The Escravos is linked by a maze of interconnected waterways to the Forcados, Warri, Benin, and Ethiope Rivers.

The Forcados River is a channel in the Niger Delta, in Southern Nigeria. It flows for approximately 198 km and meets the sea at the Bight of Benin. The Forcados River splits from the Niger River at the same point as the Nun River. At Forcados Entrance, the natural depth of the bar at the threshold is about 4.8 m.

Box 4: Niger Delta Estuaries

- Niger Delta is a tidal river estuary of fluvial erosion origin and a fully developed Holocene environment covering an area of about 680 km^2.
- Bonny river system has the largest tidal volume within the Niger Delta and lies in the strand coast.
- Cross River estuary is the largest along the Gulf of Guinea.
- Calabar Estuary is a NE–SW-trending tidal river and a major tributary of the Cross River.
- Qua Iboe River estuary is a meso-tidal estuary with N–S-trending.
- Estuaries of the Imo and Qua Iboe Rivers are underlain by sedimentary formations of Late Tertiary and Holocene ages.
- Escravos and Forcados estuaries are river estuaries which are tributaries of the Niger River located in the western Niger Delta flank.

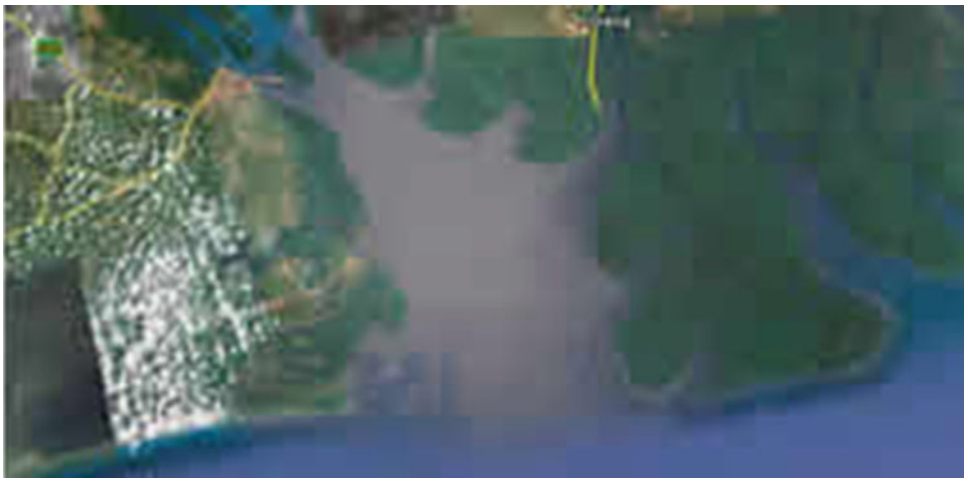

Plate 4 Cross River estuary landscape

Plate 5 Calabar River landscape

Why Ecotourism a Lucrative Option in Niger Delta Region

The Niger Delta could be a major tourist attraction because of its rich cultural, historic, landscape and ecological interest, and vast areas that could take advantage of the growing worldwide demand for sustainable ecotourism at a communal level (Plate 8). The need to sustainably develop and conserve the region's natural resources, with potential to contribute to local development and alleviate the plight of the local communities in the region, therefore lies in the development of a viable ecotourism industry.

The importance of ecotourism is evident, with global spending on ecotourism increasing by 20 % annually, the increase being about 6 times the rate of growth of the general tourism industry, while greater interest in outdoor activities has increased the scope of ecotourism. Ecotourism also minimizes the ecological impact of modern-day tourism since it travels with environmental sensitivity and is

Plate 6 Mobil Qua Iboe terminal (www.oil-spill-info.com)

Table 1 Tidal current velocities in Qua Iboe River estuary and Calabar River between August and September 2006

		Max. surface tidal current velocity (m/s)		Max. bottom tidal current velocity (m/s)	
		Qua Iboe River estuary	Calabar River	Qua Iboe River estuary	Calabar River
Flood Current	Spring	80	46.99	56	32.89
	Mean	50.99	29	35.7	20.3
	Neap	48.78	27	34.15	18.9
Ebb Current	Spring	119.05	72.99	83.33	51.09
	Mean	80	49	56	34.3
	Neap	73.8	42.99	51.66	30.09

Source Antia et al. (2012)

sustainable. It focuses on local culture, wilderness adventures, personal growth, and learning new ways of life (Shapley 2002; Ukpolo et al. 2008).

Ecotourism is an environment-friendly activity that inculcates environmental values and ethics. Ecotourism continues to be a popular option because of its claim to support conservation attempts through market-based mechanisms. It is sustainable tourism, which is nature based and incorporates a desire to minimize negative social and environmental impacts and embrace economic, environmental, social, community, and visitor benefits (Boo 1990; Herath 2002). Its purpose may be to educate the traveler, to provide funds for ecological conservation, to directly benefit the economic development and political empowerment of local communities, or to foster respect for different cultures and for human rights. Ecotourism combines environmental responsibility with the generation of local economic benefits that will have both a development impact and serve as conservation incentives.

Box 5: Factors favoring decision for ecotourism

- Ecotourism is intended as a low-impact and often small-scale alternative to standard commercial tourism.
- Commitment to ecotourism as a trade activity is increasing globally.
- Ecotourism is primarily nature based and immensely contribution to export earnings, poverty alleviation, and employment creation, among others, if well managed.
- Provision of limited development assistance to address microlevel issues such as enterprise development, increased benefit sharing among key actors, etc.
- Existence of complimentary development assistance both internal and external governmental and non-governmental sources, e.g., IUCN and World bank.

Plate 7 Part of Imo River beach landscape

Plate 8 An overview of part of Niger Delta luxurious landscape

- Favorable legislative and policy climate for environmental protection at both local and international level and conventions such as CBD and RAMSAR.

Environmental Assessment Impact of Ecotourism

One of the more fundamental issues surrounding ecotourism is the lack of standards regarding its practice. It should be noted that ecotourism is a multidimensional, complex practice being characterized by a higher degree of risk, novelty, and interaction with culture and natural fragile biological diversity. Hence, in practice, the fragile sites of ecological and cultural significance are being exposed to the threat of degradation by unregulated tourism development and overvisitation. Natural habitat is also being destroyed through the provision of ecotourism goods and services as well as infrastructures development like lodges, private reserve, roads, among others (Boo 1990; Hawkins and Mann 2007).

Non-adherent to the carrying capacity of the ecotourism area through unregulated, nature tourism can damage the environment and corrode local cultures due to pressure on the fragile environment, as a result of litter, pollution, and habitat disruption, among others.

Invasion of officially reserved nature conservation area as a nature's genetic reservoirs due to lack of sufficient fund to manage and protect them might result in loss of biological diversity. Under the pressures of hunting, logging, agriculture, and fishing, forest and marine habitats are being destroyed and some of the wildlife is being driven to extinction.

Solution

Making ecotourism a positive economic and environmental tool requires policies that foster responsible nature tourism development, broad-based and active local participation, and conservation of the natural heritage. This is necessary in order to properly regulate and manage as well as protect the environment and cultural heritage from overbuilding of tourist facilities and influx of populations around fragile ecosystems (Mowforth and Munt 2009).

Raising local awareness about the value of biological resources, increasing local participation in the benefits of biodiversity conservation (through new sources of jobs and incomes), and generating revenues toward conservation of biologically rich areas is also necessary. This will enhance total participatory involvement of all stakeholders in the sustainable ecotourism development of the region.

Identifying and mobilizing funding for potential private nature tourism investments and formulation of fiscal policies to promote nature tourism and to maximize its economic and environmental benefits is indispensable.

Encouraging international exchange of information and know-how about nature tourism opportunities and operations, through technical and management training, to meet the needs and interests of international and domestic nature tourists is necessary for good practices.

There is need to monitor and certify the performance of ecotourism activities toward promoting "green tourism". This entails promoting environmentally responsible tourist operations that conserve energy, recycle waste, and proper adherent to regulated rules and policies guiding the parks and protected areas usage.

In addition, sustainability principles must also be incorporated in all nature-based tourism activities with a detailed pricing policy designed for ecosystem-based services.

Expected Outcome of Ecotourism Strategy for the Niger Delta Region

- The strategy must be designed to suit the current national and international development agenda and priorities without destructive effects.
- There is also a need to transform and present acceptable nature-based tourism products and services to national and international markets.
- Ecotourism development strategy should fall within the new array of 'green' products and services.

Conclusion

The Niger Delta is characterized by semidiurnal tidal regimes with tidal amplitude of about 1.2 m and higher ebb flow velocities than flood flow. The geomorphic unit has 21 major river mouths/tidal inlets that intersect the coast, breaking it up into a series of barrier islands, 16 of which are within the arcuate delta region. This natural delta receives its sediments, which mainly comprise medium to coarse unconsolidated sands, silt, clay, shale, and peat, from the suspended and traction loads of the Niger and Benue Rivers and their tributaries. The salinity intrusion within the Niger Delta depends strongly on the spatial extent of the diurnal tidal range within the region, which diminishes inland (Abam 1999) with more inundation in the western and arcuate delta part of the delta. Niger Delta could be a major tourist attraction because of its rich cultural, historic, landscape, and ecological interest and vast areas that could take advantage of the growing worldwide demand for sustainable ecotourism at the communal level, if well managed. Ecotourism development in the Niger Delta region should therefore be plan to combine environmental responsibility with the generation of local economic benefits that will have both a development impact and serve as conservation incentives. Such plan should be people oriented, encompassing a range of activities such as community-based management of coastal resources and large-scale infrastructure development (ports, industrial and residential parks, etc.) and assist in organizing integrated coastal area management (ICAM) at regional level with detailed plan preparation, implementation, and management process without compromising the socioeconomic development.

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