

Proposals on COASTAL EROSION

MITIGATION OF COASTAL EROSION AND RESTORATION OF DEGRADED AREAS IN SUB-SAHARAN AFRICA

1. IDENTIFIERS

PROJECT NUMBER: COS1

PROJECT TITLE: Mitigation of coastal erosion and restoration of degraded areas in Sub-Saharan Africa

REQUESTING COUNTRIES:

Through the national reports and co-ordinators, the following countries contributed to the proposal concepts and requested direct intervention to coastal erosion, i.e. mitigation and restoration of degraded areas. Some countries will participate in some activities of direct intervention nature and some of them will participate through sharing of experience and information.

Country	Component 1 <i>Output 1</i>	Component 2			Component 3
		<i>Output 2.1</i>	<i>Output 2.2</i>	<i>Output 2.3</i>	
<i>Cote d'Ivoire</i>			X	X	X
<i>The Gambia</i>					X
<i>Ghana</i>			X	X	X
<i>Kenya</i>	X				X
<i>Mauritius</i>	X	X	X	X	X
<i>Mozambique</i>	X		X	X	X
<i>Nigeria</i>			X	X	X
<i>Senegal</i>			X	X	X
<i>Seychelles</i>				X	X
<i>Tanzania</i>	X	X	X	X	X
<i>South Africa</i>			X	X	X

REQUESTING NATIONAL ORGANISATIONS:

Cote d'Ivoire: Ministère de l'Équipement

Gambia: National Environmental Agency (NEA)

Ghana: Ministry of Environment & Science, Ministry of Works and Housing

Kenya: Ministry of Agriculture and Rural Development

Mauritius: Ministry of Environment

Mozambique: Ministry of Coordination and Environmental Affairs (MICOA)

Nigeria: Federal Ministry of Environment

Senegal: Ministère de la Jeunesse, de l'Environnement et de l'Hygiène Publique

Seychelles : Ministry of Environment

South Africa: Ministry of Environmental Affairs and Tourism

Tanzania: National Environment Management Council (NEMC)

EXECUTING AGENCIES:

Cote d'Ivoire: Port Autonome d'Abidjan (PAA), Centre de Recherche Oceanographiques (CRO)

The Gambia: Department of State for Tourism and Culture

Ghana: Ministry of Works and Housing/Hydrological Services Department

Nigeria: Federal Ministry of Environment

Mauritius: Ministry of Environment

Mozambique: MICOA

Kenya: Coast Development Authority

Mozambique: Ministry of Environment

Senegal: Office of Environment and the Classified Establishments in collaboration with the University of Dakar and Office of Civil Engineering

Seychelles: Ministry of Environment

South Africa: Saldanha Bay Municipality, Common Ground Consulting, Prestedge Retief Dresner Wijnberg, local contractors

Tanzania: National Environment Management Council (NEMC)

POSSIBLE LOCAL PARTNERS:

Cote d'Ivoire: Projet Littoral, Bureau National d'Etudes Techniques et de Developpement, Universite de Cocody

The Gambia: Department of Technical Services, Geology Unit

Ghana: Environmental Protection Agency, District Assemblies of Coastal Districts, Private Hotel Owners, Private Estates Developers, Museums and Monuments Board, Ministry of Food and Agriculture

Nigeria: Federal Government of Nigeria, all littoral States in Nigeria, Tourist Company of Nigeria, OPTS

Mauritius: Proposed Beach Authority, Ministry of Local Government, AHRIM, Mauritius Research Council

Senegal: The National Agency of Investissement Promotion (APIX)

Seychelles: Ministry of Industries and International Business and Tourism, Civil Aviation, Ministry of Land Use and Habitat/ Ministry of Tourism

Kenya: Kenya Wildlife Services, National Environment Management Authority, Physical Planning Department, Department of Roads and Public Works

Mozambique: Ministry of Public Works and Housing (MOPH), Local Authorities, Municipalities

South Africa: Department of Environmental Affairs and Tourism, South African National Parks (West Coast National Park), Development Bank of South Africa, Provincial Administration of the Western Cape Province (Consolidated Municipal Infrastructure Programme), National Ports Authority

Tanzania: Ministry of Works, Local Authorities

PRIORITY ISSUE ADDRESSED:

- GIWA ISSUE # 13: Loss and modification of Ecosystems and Ecotones
- NAIROBI AND ABIDJAN CONVENTIONS for the Protection, Management and Development of the Marine and Coastal Environment of the EA and West African Regions
- MAPUTO AND CAPE TOWN DECLARATIONS ON THE AFRICAN PROCESS: For the Development and Protection of the Coastal and Marine Environment with particular reference to Sub-Saharan Africa
- Arusha resolution 1993

REGIONAL SCOPE:

All activities will be co-ordinated and managed at both regional and national levels. It is proposed that identification of affected and vulnerable areas to erosion will be undertaken in all requesting countries except Cote d'Ivoire, The Gambia, Ghana, Nigeria, Seychelles, and South Africa. Investigation on factors affecting shoreline change and implementing mitigation options will be carried out at hotspots and sensitive areas in Cote d'Ivoire, Ghana, Mozambique, Mauritius, Nigeria, Senegal, South Africa and Tanzania. Capacity building and awareness raising will be implemented in all the requesting countries of the Sub-Saharan Africa. This component is envisaged to enhance procurement of field and laboratory equipment, training courses and workshops, intra-regional and international collaboration in restoration of degraded areas and mitigation of coastal erosion. Countries of the Sub-Saharan Africa will benefit from experiences and information gained from projects related to coastal erosion mitigation in The Gambia, Ghana, Nigeria, Seychelles and South Africa.

Other countries in the region, e.g. Cameroon, Guinea Bissau, Togo, Benin and the Comoros can benefit from the results, information and experiences from the project. In addition, they will be invited to participate in the training programmes and in regional workshops.

UNEP/RCU (Nairobi Convention) under its 2nd Biennium programme has got a specific component for coastal erosion. A workshop, jointly funded by UNEP and Reunion (France) is being organised in October 2002 on addressing coastal erosion in the region, especially those which are party to the Nairobi Convention.

PROJECT LOCATION:

Co-ordination of the project and the studies and capacity building efforts will be headquartered in one location – to be defined later. The various activities of the project will be carried out in the participating countries at hotspots and sensitive areas as follows:

Cote d'Ivoire: *Component 2* – Demonstrative restoration of the Grand-Lahou area

The Gambia: *Component 3* – Capacity building for monitoring the effects of the on-going coastal protection project in the Gambia (2002-2004)

Ghana: *Component 2* - To design the restoration of the integrity of the Ada-Volta Delta Anyanui Estuary Mangrove Complex. This will involve designing of an appropriate shoreline protection, designing of an entrenchment structure and replanting of mangroves in the degraded mangrove areas.

Kenya: *Component 1* - Assessment of sources and loads of suspended sediments discharge into the Bay. Assessment of the impacts of suspended sediments on the ecosystems especially the beach, coral reefs, seagrass and mangroves in the Malindi Bay

Mauritius: *Component 2* - Assess the present level of shoreline changes, model coastal hydrodynamics and forecasting the impact of future coastal developments, design and test novel protective measures at Flic and Flac, Riambel and Grand Bay and monitor the effect of these measures on the shoreline.

Nigeria: *Component 2:* To design the restoration of the integrity of degraded areas at Eket, Lagos, Forcados and Ondo (Mahin). This will involve testing of a protection measure at one of the degraded areas.

Senegal: *Component 2* - The implementation of the project will take place in the Cap-Vert Peninsula – Little Coast area. This objective of this project is to:

- Carry out topographic, geologic, oceanographic, hydro-meteorological and geotechnical studies
- Assess the effectiveness of the protection methods already set in place in the previous years and
- Design the restoration of the degraded areas at Mbor, Kayar, Ouraye Lake, “Fleche de Joal, Mbodiene” and Fleche de Sangomar. Implement a demonstrative protection at one of the six degraded areas.

Component 3: - Capacity building will involve formulation of technical norms for future buildings in the area and consolidation of an integrated management of the coastline in Cap-Vert Peninsula

Seychelles: *Component 3:* Capacity building in research and development of alternative building materials and *Component 2* – Re-vegetation to establish the natural coastline.

- coastal morphology capacity building for beach replenishment
- soft and engineered approaches to reducing impacts of coastal erosion
- compendium of approached and wise practices in combating coastal erosion in the region
- training in sustainable coastal monitoring
- provision of simple coastal monitoring equipment.

South Africa: *Component 2* – Design and test a structure or partial replenishment that will be appropriate to protect the beach at Langebaan.

Tanzania: *Component 1* – Assessment of the present level of shoreline changes of Tanzania shoreline

Component 2 - Design and testing of novel protective measures at Dar es Salaam and Jambiani in Zanzibar

PROJECT DURATION: 3 – 5 years depending on duration of components

WORKING GROUP OF THE AFRICAN PROCESS: Coastal Erosion Working Group

2. SUMMARY

Coastal erosion is a major environmental issue in Sub-Saharan Africa as it was indicated in the Abidjan and Nairobi Conventions and in the Arusha resolution in 1993. Widespread and significant erosion of coasts, whether due to anthropogenic or natural causes is known to be one of the most devastating environmental

problems of the coastal zone of a number of countries of the Sub-Saharan Africa, and has serious implications on the entire national economies. Due to a concentration and increase of population and economic activities in the coastal zone in general and particularly in the vicinity of the shores, the coastal zone is highly vulnerable to many types of environmental degradation. The threat of global warming that will induce acceleration in sea-level rise is an important phenomenon, which could contribute to more degradation of the coastal zone. The threat of sea level rise appears clearly from the first Initial National Communications presented by Sub-Saharan Countries and particularly Small Islands States.

The first phase of the GEF MSP project on “Development and Protection of the Coastal and Marine Environment in Sub-Saharan Africa” identified coastal erosion as one of the key issues affecting the countries. On the basis of the outputs of the first phase, Coastal Erosion was adopted as one of the themes for the five Working Groups for the second phase of the GEF MSP project.

Within the National Reports, countries identified coastal erosion as an important issue, either directly (as in the case of Ghana, Mauritius and Seychelles) or as a cause of for example habitat modification or destruction (Côte d’Ivoire, The Gambia, Senegal and Tanzania). With regards to future threats and coastal erosion, climate change is considered as one of the potential causative factors of coastal erosion, as identified in Cote d’Ivoire. The UNEP LBS report for west and central Africa refers to it as “one of the predominant problems of the region”. Modification of the shoreline has been reported both as coastal erosion (in many instances) but also as accretion in case of high loads of sediments transported to the sea front.

Along the 80 km long stretch of the **Gambia** beach front, on average the coastline is eroding at a rate of 1 to 2 metres per year (Barrow, 1991; UNEP, 1998). Using these figures, the estimated land lost annually amounts to 2.5 to 3 hectares or 200,000 - 300,000 m³ per year (UNEP, 1998). The rate of erosion is very variable, however, and is much higher in critical areas such as the developed coastline around Banjul and the sand mining areas, notably at Bijilo and Kololi beach. Even though other natural factors have been determined to be responsible for the rapid rate of erosion of the beaches along the Atlantic Ocean, “excessive removal of beach sand by the building and construction sector has equally been responsible. The main source of sand for the sector particularly has been from the coastal dunes for over thirty years. For the past decades, an estimated 100,000 to 150,000 m³ of sand per year has been extracted from beaches between Kololi Point and Bald Cape for use by the building and construction industry. There are no accurate figures available for the amount of sand extracted illegally but physical observations estimate 25,000 to 50,000 m³ per year. This area is one of the most critically eroded areas along The Gambia coastline with erosion rates estimated at 4 to 5 metres per year”.

Coastal erosion is also a major feature of the shoreline of **Ghana**, especially on the eastern shores. “With the loss of mangrove stands through human exploitation comes the loss of its shoreline protective feature. This contributed to the enormity of the erosion problem in the delta area of the Volta River. The report further notes that the erosion of shorelines destroys turtle egg-laying sites and also exposes this critical stage of the life of the turtle to predators such as dogs, pigs and humans”.

In **Nigeria**, coastal erosion results from the modification of ecosystems and is also considered under the global climate change and sea level rise issues. Affected sites include Eket, Lagos, Forcados and Ondo (Mahin).

The **Senegal** report confirms rates of coastal retreat comprised between 1 and 2 m per year (Niang-Diop, 1993). The main impact of coastal erosion includes loss of land and destruction of infrastructure. The report cites one fishing factory and a guards’ house closed in 1989 in the Saloum Delta National Park, the abandonment of the village of Palmarin that has been rebuilt on the other side of the road, displacement of tourism facilities, roads and other equipment.

The socio-economic cost of erosion is already high in countries of the Sub-Saharan Africa. For example, in The Gambia, it has already destroyed buildings, tourist facilities, and historical and cultural sites. More than 60% of economic activities (fisheries, tourism, forestry, agriculture, marine transportation, quarrying and industrial activities) are concentrated there. Coastal land lost due to erosion poses similar threat to components of the natural ecosystem such as the mangrove areas and wildlife parks. It is also posing a serious threat to the main highway linking Banjul to the rest of the country. Its impact on the Tourism sector,

which has become a leading sector in the national economy with a contribution about 10% to 12 % of the GDP, is devastating. Coastal erosion is increasingly exposing and damaging fish landing installations and infrastructure.

In Kenya and Mozambique, beach accretion has taken place, such that beach hotels have lost their beach frontage. For example, due to the nature of the river-sediment being deposited (brown sand and silt) the aesthetic value of the beach along the Malindi Bay has been lost making them less attractive to the development of tourism.

In Seychelles and Mauritius where tourism represents a major source of employment and foreign exchange, beachfronts have eroded away leading to the destruction of coastal infrastructures. Unplanned and unwise land use development, by the tourism industry itself for example have resulted in higher erosion rates, in some areas, e.g. Gambia and Mauritius. The overexploitation of mangroves in Ghana, as for example in the Ada-Volta Delta Anyanui Estuary Mangrove Complex (AVDEAMC) and the damming on the Volta River have caused sediment transport changes and thereby resulting in erosion and destruction of key species habitat.

The goal of the project is to restore the integrity of the degraded hotspots and sensitive areas through designing and testing simple but effective protection measures. Through this project, the capacity of the Sub-Saharan African countries in coastal protection and management will be enhanced. The project **objectives** are:

- (1) To assess populations and resources that have been affected and map vulnerable areas and resources to coastal erosion
- (2) To design and test restoration and protection measures in the degraded (eroded or accreted) hotspots and sensitive areas
- (3) To enhance capacity of the Sub-Saharan Africa in sustainable coastal protection methods and management

In order to meet these objectives, the activities are divided into three main components and these include:

Component 1: Identification of affected and vulnerable areas to erosion

Component 2: Investigation on factors affecting shoreline change and implementation of demonstrative mitigation options at hotspots and sensitive areas

Component 3: Capacity building and awareness raising

Expected outputs include identified sites that are affected and vulnerable to coastal erosion, regional GIS maps and database, maps containing information on the suitability of coastal areas for various economic activities. The implementation of *Component 2* will generate information on causes of coastal erosion in the hotspots and sensitive areas. The pilot/demonstration sites will be examples for other parts of Africa to emulate. As part of the project guidelines/protocols for the planning, designing and implementation of mitigation options will be produced. Alternative building materials will be investigated in the course of the project and some novel protection methods will be tested. In enhancing capacity building and public awareness, data acquisition and analysis equipment will be acquired, local professionals trained and awareness in stakeholders on the best practices of coastal protection raised. Intra-regional and international collaboration will be enhanced through study visits and workshops. A regional database may be set up for the common good of the region.

Implementation of this project will demonstrate the best practices to stabilise the shorelines and therefore save properties under threat. Areas reclaimed at the demonstration sites could now be used for tourist facilities such as hotels and other recreational facilities. Basing on the demonstration sites, national governments will use the designs to restore and protect other areas. Beneficiaries of this project include national governments, the public, investors and the scientific community.

3. **COSTS AND FINANCING** : Million US \$: 29.95 of which
- External funding : US\$24.96
 - National Governments: US\$ 4.99¹

4. **GOVERNMENT ENDORSEMENT:**

Cote d'Ivoire: Ministere de l'Equipement, Ministere de l'Enseignement Superieur et de la Recherché Scientifique

The Gambia: National Environment Agency (NEA)

Ghana: Ministry of Environment and Science, Ministry of Works and Housing

Nigeria: Federal Ministry of Environment

Mauritius: Ministry of Environment

Senegal: Mme Fatimata Dia-Toure, Director of the Environment and Classified Establishments

Seychelles : Mr Lousteau-Lalane, Principal Secretary, Ministry of Environment

Kenya: Kenya Marine and Fisheries Research Institute (KMFRI), (Ministry of Agriculture and Rural Development), Ministry of Environment and Natural Resources.

Mozambique: MICOA

South Africa: Ms Rejoice Mabudafhasi, Deputy Minister, Ministry of Environmental Affairs and Tourism

Tanzania: Ministry of Environment

5. **GOVERNMENT FOCAL POINTS**

Cote d'Ivoire –Environment Department, Centre de Recherché Oceanographiques (CRO)

The Gambia - Department of State for Works, Communications and Information

Ghana – Ministry of Works and Housing/Hydrological Services Department

Nigeria – Larry Awosika, Nigerian Institute for Oceanography and Marine Research (NIOMR)

Mauritius – Director, Department of Environment, Ken Lee Tower, 2nd Floor Port Louis

Senegal – Mme Fatimata Dia-Toure, Direction de l'Environnement et des Etablissements Classés, Ministère de la Jeunesse, de l'Environnement et des Etablissements Classés

Seychelles – Mr Rolph Payet, Director General, Policy planning, Ministry of Environment

Kenya – Mr Ali Mohammed, Ministry of Environmental and Natural Resources

Mozambique – National Director of Environmental Management – MICOA

South Africa – Saldanha Bay Municipality

Tanzania – Director, Institute of Marine Sciences

6. **AFRICAN PROCESS WORKING GROUP FOCAL POINTS:**

Coastal erosion group: Dr. Isabelle NIANG-DIOP, University C. A. Diop of Dakar, Senegal, Regional Co-ordinator

Dr Alfonse DUBI, Technical expert – Institute of Marine Sciences, University of Dar es Salaam, Tanzania

Dr Delphine MALLERET-KING, - Technical expert - Private Consultant, Kenya

¹ This budget is preliminary and has not undergone a full consultation process with the respective countries. Therefore, it does not indicate the actual financial commitment that would be provided by participating countries once the project proposal and its components are finalised.

PROJECT DESCRIPTION

1. Background and justification

Coastal erosion, whether it is caused by natural or human - induced factors, is known to be one of the most devastating environmental problems of the coastal zone of a number of countries of the Sub-Saharan Africa, and has serious implications on the entire national economies. Natural causes include climate change, i.e. increased concentrations of greenhouse gases, changes in meteorological conditions (winds, precipitation, barometric pressure, temperature) and sea level. Anthropogenic causes include damming and non-sustainable use of resources.

Climate change resulting from increased concentrations of greenhouse gases such as CO₂ and other trace gases would affect the hydrological process, which has a direct impact on water and coastal erosion. Climate change would affect precipitation such that regions with increased precipitation would experience increased runoff and river sediment load transport while the reverse would be observed in regions with decreased precipitation.

Therefore, a change in the world's weather pattern will result in the variability of water discharge and sediment supply to the coastal zone. Droughts will result in the reduction of sediment supply to the coastal zone through rivers. Information on changes on meteorological conditions, especially rainfall, winds and temperature must be obtained in order to assess climate variability and its effect on the coastal zone.

A natural coastal system that experiences sea level rise can be affected in several ways. From an erosion perspective, the most important physical effect is a slow, long-term recession of the shoreline due to direct flooding and partly to profile adjustment to the higher level. Generally a 1-cm rise in sea level would result in a 1-m shoreline retreat (Bruun, 1962)

The potential socio-economic impacts of sea level rise may be summarised as follows:

- direct loss of economic, ecological and cultural values through the loss of land, infrastructure and coastal habitats
- increased flood risk of people, land and infrastructure and the above-mentioned values
- Impacts related to change in water management, salinity and biological effects.

Studies have shown that a rise in sea level would claim vast areas of land and other economic properties. For example, Mwandosya et al. (1998) examined two sea level rise scenarios of 0.5 m and 1.0 m in Tanzania,. The study suggests that a 1.0 m – rise in sea level would permanently flood about 500 km² of land, most of which is wetlands. Inundation would claim about 250 km² for 0.5 m of sea level rise and about 490 km² for 1-m rise of sea level. Future erosion rates were projected using the Bruun Rule for Dar es Salaam in response to global warming and accelerated sea level rise of 1 m to about 9 km². Aerial videotape-assisted Vulnerability Analysis (AVVA) together with ground-truthing exercise for Dar es Salaam suggested an area of about 12 km² of land would be lost for the same rise in sea level. This land loss would claim buildings and other structures valued at about Tsh. 50 billion and Tsh. 86 billion for 0.5m and 1.0m of sea level rise respectively. Expected storm surges of 5m would bring a damage of over Tsh. 200 billion for Dar es Salaam.

In Nigeria, Awosika et al. (1992) examined four sea level rise scenarios of 0.2 m, 0.5 1.0 m and 2.0 m. for four locations in Nigeria. Table 1 shows projected land loss due to erosion and inundation for the four sea-level rise scenarios.

Table 1. Total Land Loss (km² by Shoreline Type) due to Erosion and Inundation Different SLR Scenarios (Awosika et al 1992)

SLR	Low Estimate				High Estimate			
	0.2m	0.5m	1.0m	2.0m	0.2m	0.5.m	1.0m	2.0m
Barrier	177	284	584	1167	118	289	602	1204
Mahin Mud	403	1008	2016	3456	403	1008	2016	3456
Delta	2846	7453	15125	18398	2865	7500	15332	18803
Strand	79	197	395	575	85	212	446	677
Total	3445	8942	18120	23596	3471	9009	18396	24140

The potential impacts of climate change by itself may not always be the largest threat to natural coastal systems. But, in conjunction with other stresses, such as the actions of man, they can become a serious issue for coastal societies, particularly in those areas where the adaptive capacity of natural coastal systems has been reduced (Bijlsma et al., 1996). Factors that interact with climate change are non-sustainable resource use and developments that adversely affect the natural capability of these systems to adapt to climate change. The factors include (Goldberg, 1994):

- over-exploitation of resources (sand and coral mining, mangrove cutting, groundwater and hydrocarbons)
- pollution
- decreasing freshwater availability
- sediment starvation and urbanisation (dam construction, construction on beaches, human settlements).

Existing policies and practices can also increase the coastal zone's vulnerability to climate change. These practices include:

- investments in potentially hazardous zones
- inappropriate coastal defence schemes and
- coastal habitat conversions

The threat of sea level rise appears clearly from the first Initial National Communications presented by Sub-Saharan Countries and particularly Small Islands States.

The first phase of the GEF MSP project on "Development and Protection of the Coastal and Marine Environment in Sub-Saharan Africa" identified coastal erosion as one of the key issues affecting the countries. On the basis of the outputs of the first phase, Coastal Erosion was adopted as one of the themes for the five Working Groups for the second phase of the GEF MSP project.

Within the National Reports, countries identified coastal erosion as an important issue, either directly (as in the case of Ghana, Mauritius and Seychelles) or as a cause of for example habitat modification or destruction (Côte d'Ivoire, The Gambia, Senegal and Tanzania). With regards to future threats and coastal erosion, climate change is considered as one of the potential causative factors of coastal erosion, as identified in Cote d'Ivoire. The UNEP LBS report for west and central Africa refers to it as "one of the predominant problems of the region". Modification of the shoreline has been reported both as coastal erosion (in many instances) but also as accretion in case of high loads of sediments transported to the sea front. In the Sub-Saharan Africa, modification of the shoreline has been reported both as coastal erosion (in many instances) but also as accretion in case of high loads of sediments transported to the sea front.

In **Cote d'Ivoire**, coastal erosion is linked to the degradation of habitats, as is a result of the following causes: - harbour/port construction; clearance of coastal vegetation; mining and construction; dams construction; and sea level rise. Coastal erosion is severe along the south-eastern coast (Fresco, Vridi, Port-Bouët to Ghana Border) where rates of 1 to 2 m per year have been reported. The Cote d'Ivoire National Report quotes "The loss of aesthetic value due to erosion and beach accretion in the Grand-Lahou area have led to loss of income and foreign exchange from tourism as a number of tourist hotels have lost their beach frontage. The degradation of the coastline causes, according to a study conducted by the World Bank in 1989, a loss of the landed value of the developed or non- developed properties estimated to 1,9 billion FCFA in 1998. Grand Bassam (classified as historic site by UNESCO), Assinie and Grand-Lahou, and a national

park at Azagny (RAMSAR site) are examples of historic cities and sites destined to disappear if nothing is done to stop severe coastal erosion occurring along eastern part of the coastline.”

In The **Gambia**, coastal erosion is one aspect of the issue of modification of ecosystems. It was identified as a major problem in 2 hot spots (Tanbi Wetland Complex and River Tanji Bird Reserve and Bijol island) and in 2 sensitive areas (the coast from Allahein river to Cape Point and Banjul island). The mean rate of coastal erosion along the 80 km of coastlines extending from the river Allahein to Cape Point is estimated at 1 to 2 meters per year. However these rates are not uniform and the higher rates (4 to 5 m per year) are observed close to the sand mining places (Bijilo and Kololi beaches). With these rates, the estimated land lost annually amounts to 2.5 to 3 hectares or 200,000 - 300,000 m³ per year. Coastal erosion is already responsible for the destruction of buildings, tourist facilities, historic and cultural sites and infrastructures in the two last sensitive areas. It is also a major issue in Banjul where rates of retreat of 3 to 4 m/year have been measured around the Muslim Cemetery, Radio Syd and the Boys Scout Headquarters.

Coastal erosion in **Ghana** was identified as major feature of the shoreline especially on the eastern shores in the Ada-Volta Delta Anyanui Estuary Mangrove Complex (AVDEAMC). With the loss of mangrove stands through human exploitation comes the loss of its shoreline protective feature. This contributed to the enormity of the erosion problem in the catchment. The Ghana national report reports, “ Following the damming of the Volta River, the result of which cut off substantial amounts of sediments that reach the littoral zone, erosion has become of critical concern averaging about 2 - 3 m/year in recent times. Ly (1980) estimated the recession in the Keta area to have increased from 4 m/year before the construction of the dam on the Volta River in 1965 to 8 m/year after the dam construction. The rate of erosion in the Keta area is the worst that Ghana has ever experienced”.

In **Kenya**, as a consequence of the high loads of suspended solids discharged through the Sabaki estuary, the coral ecosystem extending into the Malindi National Marine Park and Reserve has been negatively impacted (Obura, 1995) as evidenced by the shadowing of corals. As a result of the high sediment discharges and deposition, the sea-grass communities have been impacted on negatively resulting into a reduction of species diversity (Wakibia 1996); Beach accretion has taken place, such that beach hotels have lost their beach frontage. Due to the nature of the river-sediment being deposited (brown sand and silt) the aesthetic value of the beach along the Malindi Bay has been lost making them less attractive to the development of tourism.

In **Mauritius**, coastal erosion was identified as a major issue for 1 hot spot (Flic and Flac) and 2 sensitive areas (Palmar/Belle Mare and Riambel/Pomponette) resulting in shoreline change. The National Report quotes, “The worst sites for erosion are Pomponette and Riambel where a beach retreat of 4 m has been recorded during a period of 3 years.”

Impacts of coastal erosion in Mauritius include the loss of habitats for marine and other organisms; loss of beach, and the reduction in beach protection, resulting in a potential decrease in earnings from tourism and increased pressure on the coastal zone for other accommodation. There have been some studies on this issue and mitigation measures, in the form of gabions, implemented in some localities on a trial basis. However, the efficacy of these measures has to be assessed and long-term solutions have to be found and implemented. Quote from the National Report “A survey dating back to 1996 revealed the presence of over 200 unwarranted or ill-designed jetties/groynes around the island (Prayag et al, 1995). Hotels and private bungalows around the coast have their own jetties. Many of these jetties are not well designed and they interfere with the circulation of water in the lagoons. Similarly sea walls built to delimit properties or mitigate the action of waves are adversely affecting the lagoon and shoreline. In many cases the set back distance has not been respected (Jootun et al, 1994). The compounded effects of the various hard structures inevitably are having long-term consequences on the shoreline and the lagoon itself.”

Mozambique identified coastal impact of the issues of “modification of stream flows” and “modification/destruction of ecosystems”. Hotspots in Mozambique include Maputo and Beira areas. Intervention will include studies and implementation of mitigation options in one of the hotspots as a demonstration site

Coastal erosion with concomitant flooding is causing widespread loss of ecosystems/ecotones in many areas in **Nigeria**. The following extract from the Nigeria national report gives good testimony of it. “The Victoria beach

is the fastest eroding beach in Nigeria with average erosion rates of 20-30m annually. Between 1900 and 1959, Victoria beach retreated by over 1km near the eastern mole, decreasing to about 400m some 3km eastwards in the area of the Kuramo waters. However, the Lighthouse beach near the western breakwater accreted by over 500m within the same period. Annual erosion rates of 25 - 30m had been reported between 1981 and 1985. This high rate of erosion has been linked to the construction of the moles built to stop the silting up of the entrance to Lagos harbour. Erosion rates range between 18-24m annually at Ugborodo/Escravos station, 20-22m annually at Forcados station, 16-19m annually at Brass Station, 15 - 20m annually at Kulama station, and 20-24m annually at Bonny station and 10-14m annually at (Opobo river entrance) station (Ibe, 1988).

Senegal considered coastal erosion as one type of modification of ecosystems. It is identified as a major issue for one of the Hot spots (Djiffere) and for one of the sensitive areas (Saloum estuary). Rates of coastal retreat are generally comprised between 1 and 2 m par year. However in Djiffere coastal erosion has been particularly severe after a breaching of the sand spit with erosion rates of more than 20 m a year. In the Cap – Vert Peninsula, especially the Little Coast, it has been noticed that over the last 50 years there has been a retreat of the shoreline at an approximate rate of 1 to 1.3 m per year. The retreat has caused destruction of houses and infrastructure.

In **Seychelles** coastal erosion was considered as a separate issue and was identified as affecting 2 hot spots; the East Coast of Mahe and Anse Volbert. However, coastal erosion was considered as an environmental impact of the issues of habitat modification and sea level rise.

In **South Africa**, more than 150 m of beach has been lost at the northern beach of Langebaan since 1960's, of which 50-m have been lost in the past five years. The aggressive erosion has resulted in damage to seafront properties, many of which belong to residents from a disadvantaged background. There is potential loss of the town of Langebaan through the loss of an amenity and anticipated detrimental effects to the Ramsar site. In 1997 a 1.5 km temporary rock revetment was constructed as an emergency measure. This requires on-going maintenance at an annual cost of R500 000.

In **Tanzania**, shoreline erosion is one of the major threats to the stability of the coastal zone of Tanzania linked to the modification of habitats. Hotspots include Dar es Salaam, Tanga, Mtwara and Zanzibar.

The socio-economic cost of erosion is already high in countries of the Sub-Saharan Africa. For example, in The Gambia, it has already destroyed buildings, tourist facilities, and historical and cultural sites. More than 60% of economic activities (fisheries, tourism, forestry, agriculture, marine transportation, quarrying and industrial activities) are concentrated there. Coastal land lost due to erosion poses similar threat to components of the natural ecosystem such as the mangrove areas and wildlife parks. It is also posing a serious threat to the main highway linking Banjul to the rest of the country. Its impact on the Tourism sector, which has become a leading sector in the national economy with a contribution about 10% to 12 % of the GDP, is devastating. Coastal erosion is increasingly exposing and damaging fish landing installations and infrastructure.

The overexploitation of mangroves in Ghana, as for example in the Ada-Volta Delta Anyanui Estuary Mangrove Complex (AVDEAMC) and the damming on the Volta River have caused sediment transport changes and thereby resulting in erosion and destruction of key species habitat. However, the eastern shores of Ghana have been identified to be major sea turtle nesting sites. Sea turtles are listed as endangered and are among marine animals protected by law. Erosion of shorelines destroys turtle egg-laying sites. It also exposes this critical stage of the life of the turtle to predators such as dogs, pigs and humans. Thus, the prevalence of erosion on the shore contributes to the loss of sea turtle biodiversity. For instance, live Hawksbill turtle, *Erectmochelys imbricata*, has not been recorded in appreciable quantities in Ghana within the past 30 years. The Loggerhead turtle, *Caretta caretta*, could be described as highly endangered in Ghanaian waters in the Keta Lagoon Complex hot spot and the East Central Sandy Coast sensitive area where the rate of coastal retreat is estimated at 3 m per year.

In **Kenya and Mozambique**, beach accretion has taken place, such that beach hotels have lost their beach frontage. One example is Malindi Bay in Kenya where, due to the nature of the river-sediment being deposited (brown sand and silt) the aesthetic value of the beach has been lost making it less attractive to the development of tourism.

In **Seychelles and Mauritius** where tourism represents a major source of employment and foreign exchange, beachfronts have eroded away leading to the destruction of coastal infrastructures. Unplanned and unwise land use development, by the tourism industry itself for example have resulted in higher erosion rates, in some areas, e.g. Gambia and Mauritius.

This proposal is a contribution to the Programme of Intervention for the development and protection of the coastal and marine environment of the Sub-Saharan Africa. The project will enhance the capacity of the Sub-Saharan African states to restore and protect the coastal ecosystems from loss/modification of the habitats that have been degraded through coastal erosion.

2. Objectives and expected results

The goal of the project is to restore the integrity of the degraded hotspot and sensitive areas and protect them from the recurrence of erosion. Through this project, the capacity of the Sub-Saharan African countries in coastal protection and management will be enhanced. The main objectives of this project are:

- (1) To assess populations and resources that have been affected and map vulnerable areas and resources to coastal erosion
- (2) To design and test restoration and protection measures in the degraded (eroded or accreted) hotspots and sensitive areas
- (3) To enhance capacity of the Sub-Saharan Africa in sustainable coastal protection methods and management

The achievement of these objectives will lead to the following expected results:

- (a) Assessment of eroded areas and those vulnerable to erosion will avail to regional and national authorities the much-needed information on threatened areas for proper planning for investment and management of their coastal areas.
- (b) The mitigation measures will restore degraded areas, so that they continue to function for the socio-economic wellbeing of all stakeholders and biodiversity.
- (c) The capacity building and awareness raising package will :
 - Produce trained local professionals in the planning, designing and implementation of mitigation measures
 - Enhance technology transfer through international collaboration and also enhance intra-regional co-operation and collaboration
 - Raise awareness to all stakeholders

3. Project Components/Activities

The National Reports recommended the following measures to be undertaken in order to restore and protect the degraded areas:

Cote d'Ivoire: Demonstrative restoration of the Grand-Lahou area.

Gambia: Establishing a coastal area management mechanism to monitor the effect of the on-going coastal protection project using three different ways: visual observation, topographic survey and bathymetric survey. Low, middle and high level personnel will be trained on the identification and assessment of causes of coastal erosion and sedimentation and on coastal protection methods. Technicians will be trained to implementation, monitoring and maintenance of coastal protection works. Awareness of the general public, especially those living in the coastal zone, will be raised on the essence and best and low-tech practices of coastal protection.

Ghana: To design the restoration and appropriate protection of the integrity of the Ada-Volta Delta Anyanui Estuary Mangrove Complex by:

- (a) Designing and testing an appropriate protection measure for the adjacent shoreline.

- (b) Designing of an entrainment structure, e.g. breakwater to keep the estuary wider all the year round and allow salt water intrusion further inland than what is obtained now with the view to wipe out bilharzia, thereby increasing tourism potential and fisheries for the impoverished riparian communities.
- (c) Reforestation of degraded mangrove area to enhance the recovery of the lost biodiversity.

Kenya: Assessment of sources and loads of suspended sediments discharge into the Bay. Assessment of the impacts of suspended sediments on the ecosystems especially the beach, coral reefs, seagrass and mangroves in the Malindi Bay

Mauritius: Investigation on the efficacy of gabions that are already in place; assessment of the present level of shoreline changes; modelling coastal hydrodynamics and forecasting the impact of future coastal developments, designing and testing novel protective measures and monitor the effect of these measures on the shoreline.

In **Mozambique**, interventions will include studies on historical shoreline changes of the Mozambican coastline, modelling of hydrodynamics in the hotspot area of Maputo Bay and Beira, testing of a novel protection at Maputo.

In **Nigeria**, the cope of intervention will include identification of the causes, design mitigation options for Eket, Lagos, Forcados and Ondo (Mahin).and test an appropriate protection measure at one of the of the four places.

Seychelles: building capacity in research and development of alternative building materials and revegetation of degraded areas to establish the natural coastline.

For **South Africa**, the aim of this proposal is to protect the beach of Langebaan in the Saldanha Bay by constructing two groyne structures on the shoreline and partially restore the beach through replenishment. It is proposed to construct the two groyne structures approximately 500 m apart and will be 350 m in length. Partial replenishment is estimated to be 450 000 m³, after which natural replenishment is expected.

In **Tanzania**, interventions will include modelling coastal hydrodynamics and testing novel protective measures at Dar es Salaam (Ocean Rd and Oysterbay area) and Zanzibar at Jambiani village, where a settlement has lost property.

In order to meet these objectives and deliver the planned results for each of the recommended measures in the requesting countries, the activities are divided into three components:

COMPONENT 1: Assessment of affected and vulnerable shorelines to erosion in Sub-Saharan Africa

The component's objective is to the extent of shoreline changes along the sub-Saharan African coast, which are affected by erosion. The activity will also seek to assess the vulnerability of the shorelines to erosion and consequently devise national and regional management strategies to counter act the predicted impact.

Output 1: Mapping of affected and vulnerable areas to erosion

The following activities will be carried out:

- Acquisition of admiralty charts and aerial photos, satellite images of the entire coastline to obtain background information on coastal geomorphology and topography
- Assessment of the present level of shoreline change
- Demarcate locations and extent of each habitat/development type under threat to erosion in each country on detailed maps.
- Perform risk analysis and produce coastal vulnerability index (CVI)
- Digitise all spatial data for each country and enter into a suitable geographically referenced information system (e.g. Map Info or Arc View) and combine this into a single GIS data set for the entire region/continent

- Develop national and regional/continental scale strategies appropriate for each habitat/development type to be implemented in each country/region.

1.2.1.1 COMPONENT 2: Investigation on factors affecting shoreline change and implementing demonstrative mitigation options in the identified hotspots and sensitive areas

1.3 In this component, demonstration sites in the degraded hotspot and sensitive areas will be restored and protected from the recurrence of coastal erosion or beach accretion in the following participating countries:

Cote d'Ivoire: Demonstrative restoration of the Grand-Lahou area

Ghana: To design the restoration of the integrity of the Ada-Volta Delta Anyanui Estuary Mangrove Complex. This will involve designing of an appropriate shoreline protection, designing of an entrainment structure and replanting of mangroves in the degraded mangrove areas.

Mauritius: Assess the present level of shoreline changes, model coastal hydrodynamics and forecasting the impact of future coastal developments, design and test novel protective measures at Flic and Flac, Riambel and Grand Bay and monitor the effect of these measures on the shoreline.

Nigeria: To design the restoration of the integrity of degraded areas at Eket, Lagos, Forcados and Ondo (Mahin). This will involve testing of a protection measure at one of the degraded areas.

Senegal: The implementation of the project will take place in the Cap-Vert Peninsula – Little Coast area. This objective of this project is to:

- Carry out topographic, geologic, oceanographic, hydro-meteorological and geotechnical studies
- Assess the effectiveness of the protection methods already set in place in the previous years and
- Design the restoration of the degraded areas at Mbor, Kayar, Ouraye Lake, “Fleche de Joal, Mbodiene” and Fleche de Sangomar. Implement a demonstrative protection at one of the six degraded areas.

Seychelles: Re-vegetation to establish the natural coastline.

South Africa: Design and test a structure or partial replenishment that will be appropriate to protect the beach at Langebaan.

Tanzania: Design and testing of novel protective measures at Dar es Salaam and Jambiani in Zanzibar

The objective of this component is to:

- Investigate the causes of erosion and efficacy of the employed control measures
- Restore demonstration sites in the degraded areas with the application of appropriate adaptation or protection technology

Output 2.1: Assessment of factors affecting shoreline change

The following analytical activities will be implemented:

- Establish sea level variations over a geological time scale
- Collect information on meteorological data (e.g. winds, rainfall, temperature, cyclones, storms, etc.)
- Collection of existing seismic and gravity data
- Dating of corals to find out if local subsidence took place and contributed to the observed erosion (This activity is meant to augment tide gauge data)
- Assessment of the historical contribution of rivers to the coastal sediment budgets;
- Anthropogenic activities contributing to coastal erosion: sand mining, building of groynes, jetties, building on the beaches, dune deforestation, etc.
- In-situ measurement of waves, currents and sediment transport (one year)
- Hind casting and modelling of coastal processes

Then a detailed analysis and assessment of the causes affecting shoreline change in each of the selected sites will be prepared. This study will also propose a recommended course of action for mitigation.

Output 2.2: Planning and designing

This is the stage to decide which action could be best taken. The following activities will be carried out:

- Evaluation of prevailing criteria that guide local, national or regional policy preparation, as well as on existing coastal development and management plans
- Determine the optional adaptation technology and timing of implementation using such tools as cost/benefit analysis, cost/effectiveness analysis, risk/ effectiveness analysis
- Conduct EIA to identify possible adverse environmental effects resulting from implementing the optional technology.
- Through consultation with the local partners and stakeholders, agree on a set of remedy action.

Output 2.3: Implementation of mitigation options at demonstration sites

In this task and for each of the selected site, the identified technology is implemented either alone or in combination with the others. This task will involve:

- Develop concepts of alternative building materials
- Design and test an appropriate protection method.
- Monitoring of mitigation options and exchanging of experience and lessons learned through a regional workshop

1.3.1.1 Component 3: Capacity Building and awareness raising

1.3.1.2

The capacity building is expected to upgrade the level of expertise in partner countries. This may include activities such as:

- Training-on-the-job in software and data management
- Sharing of modelling and data management experience with other countries outside Sub-Saharan Africa
- Provision of software and hardware
- Conducting regional training workshops
- Support intra-regional exchange of scientists, technicians and experts in the region. Establish a regional network and database for coastal erosion information
- Support study tours and visits to the sites
- Production of public awareness materials such as brochures, booklets, flyers, etc
- Information dissemination through publications and public awareness campaign through the media.

4. Linkages to other National or Regional Activities/Trans-boundary Aspects

Links to past projects/experiences in the region: There is a regional experience accrued from past coastal erosion projects in the region and these include the following:

UNESCO funded the WACAF 3 project whose objective was to examine coastal erosion in the West African region (from Mauritania to Senegal). This project spanned from 1981 to 1985). Then the FAC (Fonds d'Aide et de Coopération) funded the "Coastal Erosion" project in the period 1986-1990 whose aim was to identify the situation of coastal erosion in the Gulf of Guinea (Côte d'Ivoire, Ghana, Togo, and Benin). The European Union funded an expertise on coastal erosion in the Gulf of Benin (Ghana, Togo, Benin and Nigeria) between 1988 and 1990. This project ended with a portfolio of concrete actions to combat coastal erosion. UAO and PNUE funded pilot projects to combat coastal erosion, one of them, whose output was building of groins based on the principle of low cost technologies, was realised in Cotonou in 1998. Numerous colloquiums, international meetings have been convened on the subject.

The Commission of the Department of Rural Development and Environment of the Union Economique et Monétaire Ouest Africaine (UEMOA) funded a feasibility study on "Regional Programme to Combat Coastal Erosion" (October 2000). Countries that were covered included Benin, Côte d'Ivoire, Gambia, Ghana, Senegal and Togo. In this report the consultant, L. Gnonlonfin, identified sensitive sites to coastal erosion, which correspond to the to the sensitive areas or hot spots identified in the GEF MSP project

Links to regional and sub-regional programmes:

The project aim and main objective are directly linked to the Nairobi and Abidjan Conventions. Paragraph 16 of the Biennial Work Programme for the Implementation of the Nairobi Convention (2000-2001) stipulates that the Contracting Parties to the Nairobi Convention recommended that one of the areas of focus under the assessment theme was shoreline changes. Paragraph 25 of the Programme stipulates that its activities should aim at refining the methodology for long-term monitoring for coastal erosion and at implementing recommended simple but effective mitigation methods on selected sites.

Article 10 of the Abidjan Convention for Cooperation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region stipulates: “The Contracting Parties shall take all appropriate measures to prevent, reduce, combat and control coastal erosion in the Convention area resulting from man’s activities, such as land reclamation and coastal engineering”.

The UNEP Regional Seas Programme is the main framework for coastal and marine environment. It is also responsible for the regional Conventions (Abidjan and Nairobi).

The Gulf of Guinea Large Marine Ecosystem (GOG-LME) had a workshop in Accra (14-18 may 2001) to evaluate the results of the pilot phase. 6 national pilot projects and 2 regional projects have been approved by the meeting. Among the national pilot projects, one is of relevance to this project: use of low cost technologies for coastal protection in Côte d’Ivoire. One of the 2 regional projects is relative to the establishment of an integrated regional system for the data and information management to help the decisions.

The Marine Science for Management (MASMA), which is funded by Sida, began in 2001. This programme replaces a former one – regional marine science program – that ended in December 1999. The long-term objective of the project is to achieve regional benefits by developing and implementing research projects that focus on maintenance, restoration, conservation and sustainable management of coastal and marine resources of the WIO region. To fulfil this objective, interdisciplinary collaboration between natural and social scientists will be an important component of the programme. The immediate objectives are to implement a series of activities that are designed to gradually and systematically build up and strengthen individual and institutional capacities to conduct research that contributes to the well being of the people of the region.

Links to existing national projects and programmes:

At national level, some projects and programmes already exist. In The Gambia, there is an ADB funded project on “Coastal Protection” At present, the Coastal Protection Project in Gambia (2002-2004), funded by the African Development Bank, is in progress. The project seeks to mitigate the beach erosion along the coastline and sedimentation at Barra Ferry Terminal. The stability of the coast will improve accessibility to tourist centres, availability of hotels and restaurant facilities and increase income for local people, especially women who sell their agriculture produce or engage in trading and fishing activities. In Ghana, there is the “Keta Sea Defense Project” whose area of concern is located in the same Volta delta area but more to the east. All the projects of coastal management could be integrated in the development of national policies such as Environmental Action Plans and Integrated Coastal Zone Management Policies.

In Seychelles, a detailed study of coastal dynamics and the anthropogenic disturbance of hydrodynamic processes was undertaken between 1996 and 1999. Basing on the study, a new beach protection strategy was defined in 2000, initiated by the Ministry of environment and funded by the Regional Environmental Programme of the Indian Ocean Commission. This is a long-term programme. The main components of this project include:

- Trial of new technical solutions where hard structures failed (beach nourishment for example);
- Training courses and field studies for technicians at all institutions and public service agencies concerned with coastal erosion

Setting up of setback lines and enforcing building permits and environmental impact assessment

This project will be linked to the regional and national projects and programmes through study of the past projects to draw knowledge and experiences from them. Efforts should be made to study the existing projects

in Ghana, Nigeria, Seychelles and Mauritius in order to arrive at a simpler but effective restoration and mitigation options.

5. Demonstrative value and replicability

This project has been formulated such that implementation follows a logical sequence. It is easy for a participating country to decide which component is required. Countries that have already assessed coastal erosion and the vulnerability of their shorelines to erosion (*Component 1*), e.g. Cote d'Ivoire, Gambia, Ghana and Nigeria are assumed to have the required information for a direct implementation of restoration and mitigation measures in the identified hotspots and sensitive areas. Their role in the region as regards *Component 1* will be to share their experiences and information with the others.

Implementation of *Component 2* is a step by step activity and covers all those hotspots and sensitive areas of the participating countries. Restoration of the areas and the mitigation of erosion will be based upon scientific study, environmental impact assessment, testing of different options and, finally in consultation with all stakeholders, decide on the optimum option. This is to be implemented in Cote d'Ivoire, Ghana, Mauritius, Mozambique, Nigeria, Senegal, South Africa and Tanzania. This process is replicable in other countries of the Sub-Saharan Africa (e.g. Togo, Benin, Guinea Bissau, etc.), other African Countries and beyond.

Implementation of the entire project will generate experiences and information within the participating countries and outside. The restored areas will be demonstration sites to be replicable for many years to come in many parts of Africa and beyond.

6. Risks and Sustainability

Assumptions:

On this project, it has been assumed that the requesting countries are committed and will share part of the costs involved in its implementation and that their economies will bear the load. It has also been assumed that African experts will be available to undertake the studies and implementation of the restoration and mitigation measures. Furthermore, it has been assumed that there will be no political instability, which will jeopardise the implementation of the project.

Measure to mitigate potential risks: The level of risk associated with the proposed project is considered "acceptable" in the context of the endorsement of the requesting governments, which shows a clear support to this renewable natural resource sector in the Sub-Saharan Africa. A number of measures have nevertheless been incorporated into project design to mitigate this risk where possible:

- The financial contribution to the project has been kept at minimum level. In most cases, the required in-kind contribution will be available
- African experts have shown commitment during the development of the proposals and it is expected that they will avail themselves to the implementation stage
- The coordination and management mechanisms of the project will consist of regional experts.

For the purposes of risk management, minimum acceptable levels of project performance are set out below. The project will fail if:

- There is political instability in one of the participating countries.
- There is weak co-ordination and management. This risk is minimised because a strong co-ordination is set up at both national and regional levels.
- Funding is disbursed in time and as required. This will be minimised if both the funding agencies and the recipient countries co-operate very closely.

To assist in the assessment of risk, Table 2 summarises the risks and assumptions as identified in the Logical Framework.. In this, informed judgements on the probability of occurrence of the identified risk/assumption were assessed and a level of impact of that risk assigned. The conclusion of this exercise was that the project should be considered to be "low".

Table 2. Risks and assumptions

Assumptions	Risks	Measures
1. National governments are committed and will share part of the costs involved.	1. Funds for cost sharing may not be available	1. There is limited in-cash contribution. Majority of cost sharing is in-kind.
2. African experts will be available.	2. African experts may not be available	2. Africa has enough experts from which to choose
3. There will be no political instability	3. Political instability is possible	3. There is enough stability. Moreover, project management will be in the hands of experts
4. Aerial maps will be available	4. Aerial maps may not be available	4. Efforts will be made to get them elsewhere, even outside the region
5. Funding will be available in time	5. Funding may delay	5. Efforts will be made to ensure funding is available in time
6. Project will be completed in time and as planned	6. Project may not be completed in time to natural disasters like floods, storms, etc.	6. Implementation schedule will have to be adjusted

Sustainability: This will depend strongly on the successful and timely completion of the project. The capacity built within this project, i.e. procurement of field and laboratory equipment, exchange of experts, region workshops and training of low, middle and high cadres will be a basis for sustainability of the project. The capacity building will strengthen institutional capacity in coastal protection and management. Moreover, It is expected that the national governments and other parties (donors, private sector, NGOs) will ensure that their participating institutions are provided with adequate budgetary means in the future to maintain the data gathering/processing stock assessment and approaches to collaborative management of the project

7. Stakeholder participation

Project Stakeholders: The National governments and their agencies such as the National Environment Management Agencies/Councils, Tourist hotels, investors, local communities, especially the local fisher-folk, Research institutions, Building Contractors and Consulting Engineers are the major stakeholders and beneficiaries of the project. On a smaller scale, overseas institutions may benefit from the project by supplying field and laboratory equipment.

Participation in the project will involve local authorities, NGOs and CBO especially the local communities in providing labour and indigenous knowledge.

8. Project Management and Implementation Arrangements

It is proposed to form a Regional Steering Committee, comprising a regional co-ordinator and at least two technical experts, one of whom should be a professional coastal engineer and the other a socio-economics scientist, to guide and supervise the operation of the project. In each participating country, a technical team comprising of at least two people within the National Executing Agency will be appointed to form the National Steering Committee.

9. Project Financing and duration

The project's duration is envisaged for five years. However, some of the components may finish earlier than this. Component 1 is expected to last one year, while Component 2 will vary from country to country. Component 3 is expected to last as long as the project lasts.

Requested funds will cover all components and administrative costs of the project as follows:

Project Co-ordination and Management: Funds will cover meetings of the Regional Steering Committee and the Full Group Steering Committee which will meet once a year. The Regional Co-ordinator and the two technical experts are expected to spend about 3 man-months in a year. Members of the National Steering

Committees are expected to spend 2 man-months in a year. The Regional Steering Committee will have two travels per year: one in mid year and the other one during the annual Full Group Steering Committee. The duration of a meeting will be three days. This component is estimated to cost \$0.75 million

Component 1: Implementation of this work package will involve purchasing aerial photos, digitising them and entering the data into GIS. This activity is estimated to cost \$1.3 million.

Component 2: This is a major component of the project, whose implementation will leave a demonstrative value to sustainable coastal protection and management. It will involve mapping of hydrodynamic parameters such as waves, currents and sediment transport in the designated hotspots and sensitive areas. For each hotspot, 3 current meters, 3 PUVs, a GPS and hiring of a boat will be required. Software for data analysis and modelling (e.g. MIKE 21) will be purchased. An EIA will be conducted, after which the selected option for erosion control will be implemented. Table 3 summarises estimates for implementing this component based on national reports and country co-ordinators.

Table 3. Estimated costs for implementing Component 2

Participating Country	Requested Financing (million USD)
*Cote d'Ivoire	1.2
*Ghana	3.1
*Mauritius	3.5
Mozambique	2.7
*Nigeria	2.5
*Senegal	4.1
Seychelles	0.8
*South Africa	2.5
*Tanzania	2.7
Total	23.1

* Source: National reports or co-ordinators

Component 3: This activity will involve research in alternative building materials, purchasing of some hardware, regional training in coastal protection methods. The course will be of one-week duration. Other activities include exchange of experts, study visits, workshops, information dissemination, raising public awareness. This activity is estimated to cost \$ 3.4 million

It is expected that office space, human resources infrastructure will be available for the project in the participating countries. Table 4 summarises proposed activity financing for the project.

Table 4. Component and Activity Financing (5 years duration)

Item	External Source of Funds (million US\$)	National Governments (million US\$)		Total (million US\$)	
		Cash	In-kind	M/m	\$
1. Project co-ordination and management	0.66		0.09	105	0.75
2. Component 1: Output 1	1.1		0.2		1.3
3. Component 2					
- Output 2.1	1.8		0.2	-	2.0
- Output 2.2	0.5		0.2		0.7
- Output 2.3					
➤ CI	0.8	0.2	0.2		1.2
➤ GH	2.5	0.4	0.2		3.1
➤ MA	2.7	0.3	0.2		3.5
➤ MOZ	1.5		0.2		2.7
➤ NI	2.0	0.3	0.2		2.5
➤ SEN	3.5	0.4	0.2		4.1
➤ SEY	0.6	0.1	0.1		0.8
➤ SA	1.8	0.2	0.5		2.5
➤ TZ	2.5		0.2		2.7
4. Component 3:	3	0.3	0.1		3.4
1.3.1.3 GRAND TOTAL	24.96	2.2	2.79		29.95

Note: This budget is preliminary and has not undergone a full consultation process with the respective countries. Therefore, does not indicate the actual financial commitment that would be provided by participating countries once the project proposal and its components are finalised.

10. Monitoring, Evaluation and Dissemination

Monitoring and evaluation plan of the project:

Monitoring of the progress of the project will be the responsibility of the Regional Co-ordinating Committee and the Executing Agency in each of the participating countries. Efforts should be made to ensure the following:

- *Component 1:* Biannual reports are produced and end-user maps are available at the end of the first year.
- *Component 2:* Biannual reports are produced, a consulting engineering company (preferably from the region) is engaged to ensure quality control for each project, a competent contractor is engaged to carry out the restoration and construction works. Baseline information should be collected in the beginning of the project for a later comparison. Proper records should be kept in accordance with the rules and procedures of building contracts.
- *Component 3:* The Executing Agency of each of the participating country will be responsible for the purchases, inventory and stock taking of the stores. The Funding Agency should put a mechanism in place to ensure audit. There should be activity reports on meetings and workshops.

Involvement of beneficiaries and other stakeholders

National governments and their agencies will be directly involved through the Executing Agencies and Focal Points. Hotel-owners should be involved right from the beginning to ensure harmony and common understanding of the project. The local communities shall be involved in the planning stage, implementation (it will be a good opportunity for them to get a job) and in the evaluation phase. Research institutions, especially those engaged in Marine Sciences, should be involved in providing expertise.

Information dissemination:

Information gathered and experienced gained from implementing the project will be disseminated through workshops, reports, flyers and peer-reviewed publications. It is recommended that the information be archived in databases.

Performance indicators of the project results: For the objectives, performance indicators include end-user maps, database, restored areas, laboratory and field equipment, workshops, proceedings, publications and certificates awarded to successful participants in the training courses. The log-framework matrix shows performance indicators for all the variables.

Work Plan and timetable

Components	Year																													
	1					2					3					4					5									
Co-ordination and Management	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Component 1	█	█	█	█	█																									
Component 2																														
- Output 2.1		█	█	█	█																									
- Output 2.2						█	█	█	█	█																				
- Output 2.3											█	█	█	█	█	█	█	█	█	█	█	█	█	█	█					
Component 3	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█					

1.3.1.4 Logical Framework Matrix

Summary	Verifiable indicators	Means of Verification	Critical assumptions and risks
<p>Overall goal of the intervention:</p> <ul style="list-style-type: none"> - Map vulnerable areas to coastal erosion - Restore hotspot and sensitive areas 	<ul style="list-style-type: none"> - Reports and Maps - No erosion 	<ul style="list-style-type: none"> - Regional meetings - Inspection 	<ul style="list-style-type: none"> - Aerial photos are available - Local GIS specialists are available - Local coastal engineers are available
<p>Objectives:</p> <p>(1) To identify populations and resources that have been affected and map vulnerable areas and resources to coastal erosion</p> <p>(2) To restore and protect the integrity of degraded (eroded or accreted) hotspots and sensitive areas that have been identified in the national reports</p> <p>(3) To enhance capacity of the Sub-Saharan Africa in sustainable coastal protection methods and management</p>	<ul style="list-style-type: none"> - Reports, maps, database - No erosion - Equipment, proceedings, workshops, publications, study visits and certificates 	<p>Regional meetings</p> <p>Inspection</p>	<p>As above</p>
<p>Project impact</p>	<p>Investment will be attracted in the formerly degraded areas. Local communities will have job opportunities and later have their landing sites restored.</p>	<p>socio-economic survey</p>	<p>Project will be completed in time and space as planned</p>
<p>Project outputs</p> <ul style="list-style-type: none"> - information on threatened areas - restored degraded areas - enhanced capacity 	<ul style="list-style-type: none"> - Reports and maps - Improved Socio-economic well being of stakeholders - Trained professionals and acquired equipment 	<p>Regional and national meetings</p> <p>Socio-economic survey</p>	<p>Aerial photos are available</p> <p>GIS is used</p> <p>Managers appreciate the information</p>
<p>Components/ Activities (project components)</p>	<p>Proceedings of meetings</p>		<p>Funding will be available and in time</p> <p>National governments will remain supportive of the project</p>