5I

Diagnostic

ETUDE DE SUIVI DU TRAIT DE COTE ET SCHÉMA DIRECTEUR LITTORAL DE L'AFRIQUE DE L'OUEST

DIAGNOSTIC NATIONAL AU GHANA

2010

DIAGNOSTIC NATIONAL
AU GHANA

CONTENTS

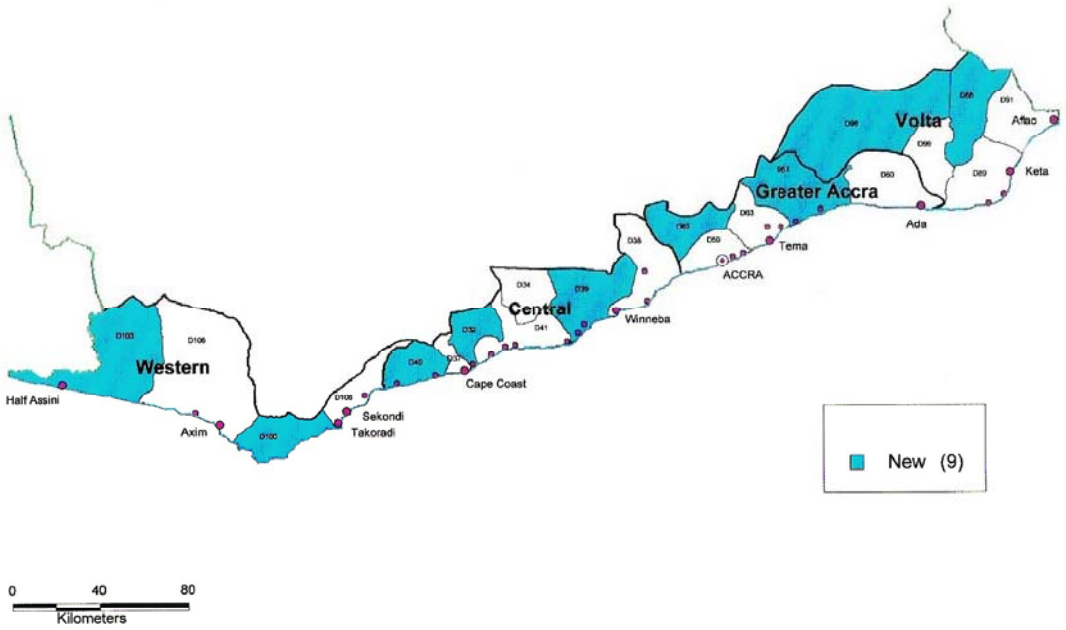
INTRODUCTION

- Background on Ghanaian Coastal Zone

Ghana lies along the Gulf of Guinea in West Africa, 5.5 degrees north of the Equator, within longitudes 3^0 5' W and $1^0$10' E and latitudes 4^0 35'N and 11^0 N. Ghana covers an area of about 239,000 km^2 .

Ghana has a coastline of 550 km. The geographical scope of Ghana's coastal zone is defined formally to include a land area extending to the 30m contour and a coastal offshore shelf area to the 200 nm depth. However, for management purposes the definition includes all areas at less than the 75 m contour. The zone is generally low lying with a narrow continental shelf extending to between 25 and 35 km, except off Cape Coast and Saltpond where it reaches up to 80 km. The coastal zone comprises 21 districts covering the Western, Central, Greater Accra and Volta regions of the country. Seventeen (17) of the districts boarder the seashore while the remaining 4 districts are inland and do not have a coastline. The coastal zone represents about 6.5% of the total area of the country (WB and EPA, 1996). Figure 1 shows the coastal districts of Ghana.

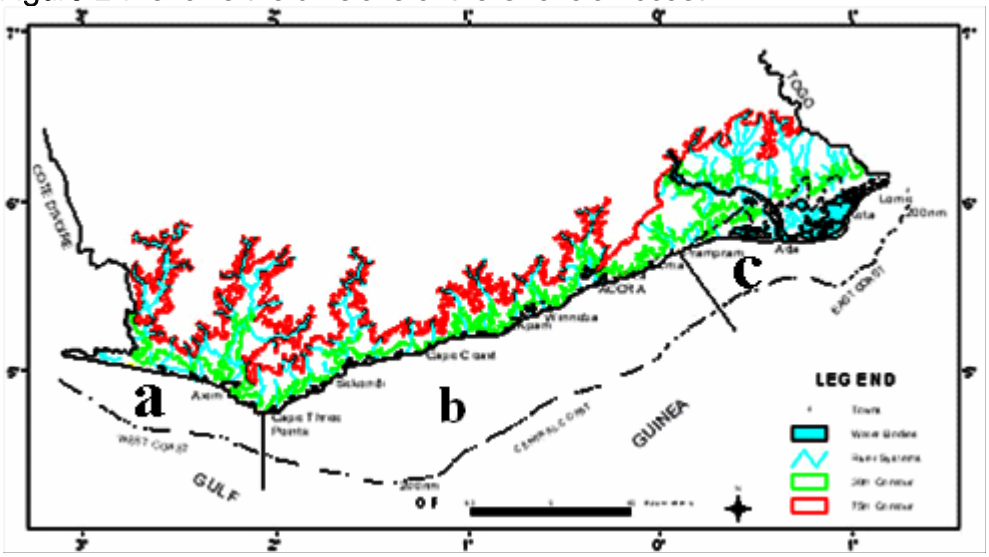
Figure 1 : Map showing the coastal districts of Ghana (EPA, 2007)



Ly (1980) divides the characteristic features of the Ghanaian coast into the west, central and east coasts as follows:

- The west coast extends from Ghana's border with La Côte d'Ivoire to the estuary of the Ankobra River. It covers 95km of stable shoreline and is basically fine sand with gentle beaches backed by coastal lagoons.
- The central coast extends from the estuary of the Ankobra River near Axim to Prampram, located to the east of Accra. It covers 321 km of shoreline. It represents an embayed coast of rocky headlands, rocky shores and littoral sand barriers enclosing coastal lagoons.
- The east coast extends from Prampram to Aflao, at the border with Togo. It covers 149 km of shoreline and is characterized by sandy beaches with the deltaic estuary of the Volta River situated halfway in-between.

Figure 2 : shows the divisions of the Ghanaian coast.



- Erosion along the Ghanaian Coast

Coastal erosion is experienced along many sections of the Ghanaian coast. High rates of erosion are experienced along the east coast. EC (1989) indicates that Ada beach, which is within the east coast, experiences an average shoreline retreat estimated at 3m to 4m per year. Ibe and Quelennec (1989) report that La (Labadi) beach near Accra, and which is within the central coast, experiences a shoreline retreat of 3m per year.

In Ghana, shoreline recession results from several factors (erosive forces) - the erosion at any site is dependent on perculiar causes and characteristics. The rate of coastal erosion depends on the composition of the shore zone and the exposure of the coast to these erosive forces. The causes of coastal erosion are both natural and man-made. Table 1.1 lists the major causes of coastal erosion in Ghana.

Table 1.1: Major causes of coastal erosion in Ghana

Natural Cause	Man-made Causes
Wave	1. Interruption of littoral drift pattern 2. Removal of sand from beaches (sand winning) 3. Reduction of sediment supply to the littoral zone 4. Disturbance of natural coastal protection 5. Concentration of wave energy on beaches

The construction of the Akosombo Dam (1961-1965) resulted in accelerated erosion at Ada, Keta and their environs due to reduction of sediment supply to their littoral zones (DMMI, 1998; UNEP, 1985). The construction of the Korle Lagoon outfall in Accra, which consists of an armour rock (rubble-mound) breakwater, resulted in accelerated erosion downdrift (i.e. areas towards James Town Light House) which necessitated the construction of a gabion revetment to protect the James Town coastal road.

Wave action is a major contributory factor to the erosion at most coastal areas in Ghana. Sand winning and removal of coconut trees have lead to the loss of natural coastal protection, and consequently accelerated erosion, in certain areas of the central and east coasts of Ghana (Armah and Amlalo, 1998). The breakwaters at the Tema and Takoradi Harbours have resulted in considerable erosion on nearby beaches to the eastern ends of the harbours due to wave energy concentration.

The problems associated with coastal erosion in Ghana vary in nature and level of impact from place to place. The problems may be short-term or long-term. These problems do have adverse consequences on the living conditions of the people in the affected areas. The problems related to coastal erosion in Ghana include:

- Loss of land for agriculture and future development.
- Injury to persons.
- Loss of property and life.
- Great monetary loss due to storm damage to infrastructure.
- Larger expenditure for coastal protection to prevent damage.
- Transport and accessibility to site.

- Management of Coastal Erosion in Ghana

The management of coastal erosion issues in Ghana encompasses many stakeholders – Government Ministries and Agencies, District Assemblies, Political Representatives (Members of Parliament), Communities, Concerned Groups and Individuals. The key stakeholders for the implementation of coastal protection projects are the Ministry of Water Resources, Works and Housing and its affiliated department of the Hydrological Services Department; and the environmental Protection Agency. Thus requests, views and any issues on coastal erosion are directed to these establishments.

The Hydrological Services Department, as part of its core functions, undertakes the monitoring of coastal erosion, identification of critical areas requiring protection, design and construction supervision of coastal protection projects. The Environmental Protection

Agency is the leading establishment in the assessment of the environmental impacts of the construction of sea defence works. Funding of such projects has mainly been accessed by the Ministry of Water Resources, Works and Housing through the Ministry of Finance and Economic Planning.

The following main factors are considered in the selection of suitable coastal protection (sea defence) structures for the management of coastal erosion.

- Use of system (structure) i.e. the goals of the protection.
- Effectiveness in solving the erosion problem (aided by considering the performance of similar structures in the vicinity).
- Economic evaluation i.e. comparing the cost of protection to the benefits to be obtained in protecting.
- Environmental impact i.e. considering issues such as the anticipated changes in coastal morphology, vegetation and landscape; retardation or improvement of social activities; dispersal of contaminants and noise pollution.

Currently, the management of coastal erosion issues faces many challenges. The challenges encompass ineffective monitoring, inadequate information for assessment and inadequate funding. The enhancement of coastal management practices is hampered by the lack of regulated monitoring activities and access to required information for the prediction of shoreline changes. Funding for coastal erosion issues is constrained by the numerous and also equally important other issues that ought to be considered by stakeholders. Consequently, the need for the implementation of coastal protection measures has generally been addressed on emergency basis.

Appendix A1.1 lists the identified stakeholders involved in the management of coastal and marine issues in Ghana.

PART I. ANSWERS AND DEVELOPMENTS

1.1 PROTECTION AGAINST COASTAL EROSION

The coastal protection systems employed in Ghana in combating coastal erosion have been mainly armour rock (rubble-mound) revetments and groynes; gabion revetments and groynes.

The construction of most of the coastal protection projects implemented in Ghana has been undertaken by local (Ghanaian) contractors. In cases where foreign contractors have been employed, an appreciable number of their staff members have been Ghanaians.

Table 2.1 summarises the information on some major coastal protection projects that have been executed in Ghana. Of these projects, the Keta Sea Defence Project has been the major project, costing about US$90 million.

For most protected areas, the functioning of the coastal protection structures has resulted in much sand accretion leading to the development of stable wide beaches. Also the structures have provided direct effective protection to facilities such as hotels, roads and forts against wave attack and the impact of beach erosion.

Table 2.2 gives an indication of some areas which need urgent coastal protection works.

Table 2.1: Some coastal projects executed

Project Name / Location	Type of Structure	Contractor (Foreign/Local)	Implementing Agency (Ministry / Department)	Source of Funding / Cost	Stretch Protected	Year of Completion
Keta Sea Defence Project / Keta	Armour rock groynes / revetment / beach nourishment	Foreign	Ministry of Water Resources, Works and Housing / Local Consultant / Foreign Consultant and Contractor	Loan from US Eximbank / About US$90.0 million	About 9000m	2004
Nkontompo Emergency Coastal Protection Works / near Sekondi	Armour rock revetment	Foreign	Ministry of Water Resources, Works and Housing / Hydrological Services Department	Government-Assisted International Funding (i.e. HIPC Funding) / US$1.0 million	About 1200m	2005
La Coastal Protection Works / Accra	Gabion revetment	Local	-do-	Government Annual Budgetary Allocation / Less than US$1.0 million	About 800m	1983
Sakumono Coastal Works / Tema (2 Projects)	Armour rock revetment and gabion revetment	Local	-do-	-do-	About 2000m (Total)	1998 / 2004
Shama Coastal Works / Shama (near Sekondi)	Armour rock revetment and gabion groynes	Local	-do-	-do-	About 500m	2004
Axim Coastal Works / Axim (beyond Takoradi)	Gabion groynes	Local	-do-	-do-	About 200m	1997
Princess Akatakyi Coastal Works / (beyond Takoradi)	Gabion groynes	Local	-do-	-do-	About 200m	2005
Philip Quarcoo Coastal Works / Cape Coast	Gabion groynes	Local	-do-	-do-	About 400m	2003
Discove Coastal Works	Armour rock revetment	Local	-do-	-do-	About 200m	On-going

Table 2.2: Current urgent coastal protection areas

Proposed Project	Reason for Protection	Current Status	Implementing Agency (Ministry / Department)	Source of Funding / Cost	Type of Structure / Stretch for protection
Ada Coastal Works	Protection of Ada Township / Promotion of Tourism / Enhancement of Salt Industry	Project has been awarded and design works are being undertaken. Construction works would start by September, 2010.	Ministry of Water Resources, Works and Housing / Hydrological Services Department/ Foreign Consultant/ Foreign Contractor	Loan from Fortis Bank S.A./N.V. (BNP-Paribas-Fortis) / About EUR60.0 million	Armour rock groynes / beach nourishment
Sakumono Coastal Protection Project	Protection of Railway Line linking the national capital Accra to the major industrial city of Tema	Under consideration by the Ministry of Water Resources, Works and Housing and the Ministry of Transport	Ministry of Water Resources, Works and Housing / Hydrological Services Department	-	-
Atorkor-Dzita-Anyanui Emergency Sea Defence Project	Protection of Dzita / Atorkor township and coastal road Township	Project has been awarded and construction works will start by September, 2010	Ministry of Water Resources, Works and Housing / Hydrological Services Department/ Foreign Contractor	Government Annual Budgetary Allocation / About US$ 35 million	Armour rock revetment
New Takoradi Sea defence Project	Protection of part of Takoradi Township	Under consideration by the Ministry of Water Resources, Works and Housing.	Ministry of Water Resources, Works and Housing / Hydrological Services Department	-	-
Amanful Kumah Sea Defence Project	Protection of Amanful Kumah Township	Under consideration by the Ministry of Water Resources, Works and Housing.	Ministry of Water Resources, Works and Housing / Hydrological Services Department	-	-
Ngyiresia Emergency Coastal Protection Project	Protection of road leading to one of the major stadia at Essipong	Under consideration by the Ministry of Water Resources, Works and Housing.	Ministry of Water Resources, Works and Housing / Hydrological Services Department	-	-
James Town / Independence / Castle Coastal Protection Project	Protection of seat of government and area in central Accra housing major establishments.	Under consideration by the Ministry of Water Resources, Works and Housing.	Ministry of Water Resources, Works and Housing / Hydrological Services Department	-	-

1.2 STRUCTURAL HABITAT PROJECTS OR COASTAL INFRASTRUCTURE

Executed projects

Project Name / Location	Type of Structure	Contractor Foreign/Local	Implementing Agency (Ministry / Department)	Sources of funding/Cost	Stretch Protected	Year
Keta Sea Defence Project / Keta	Armour rock groynes / revetment	Foreign	Ministry of Water Resources, Works and Housing / Local Consultant / Foreign Consultant and Contractor	Loan from US Eximbank / About US$90.0 million	About 9000m	2004
Nkontompo Emergency Coastal Protection Works / near Sekondi	Armour rock revetment	Foreign	Ministry of Water Resources, Works and Housing / Hydrological Services Department	Government-Assisted International Funding (i.e. HIPC Funding) / US$1.0 million	About 1200m	2005
La Coastal Protection Works / Accra	Gabion revetment	Local	-do-	Government Annual Budgetary Allocation / Less than US$1.0 million	About 800m	1983
Sakumono Coastal Works / Tema (2 Projects)	Armour rock revetment and gabion revetment	Local	-do-	-do-	About 2000m	1998 / 2004
Shama Coastal Works / Shama (near Sekondi)	Armour rock revetment and gabion groynes	Local	-do-	-do-	About 500m	2004
Axim Coastal Works / Axim (beyond Takoradi)	Gabion groynes	Local	-do-	-do-	About 200m	1997
Princess Akatakyi Coastal Works / (beyond Takoradi)	Gabion groynes	Local	-do-	-do-	About 200m	2005
Philip Quarcoo Coastal Works / Cape Coast	Gabion groynes	Local	-do-	-do-	About 400m	2003
Discove Coastal Works	Armour rock revetment	Local	-do-	-do-	About 200m	On-going

Proposed projects

Proposed Project	Reason for Protection	Current Status	Implementing Agency (Ministry / Department)
Ada Coastal Works	Protection of Ada Township / Promotion of Tourism / Enhancement of Salt Industry	Project has been awarded and design works are being undertaken. Construction works would start in September, 2010.	Ministry of Water Resources, Works and Housing / Hydrological Services Department/ Foreign Consultant/ Foreign Contractor
Sakumono Coastal Protection Project	Protection of Railway Line linking the national capital Accra to the major industrial city of Tema	Under consideration by the Ministry of Water Resources, Works and Housing and the Ministry of Transport	Ministry of Water Resources, Works and Housing / Hydrological Services Department
Atorkor-Dzita-Anyanui Emergency Sea Defence Project	Protection of Dzita / Atorkor township and coastal road Township	Project has been awarded and construction works will start in August, 2010	Ministry of Water Resources, Works and Housing / Hydrological Services Department/ Foreign Contractor
New Takoradi Sea defence Project	Protection of part of Takoradi Township	Under consideration by the Ministry of Water Resources, Works and Housing.	Ministry of Water Resources, Works and Housing / Hydrological Services Department
Amanful Kumah Sea Defence Project	Protection of Amanful Kumah Township	Under consideration by the Ministry of Water Resources, Works and Housing.	Ministry of Water Resources, Works and Housing / Hydrological Services Department
Ngyiresia Emergency Coastal Protection Project	Protection of road leading to one of the major stadia at Essipong	Under consideration by the Ministry of Water Resources, Works and Housing.	Ministry of Water Resources, Works and Housing / Hydrological Services Department
James Town / Independence / Castle Coastal Protection Project	Protection of seat of government and area in central Accra housing major establishments.	Under consideration by the Ministry of Water Resources, Works and Housing.	Ministry of Water Resources, Works and Housing / Hydrological Services Department

1.3 LEGISLATORY AND LEGAL FRAMEWORK

1. Legal Framework for Coastal Zone Management

The legal framework for the management of coastal zone issues in Ghana is embodied in the documents listed in Table 2.3.

Table 2.3 : Legal framework for coastal zone management (EPA, 2007)

Item	Relevant Laws / Regulations	Chapter Theme (Activities)
1	The 1992 Constitution	This is the mother of all laws. It sets the basis for the legal and instructional framework for Ghana.
2	Environment Protection Agency Act, 1994 (Act 490)	Provides the legal regime for the implementation of the national environmental action plan (NEAP) and the basis for environmental impact assessment regulations
3	Local Government Act, 1993 (Act 462)	Enables the creation of District Assemblies through Legislative Instruments and defines their functions. One of the main functions for the district assemblies is the making of bye laws for the operations of the assemblies.
4	Pesticides Control and Management Act 1996 (Act 528)	Empowers district assemblies to assist in securing the compliance and enforcement of pesticide applications.
5	Environmental Standards and Guidelines	These are guidelines and standards for compliance monitoring and enforcement. They are yet to be made into legislative instruments.
6	The Free Zone Act 1995 (Act 504)	Economic Activities
7	Beaches obstruction ordinance of 20th January 1897 (Cap.240)	Coastal Population/Human Activities, Natural Impacts.
8	The Minerals and Mining Law, 1986 (PNDCL 153)	Economic/Human Activities, Natural Impacts.
9	Rivers ordinance of 4th February 1903	Human/Natural Impacts
10	Land Planning and Soil conservation ordinance, No. 32 of 1953, (as Amended by the Land Planning and Soil Conservation) (Amendment) Act, 1957 (No.35 of 1957)	Natural/Human Impacts, Coastal Population
11	Maritime Zones (Delimitation) Law, 1986 (PNDCL 159)	Ecosystem, Economic Activities
12	Town and Country Planning Ordinance (Cap. 84) No. 13 of 1945	Coastal Population/Economic Activities, Human Impacts

13	The Towns Ordinance (Cap. 86)	Human Impacts, Coastal Population
14	National Building Regulations 1996 (LI. 1630)	Human/Economic Impacts, Coastal Population
15	National Museum Decree 1969 (NLCD 387)	Economic Activities, Coastal Population
16	Wildlife Preservation Act, 1961 (Act 43)	Human Activities, Ecosystem
17	Wildlife Conservation Regulations- 1971 (LI 685)	Ecosystem/Species Protection, Human Activities
18	Wildlife Reserves Regulations 1971 (LI. 710)	Ecosystem Protection
19	Oil in Navigable waters Act 1964 (Act 235)	Human Activities, Economic Impact, Ecosystem Protection``
20	Forest Ordinance 1927 (Cap. 157) (Amended by Forest Protection Decree 1974 (NRCD 243) Further Amendment –Forest Protection (Amendment) Law 1986(PNDCL 142).	Human Activities, Economic Impacts, Ecosystem Protection
21	Trees and Timber Decree, 1974(NRCD 273)	Human/Economic Impacts
22	Fisheries Resources Management and Protection (Fisheries Act 2002, Act 625).	Coastal Population/Human, Economic Impacts
23	Petroleum (Exploration and Production Law, 1984 (PNDCL 84)	Human/Economic Activity Impacts, Ecosystem
24	Minerals (offshore) Regulation 1963 (LI 257)	Human/Economic Activity Impact, Ecosystem Protection.
25	Mineral (Oil and Gas) Regulations 1963 (LI 256)	Human /Economic Activity Impacts, Ecosystem Protection.
26	Oil Mining Regulations 1957 (LI 221)	Human /Economic Impacts, Ecosystem Protection.

2. Conventions related to the Environment

Conventions signed and ratified by Ghana which are related to the environment include the following (EPA, 2007). Appendix A1.1 lists the focal institutions.

- International Convention for the Prevention of Pollution of the sea by Oil: 21 October 1962
- Convention on the Africa Migratory Locust: 25 May 1962
- Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water: 5th August 1963
- International Convention for the Conservation of Atlantic Tunas: 4 May 1966
- Africa Convention on the Conservation of Nature and Natural Resources : 15 September 1968
- International Convention on Civil Liability for Oil Pollution Damage: 29 November 1969
- International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Causalities
- Convention on Wetlands of International Importance, Especially as Waterfowl Habitats: 2 February 1971
- Treaty and Prohibition of the Emplacement of Nuclear Weapons of Mass Destruction on the Seabed and the Ocean Floor and in the Subsoil Thereof: 11 January 1971
- International Convention on the Establishment of an International Fund for Compensation of Oil Pollution Damage: 18th December, 1971
- Convention Concerning the Protection of World Cultural and Natural Heritage : 16 November 1972
- Convention on International Trade on Endangered Species of Wild Fauna and For a : 3 March 1973
- Convention on the Military or Any other Hostile Use of the Environmental Modification Techniques: 10 December 1976
- Convention on the Conservation of Migratory Species of Wild Animals: 23 June 1979
- United Nation Convention on the Law of the Sea: 10 December 1982
- Montreal Protocol on Substances that Deplete the Ozone Layer: 24 July 1989
- Convention to Combat Drought and Desertification
- Framework Convention on Climate Change: June 1992

3. Marine and Coastal Related Activities

Table 2.4 lists some major activities that have been undertaken in Ghana and which are related to the marine and coastal environment.

Table 2.4: Marine and coastal related activities

Activity	Period	Significance
Keta Sea Defence Project	2000 – 2004	Protection of Keta and its environs against beach erosion and improvement in environmental and socio-economic conditions.
Danida Water and Sanitation Sector Programme II: Support to Integrated Water Resources Management (IWRM) Component	2004-2008	Studies on the Densu river basin.
Climate and vulnerability and adaptation assessment on water resources, agriculture and the coastal zone projects.	1997 – 1999	To assess the vulnerability of the coastal zone to climate change.
Ecological Baseline Studies of Korle Lagoon	1990 – 2000	Environmental Impact Assessment and establishment of the pollution status of the lagoon.
Lower Volta Mangrove Project	1996 – 1998	To ensure sustainable management of mangrove stands.
Save the Seashore Birds Project	1985- 1995	To protect the seashore birds through the creation of conservation awareness of seashore birds.
Ghana Coastal Wetlands Management Project	1996-1999	Management of coastal wetlands designated as Ramsar Site was established
Gulf of Guinea large Marine Ecosystems Project	1996 – 1999	The development of an effective approach to preventing and controlling pollution in the Gulf of Guinea and also the conservation of its biodiversity. Regional institutional capacities were strengthened and also coastal zone management profiles and plans were produced.
West Africa Gas Pipeline Project	On-going	Supply of natural gas for power/energy generation and usage.
UNEP WACAF Projects 1 & 2.		Institutionalisation and coordination of national contingency plans, monitoring of pollution in the marine environment and control of coastal erosion.
Ada Sea Defence Project	On-going	Protection of Ada and its environs against beach erosion and improvement in environmental and socio-economic conditions.

4. Match between Legislation and Practice

Although there are no specific policies on the coastal zone, some policies which are environmentally related exist in Ghana. These include the National Environment Policy, National Wetlands Policy, Tourism Development Policy and Land Management Policy.
These national policies address the management and development of the marine and coastal environment in the following major areas.

- Integrated coastal zone management and sustainable development.
- Marine environmental protection for both land-based and sea-based activities.
- Sustainable use and conservation of marine living resources.

Various efforts have been pursued towards the better management of the marine and coastal environment resulting in the following works.

- Environmental sensitivity map of the coastal areas of Ghana, 1999 and 2004
- National Oil Spill Contingency Plan 2002
- Coastal Zone Profile of Ghana 1998
- Draft Integrated Coastal Zone Plan, 1998
- National Environmental Action Plan, 1994
- Coastal Zone Management Indicative Plan, 1990

1.4 WEATHER FORECAST AND CLIMATOLOGY

1. Marine Weather Forecast System

a. Sea Level Measurement for Ghana

There are two stations for sea level measurement in Ghana – Tide Gauges installed at the Takoradi Harbour and the Tema Harbour.

Tide Gauge at Takoradi Harbour
A Tide Gauge was installed around 1928 to determine tidal predictions for ships entering and leaving the Harbour. It also provided data for other hydrographical works along the coast of the Region. The Tide gauge was operational until 1998 when it completely broke down. The equipment employed there was the mechanical float type. Between 1998 and 2004 only visual staff readings were kept.

In 2004 the Indian Government through its National Institute of Oceanography (NIO) installed a new gauge at the Takoradi Harbour and weather equipment. With the help of two (2) scientists from NIO, the Takoradi Gauge became fully operational in July 2004. Data collection began in earnest. The equipment donated by NIO are 2 PPTR Sensors, 3 Data Loggers and 1 Laptop Computer.

The Takoradi Harbour Tide Gauge is on Longitude 01° 44′W and Latitude 04° 53′N. There is a Fundamental Bench Mark at the gauge which is part of the National Framework survey

Tide Gauge at Tema Harbour

The Tema Harbour Tide Gauge was set up around 1964. The equipment employed was the mechanical float type. During the expansion of the Tema Harbour in 1990, the building housing the equipment was demolished. The reconstruction of the new building is in progress. The equipment donated by the Indian Government through the NIO will be installed when the building is completed.
The Tema Harbour is Longitude 00º 00´E, and Latitude 05º 37´N.

Technology of Gauge Employed

The system makes use of the measurement of the hydrostatic pressure corresponding to the water column that lies over the pressure transducer and to determine the height of this column from the knowledge of the effective depth-mean density of the water body that lies in the vicinity of the pressure transducer.

The pressure transducer measures the absolute pressure which is stored in the logger. The logger-resident program is designed to average the data samples collected over 15 minutes at two seconds intervals (2 sec.) and then to store the averaged data with a time stamp. The data that is finally stored comprises date, time, absolute pressure and compensated temperature.

On the new and full moons, the visual staff is also read over a period of 3 days on a 24 hour basis. The water density is also read once in 2 weeks. These with data from the Meteorological Services are used in arriving at the Tide Forecast.

Data Availability

Primary data recorded include:

- Absolute Pressure recordings
- Visual Staff recordings
- Water density recordings and
- Meteorological data received from the Meteorological District Office in Takoradi.

The data is sent to:

- Ghana Survey Department Headquarters by post and e-mail
- National Institute of Oceanography (NIO) in India by e-mail.

The data is sent on a monthly basis.
The data is partially processed in Accra and stored. There is interaction between Accra and India on the processing of the data.
Final processing of the data is done at the National Institute of Oceanography (NIO) in India.

Data Sources

- Primary Data Source:

Ghana Survey Department
P. O. Box CT903, Cantonments, Accra-Ghana
E-mail: jtquarshie@yahoo.com and eknkebi@yahoo.com

- Processed Data Source:

Ghana Survey Department
P. O. Box CT903, Cantonments, Accra-Ghana
E-mail: jtquarshie@yahoo.com and joseph@darya.nio.org

b. Measurements for Ada Sea Defence Works

Systems for the conduction of hydrographic surveys in the measurement of wave characteristics, current characteristics and bathymetric characteristics are being employed to determine design parameters for the Ada Sea Defence Works. Measurements are on-going and being taken by the Consultant and Contractor for the project.

2. Climate Change

Ghana has been working with the global community in finding solutions to problems associated with climate change. The Parliament of Ghana passed a resolution to ratify the Kyoto Protocol to the UNFCCC at its sitting of 26 November, 2002.

Ghana signed the United Nations Framework Convention on Climate Change (UNFCCC) at the Rio de Janeiro Earth Summit in June 1992, after the Convention was adopted on 9 May 1992. For Ghana, the Climate Change Convention entered into force on 5 December 1995 after its ratification on 6 September 1995.

Ghana is vulnerable to potential negative impacts of climate change due to lack of capacity to undertake adaptive measures and also the socio-economic costs of climate change. These include climate change problems associated with flooding of coastal areas which are already undergoing erosion.

EPA (2000) assesses the impacts of sea-level rise and gives an indication that about two-thirds of the total land area potentially at risk of flooding and shoreline recession inGhana lies within the east coast. Other areas that may be impacted adversely are the west coast and limited sections of sandy beaches within the central coast. A total of 1,110 km^2 of land area may be lost as a consequence of a 1.0 metre rise of sea-level. The population at risk is estimated at 132,200. Most of the affected population is within the east coast.

The loss of land by erosion and inundation will translate into a loss of coastal habitats including important wetlands mostly in the Volta Delta. Increasing water depths and salinization of lagoons as a result of sea-level rise will impact adversely on the feeding sources of migratory and resident birds. The strand vegetation at risk include Canavalia rosea, Ipomea pes-caprae, Sesuvium portulacastrum and Phylooxeris vermicularis. Loss of habitat includes those of marine turtles that lay their eggs on sandy beaches and the habitats associated with coastal lagoons. Some species that are less tolerant to salinity increases will be displaced.

Also, sea-level rise will raise the moisture content of sandy and silty soils along the coastal zone. These soils when subjected to vibrations will liquefy. The structures founded on these soils could thus be at risk of collapse during earthquakes.

The estimated cost of protecting Ghana's coastal sections at risk with populations greater than 10 persons per km^2 with seawalls is about US$1,144 million. The protection of only the important areas reduces the cost to about US$590 million. On account of the high expenditure involved in offering protection, other alternative measures were proposed.

These include the controlled abandonment of areas at risk and the use of set-backs to control development along sections of the coast that are currently undeveloped.

Specific examples of impacts of climate change on Ghana's coast include observed erosion of many beaches and coastal areas such as Ada in the Greater Accra Region and and Ngyiresia in the Western Region; as well as important heritage sites such as Fort Prinzestein of Keta.

Significant investments have been made by government to protect some portions of the coast through the implementation of coastal protection projects. Notable among them is the Keta Sea Defence Project. In the same vein, construction works for the Ada Sea Defence Project are expected to start in September, 2010.

1.5 MARINE AND LAND PROTECTED AREAS

The Ghanaian coast has five protected wetlands (Ramsar Sites) namely the Muni Pomadze Lagoon, Densu Delta, Sakumo Lagoon, Songor Lagoon and Anlo-Keta Lagoon complex. They were all designated Wetlands of International Importance according to the Ramsar Convention on 14 August 1992. The characteristics of the Ramsar sites are presented in the following tables.

Table 2.5 : Characteristics of the Muni - Pomadze Lagoon Ramsar Site (Lincoln, Fishpool and Evans, 2001).

Location	West of Winneba; within the Awutu/Efuttu/Senya and Gomoa Districts of the Central Region of Ghana (05.23N, 00.40W), approximately 55 km west of Accra
Area	9,461.12 ha
International designation	Ramsar Site No. 563
National designations	Two Forest Reserves (Yenku and Winneba fuelwood); a Traditional hunting ground and Ramsar Site (L.I. 1659)
Importance	Serves as feeding, breeding and roosting grounds for waterbirds such as terns, waders, and herons. It also has high diversity of mammals and encompasses the traditional hunting grounds of the Winneba people. There are turtle nesting sites on the beaches.
Principal Features	A coastal saline semi-closed lagoon surrounded by sand dunes, areas of marshy land and degraded forest and scrubland. Two seasonal rivers, the Aboaku and Pratu feed the lagoon with freshwater and the lagoon opens into the sea during the rainy season. The lagoon has a surface area of 4,500 ha, an average depth of 0.6 m, a maximum depth of 1 m and an average salinity of 39.3%. Relatively unspoiled despite closeness of Winneba township. Reserve areas protect watershed. High salinity reduces biodiversity within lagoon. Some fringing mangroves. Poor aquatic fauna before rains.
Flora	The eastern fringes of the lagoon are marginally covered with *Avicennia Africana* mangroves. The drier areas are predominantly grassland, the main species being *Imperata* sp., *Cyperus* sp and *Panicum* sp. The vegetation in the seasonally flooded areas consists mainly of *Sesuvium portulacastrum* and *Paspalum vaginatum.* The degraded forests and semi-natural scrubland are dominated by a mixture of coarse grasses and sedges (*Vetiveria* spp, *Brachiaria* spp), herbs (*Cassia* sp. and *Azadirachta indica*) as well as shrubs (*Bonnetia* sp., and *Abutilon* sp.,). The adjacent forest reserve is dominated by *Cassia* sp., *Eucalyptus* sp.,) and mahogany. The vegetation on the narrow strip of sand dune, which separates the lagoon from the sea, is mainly *Sporobolus* sp., and fringed by coconut palms (*Cocos nucifera*)
Fauna	The site supports an estimated population of 23,000 waterbirds comprising 27 species of waders, 8 species of terns and 7 species of herons/egrets. The site is particularly important for terns. Water bird population is highest during August to April. There are 114 species of terrestrial birds and the area has several species of mammals. Three species of marine turtles are reported to nest on the beaches (*Lepidochelys olivacea, Chelonia mydas* and *Dermochelys coriacea)*
Human Activity	Fishing is one of the main activities in the lagoon area, as well as collection of fuel wood and hunting. The area is known as one of the most important sources of bush meat in the country. Part of the grassland is used for cattle and sheep grazing. Farming and stone mining are also taking place in the surrounding lands.
Management Authorities	Wildlife Division of the Forestry Commission and the Awutu/Efuttu/Senya and Gomoa District Assemblies

Table 2.6 : Characteristics of the Densu Flood-plain Ramsar Site. (Lincoln, Fishpool and Evans, 2001).

Location	11 km west of Accra (05.30N, 00.15W)
Area	5,892.99 ha
International designation	Ramsar Site No. 564
National designations	Ramsar Site (L.I. 1569)
Importance	The site serves as feeding, breeding and roosting grounds for water birds, including the globally threatened Roseate tern. In addition there are turtle nesting sites on the beaches.
Principal Features	The site is a flood-plain containing, open lagoon, sand dunes, scattered mangrove stands, saltpans, marsh and scrub. There is no direct outlet channel to the sea, but the lagoon often overflows into the sea after heavy rains. Seasonally inundated grasslands extend 27.5 km upstream from the sea. Tidal influences extend upstream for some 10km
Flora	*Sesuvium portulacastrum, Paspalum vaginatum, Sporobolus virginiucs, Cyperus articualatus* and *Imperata cylindrical* form the main vegetation of the floodplains. Scattered stands of mangrove *Avicennia Africana* are found
Fauna	The Densu Flood Plain has a record of 57 species of seashore birds with an estimated population of 35,000. The site is particularly important for terns. Its population of the globally threatened Roseate tern further enhances the importance of the Densu Flood Plain Site. A total of 15 fin fishes belonging to 14 genera and 9 families occur. *Sarotherodon melanotheron* and *Tilapia zillii* are the dominant species. Three species of marine turtles are reported to nest on the beaches (*Lepidochelys olivacea, Chelonia mydas* and *Dermochelys coriacea*
Human Activity	The main activities within the wetland are the large-scale commercial salt operations and lagoon fisheries mainly for Tilapia and lagoon crab. Local people gather fuel wood in the area and the site is used for farming
Management Authority	Wildlife Division of the Forestry Commission

Table 2.7 : Characteristics of the Sakumo Lagoon Ramsar Site. (Lincoln, Fishpool and Evans, 2001).

Location	3 km West of Tema (05.30N, 00.8W)
Area	1,364.35 ha
International designation	Ramsar Site No.565
National designations	Ramsar Site (L.I. 1659)
Importance	It is an important wetland for many species of water birds. In addition there are turtle nesting sites on the beaches.
Principal Features	The site includes a brackish-saline lagoon whose main habitats are open lagoon, surrounding flood-plains, freshwater marsh, and coastal savannah grassland. The lagoon is separated from the sea by a narrow sand dune, on which the Accra-Tema road is built. It is connected to the sea by a narrow non-functional (permanently open) sluice (and pipe culverts lately constructed).
Flora	*Avicennia Africana* forms the main element of the mangrove community, *Paspalum vaginatum, Sesuvium portulacastrum,* and *Philoxerus vermicularis* are the main elements of the salt marsh while *Typha australis* is mainly associated with the estuarine brackish water/freshwater marsh.
Fauna	Seventy species of waterbirds have been recorded at the site with estimated maximum numbers of some 30,000 birds. Thirteen fish species belonging to thirteen genera and eight families occur along with *Sarotherodon melanotheron,* which constitutes about 97% of the fish population. Three species of marine turtles are reported to nest on the beaches (*Lepidochelys olivacea, Chelonia mydas* and *Dermochelys coriacea*).
Human Activity	Fishing is the main livelihood of the communities around the lagoon. Farming and some industrial activities also occur near the site.
Management Authority	Wildlife Division of the Forestry Commission, Tema Municipal Assembly (TMA) and Tema Development Corporation (TDC)

Table 2.8 : Characteristics of the Songor Lagoon Ramsar Site. (Lincoln, Fishpool and Evans, 2001).

Location	About 100 km east northeast of the city of Accra, on the southeast coast, in Dangme East District, Greater Accra Region (06.50N, 00.30E).
Area	51,113.33 ha
International designation	Ramsar Site No. 566
National designations	Ramsar Site (L.I. 1659)
Importance	It is an important wetland for many species of waterbirds. In addition there are turtle nesting sites on the beaches.
Principal Features	The site is a closed lagoon with inundated mudflats that form the main habitat within the site. The lagoon is separated from the sea by a narrow sand dune on which small villages are situated. The lagoon is 16 km long and 7 km wide at its widest point, with an average depth of 1.75 m and a maximum of 4 m, within the floodplain of the River Volta.
Flora	The vegetation of the site is composed of *Paspalum vaginatum, Cyperus articulatus, Sesuvium portulacastrum* and *Eleocharis mutate* that dominate the floodplains. *Andropogon guyanus, Heteropogon contortus* and *Azadirachta indica* dominate the catchment areas. Degraded mangroves with *Rhizophora racemosa* and *Avicennia Africana* are found along the creeks.
Fauna	The Songor wetland is the second most important site, after Keta for waterbirds on the Ghanaian coast supporting an estimated number of over 100,000 birds. Three species of marine turtles are reported to nest on the beaches (*Lepidochelys olivacea, Chelonia mydas* and *Dermochelys coriacea*).
Human Activity	Local communities depend on the site for fish resources, farming, salt production and eco-tourism.
Management Authority	Wildlife Division of the Forestry Commission and the Dangme East District Assembly.

Table 2.9 : Characteristics of the Anlo- Keta Lagoon complex Ramsar Site (Lincoln, Fishpool and Evans, 2001).

Location	About 140 km east of Accra, on the south coast of the region of Volta, southeast Ghana. The Site covers all or portions of South Tongu, Akatsi, Ketu and Keta districts of Volta Region ((05.55N, 00.50E)
Area	101,022.69 ha
International designation	Ramsar Site No. 567
National designations	Ramsar Site (L.I. 1659)
Importance	Most important seashore bird site along the Ghana coast. The site is a good representative example of a wetland on the south coast of West Africa.
Principal Features	Part of the Volta estuary comprising a complex of lagoons with varying salinity (including Avu, Keta, Nogui, Logui and Angaw lagoons) and several small islands. The surround flood-plain consists of marsh, scrub mangrove and farmland.
Flora	There are substantial mangrove stands and stands *Ruppia* grasses in the Lagoon. The site falls within the coastal savannah region of Ghana. Grasses dominate the vegetation, with patches of trees and shrubs. *Andropogon gayanus,* and *Heteropogon contortus* dominate the catchment and the floodplain areas.
Fauna	The area is abundant with birds and has all the 72 seashore bird species recorded for the Ghana coast. Current estimated seashore bird population is around 110,000. Fish and butterfly species abundant. The endangered waterbuck is also found in the area.
Human Activity	The site is used for its rich fish resources, farming, salt production, charcoal production and hunting.
Management Authority	Wildlife Division of the Forestry Commission and the South Tongu, Akatsi, Ketu and Keta District Assemblies.

Table 2.10 : Trends within the Ramsar Sites up to Year 2015 (Source: EPA/NRI (UK), 1998. Development Options for Coastal Wetlands. Final Report Vol. II)

Area	Short term – medium projections to the Year 2015
Urban Encroachment	Based on events since the establishment of the Coastal Wetlands Management Project (1993-1999), this will be a major problem in the short term, especially in the "urban" sites of Sakumo and Densu Delta due to the pressure from an expanding Accra and Tema. Muni-Pomadze will have this problem to a lesser extent. However key areas for biodiversity are away from the areas of urban growth. A series of "normal" rainy seasons would solve this threat, as many of the areas being encroached upon would be under water for 3 – 6 months of the year. A number of socioeconomic factors make the Songor and Keta areas sources rather than sinks of migration.
Hydrological Change	*Increased input of seawater:* Muni-Pomadze, Songor and Keta could have increased and more regular connection to the sea due to developments in the salt industry for Muni Lagoon and Songor Lagoon and sea defense/flood control in the case of Keta Lagoon. The effect of long term drought reducing water levels in the Volta Dam, which in turn has reduced the flow of the freshwater into the Volta estuary, has caused more sea water intrusion in the lower reaches of the estuary. Some concern has been raised in regard to increased extraction of freshwater for irrigation from the perched water table under the Keta coastal strip could cause salinization of groundwater. *Increased input of freshwater*: Urbanization and the replacement of green space with roads, roofs, etc. will increase the rate of freshwater runoff into the Densu Delta and Sakumo Sites. Plans are afoot to divert freshwater inflows from the main Songor Lagoon to the margins to protect the salinity of the main lagoon. There are also plans to dredge the channel from the Volta River to the Avu Lagoon and then to the Keta Lagoon, which would significantly change freshwater inflow, should these projects materialize. These interventions are major works, which are dependent on the health of the Ghana economy before they are carried out.
Industrial Development (Salt)	If plans for the Ada Salt Project move forward for the production of 1.2 million tons of salt form the Songor Lagoon, there will be a systematic loss of wetland habitat due to construction of salt pans and other structures, i.e., the increase in water depth in the salt reservoirs will result in loss of waders. The diversion of freshwaters to protect these saltpans will result in changes to the ecology of the eastern portion of the site. Both Muni-Pomadze and Densu Delta have salt development on the sites but the scale 40 is several orders of magnitude less than the Ada Salt Project.
Sand/Rock Winning	The extraction of sand for the construction industry affecting all the Ramsar sites will be an ever-increasing problem, given the rate of urbanization and the change in aspirations of people. This is not confined only to the beaches but also to the catchment areas of the Ramsar Site, where ancient marine deposits are being extracted
Overexploitation of Resources	
Fishery Resources	There will be increased pressure on all the Ramsar Sites for their fishery resources. This is by virtue of both increased numbers of fishermen and more "efficient" fishing gears. Government regulatory organizations are

	attempting to crack down on the use of illegal mesh and gear however given the resources at their disposal it is likely that their effort will be ineffective.
Mangroves/Fuel Wood Trees	Mangroves are present in appreciable quantities in only three of the sites Keta, Songor and Densu Delta. There will be increasing pressure on this resource as the price of other alternatives such as gas and kerosene escalate beyond the reach of the common man. This will happen despite the planting of fuel wood trees in many areas of the Ramsar Sites as the rates of planting and insufficient to balance the rate of exploitation.
Reeds and Grasses	As the mangroves and other trees are cut, there will be a trend for the replacement of such areas with grasses and reeds such as *Andropogon, Paspalum* and *Typha.* These grasses and reeds do have commercial value but their growth in mangrove areas would reduce habitat heterogeneity leading to the loss of species. This is the situation that prevails in the Sakumo catchment at present. The tendency therefore is for the other sites to approach the Sakumo model.
Migratory/Threatened Species	
Seabirds and Waders	The numbers of these birds are linked very closely to the changes in habitat caused by wetland loss and due to hydrological change. Bird numbers would depreciate significantly which would have implications on nutrient recycling and on the potential for ecotourism.
Marine Turtles	The numbers of marine turtles nesting along the Ghana coast is expected to be stable due to the efforts in Education by the Ghana Wildlife Society working and other local NGOs.
Shrimps/Fish	The commercial catches of shrimp both offshore and in the lagoons will decrease as the current levels of harvest as well as the sitting of the main fishery is damaging recruitment to the parent stocks. Loss of mangrove and wetland habitat is another contributing factor.

1.6 ARCHITECTURAL, BUILT, HISTORICAL AND ARCHEOLOGICAL HERITAGE

The Ghanaian coast has some castles and forts. UNESCO has designated Ghana's castles and forts as World Heritage Monuments (Anquandah, 1999). Table 2.11 gives an overview of the existing castles and forts, including ruins and remains.

Table 2.11 : Existing forts and castles

Location	Name of fort	History/Remarks
Beyin	Fort Apollonia	Built by Britain in 1770. It was the last fort built by the British on the Gold Coast. It was renovated in the late 1950ies and converted to a rest house in the 1970s.
Axim	Fort Sâo Antonio (Fort St Anthony)	Built by the Portuguese around 1515. The fort was captured by the Dutch in 1642 and remained under Dutch control until it was handed to Britain in 1872
Princes town	Fort Gross Fredericksburg	Built by the Brandenburg-Prussians in 1683. In 1717-1724 held by an Ahanta Chief. Taken over by Netherlands in 1725 and later by Britain in 1872
Akwidaa	Fort Dorothea (Fort Akodaa)	The fort is a ruin today
Dixcove	Fort Metal Cross	Built by the British in the period 1692-1696. It was then called Dixcove Fort. The fort was captured by the Dutch in 1868 and renamed Fort Metalen Kruiz (Fort Metal Cross), only to be returned to Britain in 1872
Butre	Fort Batenstein	Constructed by the Dutch in 1656. Handed over to Britain in 1872. Today a substantially somewhat overgrown ruin.
Sekondi	Fort Orange	Built by the Dutch in 1690 and taken over by Britain in 1872. The fort is still in use as a lighthouse
Komenda	Fort Vreedeburg	Built by the Dutch in 1682. Only a little ruins remains today
Komenda	Fort English	Built by the British in 1687. Only a little ruins remains today
Shama	Fort St. Sebastian	Built by the Portuguese in 1523. In 1638 captured by the Dutch. Taken over by the British in 1872.
Elmina	Fort St. Jago	Built in 1665-1666 by the Dutch to protect St. Georges Castle
Elmina	St. Georges Castle (Elmina Castle)	Founded in 1482 by the Portuguese. It is the oldest extant colonial building in sub-Saharan Africa. The Portuguese held the Castle for 150 years and in 1637 taken over by the Dutch. Was sold to Britain in 1872.
Cape Coast	Cape Coast Castle	The Portuguese built a trade lodge on the site in 1555. Then the Swedes built a permanent fort (Carolusburg) in 1653. During the next 11 years, the Danes, the local Fetu Chief and the Dutch each in turn captured and held Carolusburg for a time. Then in 1665 it was captured by the British. Served as a seat of the British governor.
Cape Coast	Forts Victoria and William	Small outpost look - out forts for Cape Coast castle. Fort Victoria was constructed in 1837 and fort William in 1820. Fort William is now a lighthouse.
Moree	Fort Nassau	Built by the Dutch in 1612. This was the first fort built by the Dutch on the Gold Coast. Now a substantial ruin

Anomabu	Fort Charles	In 1630 the Dutch built a fort at Anomabu, only to abandon it in 1664 due to pressure from the British, who built Fort Charles on the site in 1674. Britain left the fort due to disagreements with the local traders and destroyed the fort so that it could not be captured by a rival power. The British built a new fort Charles over the foundations of the old fort in 1756
Saltpond	Fort Amsterdam	Dates back to 1631 and was the first fort built by Britain on the Gold Coast. Destroyed in an attack by the people of Anoma in 1811. It was restored in 1951
Apam	Fort Leydsaamshei d (Fort Patience)	Built by the Dutch in 1697, captured by the British in 1782, returned to the Dutch in 1783 and finally handed over to Britain in 1868. It is now a resthouse.
Winneba		Winneba was the site of an important British fort from 1673 to 1812. Traces of the old fort can be seen in the Methodist Church built on the site in late 19th century
Senya Beraku	Fort Good Hope	The Dutch built a small trading lodge in 1660 in Senya Beraku. The lodge was abandoned shortly afterwards, but in 1704 the Dutch returned and built Fort of Good Hope. The fort was handed over to Britain in 1868. In the 1980ies the fort was restored as a joint historical monument and resthouse
Accra	James Fort	Built by the British in 1673
Accra	Ussher Fort	Built by the Dutch in 1652. Taken over by the British in 1782.
Accra	Christiansborg Castle (Osu Castle)	Built by the Danes in 1661. It was briefly occupied by the Portuguese in 1679, but returned to Denmark in 1693. After that the castle remained the Danish headquarters for 150 years, before being sold to Britain with four other Danish forts in 1850. The castle has been seat of the Government from 1876 to the present day.
Prampam	Fort Vernon	Built in 1742 by Britain. Only some traces of the fort remain in the wall of a guesthouse
Old Ningo	Fort Fredensborg	Built by the Danes in 1735. Very little remains of the fort
Keta	Fort Prinsensteen	Constructed by the Danes in 1784 and sold to Britain in 1850. Today it is essentially a ruin, a large part of the fort being destroyed by waves during a storm in 1980.

PART II. CAPACITIES

2.1 RESEARCH AND GEOMORPHOLOGY OF THE COAST

Table 3.1 : Principal institutions involved in coastal erosion issues

Institution	Contacts	Contact Details	Coastal research and monitoring programmes in progress
Ministry of Water Resources, Works and Housing /Hydrological Services Department	Hubert Osei-Wusuansa / Ernest Kusi-Minkah	howmaria@yahoo.com eminkah@hotmail.com	Conduction of hydrographic surveys through the measurement of wave, current and bathymetric characteristics for the design of the Ada Sea Defence Works. Monitoring of performance of constructed sea defence works.
Department of Oceanography and Fisheries of the University of Ghana	Dr. K. Wiafe	wiafeg@ug.edu.gh	Coastal and Continental Shelf Processes in Ghana Project
Environmental Protection Agency	Carl Fiati	cfiati@hotmail.com	Regulatory assessment of environmental impacts of marine and coastal works

Table 3.2 : Shoreline systems implemented

Institution	Names and contact details	Sites monitored	Period covered by data	Measurement methods
Ministry of Water Resources, Works and Housing /Hydrological Services Department	Hubert Osei-Wusuansa / Ernest Kusi-Minkah	Ada	On-going (2009 to date)	Hydrographic surveys of measurement of wave, current and bathymetric characteristics
Department of Oceanography and Fisheries of the University of Ghana	Dr. K. Wiafe / Dr Addo	Various sites	On-going	Use of geospatial data / In situ oceanographic measurements in nearshore zone

2.2 RISK REDUCTION

Table 3.3 : National platform for disaster risk reduction

Institution	Person in charge	Contact details
National Disaster Management Organisation	Mr. Kofi Portuphy	+233-302-772926 nadmo@africaonline.com.gh

In Ghana, the national platform for disaster risk reduction is embodied in the National Disaster Management Organisation (NADMO). NADMO initiates and/or co-ordinates all activities before, during and after disasters or emergencies.

NADMO was established in 1996 by an Act of Parliament – Act 517 "responsible for the management of areas affected by disaster and similar emergencies, for the rehabilitation of persons affected by disasters and to provide for related matters" NADMO operates through the co-ordination of the resources of government institutions and the development of the capacity of voluntary community-based organizations to respond effectively to emergencies. A disaster fund has been established to facilitate the operations of NADMO.

The functions of NADMO include:

- Preparation of national, regional and district disaster management plans to prevent disasters or reduce the impact of disasters in Ghana.
- Establishment of training facilities and educational programmes to NADMO staff stakeholders and the general public.
- Co-ordinate local and international support for disaster management in Ghana.
- Provision of equipment and relief items.
- Management of refugees, internally displaced persons and Ghanaian returnee from other countries.

NADMO's chain of command is as follows, in deceasing order of authority: National Security Council, Minister of Interior, national sector of NADMO, Regional Disaster Management Committee, regional sector of NADMO, district Disaster Management Committee, district sector of NADMO and the zonal sector of NADMO

PART III. PRESSURE ON COASTAL MILIEUS

3.1 DEMOGRAPHICS AND POPULATION MOBILITY, URBAN FRAMEWORK

1. Population Dynamics

In Ghana, the coastal zone representing about 6.5 per cent of the country is home to about 25% of the population. Major cities of Accra-Tema, Cape Coast and Secondi-Takoradi have high population densities of over 500 inhabitants per km^2. Other coastal areas have population density of 263 inhabitants per $km^{2.}$ The national figure is 67 inhabitants per km^2. Relative demographic Statistics show an urbanization rate of 51.5% compared to a national rate of 35.4% (WB/EPA, 1996).

The major ethnic groups in the coastal zone include Nzema and Ahanta (Western Region), Fante, Awutu and Efutu (Central Region), Ga, Shai, Krobo, Ada (Greater Accra Region) and Ewe (Volta Region). The population along the coastline represents 17 distinct ethnic groups with the Nzema dominating the coastal stretch from the border with Cote D' Ivoire to Axim (~105 km coastline), the Ahanta living from Dixcove to Secondi (~80 km), the Fante living from Shama to Mankoadze (~150 km), the Effutu-Awutu living from Winneba to Nyanyano (~25 km), the Ga living from Kokrobite to Kpone (~45 km), the Dangbe living from Prampram to Ada (~70 km) and the Ewe from Ada to Aflao (~75 km).

Table 4.1: Population dynamics of communities/districts in the coastal zone

	District	Total 1984	Total 2000	Male 2000	Female 2000	Area sq km (1984)	Density	Urban Population %	% Increases Over 1984	Intercensal Growth Rate
Gt. Accra	Accra Metropolitan Area	969,195	1,658,937	817,373	841,564	345	4,808	100.0	71.2	3.4
	Tema Municipal	190,917	506,400	251,482	254,918	476	1,063	88.4	165.2	6.1
	Dangme West	63,079	96,809	46,550	50,259	962	100	23.6	53.5	2.7
	Dangme East	71,550	93,112	44,199	48,913	772	120	18.1	30.1	1.6
	Ga	136,358	550,468	276,531	273,937	562	979	72.9	303.7	8.7
Central	Cape Coast Municipality	85,438	118,106	57,365	60,741	125	944	69.7	38.2	2.0
	* Awutu – Effutu – Senya	89,426	169,972	80,535	89,437	713	238	65.5	90.1	4.0
	* * Gomoa	74,917	194,792	88,414	106,378	842	231	26.1	160.0	6.0
	Mfantsiman	77,506	152,855	70,212	82,643	522	292	49.8	97.2	4.2
	Abura-Asebu-Kwamankese	34,217	90,093	42,487	47,606	401	224	29.1	163.3	6.0
	KEEA	76,462	112,437	53,755	58,682	401	280	29.7	47.0	2.4
	Ajumako-Enyan-Esiam	60,951	91,965	42,395	49,570	458	200	17.7	50.9	2.6

Western	Jomoro	70,881	111,348	55,983	55,365	1,350	82	29.6	57.1	2.8
	Nzema East	87,607	142,871	71,673	71,198	2,088	68	26.6	63.1	3.1
	Shama-Ahanta East	228,651	369,166	182,769	186,397	417	885	100.0	61.4	3.0
	Ahanta – West	84,071	95,140	46,024	49,116	568	167	20.0	13.2	0.8
Volta	Keta	26,021	133.661	62,827	70,834	728	211	53.2	413.7	10.2
	North Tongu	-	130,388	62,110	68,278	1,836	71	19.6	-	-
	South Tongu	-	64,811	29,407	35,404	503	128	11.3	-	-
	* Ketu	94,894	237,261	111,150	126,111	632	375	34.8	150.0	5.7
	* * Akatsi	47,221	93,477	43,843	49,634	900	103	21.0	97.9	4.3
Total Coastal Area	2,569,3 62	5,080,542	2,537,0 84	2,676,9 85	15,601	326	43.2	111.9	4.2	
	District	Total 1984	Total 2000	Male 2000	Female 2000	Area sq km (1984)	Density	Urban Populatio n %	% Increases Over 1984	Interce nsal Growt h Rate

Sources : *Computed from GSS (1995). Analysis of Demographic Data: Detailed Analysis Reports Vol.2, GSS (2002). 2000 PHC: Summary Report of Final Results*

Greater Accra * Dangme West is made up of Shai and Dangme as in 1984.
* * Dangme East comprises Ada asin 1984.

Western * Shama-Ahanta East comprises Sekondi-Takoradi and Shama in 1984
* * Ahanta West comprises Ahanta in 1984.
* * * Mpohor Wassa East comprises Dompim district in 1984.

Central * Awutu – Effutu – Senya includes Winneba.
* * Gomoa – Akyempim in 1984 is Gomoa in 2000.

Volta * Ketu district was known as Dzodze in 1984.
**Akatsi district comprises Avenor in 1984.

2. Economic Status

Poverty levels are highest in the rural areas and are relatively pervasive in the Volta and Central regions. Substantial income differential exists between Accra and all other districts in the coastal zone. Although future economic growth will improve absolute economic prospect and social conditions in some of the deprived coastal districts, it has been projected that over 50% of the districts in 2020 will have per capita income levels of less than $700 per person.

The persistence of poverty and the pervasiveness of income disparities have important implications for economic, social and environmental security. Poverty and environmental degradation have often been characterized as being part and parcel of a "vicious cycle". In Ghana's coastal zone, absolute and relative poverty levels have contributed to environmental degradation and have in turn exacerbated environmental degradation. The urban coastal zone contributed 407% to the total poverty of the entire country whilst the rural coastal zone's share was 14.4% in 1991/92. These trends, however, changed slightly in 1988/99 where the urban and rural coastal zones contributed 40% and 16.7% respectively.

In coastal communities, attempts to expand production through more extensive land-use have resulted in resource use conflicts and the degradation of critical ecosystems (such as mangroves or wetlands) that support the overall natural productivity of the coastal zone. Efforts to expand production through a more intensive harvesting have also led to accelerated depletion of soil and water supplies.

3. Sanitation

Poor domestic sanitation is very predominant in most coastal areas of Ghana. This leads to unhealthy conditions which impact negatively on socio-economic development. Improper disposal of municipal solid and liquid wastes remain widespread. Plastic wastes form about 60% of beach litter (Nunoo & Quayson, 2003). Accessibility to potable water is a major problem in most rural coastal communities. Wells used in most of these communities are impacted by saltwater intrusion.

4. Social Status

Marital status in the coastal zone is high reflecting regional trends in the country. Accordingly, over 60% of household heads are either married or in a consensual union with a partner. However, the Accra Metropolitan Assembly (AMA) and the Tema Metropolitan Assembly have the smallest proportions of persons who are married of 43.3% and 43.5% respectively; and the highest proportion of persons living together in loose unions of 3.8% (Ghana Statistical Service, 2005).

The current high levels of urbanization and economic progress in the major cities along the coast have resulted in declining fertility levels in line with the overall declining patterns observed by Agyei-Mensah (2005). The Accra Metropolitan Assembly (AMA), the most urbanized district in Ghana, has the lowest fertility with 2.9 births per woman in 2003.

Literacy rate is highest in Accra at 78.2%, compared to the national average of 57.9%. The adult literacy rate for the Volta Region of 53.0% is lower than the national average; with the male literacy rate 65.9% being higher than that of females at 42.1%. The gap as with other regions is much wider between the urban and rural areas for each district. About twice as many men as women have completed secondary school or gone to a higher level.

The private informal sector dominates the institutional sector for employment in all Regions. As expected, it will take the District Assemblies and Central Government a fairly long time to provide jobs to all the unemployed. Unemployment is widespread and females are more likely to be unemployed than their male counterparts.Women play an important role in the processing, marketing, and distribution of fish and fish products in the country. In fact in recent years, the contribution of women in financing fishing operations by providing inputs to fishermen has increased significantly.

Concerning decision making in families, employed women who receive cash earnings have a greater say in most decisions than unemployed women and also women employed not for cash. Autonomy over cash earnings is therefore generally higher among urban than rural women (DHS, 2003). This notwithstanding, male partners are more dominant in decision making whilst the role of parents and other relatives and friends is also important.

3.2 ROAD INFRASTRUCTURE

NOT DONE

3.3 DOCK AND AIRPORT INFRASTRUCTURE

Ghana has two major marine ports – the Tema and Takoradi Ports. The Tema Port is one of Africa's largest. Port statistics show that the traffic passing through the two ports has been increasing over the years. Available data show that of the 4.29 million tons of total imports registered from January to September of 2000, the Tema port accounted for 80 percent of the cargo and the Takoradi port accounted for the remaining 20 percent. For exports, the Tema and Takoradi ports registered 26% and 74% of the total cargo volume respectively. At the Takoradi port, the commercial vessel call has increased from 338 in 1987 to 512 in 1999. The turnaround time, which previously averaged four days in 1990, had decreased to 1.5 days in 1999.

The Tema port has an oil jetty where crude oil is offloaded into pipelines that connect the jetty to the only refinery in the country, the Tema Oil Refinery. A Single Mooring Buoy (SMB) terminal has also been constructed within the vicinity of the Tema port for larger vessels to offload their cargo.

Ghana has the Kotoka International Airport with all the modern facilities of an airport in the capital city Accra. Also, extensive road networks and rail are found in the coastal zone.

3.4 FORMS OF COASTAL TOURISM

The coastal area of Ghana offers varied opportunities for tourism and holds significant tourist potentials. The major coastal tourism attraction sites are found at Keta, Ada, Ningo-Prampram, Tema, La, Accra, Winneba, Cape Coast, Elmina, Komenda, Sekondi-Takoradi, Axim and Busua. The major assets are the broad beaches and cliffs; the coastal lagoons and estuaries having a rich birdlife; historical monuments including forts, castles, light houses; and cultural activities.

UNESCO has designated some of Ghana's castles and forts as World Heritage Monuments (Anquandah, 1999). These sites are significant for tourism because of their rich and diverse history. Overall, there are about 40 forts and castles dotted along the entire coast, with 24 of them designated as structures of historical importance. These forts and castles contribute financially both to national and local economies because of the attraction they present to both local and foreign tourists.

There is a growing number of beach resorts in Ghana which are patronised immensely on public holidays, special occasions and weekends. The high patronage of beaches has its attendant problems of littering and pollution of beaches and nearshore waters (Nunoo & Quayson, 2003; Anon. 2004).

Tourism is an emerging foreign exchange earner for Ghana. Tourism is the fourth largest source of foreign exchange earnings, estimated at about US$ 650 million in 2004. It contributes approximately 5% to the country's GDP (GTB, 2006).

Tourism in Ghana has encouraged the establishment of human settlements and associated industries. These establishments if not properly planned would lead to pollution of the coastal environment, and thus an unsustainable development of the coast.

3.5 INDUSTRIAL, MINING AND EXTRACTION ACTIVITIES

1. Industrial Activities

More than 60% of the manufacturing industries in Ghana are situated in the larger towns/ along the coast. The Accra-Tema area is home to most of the industries;followed by Takoradi and Cape Coast. The industries include food-processing, metal production, textile-chemical factories, cement factories and an oil refinery. A free export zone has been established at Tema and this is expected to further enhance industrial development. The Aboadze thermal plant near Takoradi is another large industrial establishment in the coastal zone. Also the Sunon Asogli thermal plant at Kpone near Tema has been built recently.

2. Mining Activities

Mining activities in the coastal areas of Ghana encompass the mining of sand and gravel, quarrystones and aggregates. The expansion of the housing and construction industry has resulted the extensive mining for sand and gravel. Quarrying for building and road construction occurs mainly on the outskirts of cities such as Accra and Sekondi at Weija

and Essepong respectively. Sand and gravel mining on the beaches, although banned, poses immense environmental threat as it continues in some coastal areas.

3. Oil and Gas Extraction Activities

Ghana is emerging as the oil province of West Africa with recent discoveries of significant oil and gas reserves in her territorial waters. Significant results crowning years of concerted oil exploratory works were first achieved in July and August of 2007 with the Mahogany-1 and Hyedua-1 discoveries in the West Cape Three Points and Tano oil blocks, by a consortium of Messrs Kosmos Energy, Tullow Oil and Anardako Petroleum. The two discoveries have been unitized and christened 'Jubilee Field' in remembrance of the coincidence of the discoveries with Ghana's golden jubilee year of 2007; and is/are being developed as a single entity. Other discoveries have been made by the same consortium. The discoveries are in the Western Region of Ghana and are within 150km from the port city of Takoradi.

The Jubilee Field development is being run from Ghana and is registered with the country's Environmental and Protection Agency (EPA) as required by her statutes. Commercial production from the Jubilee Field is expected by end 2010.

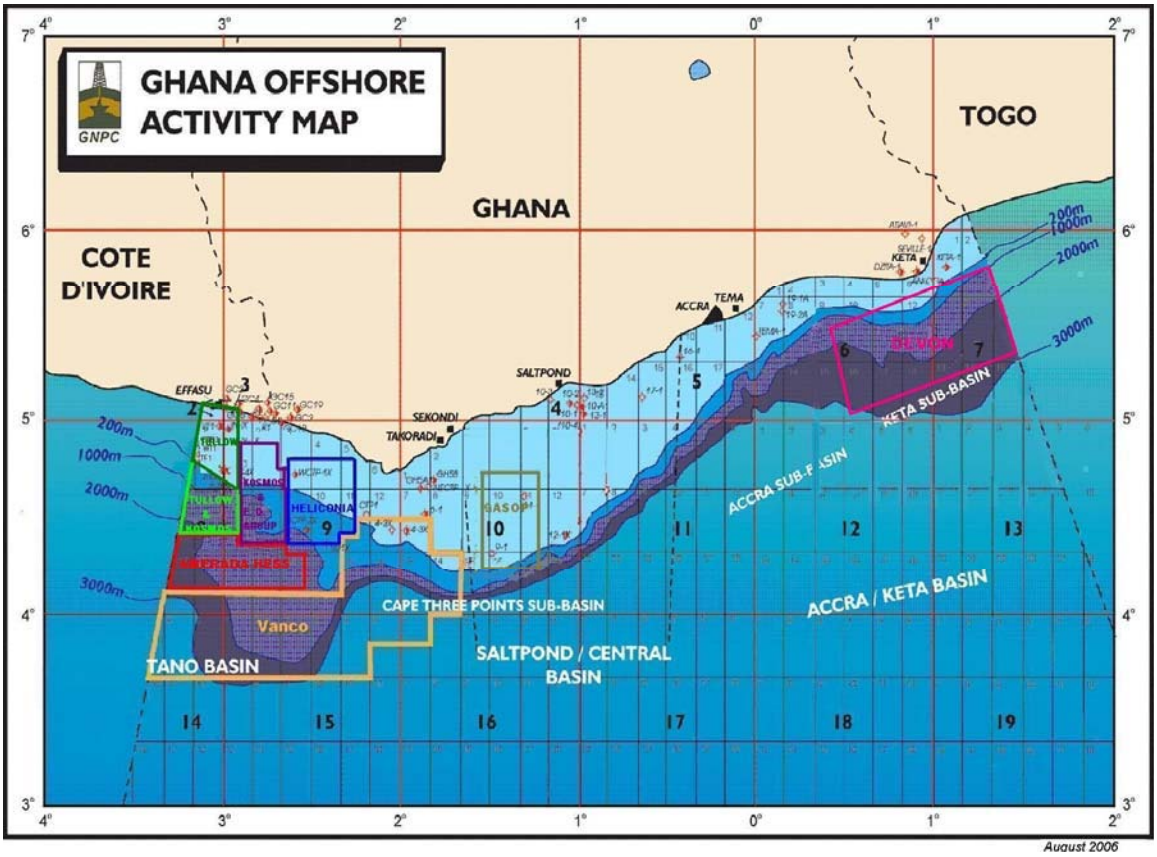
An appraisal of the Jubilee Field in April, 2008 to ascertain its recoverable reserves confirmed that it contains reserves with ninety percent probability of at least 800 million barrels of light crude oil and an upside potential of about 3 billion barrels.

The Ghana National Petroleum Corporation (GNPC) and its partners are in agreement to develop the Jubilee Field in two phases with a field development plan proposing no gas flaring, commercial production by end 2010 and a production philosophy of maximizing resource value.

The first phase of production from the Jubilee field would involve the drilling of seventeen wells; and would yield a daily production of 120 barrels of oil and 120 million cubic feet of gas. The second phase would be carried out between 2010 and 2012; and a total daily production of 250,000 barrels of oil and 250,000 million cubic feet of gas is anticipated upon completion. Four rigs have been contracted on long-term basis to drill the seventeen wells for the first phase and also do exploratory prospecting within the Jubilee Field.

The GNPC and its partners are financing the first phase of the Jubilee Field development through equity contributions. The full field development cost for both phases ranges from US$6 billion to US$8 billion.
The offshore activity map for oil and gas in Ghana is shown in Figure 4.1.

Figure 4.1 : Ghana offshore activity map for oil and gas



To augment the energy production and also to reduce emissions due to the burning of light crude oil for power generation, the Government of Ghana in collaboration with three other West African Governments are implementing the West Afican Gas Pipeline Project to facilitate the transportation of huge deposits of gas from Nigeria to Benin, Togo and Ghana through pipelines located in the sea.

The impact of the oil and gas industry in the marine and coastal environment would therefore be very significant with the anticipated development of Ghana's oil industry.

3.6 COASTAL FISHING

1. Background

The fishing season is closely influenced by the upwelling phenomenon, which is from January to April (minor upwelling) and July to September (major upwelling).
The traditional artisanal inshore fishery in Ghana is well developed and provides about 70% of the total marine production. This type of fishery is usually all-year round. However, it shows definite peaks (periods of bumper harvests) and troughs (the lean or off-season periods). Throughout the coastal areas of Ghana, artisanal fisheries rely largely on fish from both the inshore and offshore marine environment. The coastal lagoons, estuaries, and other inland water bodies are also very important sources of fish and shellfish in Ghana. About 75% of total annual production of fish is consumed locally.

The Fisheries Sector is estimated to contribute about 3% of the nation's gross domestic product (GDP) and 5% of the Agriculture GDP (Anon, 1995). It is believed that these figures are underestimated (Sarpong *et al*., 2005). As an economic policy, the Government of Ghana allows exportation of fish. Since the launching of the Ghana Economic Recovery Programme in 1984, fish is now the country's most important non-traditional export. In 2004, about 50,000 mt of fish and fishery products were exported, earning the country about US$123 million (Ghana Export Promotion Council, 2005). This amount represents about 3.5% of the country's total export earnings.

It has been estimated that the fisheries resources in Ghanaian water bodies supports the livelihoods of a total of 500,000 fishers, fish processors (including fish canneries and cold stores), traders and boat builders, who together support twice as many dependants. These people, together with their dependents, account for about 10% of the population.

The fisheries sector supports other industries of the economy. About 40,000 metric tonnes of fish waste is used in the manufacture of poultry and livestock products annually.

2. Fishing Fleet and Fishing Methods

The marine fishing fleet can be classified into 4 main groups; canoes, inshore vessels, deep-sea vessels (industrial trawlers and shrimpers) and tuna vessels.
The canoe fishery dominates the number of vessels, employment and fish landings. The number of canoes has fluctuated but currently stands at about 10,0000, out of which 52.6 % are motorized. The canoes operate from about 185 fishing villages, utilizing 304 landing sites as given by Table 4.2.

Table 4.2: Number of landing sites, canoes and fishermen in all seventeen coastal administrative districts (Source: Bannerman et al., 2001)

District	Landing sites	Number of canoes	Number of fishermen
Ketu District- Volta Region	8	195	5457
Keta District- Volta Region	34	323	6406
Sub Total	42	518	11863
Dangbe East – Gt. Accra	21	477	12041
Dangbe West – Gt. Accra	16	836	11744
Tema District – Gt. Accra	7	563	5195
AMA District- Gt. Accra	18	852	10263
Ga District – Gt. Accra	5	229	1783
Sub Total	67	2957	41026
Efutu-Ewutu Senya District Central Region	7	442	9427
Gomoa District – Central Region	19	729	5238
Mfantseman District – Central Region	34	1128	1250
Cape Coast District – Central Region	14	198	2168
Abura-Asebu-Kwamankese Central Region	8	425	3396
Komenda-Edina-Eguafo-Abrew – Central Region	19	853	9430
Sub Total	101	3775	45909
Shama-Ahanta East District Western Region	15	1086	10392
Ahanta West District Western Region	21	824	4629
Nzema East District Western Region	31	622	5766
Jomoro District Western Region	27	199	3571
Sub Total	94	2731	24358
Grand Total	304	9981	123156

The canoes use a wide variety of gears, including purse seines (Watsa and Poli), beach seines, drift gill nets (including Ali nets and nifa nifa), set gill-nets and hook and lines (Doyi, 1984).

Inshore vessels are inboard-engine vessels of up to 30.5 m overall length. Most of these vessels are equipped for purse-seining and trawling. There are harbours for these vessels at Tema, Apam, Elmina, Aboadi, Takoradi and Axim

The deep-sea vessels are also trawlers but equipped with freezers. They are more than 30.5 m in length. They are based at the Tema Harbour. .

The locally registered tuna vessels are pole and line vessels. There are 26 baitboat/pole and line vessels with a carrying capacity between 200 and 400 Mt of frozen tuna, which undertake trips of nearly one month at sea.

3. Fish Landings

Peak catches of both pelagic and demersal fishes are taken during the major upwelling. The annual fish production ranges from 290,000 to 472,000 metric tonnes for a 5-year period 1998-2002 constituting about 5 % of the agricultural GDP. About 80 % of the annual landings come from marine sources, 19 % from inland fisheries, principally, the Volta Lake and 1 % from freshwater fish culture. The annual fish requirement is estimated to be about 700,000 metric tonnes.

Table 4.3: Fisheries data for a 5-year period (1998-2002) in metric tonnes.

	1998	1999	2000	2001	2002
Fish production	472,039	422,041	450,000	-	290,008
Fish requirement	736,000	754,000	772,000	792,000	720,000
Fish consumption	411,905	405,236	486,967	486,061	-
Fish import	17,100	52,156	64,024	105,619	144,597
Fish export	57,855	68,962	44,350	73,299	3,827

4. Fish Processing and Marketing

The fisheries sub-sector provides employment for at least 500,000 fishers, processors, traders, mechanics and boat builders who together support twice as many dependants.
Nearly half of the artisanal fisheries labour force is women who are engaged in processing and selling of fish. They are responsible for the marketing of 60-90 % of the fish produced. The landed fish are bought by fishmongers who process them before selling. Some women only process and sell fish obtained from their husbands' share of the catch to wholesalers or retailers. Others buy fish in addition to their husbands' share, usually from fishermen who are indebted to them. Furthermore, some of the women are employed as hired labour in fish processing, with the aim of earning enough money to start their own fish marketing ventures.
Smoking, sundrying, salting, fermenting and frying, are generally the methods involved in fish processing. These are then taken to the market centres for sale. Smoking is most widely practised, especially, smoked sardinella, and anchovy are highly appreciated.
Fish is transported up country from fishing villages in trucks on an individual or shared basis to be marketed. The transactions and economics of fish marketing depend highly on the seasonal and local fluctuations in catches.

5. Lagoon Fisheries

In Ghana, coastal lagoons support a thriving artisanal fishery of both subsistence and commercial importance. There are over 90 coastal lagoons along the entire coastline, which serve as nursery grounds for a variety of fish, which are vulnerable to the fishery throughout the year. Fishing in the lagoons may either be seasonal or all year round. In general, productivity in the lagoons peaks up during the wet season, from May to July and to a lesser extent from August to November following the two rainfall regimes experienced in southern Ghana.
Among the various fishing methods employed in the coastal lagoons are cast nets, set-nets, drag nets, gill nets, hook and line, bottle traps, crab traps, rope fishing, acadja fishing and bamboo traps. These may be deployed from canoes or by wading through the water.

Fish populations of these lagoons are dominated by the cichlids; of which *Sarotherodon melanotheron, Tilapia guineensis* and *Hemichromis fasciatus* are the major species. Most of the lagoon fish are small (6-8 cm). Other fish species in the lagoons are *Tilapia zillii, Oreochromis niloticus, H. bimaculatus, Ethmalosa fimbriata*, *Mugil* spp. and the shellfishes, *Anadara senilis* and *Tympanotonus fuscatus.* Two species of crustaceans are also fished in commercial quantities in lagoons that are occasionally open to the sea or receive over-wash from the sea at high tides. These are the blue-legged swimming crab (*Callinectes amnicola*) and to a lesser extent, the marine shrimp (*Penaeus notialis*).

3.7 FISH FARMING

Aquaculture is being encouraged but is currently being done on a minor scale. Although the potential for aquaculture exists, there are yet no commercial large-scale projects operating. A few small-scale aquaculture ponds are found in the coastal zone. Local fish production cannot meet the country's fish requirements; and fish is imported to supplement local production. To cut down on the importation of fish, the Directorate of Fisheries has embarked on the development of aquaculture. A series of fora to promote aquaculture as a business venture has been held for entrepreneurs, fish farmers and other stakeholders. Fish farmers associations have been re-organized and trained in management skills.

3.8 AGRICULTURE AND LIVESTOCK BREEDING

Farming also plays an important role in the economic activities of rural coastal inhabitants in Ghana. Farming along the coast, done on subsistence level, is usually by the use of simple implements such as cutlass and hoes. Most of the farms are less than a hectare and are solely dependent on the rains. However, a few irrigated farms are in place along the coast e.g. vegetable farms in the Weija dam environs near Accra; and rice farms in the Okyereko dam environs near Winneba.

Farming activities are centered mainly on food crops and vegetables. Livestock and cash crops are on the periphery. Food crops cultivated along the coast include cassava, plantain, some species of yams and rice. Major vegetables which are cultivated are tomatoes, pepper, okra, and shallots. Cash crops which are cultivated on commercial bases are coconut, oil palm, shallots, pineapples and cashew.

Farming entailing crop cultivation, particularly shallot intercropped with vegetables, is done along the Keta lagoon. Shallot farming constitutes a major source of income for many households inhabiting the coastal strip between the sea and the Keta lagoon in the Volta Region.

In the Central and Western Regions of Ghana, farming entails greatly commercial coconut production. Coconut is an important cash crop which is a major source of income for the population on the coastal areas of the Central and Western regions.

In recent times, pineapples are being cultivated on commercial basis along the main road from Kasoa (Accra) to Cape Coast; while oil palm and cashew cultivation is being enhanced in the Central and Western Regions.

Livestock activities include poultry, cattle, pigs, goats and sheep rearing. Semi-nomadic rearing of cattle is an important livestock activity in the coastal savannah stretching from Winneba in the Central Region to the Volta Region.

From 1998-2004 the agricultural sector contributed an average of 36.26% annually to the National GDP (details on coastal areas are not available). Most of the agricultural subsectors also saw higher growth in 2004. In addition, agriculture contributed significantly to foreign exchange earnings and tax revenues.

3.9 OTHER TYPES OF PRODUCTION

Ghana has great potential as an international large-scale salt producer. Ghana has adequate capacity to expand its salt industry to produce a minimum annual high quality of 1,000,000 metric tonnes. With Ghana's emerging oil industry starting commercial production in 2010, there is now the urgent need for the expansion of her salt industry; considering the immense role salt plays in the oil industry in the manufacturing of varied products.

Salt mining takes place within or on the edges of coastal lagoons. Extensive salt production occurs at the Songor, Sakumo, Keta, Djange, Old Ningo, Prampram, Laloi,
Nyanya, Nakwa, Apabaka, Iture, Brenu, Akyinmu, and Ahwin Lagoons. Salt mining in coastal towns like Adina, Ada, Songhor, Weija near Accra, Apam, Saltpond and Elmina are on the increase due to promotion of the industry by Government. Salt mining is an important income generating and employment provision activity. Salt production is seasonal with the peak being in the dry season months of December to April.

Three methods for salt production are employed:

- The traditional method where brackish water is allowed to evaporate within the lagoons during the dry season (September to March). This simple method is practised in the Keta, Songor, and Nyanya Lagoons.
- The second method of production entails the use of salt pans constructed with lagoon mud. The pans are filled with water from the lagoon or tidal channels at high tide and allowed to evaporate.
- The third method entails pumping of seawater into large concrete concentration pans to evaporate.

Deposits of limestone, silica, feldspar and other minerals have been identified in the coastal belt. There is also the possibility for hydrocarbons, for which prospecting is being undertaken. Copra production is also an important economic activity along the coastal belt.

PART IV. STATE OF THE COASTAL MILIEUS

4.1 CHARACTERISATION OF CLIMATE

1. Wind

The winds are characterized by persistent south-westerly monsoon modified by land and sea breezes in the coastal area. Speeds vary between 0.5 m/s at night and 2.0 m/s during the day. Storms are not common. Weaker line squalls with heavy rains and strong winds of short duration occur occasionally. Between December and February, hot dry north-easterly Harmattan winds occur when the inter-tropical convergence zone deviates from its southerly position between 5°N – 7°N. The winds blow predominantly in a south-westerly direction with an average speed of 3 m/s throughout the year.

2. Temperatures

The mean daily maximum temperature varies between 27°C – 29°C in August and 31°C – 33°C in February/March. Mean annual temperatures range from 26°C in Half Assini to 28°C at Ada.

3. Precipitation (Rainfall)

The climate of Ghana's coastal zone is tropical. The eastern coastal belt is warm and comparatively dry, the southwest corner hot and humid. It becomes progressively drier from the southwest to the northeast of Accra. Two thirds of the coastal zone falls within the dry coastal savannah strip where annual rainfall ranges from 625 mm to 1000 mm and average 900 mm. Peak rainfall is in June and the lowest rainfall is observed in January. There is a double maxima annual distribution of rainfall in Ghana's coastal zone with the high maximum occurring in May/June and the low maximum in September/October. The lowest rainfall occurs in January. The relatively dry coastal climate of the southeast is believed to be caused by the prevailing winds (south-south-westerly) blowing almost parallel to the coast and to a cool current of water immediately offshore as a result of a local up-welling (Armah and Amlalo, 1998).
At the northern winter solstice, the doldrum zone lies to the south of the coast. The coastal areas are dominated by the NE Trade wind system, which is relatively free of clouds and rain, but is cool, dry, and dust-laden; it is known as the 'Harmattan'. Conversely, the SE Trade winds are associated with more clouds and precipitation, and divert in coastal regions above the equator as a southwest onshore monsoon. While there are two main seasons during the course of the year, the annual weather patterns are somewhat more complicated due to a short break in rainy season in August.

The typical weather is as follows:

- From April to July, there is a long rainy period (southern summer monsoon season). The period starts with storms and humid SW winds of between 15 m/s and 25 m/s. There is an up-welling event along the shoreline in July;
- A short dry period occurs in August as rainfall amounts suddenly decline about 75 percent;
- During October and November there is a short rainy period associated with decreasing winds and a weak up welling. Ocean surface temperatures increase during September, reaching 28°C; and
- From December to March there is a long dry season characterized by persistent Harmattan winds, which derive from anticyclone systems in the north.

4. Humidity

Relative humidity ranges between 50 - 80 percent in the eastern part of the coast and 70 - 100 percent in the western part.

5. Evaporation-evapotranspiration

The mean annual evapo-transpiration ranges from a low of 1370 mm in Half Assini through 1490 mm at Cape Coast to 1674 mm along the East Coast.

4.2 GEOLOGY, GEOMORPHOLOGY AND PEDOLOGY

The coastal geological formations of Ghana were likely determined by continental drift during the Cretaceous period (about 135 million years ago), when Africa broke away from South America (Allersma and Tilmans, 1993). The geological composition consists of hard granites, granodiorites, metamorphosed lava, and pyroclastic rock. Some coastal areas are covered by Ordovician, Silurian, and Devonian sandstone and shales (Allersma and Tilmans, 1993).

Seismic studies have indicated that Ghana's seismicity is associated with active faulting, particularly near the intersection of the east-west trending Coastal Boundary Fault and the northeast to southeast Akwapim Fault Zone (Tsidzi *et al*., 1995). It has been reported that the first major seismic activity in Ghana occurred in Elmina (Central Region) in 1615 (Armah and Amlalo, 1998). Thereafter, subsequent events took place in 1636, 1862, 1906, 1939, and 1997. In 1997 alone, three events were recorded in January, February, and March with magnitudes of 3.8, 4.1, and 4.8, on the Richter scale respectively.

The geomorphological conditions of the Ghanaian coast are as described by Ly (1980) in section 1.1.

4.3 HYDROLOGICAL AND HYDROGEOLOGICAL CHARACTERISATION

1. River Discharges

The major rivers which drain the Ghanaian coastal areas are from the west, the Tano, Ankobra, Butre, Pra, Kakum, Amisa, Nakwa, Ayensu, Densu and Volta. Some of these such as the Amisa, Nakwa and Ayensu flow into the sea through lagoons. The Ankobra, Pra and Volta are among the largest and flow all year round. Peak discharges occur in June and July and low discharges in February. The mean discharge rates for the peak months for the Ankobra and Pra rivers are in the order of 110 and 480 m^3/s respectively. The discharge rate for the low flow periods for the Ankobra River is about 4 m^3/s and for the Pra River 70 m^3/s. The largest river in terms of catchment area and volume is the Volta, which was dammed in 1965 for hydroelectric power generation. It now has a regulated flow of approximately 900 m^3/s.
Tables 5.1 and 5.2 show the drainage areas and discharges of some of the major rivers.

Table 5.1 : Drainage areas of main rivers

River	Drainage Area (km^2)
Volta System	165,760
Tano	14,760
Ankobra	8,550
Pra	23,310
Other coastal rivers (Amisa, Nakwa, Ayensu and Densu)	19,420
Total	237,280

Table 5.2 : Mean monthly discharge (m^3/s) of Ghanaian rivers from 1967 to 1996 (Source: Hydrological Services Department).

Month	Volta	Pra	Ankobra	Ayensu	Amisa	Nakwa
Jan	778	94.2	5.0	5.0	2.8	2.8
Feb	825.3	70.8	3.9	2.8	1.9	1.4
Mar	839.0	94.2	21.2	4.0	2.8	3.9
Apr	846.7	117.8	49.6	5.0	5.0	5.0
May	867.7	117.0	70.8	7.1	5.0	5.0
Jun	897.0	460.0	117.8	28.3	28.3	24.8
Jul	895.3	495.6	106.0	21.2	24.8	21.2
Aug	879.3	279.0	28.3	14.2	5.0	7.1
Sep	850.0	247.8	49.6	24.2	10.6	14.2
Oct	828.7	424.8	94.2	14.2	14.2	10.6
Nov	858.7	318.6	318.6	7.1	7.1	10.6
Dec	850.0	117.0	10.6	5.0	5.0	5.0

2. Salinity

The salinity along the coastline ranges between 32 and 36 $^{o}/_{oo}$. In coastal waters close to the major rivers, notably the Ankobra, Pra and the Volta, lower salinity levels of about 28 $^{o}/_{oo}$ may be recorded in the rainy season. Salinity of the coastal waters generally increases from west to east as a result of higher rainfall in the west. Water tables in coastal areas are generally high. However, salt water intrusion in coastal boreholes and wells is a major problem in most coastal areas.

4.4 CHARACTERISATION OF THE COASTAL MARINE MILIEU

1. Current Characteristics

The principal current along the coast of Ghana is the Guinea Current, which is an offshoot of the Equatorial Counter Current and is driven by westward wind stress. The Guinea Current reaches a maximum strength between May and July during the strongest South-West Monsoon Winds when it peaks at 1 knot to 2 knots (approximately 1 m/s). For the rest and greater part of the year, the current is weaker. Near the coast, the strength of the current is attenuated by locally generated currents and winds. The current is less persistent nearshore than farther offshore. The coastal surface currents are predominantly wind-driven and are confined to a layer of 10m to 40 m thickness. The direction of tidal current around the coast of Ghana is mostly north or north-east. The velocity of the tidal current is generally less than 0.1 m/s and the maximum velocity of tidal current observed in a day of strong winds is about 0.5 m/s. The wave-induced longshore currents are generally in the west to east direction which is an indication of the direction the waves impinge the coastline. The longshore currents average approximately 1 m/s and vary between 0.5 m/s and 1.5 m/s. The magnitude increases during rough sea conditions.

2. Tides and Sea Levels

The tide in the coast of Ghana is regular and semi-diurnal. The average range varies along the coast. The tidal wave has virtually the same phase across the coast of the country. The average range of Neap and Spring tides increases from west to east. Tidal currents are low and have an insignificant influence on coastal processes except within tidal inlets. The average ranges of tides along some major coastal cities along the coast of Ghana are summarised in Table 5.3.

Table 5.3 : Average range of tides along major coastal cities

Location	Tidal Range (m)			Phase (°)
	Neap	Mean	Spring	
Takoradi (4°53'N, 1°45'W)	0.58	0.90	1.22	107
Accra (5° 32'N, 0°12'W)	0.62	0.94	1.26	107
Tema (5°37'N, 0°00'E)	0.64	0.96	1.28	107

The sea levels along the same major coastal cities are given by Table 5.4.

Table 5.4 : Sea levels along major coastal cities

Location	M.H.W.S (m NLD)	M.H.W.N (m NLD)	M.L.W.S (m NLD)	M.L.W.N (m NLD)
Takoradi (4°53'N, 1°45'W)	1.5	1.2	0.2	0.6
Accra (5° 32'N, 0°12'W)	1.4	1.2	0.2	0.6
Tema (5°37'N, 0°00'E)	1.4	1.1	0.3	0.7

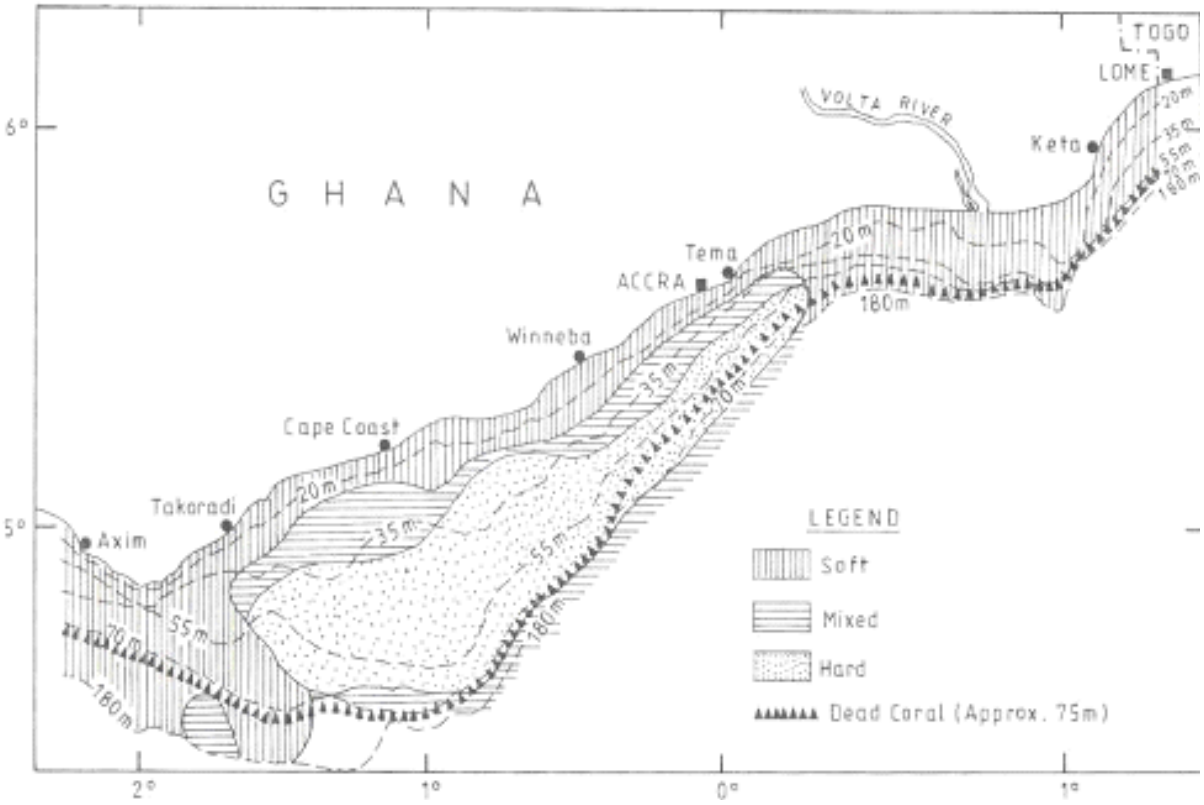
3. Wave Characteristics

Waves reaching the shores of Ghana consist of swells originating from the oceanic area around the Antarctica Continent and seas generated by locally occurring winds. The significant waveheight generally lies between 0.9 m and 1.4 m and rarely attains 2.5 m or more. The peak wave period of the swells generally falls in the range of 7s to 14s. The swell wave direction is almost always from the south or south–west. Other observations on the wave climate include a long swell of distant origin with wavelengths varying between 1m to 2 m. The swells generally travel from south-west to north-east.

4. Continental Shelf, Bathymetrics and Types of Sea Floor

The continental shelf varies in width from a minimum of about 20 km off Cape St. Paul to about 90 km at the widest portion between Takoradi and Cape Coast. Submarine canyons exist off the Volta Delta (Edwards *et al.*, 1997). A belt of dead madreporarian coral beginning at 75 m seaward traverses the entire shelf. Beyond this coral belt, the bottom falls sharply, marking the transition from the continental shelf to the slope. Soft sediments predominate along the coastline up to the coral belt.

Figure 5.1 : Marine environment of Ghana showing configuration of the coastline and bathymetry (Source: Armah and Amlalo, 1998)



The shelf has been considered seismically stable, but recent tremors suggest the presence of some crustal instability. An active faulting has been identified near the intersection of the east-west coastal boundary fault zone and the northeast to southeast Akwapim fault zone (Tsidi *et al.* 1995).

The nature of the topography of the Ghanaian continental shelf is generally known. Table 5.5 gives the surface areas of sedimentological subdivisions.

Table 5.5 : Approximate surface areas of offshore sedimentological subdivisions

Zone	Substrate	Area (km^2)
Inshore (10-50 m)	Soft (muddy to sandy mud)	8,700
	Hard and sandy	2,700
	Rocky and non trawlable	300
	SUB-TOTAL	11,700
Offshore (50-200 m)	Soft	6,500
	Hard and sandy	2,000
	SUB-TOTAL	8,500
	Total	20,200

5. Temperatures of Coastal Waters

The temperature for the coastal waters ranges from about 16.3°C to about 28.8°C. Many deepwater sites exhibit numerous distinctly stratified thermoclines while shallow near shore sites demonstrate a distinct primary thermocline with a linear temperature gradient to the bottom. The average surface temperature of the photic zone along the coast is about 27.8°C.

4.5 LAND BIODIVERSITY

The vegetation types of the coastal zone reflect the rainfall gradient and are coastal shrub and savannah, marginal forest, dry semi-deciduous and moist semi-deciduous forest, and wet evergreen forest. Also, the coast supports mangroves. A notable forest reserve is the Kakum National Park near Cape Coast.

The zone is endowed with natural resources, which are exploited by different sectors of the economy. The major primary activity of the zone is fishing. Other activities of economic importance include agriculture. The zone is also very important internationally as it provides feeding, roosting and nesting sites for thousands of migratory and resident birds. The lagoon, estuary and delta ecosystems also provide suitable environments for shellfish and fish breeding. The mangroves and the coastal forests are under great threat due to factors such as population growth and economic activity. The coastal populations, especially the rural fishing communities, are relying increasingly on the forest and mangrove as the main sources of fuel wood for cooking and fish smoking. The result has been the gradual loss of mangroves at several localities, especially around semi-closed lagoons along the coastal belt.

Ghana's coastal wetlands form an ecologically important unit. The sites include the five coastal Ramsar sites Muni-Pomadzi, Densu delta, Sakumo, Songor and Keta lagoons; and other sites such as Esiama beach, River Whim estuary, Elmina salt pans, Amisano, Nakwa, Liawi salt pans, Djenge lagoon and Atiteti (GWS annual report, 2001). Birds have been well studied in many habitats and ecological settings and their habitat associations have been well understood. Long-term continuous monitoring of the population and species composition of birds provide invaluable information on the ecological changes within the habitat. The increasing number of the shoreline birds' population along the coastline of Ghana gives an indication that the coastal wetlands are well conserved.

Significant populations of biodiversity which are threatened or endangered include the est Africa Manatee and five species of marine turtles. The Sitatunga (*Tragelaphus spekei gratus*) which is the world's only amphibious antelope has been recorded in the Avu lagoon. It is among the wholly protected animals species in Ghana.

4.6 MARINE BIODIVERSITY

The Ghanaian shores have six major types of marine coastal ecosystems i.e. the sandy marine shore ecosystems, rocky marine shore ecosystems, coastal lagoon ecosystems, mangrove/tidal forest ecosystems, estuarine wetland ecosystems and depression wetland ecosystems (EPA, 2004).

1. Sandy Marine Shore Ecosystems

Sandy marine shore ecosystems are the most prominent type of marine coastal ecosystems in Ghana. About 385km of the total 550 km coastline of Ghana is made up of sandy shores.
Fauna species diversity encountered include the ghost crab (*Ocypoda cursa*), the isopod *Excirolana latipes*, the amphipods *Urothoe grimaldi* and *Pontharpinia intermedia,* the mysid *Gastrosaccus spinifer*, mole crab (*Hippa cubensi)*, the polychates *Narine cirratulus, Glycera convoluta* and *Lumbrinereis impatien*s, the bivalve *Donax pulchellus* and the gastropods *Terebra micans* and *Olivancillaria hiatula* (Gauld & Buchanan, 1956). The benthic fauna on the shallow water off sandy beaches consists of polychaetes, arthropods, molluscs, bryozoans and echinoderms (Bassindale 1961; Buchanan, 1957; and Evans *et al*. 1993). Edmunds (1978) recorded 68 taxonomic families of mollusc. Fish A number of fish species found typically in shallow sandy seabed areas including the sergeant major fish (*Abudefduf saxatilis*), soles and tongue soles. Pelagic species such as mackerel and sardinellas are found in coastal waters (Irvin, 1947).
Strand vegetation encountered include the creepers *Canavalia rosea* and *Ipomea pes-caprae* in association with the grasses *Cyperus maritimus* and *Diodia vaginalis*, and the prickly pear cactus (*Opuntia vulgaris*). Also, the vegetation may include the dwarf palm, *Phoenix reclinata* and the shrubs *Baphia nitida*, *Grewia spp*, *Sophora occidentalis*, *Thespesia populnea* and *Triumfetta rhombaidea*. Coconut palms are also very common along the sandy shores (Taylor, 1960; Boghey 1957).

2. Rocky Marine Shore Ecosystems

Rocky marine shore ecosystems occur as rocky out-cropping alternating with sandy bays (Lawson, 1956). The rocks are substrate for a wide variety of species of macroalgae, barnacles, snails and limpets. Algae Dominating species of macroalgae include: *Sargassum vulgare*, *Dictyopteris delicatula*, *Ulva fasciata, Chaetomorpha sp.*and *Lithothamnia sp.* (Lawson, 1956). The common snails are the *Littorina punctata*. Other snails often encountered include *Nodilittorina meleagris, Nerita senegalensis* and the whelk *Thais haemastoma*. The dominating limpets are *Siphonaria pectinata, Fissurella nubecula* and *Patella safiana.* At some sites oysters (*Ostrea sp.*) are found among the barnacles (Lawson, 1956). A number of fish species are characteristic of rocky seabeds. These include rainbow wrasses (*Coris julis*), parrot wrasse (*Callyodon*), morays and scorpionfishes.

Tide pools, which are stagnant water in hollows and depressions of rocks established at low tides, house a quite rich vegetation of algae and a diverse fauna of invertebrates and fish. Due to the constantly changing temperature, salinity and oxygen concentrations in the tide pools only hardy organisms well adapted to the changing conditions are encountered. The algae include: *Sargassum vulgare*, *Dictyopteris delicatula*, *Dictyota spp.*, *Padina durvillei* and *Galaxaura marginata.* Tide pools in the supra-littoral zone are usually free from sand and are lined by *Lithothamnia sp.* and *Ralfsia expansa*. The fauna encountered in tidal pools include crabs and sea urchins such as *Echinometra lucunter.* The fauna in the tide pools also include the damselfish *Microspathodon frontatus*, *Rupescartes atlanticus* and juveniles of *Abdefduf hamyi*, the sergeant major fish (*Abdefduf saxatilis*) and the parrot-fish *Pseudoscarus hoefler.*

3. Coastal Lagoon Ecosystems

Coastal lagoon ecosystems are an important feature of the coastline of Ghana. There are more than 90 lagoons along the Ghanaian coastline. There are two types of coastal lagoons - 'open' and 'closed' lagoons. Open lagoons have a permanent opening to the sea; while closed lagoons typically lie behind a sand barrier, which separates them from the sea.
Coastal lagoon ecosystems house a wide variety of fish, shrimps, crabs, mollusc and polychaete species. Some lagoons are wintering sites for Palaearctic birds as well as roosting sites for local waterfowls. The species diversity in closed lagoons is low. The Tilapia *Sarotherodon melanotheron* is usually the dominant fish species in closed lagoons (Pauly, 1976). The species diversity in the open lagoons is much higher than in the closed lagoon. Pauly (1975) defines four groups of fish and shrimps in open coastal lagoons thus:

- Freshwater fish which swim into the lagoon during the rainy season (including the species *Clarias anguillaris*, *Hemichromis bimaculatus*, *Oreochromis niloticus* and *Tilapia zillii*.
- Fish species that spend all or most of their lives in the lagoon including the tilapia species *Sarotherodon melanotheron,* the mudskipper *Priopthalmus kaelruti* and different species of gobids.
- Marine fish species that come into the lagoon for short incursions, such as *Albula vulpes*, *Lutjanus fulgens* and *Lethrinus sp*.
- Those that spawn at sea but have their juvenile forms washed into the lagoon just after the rainy season. The species use the lagoons as nursery grounds, where they feed. Examples of species are the fish *Mugil sp* and *Gerres melanopterus* and the shrimp species *Penaeus duorarum* and *Parapenaeopsis atlantica*.

4. Mangrove / Tidal Forest Ecosystems

The occurrence of mangroves along the Ghanaian coast is sparse. In 1995, the total area of land occupied by mangroves was estimated to be around 10,000 ha (Saenager and Bellan, 1995). Today, the area is probably significantly smaller. Five species of mangroves are found in Ghana, which are the red mangroves, *Rhizophora racemosa*, *Rhizophora mangle* and *Rhizophora harrisonii*; and the white mangroves *Avicennia germinans* and *Laguncularia racemosa*.

The red mangroves are the primary colonists in the open lagoon systems, which have regular tidal exchange whereas the white mangroves are the primary colonists in closed lagoons (Sackey *et. al.*, 1993). One of the obvious exceptions to this is the Korle Lagoon in Accra, which is an open type but colonized exclusively by the white mangrove *Avicennia germinans.*

Besides the lagoons, mangroves occur in the Volta Delta and the flood plains of the Kakum River at Iture. The best stands of mangroves in Ghana are found at the Volta Delta where the most common species is *Rhizophora racemosa*. The highest species diversity of mangroves in Ghana occurs at the Iture stand. Here, five species of true mangroves occur, i.e., *Rhizophora racemosa, Rhizophora harrisonii*, *Rhizophora mangle*, *Avicennia germinans* and *Languncularia racemosa*. Other associated vegetation include: *Conocarpus erectus*, *Thespesia populnea*, *Acrostichum aureum*, *Phoenix reclinata*, *Sessuvium portulacrastrum* and *Phylloxerus vermicularis .*

In the drier areas of the mangrove habitats, where less saline or normal soils occur, other species such as *Dahlbergia escastophyllum*, *Drepanocarpus lunatus*, *Hibiscus tiliaceous* and *Terminalia catappa* may be found.

In the mangroves, an abundance of oysters, gastropods, crabs (such as *Sesarma sp*.and *Uca sp*) and invertebrate larvae feed on the enormous deposits of organic matter provided by mangrove trees and the large amount of sediments trapped by the mangrove roots. Mangroves in open lagoons and river deltas are important as nursery and feeding areas for marine fish and shrimps. Birds such as herons and cormorants raise their young in mangroves.

5. Estuarine Wetland Ecosystems

Estuarine wetlands comprise all wetland areas, which are exposed when the tide is out as well as the plains of estuaries, which are seasonally inundated during the rainy season. Again, the Volta River estuary wetland is the most prominent although due to the construction of two large dams upstream, seasonal flooding of the plains have been significantly reduced, altering the natural characteristics of this extensive wetland. Extensive stands of mangrove and other species typical of swamp forests still exist. Other floodplain wetlands occur in the west of the country where rainfall is high.

Estuarine fishes include the tarpon *(Megalops*), the shad (*Ethmalosa frimbriata*), the long finned herring (*Ilisha africana*), the ten-pounder (*Elops lacerta*), the barracuda (*Sphyraena sphyraena*), the flatfish *Citarichthys stampflii*, the tongue sole (*Cynoglossus senegalensis*), the pompano (*Trachinotus gorensis*), drums (*Pseudotolithus elongatus, Pseudotolithus epipercus),* the burro fish (*Pomadasys jubelini* and *Pomadasys peroteti*) as well as the burrito (*Brachydeuterus auritus*) and the threadfin (*Pentanemus quinquarius*) (Schneider, 1990)

6. Depression Wetland Ecosystems

Depression wetlands are those not linked to any significant watercourse. Rainfall is high throughout the year which sustains such wetlands despite the absence of any drainage system connected to them. Belibangara, Ndumakaka, Efasu and Ehuli are some of the depression wetlands.

7. Migratory Species

Ghana's coastal wetlands provide feeding, roosting and nesting sites for thousands of migratory and resident birds. Table 5.6 gives the major coastal wetlands which support migratory birds.

Table 5.6 : Important seashore bird sites in Ghana (Source: EPC, 1990)

Site	Maximum Number of Birds Recorded	Status of Sites
Esiama Beach	10,000	Important
Elmina Salt Pan	5,000	Fairly important
Muni Lagoon	12,000	Important
Densu Delta and Panbros Salt Pans	30,000	Important
Korle Lagoon	12,000	Important
Sakumo Lagoon II	14,000	Very Important
Laiwi Salt Pans	5,000	Fairly important
Songor Lagoon Complex	55,000	Outstandingly important
Atiteti (Volta Mouth)	9,000	Fairly Important
Keta Lagoon Complex	55,000	Outstandingly important

The following tables present the peak counts and national importance of the most abundant seashore bird species recorded at some of the major wetlands.

Table 5.7 : Peak counts and national importance of the most abundant seashore birds recorded at Songor (as at 30th June 1991). (Source: Ntiamoah- Baidu and Gordon, 1991)

Species	Max. count entire coast	Peak at Songor	% of entire coast
SHOREBIRDS			
Black-winged stilt	12,460	4,390	35.2
Avocet	3,750	3,740	99.8
Pratincole	1,700	40	2.3
Ringed plover	6,160	3,010	48.9
White-fronted sand plover	110	70	63.6
Kittlitz's sand plover	480	140	29.2
Grey plover	2,780	980	35.2
Knot	2,360	1,490	63.1
Sanderling	6,480	700	10.8
Little stint	12,350	2,530	20.5
Curlew sandpiper	27,980	6,920	24.7
Black-tailed godwit	1,590	200	12.6
Bar-tailed godwit	500	130	26.0
Whimbrel	460	30	6.5
Curlew	360	10	2.8
Spotted redshank	10,440	10,060	96.4
Redshank	450	50	11.1
Marsh sandpiper	290	160	55.2
Greenshank	8,350	5,070	60.7
Wood sandpiper	600	40	6.7
Common sandpiper	600	90	15.0
Turnstone	440	80	18.2
TERNS			
Caspian tern	440	110	25.0
Royal tern	7,550	2,570	34.0
Sandwich tern	6,080	5,120	84.2
Roseate tern	400	70	17.5
Common tern	12,660	11,900	94.0
Little tern	3,240	2,740	84.6
Black tern	20,680	18,060	87.3
OTHER WATERFOWL			
Long-tailed cormorant	790	110	13.9
Pink-backed pelican	900	410	45.5
Western reef pelican	1520	1,020	67.1
Western reef heron	6,400	4,460	69.7
Little egret	1,860	180	9.7
Grey heron	1,720	460	26.7
White-faced tree duck	7,060	410	2.4
Black headed gull	280	190	67.9
Lesser black-backed gull	760	540	71.1

Table 5.8: Peak counts and national importance of the most abundant seashore bird species recorded at Muni (as at 30th June 1991). (Source: Ntiamoah- Baidu and Gordon, 1991)

Species	Max. Count entire coast	Peak at Muni	% of entire coast
SHOREBIRDS			
Black-winged stilt	12460	150	1.2
Avocet	3750	50	1.3
Pratincole	1700	40	2.4
Ringed plover	6160	320	5.2
White fronted sand plover	110	25	22.7
Grey plover	2780	130	4.7
Knot	2360	30	1.3
Sanderling	6480	150	2.3
Little stint	12350	160	1.3
Curlew sandpiper	27980	840	3.0
Black-tailed godwit	1590	50	3.1
Bar-tailed godwit	500	30	6.0
Whimbrel	460	30	6.5
Marsh sandpiper	290	40	13.8
Greenshank	8350	320	3.8
TERNS			
Royal tern	7550	3200	42.4
Sandwich tern	6080	2100	34.5
Roseate tern	400	80	20.0
Common tern	12660	8210	64.8
Little tern	3,240	210	6.5
Black tern	20,680	3520	17.0
HERONS			
Western reef heron	1520	80	5.3
Little egret	6400	270	4.2
Great white egret	1860	20	1.1

Table 5.9: Peak counts and national importance of the most abundant seashore birds recorded at Sakumo (as at 30th June 1991). (Source: Ntiamoah- Baidu and Gordon, 1991)

Species	Max. Count entire coast	Peak at Sakumo	% of entire coast
SHOREBIRDS			
Black-winged stilt	12,460	900	7.2
Avocet	3,750	450	12.0
Pratincole	1,700	1420	83.5
Ringed plover	6160	1040	16.9
White-fronted sand plover	110	20	18.2
Kittlitz's sand plover	480	100	20.8
Grey plover	2780	300	10.8
Knot	2360	210	8.9
Sanderling	6480	180	2.8
Little stint	12350	2570	20.8
Curlew sandpiper	27,980	3270	11.7
Ruff	300	300	100
Black-tailed godwit	1,590	1460	91.8
Bar-tailed godwit	500	200	40.0
Whimbrel	460	40	8.7
Curlew	360	10	2.8
Spotted redshank	10,440	3280	31.4
Redshank	450	30	6.7
Marsh sandpiper	290	110	37.9
Greenshank	88350	1180	14.1
Wood sandpiper	600	190	31.7
Common sandpiper	600	150	25.0
Turnstone	440	140	31.8
Jacana	400	170	38.6
TERNS			
Royal tern	7550	340	4.5
Sandwich tern	6080	610	10.0
Roseate tern	400	40	10.0
Common tern	12660	2150	16.9
Little tern	3240	200	6.2
Black tern	20680	2630	12.7
OTHER WATERFOWLS			
Long-tailed cormorant	790	60	7.6
Squacco heron	600	110	18.3
Black heron	140	130	92.8
Western reef heron	1520	1020	67.1
Little egret	6400	1360	21.2
Great white egret	1860	380	20.4
Grey heron	1720	740	43.0
Glossy ibis	120	10	8.3
White-faced tree duck	17,060	640	3.7
Garganey	7450	830	11.3
Teal	140	140	100
Black-headed gull	280	30	10.7
Lesser black-backed gull	760	10	1.3

Table 5.10: Peak counts and national importance of the most abundant seashore birds recorded at Densu Flood-plain (as at 30th June 1991). (Source: Ntiamoah- Baidu and Gordon, 1991)

Species	Max. Count Entire coast	Peak at Densu Delta	% entire coast
SHOREBIRDS			
Black-winged stilt	12460	310	2.5
Avocet	3750	100	2.7
Pratincole	1700	330	19.4
Ringed plover	6160	1560	25.3
White-fronted sand plover	110	10	9.1
Kittlitz's sand plover	480	30	6.2
Grey plover	2780	340	12.2
Knot	2360	30	1.3
Sanderling	6480	230	3.5
Little stint	12350	2610	21.1
Curlew sandpiper	27980	4730	16.9
Ruff	300	20	6.7
Bar-tailed godwit	500	10	2.0
Whimbrel	460	30	6.5
Curlew	360	5	1.4
Spotted redshank	10440	550	5.3
Marsh sandpiper	290	30	10.3
Greenshank	8350	390	4.7
Wood sandpiper	600	50	8.3
Common sandpiper	600	50	8.3
Turnstone	440	50	11.4
TERNS			
Royal tern	7550	2590	34.3
Sandwich tern	6080	1970	32.4
Roseate ternn	400	200	50.0
Common tern	12660	3130	24.7
Little tern	3240	930	28.7
Whiskered tern	100	30	30.0
Black tern	20680	2250	10.9
OTHER WATERFOWL			
Long-tailed cormorant	790	130	14.4
Squacco heron	600	20	3.3
Black heron	140	2	1.4
Western reef heron	1520	310	20.4
Little egret	6400	1630	25.5
Great white egret	1860	290	15.6
Black headed gull	280	60	21.4
Lesser black-backed gull	760	30	3.9

Table 5.11: Peak counts and national importance of the most abundant seashore birds recorded at Anlo-Keta (as at 30th June 1991). (Source : Ntiamoah- Baidu and Gordon, 1991)

Species	Max. Count entire coast	Peak at Keta	% entire coast
SHOREBIRDS			
Black-winged stilt	12,460	12,080	96.9
Avocet	3,750	1,560	41.7
Pratincole	1,700	1,010	59.4
Ringed plover	6,160	2,860	46.4
White-fronted sand plover	110	50	45.5
Kittlitz's sand plover	480	390	81.3
Grey plover	2,780	1,390	50.0
Knot	2,360	2,340	99.1
Sanderling	6,480	580	8.9
Little stint	12,350	5,790	46.9
Curlew sandpiper	27,980	14,810	52.9
Ruff	300	140	46.7
Black-tailed godwit	1,590	1,270	79.9
Bar-tailed godwit	500	230	46.0
Whimbrel	460	60	13.0
Curlew	360	330	91.7
Spotted redshank	10,440	8,330	79.8
Redshank	450	170	37.8
Marsh sandpiper	290	260	89.6
Greenshank	8,350	6,910	82.7
Wood sandpiper	600	540	90.0
Common sandpiper	600	280	46.7
Turnstone	440	110	25.0
Jacana	400	280	70.0
TERNS			
Caspian tern	440	440	100
Royal tern	7,550	290	3.8
Sandwich tern	6,080	520	8.5
Roseate tern	400	10	2.5
Common tern	12,660	2,770	21.9
Little tern	3,240	810	25.0
Whiskered tern	130	130	100
Black tern	20,680	1,870	9.0
OTHER WATERFOWL			
Long-tailed cormorant	790	650	82.3
Pinked-backed pelican	900	690	76.7
Squacco heron	600	570	95.0
Black heron	140	40	28.6
Western reef heron	1,520	1,420	93.4
Little egret	6,400	3,980	62.2
Great white egret	1,860	1,650	88.7
Purple heron	100	100	100
Grey heron	1,720	1,170	68.0
Glossy ibis	120	80	66.7
White-faced tree duck	17,060	17,040	99.9
Garganey	7,450	6,910	92.7
Teal	140	110	78.6
Black-headed gull	280	100	35.7
Lesser black-backed gull	760	500	65.8
Little gull	225	130	59.1

APPENDIX

Appendix A1.1 : stakeholders for the management of coastal and marine issues

The following stakeholders have been identified to be involved on issues related to the management of the coastal and marine environment.

- Ministry of Water Resources, Works and Housing / Hydrological Services Department
- Ministry of Science and Environment / Environmental Protection Agency
- Ministry of Local Government / District Assemblies
- Ministry of Tourism
- Ministry of Transport
- Ghana Ports and Harbours Authority
- Ministry of Food and Agriculture
- Ghana Tourist Board
- Ghana Investment Promotion Centre
- Fisheries Commission
- Ministry of Trade and Industry
- Ministry of Lands and Forestry
- Ministry of Energy
- Ministry of Health
- Ministry of Education
- Ministry of Defence
- Ghana Navy
- Ghana National Petroleum Corporation
- Volta River Authority
- Geological Survey Department
- Forestry Commission (Forestry and Wildlife Division)
- National Development Planning Commission
- Council for Scientific and Industrial Research
- Universities and Research Institutions
- Ghana Meteorological Agency; and
- Town and country Planning Department
- Water Resources Commission
- Ghana Commission on Culture / Traditional Rulers
- Non-Governmental Organizations; e.g. Resource & Environmental Development Organization, Friends of the Earth, Green Earth, Wildlife Society, Guinea Current Large Marine Ecosystems, Recercae Cooperazione, Centre for African Wetlands, Coastnet, etc.

REFERENCES

LIST OF ILLUSTRATIONS