AFRINET N°7

LAND USE SYSTEMS ON THE GAMBIA'S COASTAL ZONE

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Generale Overview of the Gambia Coastal Zone

by *Mr. Malang K. A. Barrow* (*)

1. INTRODUCTION

The Gambia lies in the West Coast of Africa and its coastline extends from the mouth of Allahein River (San Pedro River) in the South at 13° 4' N, to Buniadu Point and Karenti Bolong in the north at 13°31'56"N. The Coast line of the Gambia is about 80 km long, and 25 km of this lie in the bay-shaped mouth of the Gambia River and the rest facing the Atlantic Ocean. It has an 80 km wide continental shelf which separates the coast from the deep ocean.

The coast line of the Gambia is flat generally, with low dunes being common in the area. The coast line is mostly sandy and of unconsolidated material which are easily eroded. Serious coastal erosion has taken place at some sites and the annual beach retreat is on the average 1-2 m/year along the coast line. Like any other coastal state, the population density is high and increasing along the coastal zone. This has its implications as human activities along the coast line contribute greatly to the rate of erosion. Natural, ware action and man-induced erosion has destroyed the second Banjul Muslim Cemetery, and nearly all the hotels and Fish Landing sites, and the newly constructed highway are all threatened by coastal erosion.

Fisheries sector is very important and therefore developing rapidly. It contributes a lot to the national economy. The continental shelf is 3,855 km^2 and is considered to have a rich fishing zone. The fisheries sector has become an important foreign exchange earner with 1989/90 exports estimated at US $ 23 million. There are six major fish landing sites along the coastal zone which are threatened by coastal erosion, and these are : Brufut, Tanji, Batokunku/Tujereng, Sanyang, Gunjur and Kartong.

Tourism is fast developing along the coastal zone. New hotels are being built along the Tourism Development Area, and there are 15 newly built hotels which may all be affected by coastal erosion. Some of them are already threatened. The number of tourists have increased from 27,000 in 1974/75 to 74,00 in 1984/85, and is now estimated to be over 100,00 annually. In 1990/91 it was estimated that Government collected about D 48 million (US $ 5.3 million) in direct and indirect taxes from tourism amounting to 10

* Director of Networks, Environmental Protection Agency, Banjul, The Gambia

percent of Government revenue. This sector provides employment for over 7,000 people half of which are directly employed by the industry.

As construction industry also expands its activities on the coastal zone, there needs to be proper planning and assessment of sites before construction to mitigate damaging effects of coastal erosion as is being experienced now with structures too close to the sea-front.

The effect of coastal erosion is felt in other areas such as the annual land loss which is valued at D 100,000-D 300,000 or US $ 20,000 - 30,000. It is therefore important that concerted efforts are taken to protect the coastal zone for posterity.

This paper therefore is an attempt to present a general situation of the Gambian Coastal zone, and the information given here has been collected by Literature reviews, and personal observations of the coastal zone over the years.

1.1.1. THE GEOGRAPHICAL SETTING

The coast line of the Gambia runs along the West African coast from the mouth of the Allahein River (13°4'N) to 13°31'56"N between Buniadu Point and the Karenti Bolon ; a total length of 80 km (Figure1). The west coast, between the Allahein River and Cape Saint Mary (56 km), facesthe North Atlantic Ocean.The sections of Cape Saint Mary to Banjul (13km) and Barra Point to Buniada Point (11km) border the bar area of the Gambia Estuary which enters the picture between Banjul Point and Barra Point.

To the North lie the estuaries of tributaries of the Saloum River (40 km) and the coastal arc towards Cape Vert (120 km) in Senegal. A zeta-shaped, 40 km long, coast runs from the Allahein River southward to the estuary of the Casamance River; also in Senegal.

An 80 km wide continental shelf separates the coast from the deep ocean. The tidal range is 0.7 to 1.4 m. The main waves and swell approach the area from between West and North.

The hinterland of the coast consists of the catchments of (Figure 2) :

a. The Gambia River in The Gambia, Senegal, Guinee and Guinee Bissau ;

b. The Rivers Saloum and Allahein at the borders with Senegal, and

c. A number of small local rivers which spring in The Gambia and debouch at various points along the coast.

The total area is about 110, 000 km^2 of which 11. 295 km^2 is in The Gambia.

A flat plateau of tertiary sandstone (called "Continental Terminal"), capped with an infertile ironstone crust, gently rises from 10-15 m at the coast to 100 m at 400 km inland. The rest of the catchments consists of older worn Paleozoic and Pre-cambrian rock with a maximum height of about 1500 m in the Fouta Djallon. Pleistocene and Holocene (Nouakchottian transgression) exist along the coast (Figure 4), along the estuaries and in river valleys.

The air temperature is 20°-35°C with little seasonal variation. Annual precipitation varies between 700 mm in the nothern part of the hinterland to 2000 mm (in 3 months) in the South. Potential evapo-transpiration is 2500 to 3500 mm annually. Winds blow mainly from nothern and western directions with mean speeds of 2 to 4 m/s and few extremes.

This semi-arid to wet and dry tropical climate with one wet season leads to a vegetation of savannah woodland with some higher density in the South. Mangrove forests grow in the saline wetlands behind the coastal barrier and along the estuaries. Fresh water swamps occur in the upstream parts of the estuaries and along rivers.

1.1. 1. THE WATERSHEDS

a. The Gambia River and its estuary

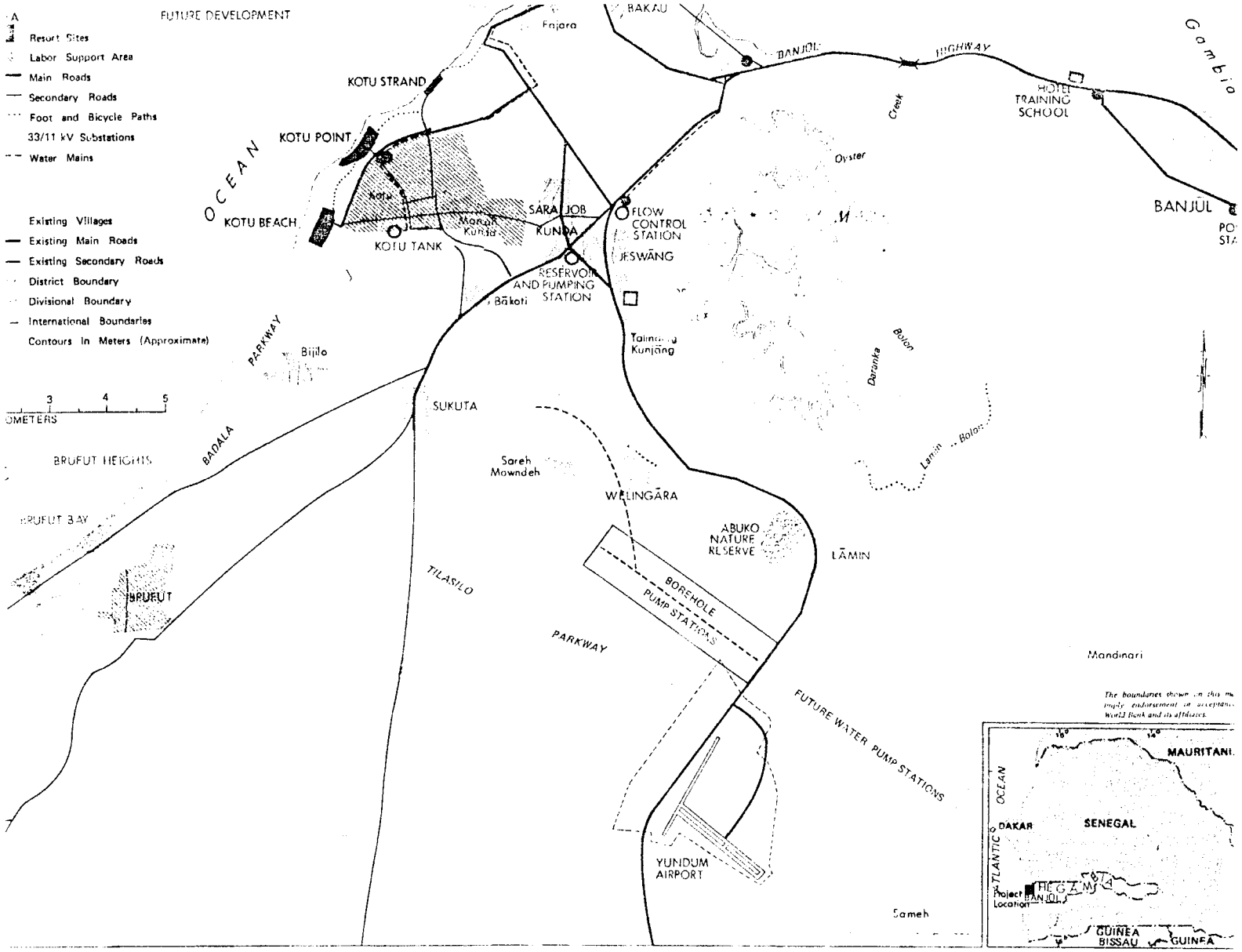
The Gambia River rises at 1125 m height in the Fouta Djallon and runs over 1150 km through Guinee (205 km), Senegal (485 km) and The Gambia (460 km) towards the Atlantic Ocean (Figure 2) at Banjul. About 70 per cent of its catchment of 77, 000 km^2 lies less than 100 m above sea level; 30 % below 40 m.

The tide (and navigation) intrudes to 460 km upstream of Banjul and thus defines the estuary and the greater part of the boundary between The Gambia an Senegal.

About 42,000 km^2 of the catchment area is situated above the hydrologic station at Gouloumbo (km 492). Of the 35, 000 km^2 area downstream of this point, 10, 500 km^2 are in the Gambian territory.

The mean annual discharge at Gouloumbo was 254 m^3/s between 1953 and 1981 with a significant decrease from about 350 m^3/s in the beginning of the period to 162 m^3/s in 1975-1980. Dry season discharges are a few tens of m^3/s approaching zero at the end. An average flood reaches 1300 m^3/s with about 2000 m^3/s once in ten years. Inflows into the estuary below Gouloumbo are not known. Groundwater contributes 10-20 m^3/s.

Some observations at Gouloumbo indicate an annual sediment tramsport of 0.65 million tons (0.4 X 106 m^3) in the months July through November. A reasonable sediment yield of 75 t /km^2 would lead to 3 million tons (2 X 106 m^3)per year. The flat country below Gouloumbo will certainly contribute much less. Sediment concentrations observed are



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25 g/ m^3 during the dry season and reach 100 g/m^3 during floods. This leads to sediment transports of 0.5 to 1 million tons per year.

The present eustatic rise of sea level of 1 to 1.5 mm / year causes a virtual loss of about 4 million m^3 per year from the estuary.

Salt intrudes into the estuary up to Balingo (km 120) under present average conditions (150 m^3/s) but it reaches Kau-ur (km 195) in the dry season (20 m^3/s).

Peak tidal discharges vary between 30, 000 m^3/s and 45, 000 m^3/s at the mouth of the estuary and between 2, 500 m^3/s and 4,000 m^3/s at Kau-ur. Comparison with the fresh water flows shows that the funnel-shaped lower 200 to 250 km of the system is more of a tidal arm of the sea than the lower part of a river.

This observation confirms the geological picture of a valley that was flooded during the Holocene (Nouakchottian) transgression (before 6000 year B.P.) and is still being filled by recent deposits. The eustatic sea level rise causes a deficit.

The density gradient, related to the salt intrusion, induces a gravity circulation in the estuary throughout the year. The effect is a resulting inward transport of sediments through the mouth and prevention of seaward movement of sediments from the catchment. The visible consequences are turbid water and muddy deposits in the estuary contrasting with cleaner water and a sandy bed outside the mouth.

The possible construction of reservoirs in the headwaters and a salt barrier in the estuary (near Balingo) will not essentially change this pattern of sediment transports.

b. The Rivers Saloum and Allahein

The Saloum River has a catchment of 32,000 km^2 in a dry area, making its trubutaries ephemeral. It enters the ocean via the estuaries of a number of tributaries forming a delta-like mangrove swamp. A 15 km long narrow spit projects in front of the delta area and pushes the main mouth of the Saloum estuary southwards. No littoral sand from this area is considered to reach the coast of the Gambia.

No information of the discharges of water and sediments is available. An average flow of the order of 50 m^3/s seems a reasonable estimate with a minimum of zero and a short wet season with maxima in the order of 200 m^3/s.

Salt intrusion in these estuaries is similar as in the Gambia Estuary. Probably, no sediments from the catchment reach the coast.

The Allahein River with its catchment of about 500 km^2 flows more directly into the sea; without a wide estuary. An estimated sediment yield of 100 to 300 tons/ km^2/year leads

to a sediment discharge of 50,000 to 150,000 tons (30,000-100,000 m^3) per year. The direction of the waves, the shape of the coast line and the situation at the mouth indicate that sediments delivered at the coast by this river are transported southward along the coast of Senegal.

c. Local watersheds

A few small rivers and creeks cross the coast of the Gambia. They interfere with the littoral transport; either because they supply sand or because of the tidal flows through their mouths.

The names of these streams and the areas of their watersheds are given below. The sediment yield of these watersheds is estimated at 100 to 300 t/km^2/year or 70 to 200 m^3/km^2/year. This leads to a rough figure of the sediment transports at their mouths.

The tidal volumes through the inlets of Oyster Creek and Cape Creek are estimated to be 4-7 million m^3 and 0,5-1 million m^2 respectively per flood or ebb.

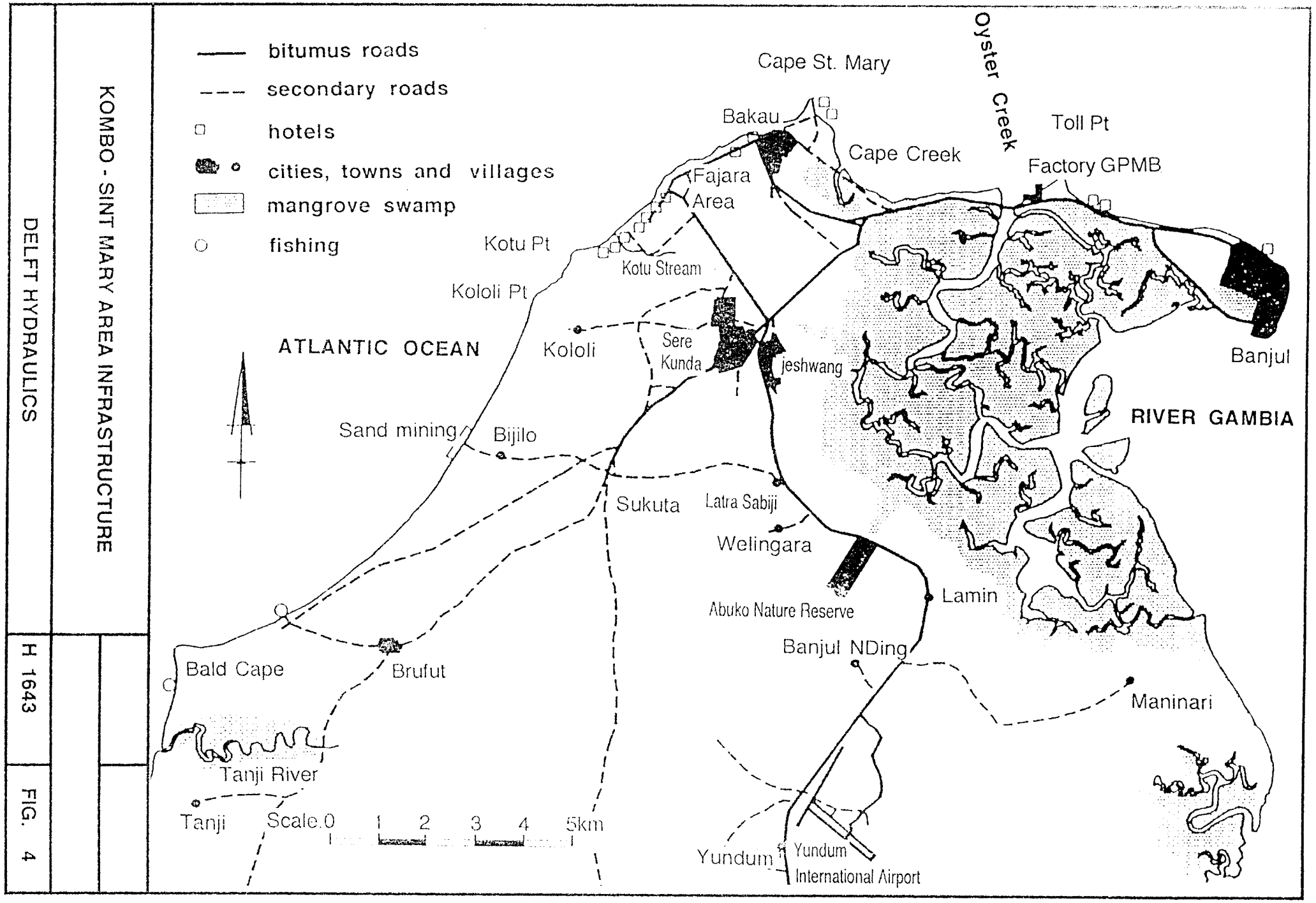
Stream	Catchment	Transport (m^3/y)
Near Barra	27 km^2	1,800 - 5,500
Oyster Creek	20 km^2	-
Cape Creek	3 km^2	-
Kotu Stream	65 km^2	4,500-9,000
Tanji River	145 km^2	10,000-30,000
Tujering R.	26 km^2	1,800-5,000
Kakima R.	100 km^2	7,000-20,000

Table 1. Local watersheds

d. The coast-catchment relationship

Summarizing, the observations given in this section lead to the conclusion that:

- the coastal system is not perceptibly influenced by the discharges of water and sediments from the Gambia and Saloum Rivers. Changes in the catchments of these rivers will not affect the coastal processes ;
- the sediments discharged by the Allahein River only influence its mouth and the coast to the South of it, and
- the local streams discharge quantities that are of minor importance compared with the littoral transports and the coastal erosion.



KOMBO - SINT MARY AREA INFRASTRUCTURE

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FIG. 4

1.1.2. THE COAST

a. General

The coast line of the Gambia is about 80 km long of which almost 25 km lie around the bay-shaped mouth of the Gambia River estuary and the rest directly faces the Atlantic Ocean (Figure 1). The coastal region is a flat and monotonous area of unconsolidated marine and aeolian sands; low dunes being typical. These Holocene deposits are underlain by tertiary ferruginous sandstone of the "Continental terminal", which occasionally is exposed along the coast as cliffs and rocky platforms (Figure 3). The continental shelf is relatively narrow, the 200 m isobath being about 80 km offshore.

The Saloum River, with its tributaries, debouches directly North from the nothern border with Senegal, forming the delta-shaped north-eastern shore of the Gambia estuary; the latter enters its bay-mouth between Banjul and Barra Point. A tidal channel runs North and West across the bar with Shallow sandy banks North of Banjul. The channel and the eastern bars of the bay have a muddy bottom. The adjacent coastal arc between Buniadu Point and Barra Point consists of sandy beach barriers based on finer estuarine deposits, partly sheltered from the ocean waves by the shallow bar of the estuary. This equally holds for the fine sandy beach barriers of the western bay-shore between Banjul an Cape Saint Mary.

Southward of Cape Saint Mary, the coast is fully exposed to the Atlantic Ocean and displays an echelon-like arrangement which is related to the differential erosion of the beaches and the cliffs and rocky platforms, cut into the sandstone of the "Continental terminal". A few small streams have their mouths along this north-south oriented coastal stretch. The San Pedro or Allahein River, a bit larger, forms the southern border with Senegal.

b. Meteo-marine conditions

The climate of the coastal zone of The Gambia belongs to the tropical boreal type, with a long dry season in winter and rains concentrated in summer (July-September) ; August is normally the rainiest month. During the wet season 762-1143 mm of rain may be expected. In recent years the country has experienced severe droughts, causing the rainfall for 1970-1980 to drop to only 345 mm/yr.

On the coast, the intensity of the dry season is lessened by heavy dew, by high relative humidity, lower temperatures and by sea breezes. Marine trade winds account for 43 % of the average readings at Banjul, the (northeasterly) Harmattan for 17 %, and the rain-bearing westerlies or northwesterlies for 18%, the rest being calms.

Tide is of a semi-diurnal type, with two daily maxima and minima. The tidal range is relatively small; at Banjul the range is 1.6 m in spring tides and 0.7 m in neap tides. As

a consequence, tidal currents along most of the coast are weak (< 0.1 m/s) except for the Gambia estuary. Here tidal filling and emptying causes tidal currents to be well over 1 m/s.

With respect to wave action from the Atlantic Ocean, it can be observed that the Gambia coast is situated in between the exposed coasts of Maurintania and Senegal. Affected by northerly to northwesterly swell regimes - and the more sheltered coasts of Guinee-Bissau and Guinea - affected by south-southwesterly to westnorthwesterly swells. Consequently, along the Gambian coast the northwesterly swell greatly prevails over the southwesterly ones; its period varies between 8 and 12 seconds. This swell is strongest during the dry season.

c. Littoral Regime

The NW swell is, thus, the main factor controlling the regional coastal morphology. It induces a major south-going sedimentary transit owing to the genegal coast orientation, running in a north-south direction. The west-east oriented coast in between Cape Saint Mary and Banjul, however, experiences an east-going littoral drift which is strengthened by the flood-dominated tidal flows running close to the shore. These two mechanisms thus promote a littoral drift directed from Buniadu Point in the North and Cape Saint Mary in the West towards the estuary mouth, which acts as a sediment sink. This is due to the fact that the Gambia estuary constitutes a drowned valley still in the process of being filled up, both from the river and the sea (Section 1.1.2).

To the South of Bald Cape, the north-south coast again experiences a predominant south-going littoral drift, as evidenced by the distinct zetashape of the beaches in between the various headlands. Along the SW-NE running coast in between Cape Saint Mary and Bald Cape, a divergence point in the littoral drift system is thus apparent, sediment being transported in opposite directions towards Banjul Point in the north-east, with the estuary acting as sink, and Kartong Point in the South, where the accumulation development across Allahein River forms the terminus of the south going drift.

As a consequence, it may be concluded that the whole of this coastal region for a long time must have been in a state of erosion, owing to its natural development, as induced by the littoral regime and more recently by sea level rise. Over the past decades, human interventions also play a significant role. The construction boom in the coastal zone which is related to urban developments and particularly the tourist industry, has led to widespread removal of the natural vegetation cover and dune formation (rendering the coast more vulnerable to erosion) and mining of significant quantities of sand from the beaches, which is still continuing today.

Estimates of the littoral drift along the open Atlantic coast have been made on basis of the extensive spit development over some 20 km at the mouth of the Saloum River (Sangomar spit) and amount to some 100,000 to 250,000 m^3/yr. These figures may

equally be applicable to the coast South of Bald Cape. The mechanism of sediment transport along the coast to the East of Cape Saint Mary are complicated by the fact that along this bay coast sheltering of ocean waves takes place concurrently with increased tidal influence by flood-dominated flows. From the distinct offshore bar bypassing at Oyster Creek it may be inferred on the basis of governing rules for tidal inlets that, the littoral drift along this coastal stretch must be in the order of 30,000 to 100,000 m^3/yr at most.

Possible sources of sediment for this littoral drift system are the coast itself through erosion, and the sediment yields from watersheds into the coastal system. In the latter respect it can be noted that the Gambia River constitutes a sink rather than a source of sediments. The remaining rivers debouching at the coast have too limited catchments to produce any significant sediment yield. The only major river, the Allahein River, debouches its sediment yield to the South of Kartong Point, at the terminus of the coastal system.

The above appraisal of the littoral drift system and yields of watersheds imply that on a yearly basis some 200,000 to 300,000 m^3 of sediment is lost through erosion of the Gambian coast line in between Banjul Point and Saniang Point (the more southern stretch towards Kartong Point being relatively stable), i.e. an average erosion of some 1 to 1.5 m/yr along the entire coastal stretch of 20-25 km. The loss of land is 2.5-3 ha per year.

As the cliffs and rocky platform cut into the sandstone of the "Continental terminal" are relatively hard (erosion rates <0.5 m/yr), the "production" of sediment through coastal erosion is even more important along the vulnerable and low sandy beaches. This is evidenced by the inventory of coastal erosion problems as given furtheron.

The above coastal erosion resulting from the overall sediment balance, is further aggravated by the sea level rise (1 to 1.5 mm/yr) over the past century. Strictly, a change in sea level does not change the quantity of sediments forming the coastal system. However, the coastal system reacts with a redistribution of the sediments, maintaining the cross-sectional profile with respect to the sea level. At the present rate of sea level rise the apparent loss of sediments along the Gambian coast line is preliminary estimated at some 75,000 m^3/yr, not yet accounting for the sediment loss via raising of the coastal plains. The effect of sea level rise on the coastal sediment balance is thus significant. The global Greenhouse effect may even cause a considerable acceleration of the rate of sea level rise in the future, which over time may seriously aggravate the state of natural erosion for the Gambian coast.

A further sink in the coastal sediment balance is constituted by the sand mining activities taking place along the beaches but on a large scale at the Bijilo quarry site, now restricted. These minerals are used for construction of roads and buildings. No proper record has been kept of the volumes extracted although the negative effects of those activities are

very visible. A tentative appraisal of the ongoing mining activities at Bijilo lead to estimates of sand extraction of 100,000 to 150,000 m^3 / yr, which is about half the annual erosion volume due to natural processes. As such, it considerably contributes to the present degradation of the coastal environment.This large-scale mining of sand from the beaches is already going on for decades. Till 1985, a quarry site around kololi Point was utilized, after which date the site was moved out of the area of principal tourism development down South to the present Bijilo site. Awareness is growing that sand mining should also be stoppend here; the Government is considering plans to move the quarry site still further to the South towards areas with accumulating beaches.

1.1.3 COASTAL EROSION

Over the past decades, the coastline of the Gambia as in many other places has been developed intensively and presently is occupied up to the very limits of the sea. This occupation includes residential, commercial and fish landing facilities and following the tourist boom of the 1970's, a singnficant number of beach hotels.

Viewing the dynamics of the coast in relation to the littoral drift regime and the effects of sea level rise and mining activities, over the years the sea has encroached at several places to such an extent that valuable structures and socio- cutural heritages are theatened or already even damaged. As such the experienced erosion problems can be intimately linked to the socio-economic pressure on the coast, an illustration of which can be given as follows.

a. North Shore of St. Mary's Island

The North shore of St. Mary's Island (Banjul and vicinity), extending from Banjul municipal area towards the Oyster Creek, is under the influence of a west-east running sediment transit, fed by the littroral transport from the west across Oyster Creek. From aerial surveys performed over the last decades (1964, 1972, 1983) it can be noticed that this transit occurs as an offshore bar bypassing with unstable sand spits and bars developing to the East of Toll Point. This area is highly dynamical as coastal behaviour is determined by the fact whether or not reattachment on the coast of the spits and bars occurs and, consequenly, nourishment of the littoral to the East of Toll Point takes place. The erratic behaviour of the North shore of St. Mary' s Island over the last decades gives evidence of this susceptibility. Presently, a spit development of more than one km extends eastward from Toll Point, presumably established since the last aerial survey of 1983 (no spit visible). This offshore spit leaves the eastern littoral devoid of sediment supply, be it that increasing sheltering from ocean waves is provided in the lagoonal area in the lee of the spit development. A preliminary appraisal of the sediment volumes accumulated in the spit since 1983, leads to an assessment of the littoral drift along the North shore of St. Mary's Island of some 50,000 to 75,000 m^3 / yr. This transport capacity is responsible for the observed coastal erosion in the Banjul-Toll Point area over the last decade.

In this area, notable points of concern include the Banjul Muslim Cemetry and the beach areas of Atlantic, Palm Grove and Wadner Hotels. The latter hotel area is presently situated in the lee of the offshore spit development, whilst the more eastward Palm Grove Hotel area and beyond is still exposed. The beach in front of this hotel complex has almost completely disappeared and wave action frequently reaches the premises. This state of degradation of the shorefront can also be conserved further eastward at the Radio Syd and, althgough to a lesser extent at Atlantic Hotel, situated at the outskirts of Banjul.

At the Banjul Muslim Cemetry, situated in the area between Palm Grove Hotel and the radiostation, the erosion is even more dramatic. Nearly three quarters of the cemetry have been lost to the sea. The erosion in this area totals some 30 m since 1964.

Over the last decade, the erosion of the North shore of St. Mary's Island may have been aggravated by sand mining activities along the Toll Point beach area by the contractor of the Serekunda-Banjul highway. According to Public Works, in total some 60,000 m^3 of sand was extracted from the beach. It can yet be noticed that to the East of the radio station the sea already encroached within 50 m of the recently completed highway.

b. South-West Attlantic Coast

The Atlantic Coast stretching West and South from Cape Saint Mary is characterized by a series of pocket beaches enclosed between rochy headlands and cliff formations, cut into Tertiary sandstone. At several places the beach in front of the rock plateau has disappeared and cliffs are readily exposed to the ocean waves, such as at Fajara. Due to the general orientation of the coast and the predominant NW swell, a southgoing sedimentary transit exists along the coast, as evidenced by the zeta-shaped beach formations to the South of Bald Cape. In the area between Bald Cape and Cape Saint Mary a divergence point in the littroral drift system is apparent, its exact location yet unkown, but it is possibly located near Kololi Point.

North of this erea, with North-East running sediment transit towards and around Cape Saint Mary, socio-economic pressure on the coast is high with the major tourist development area and adjacent resdential area of Fajara and Bakau extending up to Cape Saint Mary. The sediment transport in this area is exclusively generated via 'production' of sediments though erosion of beaches and cliff platforms, the (slow) rate of erosion being determined by the erodability of the sandstone formations. At Cape Saint- Mary, the bypass of littoral drift around the headland is evidenced from aerial hpotographs (1964, 1972) as unstable sand spit and bars. The coastal area to the East of Cape Saint-Mary, therefore, is highy dynamical as coastal behaviour is determined by the fact whether or not reattachment on the coast of the spit and bars occurs and, consequently, nourishment of the littoral to the East of Cape Saint Mary takes place. The erratic benaviour of this coast over the last decades gives evidence of this susceptibility. Since

1983, pronounced spit or bar development at Cape Saint Mary is absent,which may point to reduced bypass transport arriving from the Fajara - Bakau coastal area.

From the above, it is not surprising that a major area of concern with respect to coastal instability is the area immediately to the East of Cape Saint Mary, Here, villas and hotels (Sunwing, Amie's) all are in intermittent threat from beach erosion, because the width of the beach is subject to great inter-annual fluctuations due to movements of sand spits and positions of offshore bars.

To the Southwest of Cape Saint-Mary there are active cliffs which border the shore line. The altitude of the cliffs at the highest point is 10 to 20 meters above high tide. The soft layers of lateritic soils and perched sand dunes above the consolidated basement are subject to erosion. There is considerable cliff erosion at this point due to direct wave action on loose cliff material with slope failures and landslides. The Tropic Garden Hotel and the Medical Research Council Park are in threat of the rapid erosion rate on the beach. A cliff recession rate of half a meter per year is noticed at this area. The African Village Hotel already lost its beach to the sea.

At Fajara cliffs further down the coast, the erosion process is very pronounced. The cliffs are retreating very fast and the structures at this vicinity are in danger. It is at this area where very expensive villas and official residences (Government House) ase located. Most of them are within 50 to 100 meters range from the sea front which has been threatened by beach erosion causing cliff failures, and the run-off water from storms eroding the cliff tops.

The area South of Fajara cliffs up to and beyond Kololi Point is the major tourist development area till now. There is a chain of over 10 large hotels and other facilities. Often the tourists can't fully enjoy the beach which is narrowing due to erosion.

The beach at this area from Kotu Point to Kololi Point has been retreating at a rate of 1 meter to 2 meters annually for the past twenty years as observed from the aerial photos (1964-1982). Shoreline recession caused by beach erosion is still prominent at Kololi Point where dune erosion produces sandy cliffs of 2 meters high.

Between Kololi Point and Bald Cape, the erosion rate varies from 40 m - 60 m over the past 26 years. At Kololi Beach, the beach bars and restaurants located at the sea front near Senegambia Hotel are threatened by beach erosion.

The erosion behaviour between Kololi Point and Bald Cape may well have been aggravated by the extensive commercial sand mining taken place along Kololi Beach till 1985, but since that time the large-scale sand mining shifted down South towards Bijilo. Estimates of the annual sand extraction from the beach range between 100,00 and 150,000 m^3/yr ,which significantly contributes to the sand budget deficit in this area.

Down South from Bijilo, a number of important fish landing and curing sites are located; the Brufut site just North of Bald Cape being the only one affected by the sand mining activities. It can yet be noted that this area South of Bijilo is designated for future tourist developments.

1.2 THE ENVIRONMENT

The environment in the coastal zone is affected by coastal erosion as well as by related human interventions. The erosion is destructive. Coastal engineering works may stem the process but they may also spoil a beach. Damage has already been done and more may be expected in the future.

Erosion of cliffs and recession of beaches leads to loss of land, vegetation and facilities for tourism and fishery along the coast between Banjul and Solifor Point. Even a strong variability of the coastline has detrimental efects.

Various important habitats lie in the coastal zone within the reach of erosion. Extensive mangrove forests exists around Oyster and Cape Creeks, in lagoons and along lower reaches of local streams. Fresh water swamps follow futher apstrean and in valleys between recent dune ridges; particularly in the Northern and Southern extremities of the coastal lagoons are found between Cape Saint Mary and Banjul, and at the mouth of Tanji River near Bald Cape. These wetlands harbour many (migratory) birds and some are of ecological and economical value.

Intrusion of saline water and of tides accompanies coastal erosion. Fresh waters, aquifers and soils become saline and tidal. Sources of water can be polluted and habitats change.

Sites of historical, cultural and scenic value are affected or threatened. Part of the Muslim cemetries between Toll Point and Banjul have been washed away. Many graves were disturbed, grave stones tumbled on the beach, skeletons were exposed and washed away by the waves. The Process continues and extends towards the adjacent Christian cemetry.

Undisturbed beaches and steep eroding cliffs and headlands themselves are of scenic value. Groynes, ruins of structures and damaged vegetation may spoil the scene.
The fort at Barra and sait matty's graveat Cape Point are threatened.

1.3 THE ECONOMIC SYSTEM

1.3.1 RECENT DEVELOPMENTS IN THE GAMBIAN ECONOMY

The Gambia has a total land area of 11,295 km^2 and a population of 1,075,867 in Avril-1993. The Gambia is situated on the southern edge of the Sahel region, with rainfall varying from 1100 mm in the west to 900 mm in the east. The usefulness of this relatively

favourable precipitation is limited by the erratic rainfall pattern and the very concentrated period of rains, leaving a long dry season. Irrigation is limited to some 3000 ha in the Georgetown area, due to the precious water balance in the Gambia river it has been estimated that for every m^3 per second water extraction, Salinity moves1 km upwards the river.

The Gambia is, with a per capita GNP estimated at US$ 260, classified among the poorest countries in the world. The economy is still dominated by agriculture which contributed about 28 % to GDP in 1989/90 but employs an estimated 65 % of the labour force in largely smallholder activities. Within the agricultural sector groundnut production alone accounted for 10 % of GDP. Industrial activity, mainly limited to groundnut processing, fish freezing and drying, the banjul brewery and leather tanning contributed 9 % to GDP. Services constituted about 43 % of GDP, the lagest contribution arising from trade (16% - including the profitable re-export trade), government (10 %) and transport (8 %). The direct contribution from tourism through hotels and restaurants was 3 %.

The Gambia's small size, undiversified agricultural economy, and trade openness make it vulnerable to weather conditions, the price of groundnuts and economic conditions in neighbouring countries. Furthermore the economic situation in Western Europe has a profound influence on the number of tourist arrivals. The Gambia imports about one-third of its food, all its fuel and capital goods and most manufactured goods. There is some potential for diversifying the agricultural base into horticultural, fisheries and livestock products and potential exists for increasing resouce-based manufacturing and tourism.

Human resource development is marked by an estimated 25 % literacy rate, a 76 % enrolment of school age children in primary schools, very low secondary school enrolments, infant and child mortality rate was 145 per thousand live births, but has greatly unproved due to the success of Primary Health Care Programme (PHCP). Live expectancy at birth is 43 years. Population growth is among the highest in Africa at 3,4 % per year.

After a period of relatively good economic performance in the early 1970s, The Gambia's economic and financial situation deteriorated during the period mid-1970 until 1984/85 as a result of expansionary financial policies, inappropriate exchange rates and other pricing policies as well as adverse exogenous conditions such as the oil price increase. The resulting imbalances led to interrupted economic growth, accelerated inflation and external payment arrears. In 1985, the Government adopted a comprehensive Economic Recovery programme (ERP), supported by the IMF and the World Bank structural adjustment financing and an increase in foreign aid. The adjustment programme has laid the base for sustained economic growth, which has reached an average of 4-5 % (real GDP growth). Among the achievements of the adjustment programme are; the floating exchange rate system; the meeting of budgetary targets; restraint in overall credit policy; controlling inflation and real interest rates have become positive. The Government has laid off as much as 30 % of its employees. In the public enterprise sector, rationalization

measures have been carried out since 1986/87, involving phased divestiture of the Government's holdings in enterprises and introduction of performance contracts for enterprises remaining in the public sector. Following up on the ERP, the Government has launched a Programme for Sustained Development (PSD)

Due to its narrow resource base, foreign aid has been a major contributor to development investment in The Gambia. Public development expenditure amounted to Dalasis 195 million (US$ 21m) in 1990/91, of which Dalasis 150 million was supported by grants. The total annual aid flow to The Gambia, including multilateral and bilateral loans and grants and structural adjustment financing, amounts to US$ 70 million per yaer.

1.3.2 ECONOMIC ACTIVITIES IN THE COASTAL AREA

As especially the coastal area (Figure 4) is affected by erosion, this section reviews the economic activities that are directly or indirectly influenced by coastal erosion. Economic activities in the coastal zone are dominated by ficheries, tourism , housing, industry, agriculture and mining. There are also roads close to the coast. In this section an analysis is made of the economic importance of these activities and to what extent these infrastructures appear to be threatened by coastal erosion.

a. Fishery

The Gambia, with a continental shelf of 3,855 km^2, is considered to have a rich fishing zone. In 1990, 1500 artisanal fishing boats and 71 industrial vessels operated in the Gambia. Artisanal fishery (also in the mangrove systems) is estimated to employ as much as 20,000 nationals. It is on the increase. The fishery sector has also become an important foreign exchange earner with 1989/90 exports estimated at US $ 2.3 million. Along the Atlantic coast six fish landing points have been constructed, which will be affected by coastal erosion :

Landing site	Estimated catch (in Tons in 1991)
Brufut	1,103
Tanji	4,399
Batokunku/Tujereng	39
Sanyang	245
Gunjur	8,955
Kartong	-
Total fish landed in 1991	14,741

Table 2 Fish Landing sites of importance

Source : Department of Fisheries

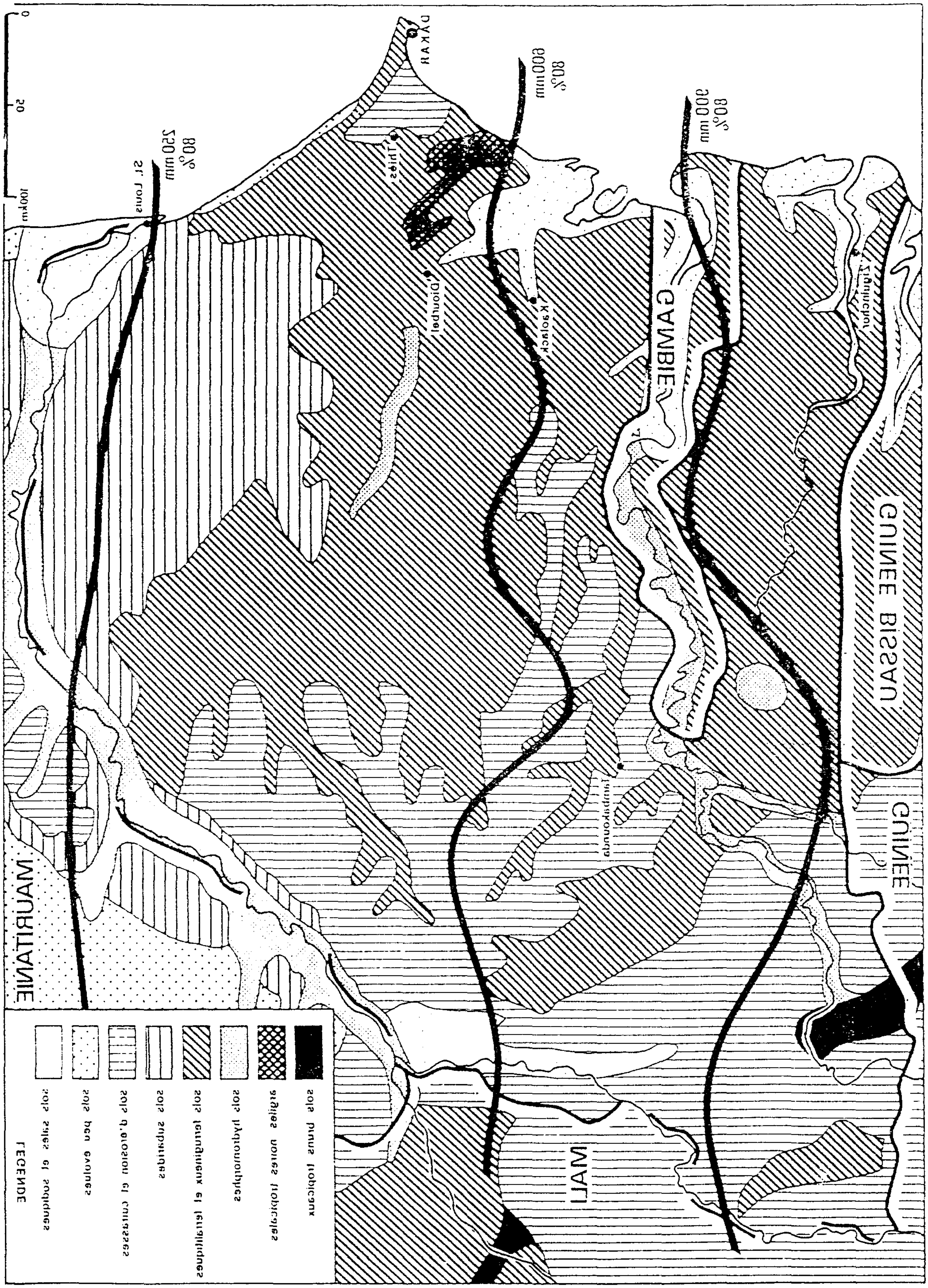

Fig. 7 Sénégal : carte des sols (Ministère Coop. et ORSTOM-1976

The infrastructures at these sites have been improved under EC funding in 1988/89. Most of the structures at the landing sites are of a low cost type, but the drying/smoking facilities are of concrete and these as well as the houses of the fishermen will eventually have to be relocated as coastal erosion continues. At present especially the landing sites at Brufut and Tanji appear to be threatened. The Brufut landing site seems most seriously affected and suffers in particular from increased erosion due to the sand-mining at Bijilo. The only expensive infrastructure consists of an ice-plant at Tanji, but this plant is a bit further from the beach. At the other landing sites, although also located near the beach, no immediate problems are envisaged, as the coast is more stable in these areas down south.

Total recent investments in concrete buildings at the six landing sites are estimated at Dalasis 5.8 million or US $ 0.64 million. Of these one third are endangered by coastal erosion. If the housing of the fishermen (1500 families) is added, the value of threatened infrastructure can be estimated at about US $ 1.0 million.

The mangrove systems are an another important asset, which eventually will be at risk if erosion continues at the present rate. The mangrove systems provide important revenue in terms of oyster and shrimp culture. Mangrove forests also provide a source of wood and experience some threat from agriculture but this effect seems more important in the estuary that in the coastal area. It is difficult at this stage to determine the value of the mangrove systems or to estimate the potential loss in productivity.

b. Tourism

Tourism has become an important source of income for the Gambia. The number of tourists arriving annually in the Gambia has increased rapidly from 27,000 in 1974/75 to 74,000 1984 /85 and has reached over a 100,000 now. Tourism infrastructure invested along the coast is the most valuable infrastructure found in the coastal area. 15 modern hotels have been established along the coast. Of these four major hotels are along the coast between Banjul an Cape St. Mary, while the more recent hotels have been on the Atlantic coast down from Cape St. Mary. A number of these hotels face serious beach erosion problems and in most cases the beach in front of the hotels have been reduced by at least half and only a fairly narrow beach is left. In some cases, like the Palm Grove and Tropical Gardens hotels, the beach has already disappeared.

In assessing the damage caused by coastal erosion to the tourism industry it should be noted that tourists to the Gambia are principally attracted by sunny beaches. Unfotunately the hotels are all built in a zone that is subject to considerable erosion. While physical damage to the hotels has been limited to a falling fence (Amies Beach hotel) and the destruction of a pool bar (Palm Grove hotel) and possibly seawater entering some facilities during spring tide, it may be expected that tourists will turn away from these hates if they would no longer have access to a reasonable beach. While tourists may spend

the majority of their time alongside the swimming pool, the beach remains the principal attraction. This is why it must be assumed that hotels may need to be relocated the moment they would no longer have a beach. The economic damage that would occur to the hotel industry if erosion continues is thus likely to be much bigger than the financial costs of reconstructing a pool bar, replacing a fence that collapsed, or construction of a sea wall.

A conservative estimate of the replacement value of the hotel infrastructure along the beach comes to US $ 300 million (capacity 4700 beds). The actual value of the hotels would be less than this: possibly around $ 150 million, the average age of the hotels being 11 years although some have been renovated 4-5 years ago. While a more detailed estimate is warranted it becomes clear that some investment to protect this infrastructure is justified.

At least one hotel has started to use its own funds to replenish the beach: it has collected six trucks of beach sand down south (at a cost of D 200 per load) and put this on the beach before the start of the tourist season. This is a short term but very inexpensive solution.

When assessing the damage that is occurring to the hotel industry, it must be remembered that income from tourism is important for the Gambia. It is estimated that in 1990/91 the Government collected about D 48 million (US $ 5.3 million) in direct and indirect taxes from tourism, which amounts to about 10 % of Government revenue (for details see Table 3).

	89/90	90/91	91/92
Hotels sales tax 1)	10,3	13,0	21,7
Restaurants sales tax 1)	0,9	1,0	1,7
Corporate tax H&R 2)	4,8	6,0	7,0
Import tax food/drinks 2)	9,0	10,0	10,0
Departure tax tourists airport 1)	5,0	7,0	7,0
Land rent paid by hotels1) (D 100 per bed)	0,5	0,5	0,5
Total direct income in Dalasis	30,5	37,5	47,9
Total direct income in $ US	3,8	4,4	5,3

1) Data : Department of Tourism
2) Mission estimates

Table 3 Summary of incone from Tourism.

On the other hand, the Government has also incurred expenditure on infrastructure to facilitate the construction of hotels. For the Tourism Development Area Phase I (TDA I), where the existing infrastucture is concentrated, for instance $ 12 million was spent on water and sewage infrastructure (World Bank loan from 1972). For the new TDA II zone (the area down from Kololi Point) it is envisaged to upgrade the coastal road (estimated cost 150-200 million Dalasis) and furthermore a new airport terminal is envisaged at the international airport, as the present one does not meet today' s standards in terms of convernience, baggage handling etc. These investments are entirely to the benefit of the tourist industry.

New investors in the hotel industry enjoy a tax holiday for 5 years on all imported equipment and materials, but not on sales tax and import tax on food etc.

Most hotels are privately owned. The Govenement owns still the Atlantic Hotel, has a 49% share in the Senegambia Hotel and a minor share in the new Kairaba Hotel. The Govenment anticipates to sell its shares to the private sector in the context of the privatization programme. The tourism sector provides employment to an estimated 7000 persons, of which half is directly employed by the industry.

Tourism hardly has any negative impact on the environment. On the contrary the known appreciation of tourists for nature helps preserve the rich flora and fauna of The Gambia. Its negative impact is probably limited to the "safari-trips" in trucks or 4WD jeeps along the beach.

c. Housing

In the Fajara area a number of residences have been constructed along the cliff, among which the President's residence.The annual erosion to the coast is less here, as the cliff erodes only slowly. Most of this property does not seem to be in immediate danger. The mission has not been able to obtain an estimate of the value of these properties.

d. Industry

The CPMB groundnut oil milling factory located at the Oyster Creek bridge near Toll Point has buildings on both sides of the main road. On the sea side there is no beach left at this place and some rock fill has been done to protect the buildings. The rear buildings are in immediate danger and one in fact already collapsed. The buildings on the side are however all very old and generally in a bad state of maintenance. Little value is to be attached to them, especially to the buildings near the sea. The factory is owned by GPMB and is to be sold to the private sector.

e. Agriculture

The agricultural sector presently experiences no damage from the coastal erosion. The problem of salinity instrusion up-river appears primarily caused by the lower rainfall.

Agriculture is however important in the coastal area and any breach of the dunes would cause considerable damage.

f. Road infrastructure

Part of the new Banjul-Serekunda highway is very close to the high water mark. Along the cemetery area no more than 50 meters distance between the high water mark and the road is left. The 11,3 km long highway, of which 2-3 kms is in immediate danger, was constructed during the period 1981-89 at total coast of Dalasis 83 million. The cost of the theatened part would thus be around Dalasis 18 million or US $ 1.9 million.

The roads down south are, with the exception of the toads at fish landing sites, at a more than safe distance from the coast. These roads are all of a laterite type.

g. Mining

While some sand mining takes place all along the coast, commercial beach mining is since 1985 concentrated at Bijilo. It is estimated that annually some 150,000m^3 of sand are extracted from the beach at this site which causes major environmental damage. Laterite is also mined at Bijilo just next to the beach. Per truckload (containing 3-5 m^3 of sand) a minimal charge of Dalasis 20 or US $ 2 is levied by the Local Government. This charge clearly does not refflect the value of the sand as any sand mined in this area is a definite loss to the beach . As a comparison, to replenish the area is a definite loss to the beach from off-shore may cost as much as Dalasis 40 per cubic meter.The ›pportunity costs are thus almost ten fold the price of the sand mined. It is to be noted also that the price of the sand (D 20 plus the cost of the manual loading of the truck) constitutes only a small fraction of its price at destination (D 180 to D 200), which means that an increase in the price of sand would only have a moderate effect on its cost to the consumer.

More to the south ilminite used to be mined but its mining has been stopped as it was apparently not economical.

The Government has identified two alternative terrestrial sand quarries at Sayang Ba and Brikama. Both places are located further away from the construction sites presently concentrated in the Bakau area. Extracting the sand (the deposits start at six meters depth) will be considerably more expensive and the sand is, unlike the beach sand, unwashed. The reason beach mining continues is thus a purely financial one. As long as the Government allows this to continue, sand will not be mined from terrestrial sources.

h. Other infrastructure

The two Muslim cemeteries on the sea-side near Banjul town are experiencing very serious erosion, where as much as one third of the graves have been washed away by the

sea. Relocation of these cemeteries and possibly in the near future the Christian cemetery next to it seems unavoidable unless an immediate solution is found to restore the beach at this point. The nearby radio station is equally in danger, while the building of the former Q-club has already collapsed.

The Gambia port experiences presently little damage from sedimentation. The channel seems stable and the last few years no dredging has taken place. For the third phase port extension only some maintenance dredging is envisaged. Apparently the Government wharf experiences a little more inconvenience from sedimentation.

1.3.3 EFFECTS OF COASTAL EROSION ON THE ECONOMY

From preliminary assessments it appears that an important part of the coast is retreating at an average rate of one to two meters per year. This means that an equally important part of the infrastructure outlined above is in immediate anger. The most costly and probably also most affected economic infrastructure is that of the hotel industry. Here the simple disappearance of the beach may lead to the close-down of hotels. While at present net tourism revenue may be limited due to its high import content (imported food, drinks, materials and management staff) it is still a crucial source of income to the economy as well is for Government revenue. The industry is also a very important employer in the country.

The annual loss of land along the coast is estimated at 2.5 to 3 ha. As land along the coast is not usually sold but for instance rented out to the hotel industry and given out at a very concessional rate to residents for housing construction, it is difficult to determine the value of the land lost annually due to erosion. Provisionally an economic value of D 30,000 to 100,000 may be attached to the land equal to its opportunity cost depending on the land-use. The annual land-loss may then be valued at D 100,000. - to 300,000. - or US $ 20,000. - to 30,000.

The preliminary assessment of the present value of the hotels (at least US $ 150 million would justify considerable expenditure in the protection or the replenishment of the beaches. In the extreme case a similar amount or an amount equivalent to the net present value of future revenues from these hotels would be justified to spend on beach protection. Eventually even the most expensive option of a beach replanishment which may cost as much as US $ 15 million (3 million m^3 sand at a cost of US $ 5 per m^3) and which could completely restore the beaches for at least another ten years should not be excluded. Such measures may eventually be cost-shared by the Government and the hotel industry which are both beneficiaries.

Before such an investment is made the effects of possible solutions must be studied in detail and a more detailed assessment of the value and revenue from the endangered hotels will be required. Cheaper methods such as the annual replanishment of specific

beaches (with sand transported from the south) or the rehabilitation of the groynes must be studied to achieve the same benefits, i. e to safeguard future tourism revenue. More detailed estimates are also needed of the actual annual rate of erosion at the various sites and the potential damage to other infrastructure, including the environmentally precious but also productive mangrove systems.

At present, the Government spends annually between 1 and 2 million Dalasis on coastal protection, mainly on the area near the cemeteries (rock fill and the construction of gabions). The groynes constructed in the 1950s along the coastline between Cape St. Mary and Banjul have however not been maintained.

1.4 INSTITUTIONAL ASPECTS

Although a reasonable legal framework is available in the Gambia, the regulatory system, the organization and the implementation with repect to coastal zone management are weakly developed ; mainly because of the small scale of all aspects of the system. Awareness of coastal erosion is of relatively recent times and the means are limited.

a. The legal framework

The legal system in the Gambia provides ample basis for regulations and guidelines in the field of coastal zone management. Relevant acts are :

- Local Government and City of Banjul Act (1912 and amendments);
- Land Provinces Act (1935 and amendments), includes physical planning;
- Minerals Act (1953) ;
- Environmental Continental Shelf Act (1965);
- Tourist Industry Act and Hotel and Restaurants Act (1974); include licensing;
- Roads and Highways Act (1974)
- Physical Planning Act (1984);
- Environmental Protection Act (1988);
- National Council for Art and Culture Act (1990)
- Fischeries Act (1991);
- Physical Planning an Control Act (1991), and
- State Plans Act (1991).

The lack of regulations and guidelines, based on these acts, is mainly due to the very limited (legal) capacity available in the various government organizations.

An Environmental Management plan, prepared by the Environment Unit of the Ministry of Natural Resources and the Environment is in the draft stadium. Attention is given to the coastal zone in this document.

b. Organization

No organization is specifically entrusted with the management of the coastal zone. The

Department of Technical Services, in the past constructed and maintained sea defence works such as groynes and revetments. Its present budget and capacity are very limited.

Other organizations operate in the field of planning, environment, tourism, mining, public serves, fishery and agriculture but co-ordination is very poor. No scientific organization exists in the country which could support the management.
Some private organizations have taken measures to protect their assets. Hotels co-operate in the Gambia Hotels Association.

A sub-committee, initiated by the Ministry of Natural Resources and the Environment in 1986, was established by the Cabinet "to investigate causes of coastal erosion along the coastline and give recommendations to solve the problem". It included representatives of :

- the Department of Technical Services (chairman and one member);
- the Environment Unit (secretary and one member);
- the Physical Planning Board (2 members), and
- the Department of Physical Planning (3 members).

The sub-committee submitted recommendations and it prepared Terms of Reference for a study. The latter was presented to the United Nations Environment Program and, eventually, led to this indentification mission. The sub-committee could be revived if necessary.

c. Implementation and enforcement

Lack of adequate regulations and guidelines, organization, personnel and logistics add to poor official and public support to cause a very weak implementation and enforcement of even the few rules that exist and measures that are deemed necessary, "Regulation" of sand mining is restricted to a levy charged by the local authorities. Existing shore protection works are hardly maintained.

2 MITIGATION OF EROSION

2.1. PAST AND CURRENT ACTIVITIES

a. Background

The rate of erosion of the beach on certain section of the coastline of the Gambia has become a source of great concern for the public in general and the Government in particular. It is already apparent that the sea defence structures built over the years up to the mid- seventies are now incapable of protecting the beach and property as they once appeared to be doing so effectively. The lack of regular periodic maintenance of these structures coupled with the high rate of extraction of beach sand for commercial purposes in certain sections, are some of the factors responsible as are the vagaries of the tide and wave action.

The amount of erosion and land lost to the sea varies from section to section but two main areas more than anywhere else seem to be persistently vulnerable over the years and these have therefore had defences built and where possible, periodically maintained. Account of the defence activities can be given as follows.

b. The North Shore of St. Mary's Island

The first serious attempt to provide protection to the beach in this section appears to have been made in 1957. At this time, the old Muslim Cemetery and part of the Christian Cemetery suffered from flooding during spring tides as the sea water almost reached the main road causing considerable loss of beach. The scheme was to provide groynes constructed of rhun plam piles with concrete panels between the piles. The results were not satisfactory and the scheme was later abandoned.

The following year, subsequent to the recommendation of consultants Lewis and Duvivier (who prepared a report on Sea Defence in 1955), work was put in hand to provide groynes and breastwork to the east of the new Musllim Cemetery. The structure consisted of rhun palm main piles connected just above beach level by timber walings, and rhun palm sheet piles jetted into the sand secured to the walings by nailing. This scheme is he so-called North Shore Sea Defence works.

During the course of these works however, the beach in the vicinity of Mile 3 was gravely threatened as high water at places reached only a few metres from the then main Bathurst/ Brikama Trunk Road. The construction works at Mile 2 were therefore stopped and 14 new groynes were instread constructed at Mile 3. In this case, boulder stone pitching was employed to protect the cliff; the pitching being retained by toe gabions. This work proved successful and erosion was brought under control.

Between 1958 and 1962, the early groyne protection scheme was completed and the protection extended eastward from the Muslim Cemetery to a point just beyond the Atlantic Hotel. Breast work was omitted over most of this length.

Further scouring of the beach at Mile 3 occured during the Summer of 1967 and it was necessary to lower certain groynes by 0.6 to 1 metre and construct some new groynes. This work sufficed to control the situation and the immediate danger at this point was removed by rapid accretion from Toll Point past Wadner's Beach and Palm Grove until at least 1980/81.

Further work was undertaken in 1967, 1968, 1969 and 1970 to close the gap between the sea defences at Mile 2 and Mile 3. Once more, during 1970-71 it was found necessary to employ boulder pitching and ganbions to protect a stretch of coast bordering the new Muslim Cemetry. To date there appears to have been no recovery of the beach in this area but, all the same, work continued albeit limited to the maintaince of the existing groynes, boulder pitching, and gabions.

In 1975, exceedingly severe flooding during spring tides caused serious damage at the new Muslim Cemetery from Radio Syd westwards for a distance of about 1 Kilometre. The boulder stone pitching was washed away and the cliff in some areas was eroded landwards by up to 10 metres. This state of affairs has continued at en ever increasing and alarming rate through the eighties to the present as the under-allocation of funds meant that neither the required minimum maintenance to keep the groynes functional nor the construction of a breast work with back fill could be done.

In 1990, the new Banjul to Serekunda asphaltic dual carriageway was opened to traffic. The east bound lane of this carriageway is now less than 50 metres from high tide water mark at certain sections along the cemetery. Further westwards, the Gambia Utilities Corporation (GUC) water tanks are also threatened as well as the entire beach front of the Palm Grove Hotel. Where severe flooding and wave action has caused considerable damage.

c. East of Cape Saint Mary

The beach to the east side of the Hotel Sunwing at Cape St. Mary is constantly changing position due to the erosive action of the sea. The marine forces acting on this portion of beach are probably uncharacteristic compared to other areas as it is situated behind the headland separating the Atlantic Ocean from the River Gambia estuary. Consequently, all attempts at coastal protection have been on a trial and error basis since 1976 when the problem of erosion in front of the hotel was first observed.

In March 1977, the erosive action on the beach seriously undermined the foundations of one of the hotel's buildings. An attempt was made to remedy this situation by constructing two experimental timber groynes each of 40 metres lehgth. This scheme was remarkably successful and within a very chort time sand rapidly built up in the area. This was later followed in 1983 by the construction of an additional 3 groynes an 150 metres of breastwork northwards from the undermined hotel building.

Since then no further construction of groynes. has been undertaken and works have been limited to very minimal maintenance because of lack of sufficient allocation of funds. Consequently the groynes and breast work have deteriorated considerably leaving the beach very vulnerable once again. Some artificial nourishment was applied in cases that the beach was in a bad state at the beginning of a tourist season.

2.2 POSSIBLE MEASURES

a. Introductory considerations

Whilst a complete rehabilitation of the sea defence structures may yet restore some of the presently eroding beaches, this is not only expensive but can be nothing more than a short term expedient.

For the long term, a detailed and comprehensive study of the whole problem of erosion on the coastline of the Gambia is required with the formulation of a coast protection master plan which can be implemented in phases.

A review of the coastal situation and littoral regime in the Gambia shows that some of the erosion-inducing processes are inevitable and may even grow in intensity. For example, a recent United Nations projection shows that the global rate of sea level rise will probably increase from 1.1.5 mm per year to 6.7 mm per year over the next century because of the increasing Greenhouse effect. Such accelerated sea level rise may not be dramatic on cliffed coasts such as Fajara, but the resulting landward translation of the shoreline may well imply a continuation of the present coastal erosion, (maybe at ever increasing rates) on low-lying coasts such as the North shore of St. Mary's Island.

Attempts to modify coastal changes to halt erosion will require an appreciation of the factors at work in the coastal morphogenic system, the pattern of change, the sources (and sinks) of the sediments, the paths of the sediment transits and the impacts of protection works. In the latter respect, it would not be enough to point to defence measures that have proven successful elsewhere, particularly in Europe, Japan and the USA. And to seek to transplant such solutions to the Gambia. Erosion control measures that are appropriate in one place may prove an abysmal failure in another. Experience from various parts of the world where coastline stabilization measures have been applied without adequate understanding of the coastal sedimentary processes, frequently show poor performance and/or early failure. In some cases, even, the mitigative measures served to aggravate the very problems they were designed to solve. Also, along the Gambia coast visible tertimonies to the failure of stabilization schemes (such as collapsed seawalls, groins detached from the coast) can be found, which have been applied without due regard to coastal processes and coastal engineering background.

This awareness brings into focus the need to react timely and appropriately to coastal erosion problems, including adequate monitoring and maintenance procedures and - in case of non-structural solutions - appropriate legislation and enforcement. The next paragraph summarizes the options which - in principle - are available to the Government of the Gambia faces with the ongoing and possible future erosion problems.

b. Methods of Coastal Protection

The variety of options aplicable to any on erosion problem in the Gambia are linked with the causes and consequences of erosion and the socio-economic environment of the coastal site concidered. In principle, both structural and non-structural methods of coastal protection can be viewed in this respect.*

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* A.C. Ibe and R.E. Quelennec Methodology for assessment and control of coastal erosion in West and Central Africa. UNEP Regional Seas Report No. 107,1989.

Non-structural methods

Non-structural mathods of coastal protection would essentially consist in deciding :
- not to act at all: the risks of erosion and their consequences are viewed as acceptable in the short- and medium-terms ;
- to move and to reconstruct the works in danger on a set-back line further inland or a relocation elsewhere along a stable stretch of the coast ;
- to manage the situation ; prepare, implement and enforce regulations governing land use planning, extraction of sand from the beach etc.

Structural methods

Structural methods of coastal protection essentially would be related to one of three categories:

- passive protection methods ;
These methods involve works built longitudinally along the shoreline, the objective being to fix the shoreline by protecting it from direct wave action without seeking to maintain or to enlarge the beach by affecting sedimentary processes, the most commonly used longitudinal coastal defence works are of three types : sea-front walls, revetments, and embankments/bulkheads. Such longitudinal structures are not to be recommended for mobile coasts, subject to rapid coastal retreat, because the gradual drop of the beach level will tend to destabilize the works. However, they may well function to protect erodable cliff coasts.

- active protection methods ;
As opposed to passive protection works, which protect only that part of the shoreline where they are built, active protection works affect the characteristics of the swell and of littoral sedimentary transport, aiming to trap and retain mobile sedimentary stocks on the coast. Frequently used active protection works are groynes, detached breakwaters, and artificial beach fill. The latter has the distinct advantage that one (partly) re-establishes the sedimentary equilibrium of the coastal segment suffering from a sediment deficit. Active protection methods are often used along mobile coasts.

-restoration methode ;
Unlike the preceding methodes, restoration methods aim to re-estalblish the destroyed equilibrium or to reinforce the stability of natural systems. They are applicable basically to three types of littoral facies :

- erodible cliffs : combatting infiltration of rainwater and improving drainage operations.
- dune formations : erection of wind-breaking screens and planting of suitable grass species.
-maritime marshces:direct protection of mangrove barriers in order to enhance sedimentation.

Altenative solutions among these categories should be viewed vis-a-vis the particular needs of the erosion problem, as to enable a comparison of the costs and advantages/ disadvatages of the possible solutions. Selection criteria in this respect include considerations such as :

- type of erosion process ;
- objectives assigned to the defensive works ;
- current and future use of the coastal site ;
- urgency to complete the works ;
- lifetime of the works and (cost of) maintenance ;
- technical means (materials, equipment) and financial resources available.

c. Decision framework for coastal protection and management

The choice of appropriate coastal defence techniques in the Gambia will frequire an in-depth knowledge of the pertinent morphogenic system and a broad experience in coastal engineering works. It is sensible to make such a choice within a coatal management decision framework allowing for a logical procedure that would ensure that all appropriate alternatives, resources and factors are considered and carefully evaluated towards a nation-wide Master Plan. In this respect the coast protection Master Plan should be one that in its entirety minimizes costs and environmental damages, and provides maximum short and long term efficiency to (management) decisions and coastal operations, while having a minimum impact on the socio-economic and cultural texture of the country.

d. Alternative sand mining

As mentioned earlier, in the Gambia, sand and gravel are mined for use in construction of roads and buildings. As these minerals are indiscriminately extracted, it is difficult to quantify by volume the amount extracted periodically, because of the fact that they are not managed and are also taken from many sites. No proper record was ever made of the volume extracted although the effect is seen on the environment.

The commercial sand mining operation at Bijilo has been going on for some years now. The estimated extracted level of 100, 000 to 150, 000 m^3/yr is a major cause of beach erosion in the coastal area between Kololi Point and Bald Cape, as the sand extraction creates a significant deficit in the sediment budget, which along this stretch also suffers from a natural deficit in the littoral transport. As such, the mining of sand near or on the beach should generally be discouraged because coastal erosion is becoming a major problem in the Gambia.

Mining of sand is among the coastal activities which should be carefully regulated, using such management tools as periodic rotation of coastal sites, licensing and quantity quotas as needed. Preferred sites would include growing beaches or other stable areas known to be the terminus of sand circulation cells.

Apart from mining regulation at the coast, it would be recommendable to transfer (par of) the mining activities to propective quarry sites inland. Moreover, it would be worthwile considering the possibility of substitute materials for the sand and gravel demand in the construction industry, which use would be less harmful to the environment.

Land Use Planning

by *Mr Sainey MANNEH* (*)

PREAMBLE

Since the coastal strip runs from Banjul to Kartong and Greater part of it is what is designated the Tourism area, Land Use planning in the coastal area will largely deal with the TourismDevelopment Area (TDA) as delineated - 1/2 a mile from the high water mark outwards extending from the Kotu Stream to the Allaheim river.

The Department of Physical Planning and Housing responsibility has been absolved and vested on the Tourism Area Development Board. Such vital Department has no control over the coastal area, even though landuse functions are the Department's responsibility.

Consequently, present TDAB needs to assume greater responsibility over the TDA in matter beyond Tourism or should relinquish this responsibility to the competent authorities who have the capacity to issue guidelines and monitor the landuses. Example as a large degree the coastal strip is suffering from erosion which remain, unchecked to the detriment of the environment.

Also, present allocation of land in the tourism area negates environmental responsibility. Allocation violate official existing landuse plan and therefore the attractions of the tourism industry is not created but destroyed.

1. DEFINITION OF COASTAL ZONE OF THE GAMBIA

Coastal zone in The Gambia could be defined as the strip of land along the coastline extending from Banjul to Kartong.

Since the preparation of The Greater Banjul Area (GBA) Physical development plan in 1984/85, the plan has defined various landuse for the whole of the GBA. This include coastal area development with over compatible uses. The area as defined by landuse plan as Tourism Development Area (TDA) runs from Kotu to Kartong. The TDA does not cover Banjul coastal zone. The Physical development plan has no specific plan for coastal zone of Banjul.

Coastal development within Banjul Port Authority (GPA), apparently any development with regard to coastal zone in Banjul need clearance from the GPA.

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* Department of Physical Planning and Housing, The Republic of The Gambia

2. CURRENT STATE OF LAND USE PLANNING IN THIS ZONE

The current land use is specifically based on the planned coastal zone which is the Tourism Development Area.
In 1970, the TDA was legally designated under Ministry of Local Government and Kombo North/South District Authority Act as a mile zone along the Atlantic coast reaching from Kotu river down Tanji River initially and subsequently extending it down to the Atlantic River.

Thus, the TDA covers almost the entire Southern coast of the Gambia.

This legal designation of TDA has facilitated the Tourism Liaison Board (TLB) now the Tourism Area Development Board all developments so far and it is emphasized that designation TDA as a planning Area in future should enable the authorities not only to control landuse but also to protect natural beauty of the TDA.

The Bafuloto plan of 1973 is still the Basic of all Physical Planning within the TDA. The plan aim to promote the development of Atlantic coast of the Gambia for the dual purpose of Tourism and urban development. The area along the coastline with an average depth of 800 meters is reserved for resort and related development whilst the area in land from the coast and separated from it by a Highway (Badala Parkway) is planned for urban improvement and expansion.

Existing infrastructure

Roads

The access ti the Kotu is provided by three culs-de-sac roads of 1.5 to 2 kms. This parkway presently ends at the Senegambian Hotel in Kotu Beach.

It is proposed in the Greater Banjul Area land use plan to extend this parkway via Bijilo sand pit to connect to Sukuta - Brufut Road and Further on to Yundum Airport.

The existing Kotu Sewerage Treatment plant has been designed for a maximum capacity of approximately 5,500/hotel beds.

It presently handles the Sewerage of 2,000 beds so that there remains an additional capacity to serve 2,500 beds.

Thus only half of the recently allocated hotel projects can be connected to the existing plant and the other half would require the services of a second treatment plant.

WATER

The water supply already at present is a major problem of the whole area, the level of the ground water is constantly sinking and there have been water shortages since several years. This mainly is due to enormous use of water for Tourism facility. In the Senegambia Hotel, in 1986, the water consumption per bed amounted to 500 litres a day.

The situation will only be improved by drilling new bore holes and constructing more over head water tank at Kotu South. But again, this may not be realized in the immediate future. Therefore, considering the present water supply and ecological implications, all allocated and future projects have to be carefully and critically scrutinised before they are approved or implemented.

THE SOUTH COAST

From Ghana Town to Allaheim River along the coast area very few tourist facilities are existing.

These are as follows:

* CAMPS

On the beach between Gunjur and Kartong is located a small camp with four huts consisting of 16 beds and a small kitchen to serve over night guest. South of Kartong at the mouth of Allaheim River is another camp which has been built illegally.

Bush and Beach bars are simple temporary huts for the use of tourist picnic and one day visits. Though temporary they are attractive and in harmony with the nature and landscape. There is one near HOW BA called "Sanyang Village" and one at solifor point (see plan attached).

* FISH CURING SITES

These typical Gambian sites are attractive spots for tourists excursions. Four of them exist along the South Coast: Ghana Town near Brufut, Tanji next to the mouth of the river Tanji, HOW-BA near Sanyang and Bator Sateh, South Gunjur, the last one being the biggest in the country.

These fish Curing sites should be left as they are, without being encroached or surrounded by other developments (see plan attached).

3. EXISTING LEGISLATION AND INSTITUTIONAL ARRANGEMENT DEALING WITH THE COASTAL ZONE

Refer to: The Gambian Port Authority Act, July 1972; Land Provincial Act cap 103 and State lands Act 1991.

4. PLANS FOR IMPROVING PLANNING AND MANAGEMENT OF THE COASTAL ZONE

The main idea behind the general plan for TDA is to distinguish two different types of tourists zones along the coast. The northern zones, where the main tourist development shall take place within clearly defined areas such as Kotu and Bijilo and later the Brufut Area, and the southern zone, where there would be only small "Tourist sport" for excursions and short time visits.

No further Physical development of tourist area is envisaged in the Southern zone. Based on the latest forecasts as well as the actual growth of tourist and also on the assumption that tourism will grow faster in the future, a study made by GTZ short team expert on the TDA in 1989 has concluded that the Northern Zone alone can adequately meet the demands for hotel beds in the future. This affords the opportunity to preserve the Southern Zone as a nature park of unique beauty untouched by the adverse affects of tourists developments. The proposed nature park "South Coast" will provide a far greater attraction for the Tourism in The Gambia than a multitude of half furnisher hotel-sites dotted along the whole coaster strip.

Also economic reasons will justify the above general concept. To concentrate the development in the North will imply a far low infrastructure investment than developing the whole coast. The "Tourist Spots" which are planned within the nature park will be self-sufficient sites, which will be accessible by earth roads requiring low construction and maintenance costs.

As it has been already pointed out, the recently allocated areas for additional hotels project in the Kotu Zone do not correspond to the original Bafuloto Plan. The area, if and when fully developed will become congested, overcrowded and it will loose its present attractive which is characterised by the contrast between the nuclei of modern hotels with all entertainments and wide stretches of quiet and untouched nature around.

Both the allocated projects and Bafuloto Plan have to be reviewed in order to preserve the environmental qualities of existing and proposed tourist area and review has to take into account the actual growth to tourism.

It should be borne in mind that all landaus planning for tourists propose should handle

nature and natural resources with utmost sensitivity. This means that the physical planning has to propose reasonable stage for development and that new areas should not be developed until the existing once are built-up. It also means to stipulate a reasonable density for the plot.

To conclude, the coastal strip, however, should be kept free from all physical developments other than hotels and compatible uses and related leisure facilities (like Bijilo forest park). Any new facilities should, just like the existing ones, be grouped together with park-like area in between, this arrangement is a touristic asset which gives The Gambia a comparative advantage over similar international beach resorts which are densely built.

Tourism Development
with specific reference to the Tourism Development Area

by *Mr Alkali F. CONTEH* (*)

When tourism started in the Gambia in 1965, only 300 tourists hailing from Scandinavia spent their holiday on our beaches. The following year, the number rose to 528. The industry which was introduced by foreign business interest, was encouraged by the following factors:

* a stable democratic government government;
* a policy design to attract foreign capital through tax incentives and duty waivers on imports;
* high rates of return on investments;
* a favourable climate and beautiful beaches;
* accessibility.

The industry became so successful that by 1970, existing facilities became overstretched, creating the need for more basic infrastructure. Consequently in 1972 the area stretching from Cape Point to Kololi (and later extended to Brufut/Kartong as well as Barra Point) was designated a Tourism Development Area.

This TDA is formed by coastal stripped of some 750 to 800 m in width and approximately 15 k in length along the Atlantic shore. The original plan or first phase aimed at accommodating up to 3,000 beds in 3 different sites i. e.:

* Kotu Strand: 2 hotels of 250 beds each
* Kotu point : 4 hotels of 250 beds each plus 1 of 500 beds. This includes facilities such as restaurants, night clubs, casino and golf course.
* Kotu beach: 4 hotels of 250 beds each.

The second and the third phases cover:

* Brufut heights and Brufut Bay (with the plan density of 80 to 120 beds per hectare each, provided by 4 hotels with 250 beds each and 1 of 500 beds in Brufut Bay).

* South Brufut for which were planned 2 hotels sites of 250 beds each, with a density of 50 to 150 beds per hectare.

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* Senior Tourism officer Development

The plan also includes condominiums in Kotu and Brufut with a bed capacity meeting 25% of hotel capacity of each TDA. In Order of forester contract between hotel guest and the local people the plan further included setting up of craft markets (Bengdulalu) in each area .

Master plans are also provided (i.e. for Kotu and Brufut) including plans for residential and working areas.

In the same year that the above area was designated a TDA a Tourism Liaison Board was set up comprising of:

* Permanent Secretary, Ministry for Local Government and Lands;
* Physical Planning Officer; Land Officer;
* Development Secretary;
* Deputy Secretary General;
* Permanent Secretary, Ministry of Agriculture;
* Tourism Adviser.

The TLB was charged with the responsibility of advising the Minister of State responsible for tourism on such matters as tourism legislation, tourism security and land use policy in tourism.

In respect of the latter, the Board was charged with the task of preparing draft for tourism related projects. Therefore between 1975 and 1981, this Board among others accomplished the following:

* the preparation and implementation of the planning and building regulations for TDA;
* the development access roads;
* the provision of water and electricity;
* the identification and construction of beaches facilities.

In november 1987, Cabinet agreed to a proposal to change the name of the Tourism Liaison Board to the present Tourism Area Development Board (TADB) with a reconstituted membership consisting of the following:

* Permanent Secretary, Ministry of Information & Tourism (Chairman);
* Permanent Secretary, Ministry for Local Government & Lands (Deputy Chairman);
* Chief Executive Investment Board;
* Director of Tourism;
* President, Gambia Chamber of Commerce & Industry;
* Permanent Secretary, Minister of Trade Industry & Employment;

* Deputy Permanent Secretary, Ministry for Local Government & Lands;
* Deputy Permanent Secretary, Ministry of Information & Tourism (as Secretary).

The terms of reference of this Board are:

1. To advise the Minister of Information & Tourism on the management and development for TDA generally;

2. To consider detailed plans for development of areas designated as TDA;

3. To receive, consider and advise the Minister of Information & Tourism on applications from companies and individuals wishing to be allocated space within the TDA.

The Board is assisted by a Technical Committee in the processing of applications for land within the TDA. This Committee (which has since been disbanded to reduce bureaucratic red-tape and delay in the processing of applications for land) comprised of the following:

* Director of Physical Planning & Housing;
* Director of Tourism;
* Director of Lands and Surveys;
* Director of forestry;
* Managing Director - GUC;
* Chief Executive NIB.

With regards to the consideration and allocation of land within the TDA, the Board has set the following requirements and procedures:

1. all applications must provide a business registration certificate;

2. for groups of persons and companies, the must provide an article of association and a memorandum of incorporation;

3. the presentation of a feasibility study document;

4. a minimum deposit in local bank of 10% of the total financial cost of the proposed project.

Upon the fulfilment of these requirements, the Board processes the application and recommends it for approval by Minister of Information & Tourism. With this assent to the Board's recommendation, this Minister sends the application to the Minister for Local Government & Lands for his concurrence. Thereafter the Director of Lands & Surveys is instructed to convey approval to the applicant with conditions amongst which is a

conservative clause stipulating the maximum heights of structures and the conservation of existing floral life as much as possible.

Leasing processes could start immediately after allocation of land is made but an understanding has been reached between the two Ministries (i.e. Ministry of Information & Tourism and Ministry for Local Government & Lands) that lease should not be granted until after completion of a significant level of development in respect of civil works by the applicant. This condition together with the 10% cash deposit requirement is deter land speculators from acquiring land within the TDA and converting it as colaterals in their commercial business transactions or freezing the desired speed of development in the TDA.

Port Development

by *Capt A. R. BAH* (*)

INTRODUCTION

Populations often settled near estuaries and developed harbour on the river banks because of their reliance on shipping. It is at this point that the current of widening river loses its speed and turbulence and where interaction of fresh and salt water induces precipitation; the sediments settle and heavy siltation creates the typical estuarine delta.

In addition, there were often sandbanks, created offshore, obstructing the easy out flow of the river and tidal current responsible for continuous input of marine silt. All the above conditions impaired navigation and it was in these areas that the dredging become a prominent art. The problems associated with dredging and the disposal of dredging materials and their impact on the environment varies from place and is an issue to be addressed by the environmentalists.

1. INSTITUTIONAL AND LEGAL FRAMEWORK

Legal Framework

Powers of the Authority under Ports Act 1972, Section:

a. acquire, construct, manufacture, maintain or repair anything for the purpose of the Authority;

d. clean, deepen, improve or alter any port or its approaches or if so required by the Minister any waterway;

m. control the erection and use of wharves in the area of its jurisdiction;

n. reclaim, excavate, enclose or raise any part of the lands vested in it.

DUTIES OF THE AUTHORITY

f. to prevent pollution in Gambian Waters:

Pursuant to above and in order to have effective control the regulation made under Ports Act 1972 have these regulations:

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* Harbour Master Gambia Ports Authority

Other legal frameworks are as follows:

1. The Treaty of OSLO
2. The London Dumping Convention (LDC)

The Gambia is signatory to the above convention and the conventions are used as guidelines. Also one has to mention here the IAPH Guidelines for Application of the Annexes to the Disposal of Dredged Materials.

The drafters of above conventions tended to be lawyers and not navigational or environmental experts and they often tackle the symptoms and not the causes.

LASTLY

The Gambia is signatory to the Marine Pollution Convention and alredy enacted the Environmental Management and (Prevention of Dumping) Act 1988,which has spelt out how and when and which materials can be dumped.

PLANNED AND FUTURE ACTIVITIES OF THE GAMBIA PORTS AUTHORITY

The GPA is envisaged the commencement of Banjul Third Port Development Project, the feasibility studies having been completed.

Of particular interest to this conference are some of the Projects listed below:

Dolphins and expansion of Jetty Head

This project consist of the following:

1. Expansion of the Jetty head by a 177 m long and 24 m wide section supported on long piles. The northern end of expansion will be shaped so that ro-ro vessels with a stern ramp can be served.

2. Constructions of dolphins for mooring and for accommodation of ro-ro vessels.

3. Maintenance dredging of the inner berth of Banjul Wharf with respect to the projects outlined above, the following would be required.

    * Geo-technical investigations;
    * Mathematical model tests: siltation and navigation.

Recent trends in the growth of the port will require the relocation of the population of Half Die and the acquisition of land for future Port activities. Recently, the former yard of the

Public Works Department has been acquired for the construction of a Container Freight Station (CFS), the construction of which facility is now eminent in the light of the explosive growth in the Container Freight to the Gambia.

Potential for using Dredged sand for Building Construction

One of the most outstanding concerns associated with ports with respect to dredging is the eventual disposal of the dredged materials not so much due to the costs accompanying their eventual disposal but also to environmental hazards which may ensue.

The contaminants normally found in dredged materials generally come from industry based near the upper reaches of the river in question. Although no exact figures of Worldwide contamination exists as yet, it is estimated that some 90% of the total of the material to be disposed of, is clean or at least not permanently harmful.

The above figure quoted must be higher in the case of the Gambia where there are no known industry of significant important passing effluent in the River Gambia. Various disposal techniques have been identified and it has been shown that each option can be contained or not constrained. Naturally, the contained disposal options are more advantageous owing to 2 mains reasons:

1. it is safer;

2. the dredged material is liable to more beneficial treatment.

Uncontaminated materials can on the other hand be used to advantage; a significant application of this issue is the consideration of using dredge sand for building construction and this method is widely in use in a lot of developing countries and has been used in the past in the Gambia i.e. in the reclamation of land around the present Port and at the bond road in the areas where the national Partnership Enterprise and the Pelican Sea Food have their fish factories.

The justification of using dredged sand for building construction in the Gambia is a feasible option but one may ask the question: *"how far is it possible to achieve this and how much would it cost?"* . Already practical methods have been achieved and an outstanding one is the method of backpassing - the transfer of materials back to the shore by a mechanism which moves materials from offshore to the beach or to the nearshore bottom. Various backpassing methods can be exploited which include the following options:

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* Report of the Survey on the Disposal of Dredged material (1987 -1990), september 1992 edition

* By transferring material to shore through permanently installed backpassing stations as has been done in the Danish North Sea Coast. This can be efficiently done by using split hull barges dumping material in a large dredge trap. This would then be emptied by a jack-up dredger barge carrying fluidization or jet cater pumps, to prime the pipes in the trap and booster pump to pump the material to and along separated shores with transfer station at every mile.

* Hydraulic methods of backpassing are also in use - hydraulic pipeline dredgers being made use of for less exposed shore while hopper dredgers are practicable on exposed shores to bring the material closer to the shore beach.

Dilating on the economic aspects in sand pumping 3 factors stand out:

1. The fixed cost of the equipment;
2. The degree of utilization;
3. Downtime due to mechanical or weather condition;
4. The efficiency of pumping units and the heads involved.

The costs associated with the mobilization and the set up for a particular project may contribute significantly to be overall cost.

At it stands, the only major constraints is the initial capital outlay.

SOURCES:

- The Ports Act 1972.
- Terra Etaqua
- IAPH and IMO Report on the Surveys on the Disposal of Dredged material, september 1992.

Sand Mining
And the Construction Industry

by *Mr Edi NJIE*(*)

The Human being in this century and the generations to come will not only want to live but to live well. In his quest for a better standard of living, man has developed the brilliant technology to achieve this. Often, it is these skills that conflict with the requirements of nature.

The Gambia cannot and will not grow in size, all being equal. However, the population of this countries increasing at an alarming rate. With this, the need for better and more housing, roads and other facilities become imperative. Consequently therefore, pressures are put on the environment and in the specific case of our coastline, with devastating results.

To develop, we need the infrastructure; infrastructure needs building materials and almost all building materials are derivatives of quarrying operations which in itself disturbs nature. It is this disturbance, its effects upon the environment and how we can avoid or at least mitigate its harmful effects that is the subject of this paper.

Before we delve into the sand and gravel requirements, quality and the potential alternatives to these, I would want to mention the geology and geotechnic of these materials. What are they? How do they occur?

Geologists often apply the term "rocks" to all constituents of the earth's crust. The engineer however, sub-divide these constituents into rocks and soils. Thus, to the engineer, hard and compact natural materials of the earth's crust are rocks and their derivates are soils.

Soils may be residuals or transported. The residual soils are those which remain in place directly over the parent materials from which they were derived. Transported soils, on the other hand are those which have been moved from original bedrock and deposited at another location. Transporting agencies may be Ice (glacial soils), Wind (aeolian soils), Water (alluvial or fluvial soils) or the Force of Gravity (colluvial soil such as talus).

The alteration of the composition or structure of rocks near or at the earth's surface by physical and chemical agencies is called weathering or alteration. The weathering process are further sub-divided into those which cause disintegration and those which cause decomposition. Decomposition refers to the changes in rocks produced by

* Managing Director, GAMECS

chemical agencies such as oxidation, hydration, carbonation, and the chemical effects of the vegetation. In warm humid climates, rocks are weathered predominantly by decomposition. In our own situation, the weathering of granite causes the formation of red laterites.

In The Gambia, soils and local quarried gravels and shells are used in the construction of houses, roads, bridges, etc. In addition to these, imported basalt aggregates are also used. Aggregates can be divided into two types namely fine and coarse aggregates. For the attainment of high strengths, and to achieve high quality work, beach sands, selected and treated laterites are normally used. However, for higher strength requirements, basalt aggregates are used. Today most of the sand used in construction is derived from our beaches and its shorelines while our coarse aggregates for making of concrete and building of roads are mined from quarries everywhere in the country.

It is estimated that nothing less than one thousand cubic metres of sand is removed from our beaches everyday and its destructive effect is evident everywhere. It is therefore imperative and urgent that the problem be addressed.

Since a solution cannot be the total stoppage all mining operations, then operations can only be controlled, planned or relocated somewhere else. Because of the urgency in finding a solution to the problem of our erode beaches and because of the scale with which sand is required for construction works the planning and the control aspects which may take a long time to evolve, may not be applicable as they may hinder the process of development. The only alternative left before is the relocation of extraction area. However, it must be borne in mind that before any transfer of operations is contemplated, four elements are given serious conderation viz:

1. The distance and the accessibility to the new site will have a great impact on transportation costs and will indirectly reflect on the cost of construction.

2. The quality of the materials must be acceptable to the construction requirements in terms of size, grading and chemical content.

3. The quantity of materials at the new location must be such that all materials is not exhausted in a short time thereby necessitating the relocation of the mine and the provision of access roads, administrative buildings, etc. h)

4. Having learnt from experience which have gained from our present situation it will be necessary and vital for an Environmental Assessment to be carried out at the proposed site before a final decision is taken.

It is worth mentioning that beach sand is not the only soil than can be used in construction. Indeed beach sand can be replaced but to do this a soil of comparable quality or even better, must be found. With our knowledge of geotechnic, this is not impossible but it requires financial resources to accomplish.

The above stipulations do not only apply to sand mining and must be extended to all quarrying operations. Since development must continue and since development require the natural resources that have been provided by nature, there will obviously be a conflict between development and environmental protection. The objective is to find a balance between these two and point the way to resolving the difficulties that may arise. If we fail to do this, posterity will hold us responsible for their misery.

Forestry Development on the coastal zone

By *Mr Abdoulie DANSO* (*)

INTRODUCTION

A relatively small area of land 34, 029 hectares equivalent to 3 percent of total land area and 7 percent of total forest and woodland areas is reserved by government for production or protection called forest parks. There are 66 gazetted forest parks located in different parts of the country.

Some of these forest parks are situated on relatively poor soils and laterite hills. However, other parks are productive, but are now highly endangered by human influences such as bush fires, illegal felling and cattle browsing.

Under the 1966 Land (provinces) Act, forest parks are protected from exploitation of their vegetation, stone, gravel and/or sand without permit. However, the mangrove forest which constitutes and contributes a significant portion of our total vegetation cover, do not lie within the existing forest parks and thus the 1966 Act do not cater for their protection, exploitation and sustainable management.

However, the 1978 Forest Act and Regulations catered for the legal protection from exploitation and prohibition of certain acts in the gazetted forest parks, forest and woodlands outside these parks and the protection and management of the mangrove forest.

The Forestry Department under the Ministry of Natural Resources and Environment has the mandate to reserve and maintain forest resources (minimize soil desiccation and soil movement, maintain river bank stability, provide supply of wood and other forest produce) and promote tree planting and develop economic use of forest produce. The implementation of such a mandate is guide through the Forest Act and regulations.

In its implementation the forestry department through the Ministry of Agriculture in 1979 initiated plans for the sustained protection and maintenance of the forest parks. Such plans were translated into action in 1981 under the Ministry of Natural Resources and Environment through Gambian-German Forestry Project (GGFP) with both technical and financial assistance from GTZ. Under a different donor, in september 1981, a feasibility study was conducted on the mangrove vegetation.

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* Assistant Director, Forestry Departement

At the start of GGF Project, all forest parks were resurveyed and demarcated. One of such park is Bijilo forest which is the subject of this paper.

BIJILO FOREST PARK

Situation

The park with area of 51.3 hectares, situated to a village (now growing and developing) called Amdulai with close proximity to the Atlantic coast, has a total length of 1,500 meters parallel to the coast and width of 350 meters.

The park was first demarcated and surveyed in 1950 then resurveyed in 1951 and finally gazetted in 1952. From 1951 - 1956 the only management activity implemented was the clearing of fire lines along the boundaries on either sides of the fence. In 1977 the park was resurveyed by forestry department and once again in 1982. This activity was followed by the inventory of the park.

The following sketch shows the changes in topography from the NE to the SW connected with changes in forest cover.

The soil association map of the Gambia - Scale 1 : 125 000, Directorate of Overseas Surveys (1976) - shows the following two different soil associations.

Soil Type

The soils are deep and well drained developed over fine medium textured parent material.

Total wood volume is estimated as 92 m3/ha. Firewood constitute 67.4 percent (62 m3/ha) on the estimated volume.

Forest types

The forest types are classified with reference to the topography and soil conditions. They include the following:

Mixed Pterocarpus and Borassus stand:
The stand covers a total of 22.8 hectares and is found on the plateau (see sketch pg 2). Other species present in the stand include oil palm, Terminalia and a variety of other species like Prosopis, Cordyla, Piliostigma, Entanda, etc.

Rhun Palm stand
This stand exist on the slope to the Atlantic Ocean covering an area of 16.3 hectares. This stand shows the best growth rate.

Shrub and Parinaria macrophylla stand
The sand dunes on the sea side is stocked with shrub and brush. Despite the less economic importance this stand has to forestry they could still provide fodder to livestock in the surrounding area. Volume increment is estimated at 1.8 m3/ha/yr and the total annual increment estimated at 71 cm3.

Past activities

One major activity clearing of fence lines (firelines) was practised from 1951-1956 to protect the park from annual bush fires. Then after, there was no fire line learning until 1982 when the GGFP started initiating and implementing the first management activities. Following the demarcation, resurveying and inventory of the site, the dead rhum palms were felled and utilized in situ.

Species site trial was initiated with established of 7 trial plots to test the different tree species for enrichment planting. Cashew plants were also established in rows along the fence line to provide a natural fire break.

Planned activities

The planned activities are centred mainly in the areas of protection and utilization.

For protection, the GGFP will continue with clearing of fire lines on the fence line annually. Through recommendations obtained from the inventory exercise the different compartments will be managed on a sustained yield bases to provide resources and to conserve nature in maintaining an equilibrium of the ecosystem. Provision is also made to attract tourist into the park for bird watching and for educational purpose.

MANGROVE FORESTS

Commonly found all over the country along the coast of the main stream and tributaries, they constitute a significant component as natural resources on the coast. The river front species, plays a vital role in stabilizing and protecting the marine environment.

A study conducted in 1982 titled "Mangrove feasibility study" emphasized the dying out of the mangroves (Rhizophora racemosa) along the 170 km upstream. However, most of the mangrove forest areas are still covered with mangroves (Avicenica and Rhizophora). Traditionally the usage of mangroves wood is limited to fuel wood, rural house construction and fencing poles. The total volume of mangrove-wood in the project area (Yelitenda to Kauaur) is estimated at 1,150,000 m3 distributed in 8,713 hectares ares. Recommendations were to salvage the dying mangrove as fuelwood, if not, the shore lines to be replanted.

Past activities

Other than the study conducted by the team, no follow ups were made in respect of monitoring the actual rates of die backs established. Further more there are no efforts to replace the dead mangroves either with mangrove or other salt tolerant species.

Planned activities

There are no viable and economic short and medium term plans for the utilization and proper management stand by the forestry department even through the management of the mangrove stands is part of our mandate.

Other activities

It is not unusual to find other small and medium activities along the coast and other river fronts which would claim for the destruction of the natural vegetation. Typical examples are the illegal exploitation of mangrove stems for export to Senegal and other neighbouring countries, development of tourist attraction areas. Many of such projects would live short of their expected output in addition to increasing the environmental risks for the surrounding communities and eventually with far reaching impacts.

Constraints

- The department has limited number of trained staff for the effective and efficient implementation of the department mandate;
- Other non-human resources are also limiting;
- Lack of coordination and cooperation in the implementation of programs and projects;
- Presence of conflicting interest in management objectives of common resources.

Wildlife Conservation

by *Mr Almami CAMARA*(*)

INTRODUCTION

As stated in the Banjul Declaration I quote "...*in a relatively short period of our history most of our larger wildlife species have disappeared together with much of the original forest cover and, the survival of the wildlife still remaining with us and the setting aside of protected natural habitats for them is the concern of all of us...*". For example the elephant was last seen in 1913 and the Giant Eland in 1903. Several other species like hippo, West African Manatee and all species of sea turtles are threatened with extinction.

In response to the urgency of the wildlife situation and the result of the importance government attaches to the conservation of our natural heritage, a wildlife conservation unit was created in 1968 and, placed under the direct purview of the Office of the President. In 1981, a Ministry of Natural Resources and Environment was created and the wildlife conservation unit was correspondingly transformed into a fully fledge Department.

CURRENT ACTIVITIES AND STRATEGIES

The Technical Department of Wildlife Conservation and Management is charged with the responsibility of managing the Nations Protected Area systems and its wildlife resources on a sustained and equitable basis and, to establish a harmonious future for posterity within the Gambian Environment through setting aside different categories of protected natural habitats for the propagation, the conservation, and management of fauna and flora as well as for the protection of sites, landscapes, or geological formations of particular scientific or aesthetic values, for the benefits and enjoyment of the general public, and in which hunting of wild animals, destruction or authorised collection of plants, human settlements, and certain other human activities descriptive of wildlife and the natural environment are prohibited or strictly controlled in accordance with the provisions of Part III of the Wildlife Conservation Act, 1977.

In response to the conservation principles outlined in the Banjul Declaration 1977, the following coastal and wetland protected areas have been established:

1. River Gambia National Park (Baboon Island, 579 ha): Established in 1978 by legal notice 33, this park consis of a group of five islands in the River Gambia. The area is situated in MID - Mc Carthy Island Division -about 150miles from

* Director, Wildlife Conservation

Banjul and its establishment contributed as last refuge for the very threatened hippopotamus in the Gambia. This National Park houses the Gambia's famous chimpanzee Rehabilitation Project.

2. Niumi/Sine Saloum National Park (4,940 ha) : This area ofapproximately 4,940 ha was established in 1987 and is contiguous with Senegal's Delta du Saloum National Park and Biosphere Reserve. Apart from being an important fish breeding ground, the area constitutes one of the last untouched mangrove areas on the West African coast north of Equator. This complex of mangrove, bolongs (tributaries) and adjoining habitats is a veritable magnet for many thousands over-wintering migrant birds. Recent surveys indicate that at peak population periods, a good number of the world's known osprey are to be found in this region. Although the mammal population of this area is by no means as rich or as obvious as its avifauna population, one of the world's rarer mammal species is found here - the West African Manatee. The endangered cape clawless otter is also found here.

3. Baubolon Wetland Reserve (proposed, 35 km^2) : The Baubolon is a valleywhich stretched over a length of more than 140 kms from the Senegalese border south of the Ferlo towards the River Gambia. This valley crosses several regions in Senegal and penetrates the Gambian Province of Illiassa.Large in certain places - more than 2 kms - and possessing secondary ramifications, it is entirely dry during 8 months of the year (except for the bottom of the valley), but during the rainy season it is more or less like an immense creek where the waters are full of large seaweeds and fish without any large exit to the river. Presently the area is not being used for agriculture because of salt water intrusion. However, the area still remain a wetland of great significance not only for weatherboards, but for the local communities as well because of its importance as a source of fish (Tilapia), fencing materials and thatch grass. The proposed Baubolong wetland Reserve will be the first Ramsar site to be designated in the Gambia.

4. Tanji Bird Reserve incorporating the Bijol Islands (136.87 ha) : This is the estuary and adjacent land at Bald Cape (the Promontory between Ghana Town and Tanji) together with the Bijol Islands. This area has been declared a bird reserve with species emphasis on the remarkable bird faunas that are to be found there. The Bijol Islands are a major offshore roosting area for very large number of seabirds, migrants ospreys, shorebirds, etc. The are little visited. Their inclusion as part of Tanji bird Reserve is a major asset to the status of the reserve.

The significance of Tanji Bird Reserve lies in the followings:

Excellent existing knowledge of Tanji bird fauna which shows: high diversity of bird species both African and Palaearctic, approximately 300 species.

* Significant numbers of migrants: Intra-African migrants 32 species (11%), palaearctic migrants 82 species (27%) and Resident species 181 (61%). This constitutes 295 species from 61 families out of 515 species and 75 families nationally.

* Offshore the following species are recorded: Dolphin, upside down jelly fish, fiddler crabs, Ghost crabs, sand crabs, mud skipper, etc; and the list of mammals include but not limited to the following: Senegal bush baby, Bushbuck, clawless other and Gambian mongoose.

* Small site critically placed on prominent point of coastline (3700 m) not including estuary thus, the main reason for the importance of the site to migrants;

* Very high habitatdiversiyin smalll area: marine, estuary, freshwater swamp, coastal dune, woodland, thicker. Most of these are not represented in the other existing resources.

* Close to the centre of population as well as the tourist development area; Limited existing utilization: some firewood extraction, clam gathering in the lagoon, some grazing and access for fishing pirogues.

PROBLEMS

The problems confronting the conservation and management of wildlife and wildlife protected areas are many, but the most obvious for the Gambian's coastal and wetland reserves include the following:

* Liaison problem: Lack of close liaison between the different institutions with a stake in the various aspects of coastal zone and other wetland area development often result in conflicting recommendations which cannot in isolation achieve wise use of land and water resources in these areas, as in most cases, full consideration is not given to ecological, cultural, historic and aesthetic values of such areas.

* Competing Land and Water uses in the coastal zones: The increasing human population and the corresponding poverty situation places considerable emphasis on the needs for economic development without closely looking at what such developments might have on the Gambia's fragile and finite coasts. In such instances the ecological significance of the coast as one of the most productive natural resources as well as vital link in the marine food chain is given secondary importance. Consequently, coastal zone reserves which respond to threats like the loss of living marine resources and wildlife habitats are allocated for development purposes with little or no consideration for the

environment. Sand mining and laterite extraction have resulted in severe habitat destruction in coastal reserves. These problems are particularly true of Tanji bird reserve.

* Pollution : While it cannot be disputed that coastal and wetland reserves and tourist lodges and facilities are complementary to each other and provide useful services for the general enhancement of socio-economic development, the waste disposal mechanism of some of the lodges leaves much to be desired. Untreated sewerage and human waste are dumped into the river polluting the whole environment with catastrophic consequences on the marine life and avifauna dependant on this. This problem is particularly true of the Kiang West National Park and Baubolon wetland reserve.

* Inadequate legislation : The 1977 Wildlife Conservation Act does not categorise protected areas, but rather, deals with them in a general manner. The wildlife legislation therefore needs to be improved to include aspects that will address coastal and wetland protected areas which have somehow unique features and problems.

* Manpower problem: The Gambia wildlife resources development programmes and policies are managed by a staff of 35: two (2) professionals and four (4) technicians and 29 field workers and others supportive staff. The department also lacks professionals, technicians at all levels to manage the country protected area system, including the coastal reserves in a professional and scientific manner. Unless protected area management and its manpower development are regarded as a profession, seriously pursued and the necessary field equipment provided, effective management of wildlife and protected areas in the Gambia remains wishful thinking.

INSTITUTIONAL AND LEGAL FRAMEWORK: The legal mandate for the development of wildlife subsector in the Gambia include the Wildlife Conservation Act 1977 and the Banjul Declaration of 1977 and the subsequent wildlife legal notices nos 32 and 36 of 1978. In 1981, these legal instruments gave the then wildlife conservation unit a full departmental status with the creation of a corresponding Ministry of Natural Resources and the Environment.

The effective implementation of wildlife management programmes will depend not only on providing a good institution structure, but on the technical, professional and managerial development of staff at the required levels and numbers as well.

With a staff roll of 35 - two professionals, four technicians and 29 field workers - the department finds it extremely difficult to cope with the enormous task of protecting and managing the nation's wildlife resources.

PLANNED ACTIVITIES AND RECOMMENDATIONS:

In furthering the goals of the Banjul Declaration the Department will continue to set aside protected natural habitats both Inland and on the coast in the form of coastal and wetland reserves for the benefit of wildlife and surrounding human communities and for the maintenance of delicate natural relationships. Because of the complex nature of the coastal ecosystem its management from the wildlifer's points of view should be integrated and guided by a coastal zone management Act (CZMA) with emphasis on the following considerations:

* To forester the goals of the Banjul Declaration by setting aside, where appropriate, protected natural habitats - including coastal and wetland habitats to ensure the maintenance of ecological and physical processes which are so vital for all the species living there. Such a national system of estuarine and wetland reserve will serve as a natural field laboratories and will provide for research and education to assist in coastal management decision making.

* Where appropriate establish at least a 100 metre buffer between development and the water. Such buffers minimize the risk of pollution as well as provide sanctuary for wildlife.

* To reduce conflicts, through dialogue, consultations and team work, among competing land and water uses in the coastal zones, while protecting fragile coastal resources.

* Programme development and implementation in the coastal zone should give full consideration to not only the needs for economic development, but to ecological, cultural, historic and aesthetic values as well.

* Because of the pressure on land due to the expanding human population and the fact that human settlements occur in some coastal and wetland reserves like Niumi/Sine Saloum National Park, management will put in place different land use categories or zones to minimize the impact of growth on water quality and biological diversity. Examples of zones will include:

  ./ Resource Conservation Areas (RCAs) - These should be mostly composed of wetland, forest, uncultivated and cultivated areas, and the main function will be to conserve, protect and enhance ecological values, biological productivity, and species diversity in such areas.

  ./ Limited development Areas (LDAs) - land use here will be mixed, but not to be dominated by agriculture, wetland, forest or open space.

A similar approach can apply to the coastal zone as a whole.

* Being responsible for implementation and monitoring wildlife management programmes on the coast, there is need to strengthen the Wildlife Conservation.

* From the wildlifers' point of view certain coastal areas are extremely vulnerable and unauthorised and unsustainable development must be rejected on such areas. These include:

  ./ Estuaries - Estuaries, the waters at the mouth of coastal streams andrivers, are parts of a river or stream or body of water having unimpairedconnection with the open sea, where the sea water is measurably diluted with fresh water derived from land drainage. Estuaries are rich spawning ground of marine life because of their nutrient rich waters. Every effort should be made to spare estuaries from pollution and unplanned development.

  ./ Wetland: - These are the areas that fall between the mean low tide mark and the yearly high storm mark. Coastal wetland generally take the form of grass meadows or marshes. These critical areas help to regulate the flow of run-off and provide important nutrient rich food for wildlife and are highly susceptible to damage from unplanned development.

  ./ Dunes and beaches: The dunes and beaches we all enjoy on a vacation trip serve an important natural function. They are the buffer between land and sea, protecting land from storm winds and waives. Dunes are held inplace by plants. Erosion and flooding have altered many proportions of the beach/dune/plant system.

The coast is one of our most productive natural resources, (..) a vital link in the marine food chain. The sand, dunes, etc, are a protective barrier against harsh ocean storms. The rich soil near the water's edge provides some of our most fertile agricultural lands. The resources of the coast are tapped by scores of vital industries. This fringe of land is both fragile and finite. It can be used wisely or it can be wasted.

Sewerage Disposal

By *Mr Shola JOINER* (*)

INTRODUCTION

Water is the most important ingredient of life. As soon as humans begin to live in organised communities they have to establish a reliable, sufficient and safe supply of water; But in so doing they also generate a sure amount of waste and hence the disposal of waste waters becomes a necessity.

Sewage can be generally defined as any waste water and it comes in different forms. Rainwater can be classified as sewage, especially where it falls in urban areas. Industries produce sewage and of course sewage is generated in households as a result of washing up and flushing. The form can also defer depending on the composition and degree of dilution. Thus in areas of very low standard of living rain and washing water is allowed to run off and seep into the underground, whereas faecal matter is disposed of in pit latrines. As the settlement becomes more urbanise we see the use of pails, cesspits and septic tanks, and for the advanced societies, the use of pipes and gutters.

The organised collection and proper disposal of sewage becomes a necessity if the underground water source is to be protected and if the spread of waterborne diseases is to be controlled.

METHODS OF SEWAGE DISPOSAL

In rural set ups where the sewage generated is not much and is purely domestic disposal of faeces in pit latrines is quite acceptance if certain standards are observed. These include at least a 30 m gap between the pit and the nearest water well (well and pit to be lined preferably); The pit must be covered to prevent insects using it as breeding grounds. The microbiological degradation is limited to the pit and pathogens, warms, etc, will be trapped in the soil. This form of separation of faecal matter from wash water can result in very smelly messy atmosphere. Some studies have been carried out on ways to improve the functioning and safety of pit and, as a result, various forms of ventilated improved pit latrines (VIP) have been developed which reduce the odour problems, and prevent insects visiting the pits.

The methods of employing pails as is hitherto done in Banjul, is very similar to pit latrines. The fundamental difference is that the pails only serve as a temporal storage, the content are later disposed out in an identified site. This disposal system has its further

* Manager Sewerage Division, GUC Sewerage Disposal

disadvantage as a collection and transportation to the final disposal site is very unhygienic and inhumane. However, in urban or semi-urban areas where the volume of sewage produced is quite significant, and where space is not avowable to safety locate pits, pails are cheapest solution to disposal problems.

In the earlier nineteenth century the ideas was conceived of diluting the faecal matter with more waste water, and it led to the development of the water closet. The effluent now required more storage space and so the septic tank/cesspit came into being. As septic tank provides a method of primary treatment for sewage in the form of settling tank, designed to retain the sewage for one or more days and for dislodging at frequent intervals. Even when the tank is correctly designed and well maintained, the effluent will not be suitable for discharge to a stream without further (secondary) treatment. That is why the effluent is discharged through a soakaway or perforated pipe into underground where it can undergo the further treatment required.

The development of industries and installation of water closets in the earlier nineteenth century led to the development of drainage systems for the removal of offensive wastes both from the industries and from the houses. The drains and sewers constructed during that period merely transferred the pollution from the houses and factions to the rivers. The outcome was a deterioration in the standards of many river waters so that fish were killed and the water became useless for either domestic consumption or for industrial use. This effect can be very marked in some rivers near towns and cites, and if such rivers are used as sources of drinking water there can be outbreaks of disease.

To reverse this trend, "sewage farm" were established to provide some form of treatment to the sewage before it is discharged to the river. With the increase in the use of surface waters as sources of potable water supply, there is now a greater emphasis on the control of river water quality and on the reduction of pollution generally.

THE PROBLEM

Domestic sewage contains waste water from bathes, kitchens, and toilets. In addition, sewage usually contains some rainwater either in the form of infiltration through faulty pipes or joints, or as surface water run-off from roads, dries, roofs, etc. The characteristics of any industrial waste waters will, of course, vary from one industry to another. The resulting mixture in the sewers will contain organic and inorganic matter, including soaps, and grease; this will be party in suspension, party colloidal and party in solution. The normal solids content of sewage is extremely low; this is often less than 0.1% i.e. the sewage will contain 99.9% or more of water. The quantity of sewage per head (in terms of dry weather flow) varies from about 70 to 300 litres per day; the lower figures generally apply to rural districts, while the higher figures apply to new development. The aim of sewage disposal is the removal of water wastes borne from domestic and industrial communities without causing any danger to health. Disposal does not necessarily

include treatment. The principal aim of sewage treatment is to remove as much of the solids content as is practicable and economical, and then to oxidise (and subsequently remove) the colloidal and dissolved solids. The effluent when discharged should not pollute the stream, be a danger to public health, or cause a local nuisance. Whether sewage is to be treated or not, and if so, the method chosen for any particular installation will depend on the quantity of effluent required, the size of receiving water body, and on the area and type of land available. The method chosen should preferably be most economical (in annual costs) and should not cause a nuisance to adjacent properties by noise, smells or insects. There can be no stereotyped system of sewage treatment and disposal, and individual works, although conforming to the same broad principles, must be designed and operated in accordance with the characteristics of the particular sewage to be dealt with.
Water usage is increasing annually, and this will continue as more houses are provided with modern sanitation and as the per capita demand increases as a result of modernisation. An organised collection and disposal of sewage could safe guard and enhance our drinking water sources.

WATERBORNE DISEASES

The dangers of inadequate disposal of sewage and other waste liquids arise mainly from the pollution of water supplies, and to some extent from the pollution of the land. The pollution of river waters not only result in harm to fish and other aquatic life due to depletion of oxygen in the water, it can also lead to gastro-intestinal complaints when the water is subsequently used for drinking. More important, however, is the possible contamination of water by pathogenic organisms such as bacteria and protozoa, the eggs of parasitic worms, and various viruses. The conventional methods of sewage treatment do not remove all these organisms. Lagoons and grass plots have proved to be the most effective. Crude sewage will normally contain millions of bacteria per millilitre, but usually only a small amount of these are pathogenic.

Bacterial disease in temperate climates include typhoid, the paratyphoid and bacillary dysentery. In tropical and subtropical countries there are the additional possibilities of both amoebic dysentery and of cholera. Vibrio Cholera are contained in the faces of infected persons and become disseminated by means of drinking water as well as by person to person contact. Few pathogens like typhoid bacilli, have a long period of survival in sewage.

Parasitic worms and flukes spread by poor sanitation include those of hookworms, schistosome, roundworms and thread worms. The eggs of these parasites can survive for many months outside the human body and can easily be transferred from one person to another if food is directly contaminated with human waste.

The more important virus diseases include poliomyelitis and infective hepatitis. Both of these viruses have been located in sewage and in sewage contaminated waters. Preventive

measures for infective hepatitis include good community sanitation and personal hygiene.

THE FUTURE

The demand for water to growing throughout the world. This must surely lead to an increasing awareness of the need for conservation and re-use of water, and to an increasing need for the transfer of water from one part of the country to another. The logical outcome must be an increase in the quantity of sewage and industrial wastes to be treated, and a tightening of the standards for the quality of effluent. To some extends this may involve a grouping of the authorities responsible for sewerage and the environment, and to a strengthening of liaison between those authorities and those responsible for water supplies and rivers.

THE SEWERAGE OF COASTAL TOWNS

The sewerage of coastal towns defers from that of inland towns in that there are more possible methods of sewerage disposal available on the sea coast, and that the coastal towns often, tend to spread along the coast, rather than in land which fact influences surface - water sewerage. It is comparatively rare that sewage from coastal towns is discharged other thanrinto the sea, and complete treatment is the exception. It has always been considered that if sewage is discharged into the sea, the high degree of dilution and the oxidation which are known to occur provide natural treatment.

Studies have revealed that Crude sewage may be discharged into natural watercourses when the dilution is more than 500 to 1. Discharge in the sea does not involve danger of interfering with water supplies, destroying fish life, or otherwise causing nuisance except the possibility of fouling the foreshore or contaminating shell-fish beds. These can be avoided by taking the following precautions. The former problem requires detailed studies and experiments to as certain that currents, at all stages of the tide, cause sewage either to go straight out to sea or to keep a reasonable distance from the coast for a period sufficient to ensure (dilution???) of the sewage. The second precaution, i.e. the avoidance of visible floating solids, requires that solids of a type liable to float or strand on the beaches be removed by screening of sedimentation.

CURRENT AND FUTURE ACTIVITIES

Our current activities involve two schemes: one in the Kotu Tourist resort area and other here in Banjul.

In Kotu, nearly all sewage from hotels between and including Kairaba Beach and Fajara hotels is collected through a piping system and four pumping stations and transported to a treatment site which consists of 4 oxidation ponds in series. The treated sewage is discharged into the Kotu stream.

Similarly, in Banjul we have installed a collection system throughout the city and we are in the process of connecting all compounds to it. We have already connected 45% (i.e. some 990 compounds). We only screen the sewage and pump it out to sea through a 1 km sea out fall, without treatment. The implementation of our phase 1 will see to be abolishment of septic tanks (99% of which are now out of use) and the much dreaded pails.

We do not have any major problems. One of our problems is the blockage of our pipes by sand in the streets and (2) very large solids from users, such as female sanitary towels, stones and sticks. The first problem can only be addressed with the reconstruction of all streets in Banjul and the other we are tackling with an education campaign.

We are mandated to operate and charge for sewerage facilities wherever they are in place in the country. The GUC Act empowers us to do so, and we have sewerage by-laws which define the usage of our installations. As part of our responsibilities in Banjul,we operate and maintain the flood control pumping station at Bond Road, but the drains that convey the water to the stations are not our responsibility, other institutions or government agencies are responsible regulating and monitoring the use of septic tanks, pit latrines, garbage collection, etc. in the rest of the country.

At the moment we are pre-occupied with consolidating the Banjul sewerage scheme and this includes careful monitoring of our discharges to be able to anticipate possible pollution problems.

Fisheries Development

By *Mr Momodou CHAM* (*)

INTRODUCTION

It is not easy to define precisely the term "coastal zone". However, all definitions will tend to include coastal waters, marine and estuarine, and some portion of the land along the coast in which human activities and natural processes both affect and are affected by those in waters. In the Gambia the coastal zone would essentially be a relatively narrow band of water and land along the Atlantic shore line and those lands adjacent to the numerous tributaries. Its natural features include the beach and estuaries. For example there is the nice stretch of white and clean sand from Bakau to Kartong up to the Allahein River bordering the Casamance. There are also the numerous madflats, marshes, swamps and mangrove vegetation adjacent to the wide estuarine area - from the creeks at Denton Bridge to the Bintang Bolong and Yellitenda in the South Bank, and from Ginack/Barra/ Albreda to Kerewan/ Bambatenda in the North Bank. The man-made features will include the port and other jetties, commercial fisheries and aquaculture establishments like those from Banjul to Kartong. Community Fisheries Centres (CFCs) can be seen all along the coast from Brufut to Sanyang (as currently at Bakau another centre is under construction). For aquaculture concerns there are the two shrimp hatcheries of the defunct Scangambia Shrimp Ltd at Mile 5 and Sanyang point, and also at Pirang the 1,000 hectare shrimp farm. Others include industries such as the oil mills at Denton Bridge, recreational and tourist development (in the form of hotels and other tourist attractions along the coast). Still others include the raw sewerage dumping points on Bund Road and at the beach front near the Lands Office area, the fuel storage tanks behind the Albert Market and a few others that do not need to be mentioned. The coastal zone has above all, one the largest and most densely populated suburban settlements (Serekunda). The Serekunda/Banjul coastal area has a population of about 250,000 (about 35% of the total Gambian population).

The economic significance of the coastal zone is vast; almost all the shell fish (oyster, cookies, etc.) used in the Gambia live and have harvested there. Most of the country's commercially important fish species depend on the coastal zone, and indeed, over 70% of commercial shrimp production comes from there. The land is attractive and valuable for residential use, and less obvious but also important economically, are services the natural features of the zone perform, without cost: shoreline stabilisation, protection from storms, fish nurser/spawning grounds, and nutrient cycling, etc.

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* Assistant Director, Fisheries Department

It is Generally accepted that to manage development in the coastal zone that is environmentally sound and sustainable is not easy because the coastal zone is among the most sensitive areas to the impact of development. Activities such as siting of industries, intensive urbanisation and conversion for agriculture and aquaculture are relatively irreversible transformations. Many economic development projects in the coastal and marine areas have the potential to seriously affect the resources located in these areas, and usually present conflicts among competing resource users. Consequently, special attention to regional planning is required to minimise or mitigate adverse impacts and promote optimal use of available resources. This will allow a rational integrated and sustainable development to the coastal zone.

SECTORAL AND INTER-SECTORAL LINKAGES

In the Gambia sectoral development programmes tend to focus on single-purpose projects. For instance the Ports Authority will want to build a large port facility, or the Agriculture Department might devise a scheme to convert mangroves and other vegetation to rice production, or the Fisheries Department building Community Fisheries Centres and shrimp ponds along the coast within the estuaries. These are good examples that warrant a multiple-use resource management approach within the coastal zone.

Usually Government agencies and NGOs associated with sector development tend to align themselves with one sector or another. Conflicts and some times wasteful duplication of efforts can arise (as they have often done) between individual economic interests among government departments responsible for the management of individual resources, or between those agencies and the organisations charged with broader planning responsibilities. For instance, in the case of the mangrove vegetation within the estuaries in which the Forestry, Agriculture, and Fisheries Departments each has legitimate economic interests. On the other hand, as the basis of the detritus food chain or lost to both the the Forestry and Fisheries Department. These and similar conflicts can manifest themselves economically and ecologically because the productivity of the coastal zone and its ability to recover from misuse and other disturbances is often affected by the effects of one activity or another. Another important Government agency which can play a very significant role is the Planning Department Ministry of Local Government and Lands which should study land use patterns to determine which activities in any particular area are compatible for rational development.

Consequently, many different kinds of resources in the coastal zone are demonstrating a decreasing ability to sustain development. For example, there is evident decline in fisheries production, spoiled beaches through sand mining and littering. Even in tourism there are conflicts between local cultures and tourists. There is even the possibility of disgracing groups which subsist on coastal zone resources. One that readily comes in mind is the development of commercial scale estuarine shrimp aquaculture where traditional agricultural land is converted into shrimp farms thus displacing the traditional land owners. This trend can be reversed when management needs of the coastal are

recognised. Integrated approaches to planning and resource management are essential to avoid adverse inter sectorial impacts. Coordination is perhaps the single most important approach for an effective coastal zone management programme.

COSTAL ZONE MANAGEMENT INSTITUTIONS

The term *"institution"* as used here covers Government agencies such as the Environment Unit/Agency and other agencies with activities that affect the coastal environment (Fisheries, Tourism, Agriculture and Industry). Of particular importance is the planned oil exploitation off-shore under the Ministry of Trade Industry and Employment. Also included under "institutions" are legal framework within which the organisations function, including environmental laws and other legal instruments that define the organisations responsibilities, authorities or privileges.

There is no universal model or set of institutions that will be satisfactory in every situation. Further, there is no single institutional structure for any particular situation. There are however functional components that appear to be most useful in any organisational structure. In this country some of these components already exist. For instance the newly named Environment Agency will be backed up by legal framework which will require, among other things, that some of Environmental Impact Assessment (E.I.A) report be submitted for a proposed project within coastal zone. Such legal requirement will obviously preempt any potential misuse of the resources and so will minimise any negative impact the project might have. Another important component of any institutional structure is the staff capability to conduct and administer Environmental Assessment processes. This is important because mitigating measures and monitoring programmes identified in an EIA report will be difficult to put into practice without a strong implementing institutional structure to provide an independent technical assistance. The Environment Agency at this time is very thin on the ground and cannot meet all the crucial challenges that general environmental protection needs, and therefore will have to rely heavily on the other local capabilities in existing institutions. Together the institutions can identify approaches for strengthening, modifying and supplementing existing capabilities in ways that are implementable and effective. This paper strongly believes that a forum like is very important because it brings together the many and varied disciplines and "experts" to look at the environment in general, and in particular the coastal zone as one single entity.

POLICIES AND LEGAL INSTRUMENTS: Suggestions and recommendations

The most significant recent development has been the elevation of the environment Unit to an Agency and under the President's Office and the President as chairman of the National Environment Council. This clearly shows strong political will and implies the involvement in high level leadership in Environmental matters. This action by Government has loudly emphasised that rather than ad hoc policies a high level policy making body

and a mechanism for policy formulation will be in place. Therefore, clear policies (especially based in law) that enhance environmental concerns, development planning, and decision-making should be formulated to support environmental management and protection.

As mentioned earlier, legal authority to implement national environmental policies should be clearly established. Indeed, it is necessary to promulgate regulations and administrative orders to establish the authority for setting environmental quality and performance standards; to establish authority for enforcing compliance with regulations, or for requiring licenses, permits or EIA reports for certain activities particularly in environmentally sensitive zones such as the coastal zone. The Environment Agency, in consultation with other line agencies, should promulgate regulations to set EIA guidelines and procedures, procedures for EIA review, and requirements for community involvement.

Reference

Barrow, M.K.A., Coastal Erosion in The Gambia,
Paper presented at a Sub-regional workshop on
Coastal Erosion in West and Central Africa,
UNESCO/ROSTA, Dakar, Senegal, March 1985

Hogben, N.M.C. Dacunha & G.F. Olliver.
Global Wave Statistics
Inwin Brothers, 1986

A hotel guide to the smiling coast
The Gambia Hotel Association, 1989

Hydraulics Research Station (K. Sanmaganathan and P.J. Waite).
Analysis of the discharge measurements carried out at Bansang, The Gambia during March 1974
HRS, Wallingford, 1975

Hydraulic Research Station .
Gambia Barrage Study ; effect of the barrage on the tidal regime downstream,
HRS, Wallingford, 1977 (EX 795)

Hydrographic Maps
- 608 : River Gambia entrance
  1 : 75 000 ; 1942-1970
- 608 : River Gambia entrance
  1 : 75, 000 ; 1977-1990
- 607 : Rivière Saloum
  1 : 75,000 ;1988
- 609 : River Gambia: Albreda to Kuntaur
  1 : 100,000; 1942-1963
- 609 : River Gambia : Albreda to Kuntaur
  1 : 100,000; 1942-1990
- 610: Dakar to Punta da Caio
  1: 400,000; 1991

Hydrographer of The Navy, Taunton

IMF (1991),
The Gambia, Mid-term review

J.P. Lamagat, J. Albergel, J.M. Bouchez et L. Descroix.
Monographic hydrologique du Fleuve Gambie
ORSTOM-OMVG

Land use map (1:30,000),
Land use plan 2000; Greater Banjul Area
Ministry for Local Government and Lands and G.T.Z., 1988

Ministry of Information and Tourism,
Proceedings of the First Gambia Tourism Review Conference,
7 September 1991, Banjul

Ministry of Works and Communications,
Terms of Reference for a study for the control of erosion and the protections of the foreshore along the Altantic coastline of The Gambia, 1990

E. Momok,
Maintaining the pace of economic recovery
Gambia Special, AED,7 May, 1990

NEDECO,
Proliminary engineering studies for the bridge-barrage of Yellitenda and the Gambia River; Final Report
For, Gambia River Basin Development Organisation. 1981

OMVG;
Port-Barrage anti-sel Balingo/Fleuve Gambie; Rapport final
Rhein-Ruhr Ing. Ges. , Dortmund, 1984

ORSTOM (C. Rochette),
Monographes hydrologique ORSTOM
No. 1; Le Bassin de Fleuve Senegal, Paris, 1974

P.A. Pirazolli and J. Tluet,
World atlas of Holocene sea-level changes
Elsevier, Amsterdam, 1991

Topographic Maps
- The Gambia 1 : 25,000
  West Sheet and East Sheet
- The Gambia 1: 50,000
 . Sheet 2 : Ndungu Kebbe
 . Sheet 10 : Banjul
 . Sheet 22 : Gunjur
The Gambia Governement, 1981

Tourist Map of The Gambia,
1: 222,000, 1 : 60,000; 1 :50,000
Ministry, of Information and Tourism

UNEP (A. C.Ibe and R.E. Quellenec),
Methodology for assessment and control of coastal erosion in West and Central Africa
UNEP Regional Seas Reports and Studies No. 107, 1989

UNEP,
Coastal erosion in West and Central Africa
UNEP Regional Seas Reports and Studies No. 67, 1985

UNESCO/UNEP,
River inputs to the West and Central African marine environment
UNEP Regional Seas Reports and Studies No. 3, 1982

UNESCO,
L'estuaire de la mangrove du Sine Saloum; Resultats d'un Atelier regional UNESCO-COMAR tenu à Dakar (Senegal) du 28 fevrier au 5 mar 1983
Rapports de l'UNESCO sur les sciences de la Mer 32, UNESCO, 1985

University of Michigan,
Gambia River Basin Studies
- Aquatic Ecology
- Terrestrial Ecology
- Water Associated Diseases
- Rural Development
- Water Resource Management

For USAID and OMVG,1985

World Band,
Trends in Developing Countries, 1991