

**COASTAL WETLANDS MANAGEMENT PROJECT  
(CWMP)**

**KETA LAGOON COMPLEX RAMSAR SITE  
MANAGEMENT PLAN**

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*prepared for*

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# MANAGEMENT PLAN FOR KETA LAGOON COMPLEX RAMSAR SITE

1.	BACKGROUND.....	1
1.1	Terms of Reference (TOR) .....	2
2.	SITE DESCRIPTION.....	2
2.1	Location and Boundary.....	2
2.2	Status.....	4
2.3	Land Tenure .....	5
<b>2.4.</b>	<b>General Information.....</b>	<b>6</b>
2.4.1	Topography and Drainage.....	6
2.4.2	.....	G
	ecology.....	6
2.4.3	.....	S
	oils.....	6
2.4.4	Climate.....	6
2.4.5	.....	S
	urface Water.....	8
2.4.6	Water Quality.....	9
<b>2.5</b>	<b>Ecological.....</b>	<b>10</b>
2.5.1	Flora in the Keta Lagoon Complex Ramsar Site.....	10
2.5.2	Fauna .....	12
<b>2.6</b>	<b>Socio-Economic Features.....</b>	<b>13</b>
<b>3.0</b>	<b>REVIEW OF EXISTING MANAGEMENT PLAN.....</b>	<b>15</b>
3.1	Staff strength, qualifications and deployment .....	15
3.2	Job description .....	15
3.3	Implementation of management measures.....	16
3.4	Public awareness and education .....	18
3.5	Community Participation in site management.....	18
3.7	.....	
	Community Infrastructure development.....	19
3.7	Management stakeholder collaboration for sustainable wetland resources exploitation.....	19
3.8	.....	
	Aesthetic, and cultural value.....	19
3.9	Recreation.....	20
<b>4.</b>	<b>REVIEW OF CURRENT INSTITUTIONAL ARRANGEMENT FOR MANAGEMENT</b>	<b>21</b>
4.1	Wildlife Division.....	21
4.2	District Assemblies .....	21
4.3	Non-Governmental Organisations (NGOs) .....	22
4.4	Traditional Authorities.....	22
4.5	Major Stakeholders and Local Communities .....	23
4.6	Strategies for Improvement towards long-term Participation.....	23

5.	LONG-TERM OBJECTIVES FOR SUSTAINABLE MANAGEMENT AND FACTORS INFLUENCING THEIR ATTAINMENT .....	25
5.1	Long-term Management Objectives, .....	25
5.2	Constraints .....	25
5.2.1	Internal Natural Factors (succession, water level dynamics) .....	25
5.2.2	Internal Human Induced Factors .....	26
5.2.3	External Natural Factors (eg climate) .....	27
5.2.4	External Human Induced Factors (eg dams upstream) .....	28
5.2.5	Factors Arising From Legislation or Tradition .....	28
5.2.6	Physical Considerations (eg inaccessibility) .....	28
5.2.7	Available Resources (including Finance) .....	29
5.3	Measures for Addressing Constraints .....	29
5.4	Operational Objectives .....	31
<b>6.0</b>	<b>ACTION PLAN/PRESCRIPTIONS .....</b>	<b>33</b>
6.1	Activities Undertaken so far .....	33
6.2	Species Management .....	33
6.2.1	Management of the Flora .....	33
6.2.2	Faunal Management .....	34
6.3	Marine Turtles .....	41
6.4	Land Management .....	41
6.4.1	Compatibility of Land uses .....	41
6.4.2	Major Land uses .....	41
6.4.3	Drastic Changes in Hydrological Conditions of the KLCRS .....	42
6.4.4	Fertilizer Use .....	42
6.4.5	Pesticide Use .....	43
6.4.6	Environmental Health .....	43
6.5.0	Monitoring and Evaluation .....	43
6.5.1	Monitoring .....	43
6.5.2	Guidelines .....	43
6.5.3	Fragility of the wetland ecosystem .....	44
6.5.4	Rarity/Decline of popular species .....	44
6.6.0	Research .....	45
6.7	Projects and Estimated Cost .....	46
6.8	Project Details .....	47
<b>7.</b>	<b>ADDITIONAL INFORMATION .....</b>	<b>58</b>
7.1	References .....	58
7.2	Species Lists .....	60
7.3	Budget .....	64
7.4	Profile on KLCRS .....	65

**LIST OF FIGURES**

Map of Keta Lagoon Complex Ramsar Site.....3

**LIST OF TABLES**

Table 1. Mean values of ionic concentrations of selected ions in Keta lagoon.....10

Table 2 Staff Strength, Qualification and Deployment .....15

Table 3. Staff Positions and their Responsibilities .....16

Table 4 Recommended Action Plans/Prescriptions For Management of  
Keta Lagoon Complex Ramsar Site.....35

## **1.0 BACKGROUND**

A management strategy was formulated for Ghana's coastal wetlands in 1991 (Ntiamoah-Baidoo and Gordon, 1991). This document described the biological importance of wetlands along the coast of Ghana and the dependence of local communities on wetland resources. The document also identified some threats to wetlands and provided recommendations for conservation practices necessary to maintain their ecological integrity while enhancing benefits derived from them wetlands by local communities. On the basis of this document, the Ghana Coastal Wetlands Management Project (CWMP) funded by the Global Environment Facility (GEF) and administered by the World Bank was initiated in 1993. It is being implemented by the Wildlife Division of the Forestry Commission. The project focused on five key wetlands which have also been designated as RAMSAR sites namely Keta Lagoon Complex, Songor. Sakumo. Densu Delta and Muni-Pomadze lagoons.

Since the formulation of the management strategy in 1991, various baseline studies have been undertaken at these five sites covering flora, fauna, hydrology, limnology, soils and socio-economic aspects of the within and around the RAMSAR sites.

Based on these studies, a participatory management process has been put in place at these wetlands sites. The project is assisting in poverty alleviation and infrastructural development in the local communities as well as increasing public awareness on the value a uses of wetlands and the need for sustainable use of the resources therein. The development of a management plan is seen as one of the key activities necessary to consolidate the achievements of the CWMP. The purpose of such a management plan is to outline a well defined management system that will continue to build on the sound foundation of wetlands management that has been established through the Coastal Wetlands Management Project.

It is with this background that the Wildlife Division organised a one-day consultative workshop that brought together District Assemblies, traditional authorities opinion leaders, social and environmental scientists and other major stake-holders whose activities affect the designated wetlands. The workshop discussed Management Plan implementation and achievements. The views of the stakeholders were sampled and noted.

Based on the experience of the participating resource persons at the workshop, five working groups were set up with each group responsible for collating the results of various scientific and workshop reports and outlining the format for the drafting of the icspective management plans. This group was tasked to review the existing management plan and develop a new one for the Keta Lagoon Complex RAMSAR site.

The revised management plan will look at broader issues operating concurrently within the same environment namely rural development, poverty alleviation, natural resource development- and thus integrate interventions from several sectors -local government.

Ministry of Lands and Forestry, Ministry of Energy, Environment, Agriculture, Trade and Tourism and the National Board for Small Scale Industries, among others.

## **1.1 The Terms of Reference**

The Terms of Reference for the development of a management plan for the Keta Complex Ramsar site is presented as follows:

- i. Collate and evaluate available biophysical information for the Keta Lagoon Complex Ramsar Site
- ii. Review existing site management plan for the -site with particular reference to.
  - a. Staff strength, qualifications and deployment.
  - b. Implementation of management measures.
  - c. Public awareness and education.
  - d. Community participation in site management.
  - e. Community infrastructure development; and
  - f. Management-stakeholder collaboration for sustainable wetlands resource exploitation ;
- iii. Review the current involvement of the Wildlife Division, District Assemblies NGOs, traditional authorities, major stakeholders and local communities in management of the Keta site and formulate strategies for improvement to ensure their long-term participation;
- iv. Formulate long-term objectives for the sustainable management of the Keta site according to the Ramsar wise use concept;
- v. Identify factors influencing the attainment of the long-term objectives and outline measures to address them within a five-year implementation period. Particular attention should be given to reference (ii) above.
- vi. Based on the review, formulate objectives and the management interventions, develop fully costed five-year integrated management plans for the Keta Lagoon Complex Ramsar Site for donor support. In doing this, identify the specific time-bound outputs and indicators which would be used to evaluate the success of the interventions.

## **2.0 SITE DESCRIPTION**

### **2.1 Location and Boundary**

The Keta Lagoon Complex Ramsar Site (KLRS) is situated in the Southern part of Volta Region. The Wetland is located between latitudes 5° 45' N and 6° 05' N and Longitudes 0° 50'E and 1° 08' E. It is bordered on the west by the Volta River, in the south and east by the Gulf of Guinea and in the north by the highway linking Accra Lome (Figure 1.).

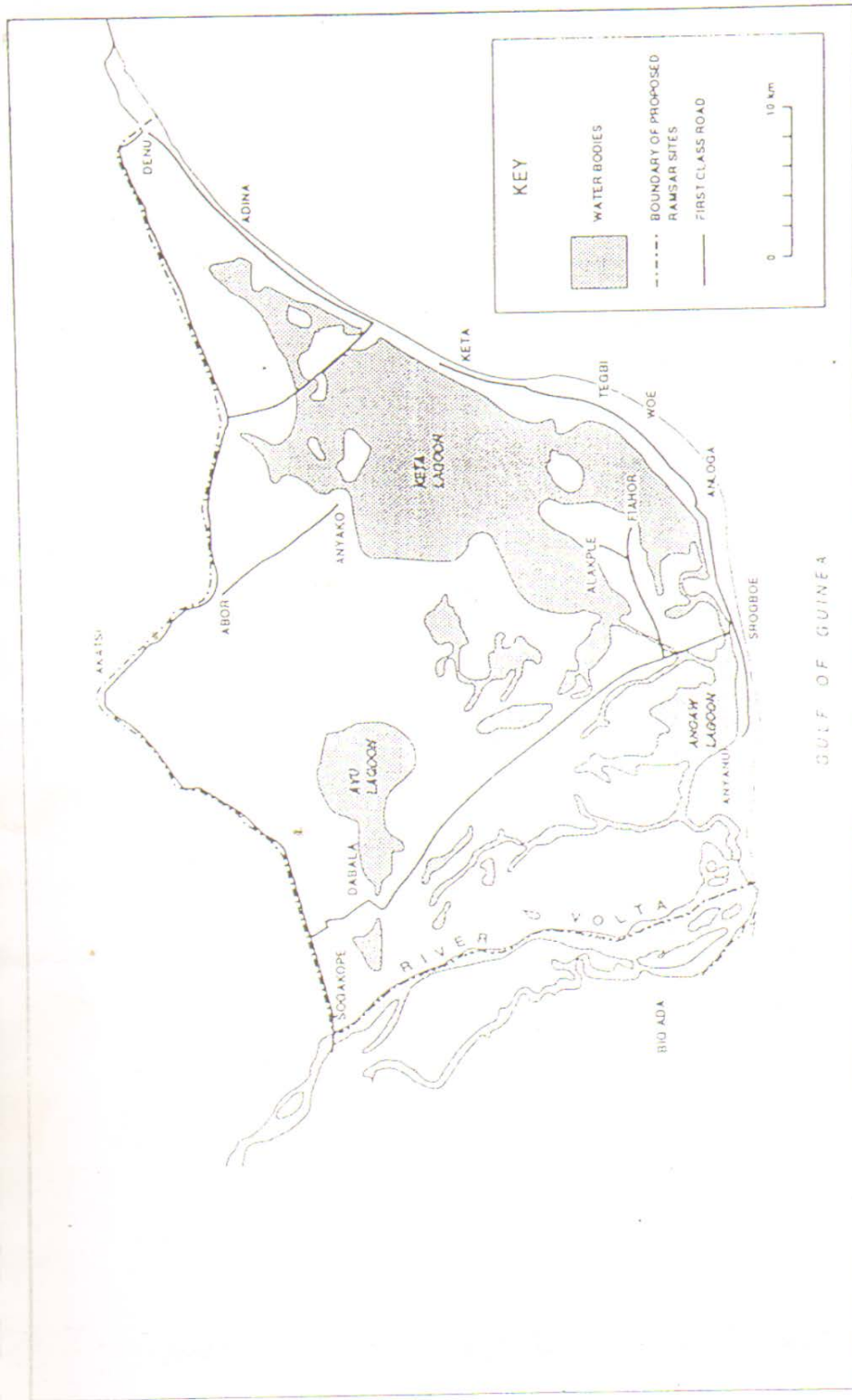


Figure 1: Map the Keta Lagoon Complex Ramsar Site.



## 2.2 Status

The Ramsar Site comprises a large expanse of open lagoon with brackish water, flood plain, marshland and extensive mangrove stands. The lagoon is interconnected to the Avu lagoon located in the northern part and also to the delta of the Volta River through series of inter-connecting streams. The Keta lagoon complex is generally closed to the sea. The open water of Keta Lagoon is estimated to cover an area of 300 km<sup>2</sup> which varies with the season. The Site itself covers 530km<sup>2</sup> stretches for 40 km along the coast. It is separated from the sea by a narrow coastal ridge which is only 2.5 km at its widest point and 0.92 km at the narrowest portion. The total catchment area feeding the lagoon is about 2900<sup>2</sup> and was designated as a Ramsar site in 1992.

Keta Lagoon Complex Ramsar Site (KLCRS) is located within the following districts: Keta, Ketu, Akatsi, and South Tongu. Along the main Accra -Aflao road, the site can be accessed from Dabala, Akatsi and Abor junctions. The site has numerous settlements: flood plains consisting of marsh, scrub and farm lands and substantial mangrove stands, which are heavily exploited for fuelwood.

The construction of the Akosombo dam has been blamed for a number of ecological changes which have occurred within the site in the recent past. These include silting and blockage of the channels interconnecting the lagoons which is thought to disrupt the direct and natural drainage system that used to regulate the lagoon water levels. The result is that in the dry season, large areas of the lagoon and marshlands dry up, leaving small pools of hyper-saline water. In the wet season and during heavy rainfalls, the water level in the lagoon becomes so high that houses and crops around the periphery of the lagoon become inundated.

The indigenous people within the site are the Anlos in the south, the Tongus and Avenors in the north. Fishing (both marine and lagoon), salt wining and vegetable farming are the main occupations of the people in the south, while those in the northern sectors are mainly farmers with some fresh water fishing in the areas along the rivers and channel. The southern part is famous for its shallots and market gardening and produces large quantities of onion and okro. Other crops grown include pepper, tomatoes, cassava and maize. Lagoon fisheries is a major source of livelihood for many people in the area. The species caught are mainly tilapias which are sold locally and as far as Accra. Salt mining is a substantial industry, particularly during the drier periods of the year, November to March. Mangrove exploitation for fuelwood is another important source of income in the area; stacks of mangrove wood are usually sold along the main road from the Srog'r to Keta. A major fuelwood market thrives in the village of Anyanui, where the wood is transported in canoes from the mangrove stands.

Three major socio-ecological problems are apparent in the Keta Lagoon Complex Ramsar Site:

- Severe coastal erosion: over the past 50 years, the coastline in the area is reported to have receded by some 500 m (Dorbu, 1985) and the ruins of eroded houses are a common sight from Keta through Vodza to Kedzi.
- periodic flooding of the lagoon and its surroundings which occurs rapidly with the onset of the rains, leading to destruction of farms, houses and other property.
- Insufficient land, suitable for both farming and human settlement leading to high human population densities.

Various works have been done at the site viz; fisheries (Shenker et.al 1998), hydrobiology (Finlayson et al., 1998) soils and land use (Amatekpor, 1997) and migratory birds populations (Ntiamo-Baidu and Gordon, 1991; Ntiamo-Baidu and Hepburn, 1998).

The lagoon exhibits significant spatial and temporal variability in environmental conditions. Salinity is the most variable parameter reflecting different river run-off and evaporation conditions at different parts of the lagoon.

Twelve fish species have been found in the lagoon (Shenker, et al. 1998) with the black chin tilapia (*Sarotherodon melenantheron*) and the redchin tilapia (*Tilapia guineensis*) being the most dominant species. Their small size at maturity indicate that the fisheries is under extreme fishing pressure. There are also indications that catches from the lagoon have been reducing in numbers and in value with certain species becoming rare or completely absent.

The landscape of the site generally shows large areas of degraded vegetation and farmlands. Contributing factors to this state of affairs include the slash and burn and shifting cultivation methods employed in traditional farming. In addition to this is the generally poor nutrient nature of the soils and their credibility.

Fuel-wood harvesting, grass and sedge cutting for thatch and mats weaving, encroachment for developments (housing, roads, salt winning etc.) has also invariably contributed to the degradation of the flora in the area.

### **2.3 Land Tenure**

The land is owned by families and clans but vested in the traditional council. The families and clans lease out the land to settlers who will have to seek their consent for any form of development other than fishing and farming.

## 2.4 General Information

### 2.4.1. Topography and Drainage

The topography of the area is characterised by generally flat and gently undulating low lands with altitudes varying from below 15 m at the coast and increasing to 66m inland. Further southwards, towards the coast, elevations are lower and is even below sea level at some locations. The study area is drained southwards, with the River Tordzie (Red River) being the main drainage course. This river takes its source from the Togo mountains and discharges into the Avu lagoon which is interconnected to the Keta lagoon (Tumbulto, 1997).

### 2.4.2 Geology

The Keta-Anloga area lies in the Tertiary Eocene and Cretaceous formation which cover the south-eastern and south-western corners of the country (WRRI, 1993). The Eocene rocks are sedimentary rocks covering the Cretaceous rocks and consist of clay, loose sand and gravel deposited at the mouth of major rivers and around the Keta Lagoon. The Cretaceous rocks consist of sandstone, shale and limestone found at the extreme ends of the coast. Prospects for shallow groundwater are good in the Cretaceous and Tertiary sediments. However, the water tends to be saline in some cases.

### 2.4.3 Soils

The soils of the Keta Lagoon Complex Ramsar Site were extensively investigated by K Amejekpor (1997). Tukru series occur at the luxuriant red mangrove areas. These are organic soils classified as Typic Sulfaquents (USDA) or Thionic Histosols (FAO). The wet pH of the surface tiers of the Tukru series range from slightly acid to neutral (pH 6.0-7.3). When air dried, the pH values decrease by 0.5 to 2.5 units and when oxidised with  $H_2O_2$ , they become extremely acidic (pH 2.0 - 3.0).

The pyrite ( $FeS_2$ ) contents are high, ranging from 33 to 240g/kg. Calcium and Magnesium contents are also high.

This soil type is therefore potential acid sulfate soils which are capable of developing into true acid sulfate soils upon drainage and oxidation.

At the degraded mangrove sites, the Oyibi series (acid variant) occur. These are mineral soils classified as Typical Sulfaquents (USDA) or Thionic Gleysols (FAO). The wet pH values of these soils are extremely low to very strongly acid (pH 3.9-4.9).

When air dried the pFI values decrease by only 0.1 to 0.5 units but upon rapid oxidation with  $H_2O_2$  the values decrease by 1.0 to 2.0 units.

The FeS<sub>2</sub>, Ca and Mg contents of these Oyibi series are relatively very low compared to the Tukur series. The Mg content is generally higher than the Ca content.

From the morphological and chemical characteristics, the Oyibi series at the degraded mangrove sites are fully developed acid sulfate soils.

Other soil types found on the higher grounds in the immediate surrounding of the mangrove swamps are Keta, Amo and Oyibi (normal) series. The Keta series are developed on the narrow coastal sand dunes which separate the sea from the lagoons; the Amos series are developed in Volta alluvium; and the Oyibi (normal) series are developed around the edges of the lagoons and are liable to periodic flooding by slightly to moderately saline water, i.e., brackish water.

#### **2.4.4 Climate**

The climate of the study area lies within the Dry Equatorial climatic region of Ghana, which also covers the entire south eastern coastal belt of the country. This region is the driest in the country and is referred to as the central and south-eastern coastal plains. The prevailing wind direction is from the southwest all year round (the south-west monsoons). This is a characteristic feature for the entire coastal belt of the country (Tumbulto, 1997).

##### **2.4.4.1 Rainfall**

The study area experiences two rainfall maxima with the annual average ranging between 740 mm and 910 mm. Rainfall occurs between March/April to July and September-October. The low rainfall gives rise to stream flow mainly in the rainy season only. Between November and April, the numerous small streams that drain the area dry up; and even the Tordzie river in the last decade dried up into pools at its lower reaches.

Rainfall data in the Keta basin area covers stations such as Keta, Anyanui, Sogakope, Dabala, Anyako, Atiavi, Anloga, Adina, and Afiadenyigba. Rainfall records at these stations were good up to the 1980s. However, after this period, there are a lot of gaps in the data. It is only the stations at Keta and Ada that have good rainfall data. (Tumbulto, 1997).

##### **2.4.4.2 Relative Humidity**

Relative Humidity data for the study area is estimated using data at Ada and Keta. Since local variation in relative humidity is not appreciable, humidity values at Ada and Keta can be representative for the entire Site. Generally, relative humidity is high in the mornings and at nights but is minimum in the afternoons (Tumbulto, 1997).

#### **2.4.4.3 Temperature**

Long-term temperature data is available at the Keta observation station. Records from this station show that the minimum average temperature is 24°C whereas the maximum average is 31°C with the coldest month being August or September (Tumbulto, 1997).

#### **2.4.4.4 Evaporation**

An important component of the water balance in the Keta basin or in any hydrologies system, for that matter is the magnitude of the potential evaporation especially from the free water surface. Pan evaporation for the study area was estimated using direct measurement of evaporation from evaporation pans available at Ada and Tema. It was observed that there is a decrease in evaporation from Tema to Ada. However an average value was considered better than the records from a single station located at one end of the Ramsar Site (Tumbulto, 1997).

#### **2.4.5.0 Surface Water Resources**

In general, stream flow in the area is seasonal, and correponds to the seasonal variation in rainfall. A few coastal streams drain the area above the Keta lagoon. The majo streams apart from the Volta River include River Tordzie, which discharges into the Avu lagoon just north-west of Keta lagoon and River Belikpa which discharges into the Ke'lagoon directly. The Tordzie river has a catchment area of approximately 2200 km<sup>2</sup>; part of which lies in the Republic of Togo. River Belikpa commands a relatively small catchment area of less than 300 km<sup>2</sup>.

#### **2.4.5.1 Volta River**

The Volta River is the largest drainage system in the country with a total drainage area 379.000 km<sup>2</sup> up to Akosombo. H is an international river. It flows along the easte: boundary of the Greater Accra Region and is dammed at Akosombo and Kpong to provide electricity for the country. The reservoir which is a potential source of raw water supply to a number of towns also supplies water to Accra and parts of Eastern Region. The mean annual flow at Senchi before the construction of the dam was  $36.6 \times 10^9 \text{ m}^3$  (1160m<sup>3</sup>/s).

After the construction of the dam, the river had an annual runoff depth varying between 30mm and 240mm and a mean annual ilow of 1.100 m<sup>3</sup>/s downstream of the Kpong dam. The highest recorded flood on the Volta River was 14,200 m<sup>3</sup>/s in 1963. The m. discharges into the sea at Ada Foah where it commands an area of over 400,000km<sup>2</sup>.

#### **2.4.5.2 Tordzie Runoff**

annual runoff of the Tordzie River is highly variable. Over the period 1957 to 1968, the minmim annual runoff (1958) was  $79 \times 10^6 \text{ m}^3$  whereas the maximum was  $587 \times 10^6 \text{ m}^3$

(1963). The mean for the period was  $345 \times 10^3 \text{ m}^3$ . The Tordzie river has a catchment area of  $2200 \text{ km}^2$ . However, the area commanded by the gauging stations Tordzienu and Tove is slightly lower and totals  $2120 \text{ km}^2$ . The mean annual flow at Tordzienu on the Tordzie river is estimated at  $11 \text{ m}^3/\text{s}$  with a reliable yield (50 yr return period) of about  $0.05 \text{ m}^3/\text{s}$ . The 100 -year flood is estimated at about  $140 \text{ m}^3/\text{s}$ . In view of the monthly and annual variability in the flow, Tordzie river could significantly contribute to flooding in the Keta lagoon as has been reported in earlier studies. The estimated capacity of the Keta lagoon, when there is no inflow into it is about  $360 \times 10^6 \text{ m}^3$  in April.

#### **2.4.5.3 Rivers Aka and Belikpa**

These two small rivers have a combined catchment area of  $700 \text{ km}^2$  and drain into Keta lagoon. They are situated north of the Keta Ramsar site. They discharge their water through culverts crossing the highway at Afife and Atiteti. There are no historic records of flows on these rivers. However, rainfall data and its distribution is known in the catchments and that can give an appreciation of the flow regime from these streams. They are known to dry out between December and April each year. By analogy, to the Tordzie catchment runoff coefficients have been transferred to these catchments and estimates of runoff made. For a wet year, the estimated runoff from the two catchments is  $100 \times 10^6 \text{ m}^3$  (based on an annual rainfall of 1300 mm and a runoff coefficient of 11%).

Aka has an area of  $420 \text{ km}^2$  and Belikpa  $280 \text{ km}^2$ . As the runoff for June in rainy months could be as high as 25% of the annual runoff, the combined flow of the two streams in a rainy June could be as high as  $25 \times 10^6 \text{ m}^3$ , Aka being  $5.8 \text{ m}^3/\text{s}$  and Belikpa  $3.8 \text{ m}^3/\text{s}$ .

### **2.4.6 Water Quality**

#### **2.4.6.1 Quality of Well Water in the Keta Lagoon Complex Area**

The study by WRRRI (1993) concluded that in terms of quality, there are basically two types of water in the Keta area. One type consisted of about 50% NaCl and covers areas like Dzita, Adakordzi, Wuti, Abor, Heluvi, Sasieme and Magokope. The other type (49%) is dominated by calcium and magnesium and is in areas such as Anloga, and Afiadenyigba. The results showed a high mean nitrate concentration of  $11.26 \text{ mg/l}$  in the well water.

Iron was generally not a problem except for a few places like Alakple, Atito, and Blamezado.

#### **2.4.6.2 Physical Water Parameters**

The pH of the water in the Keta Lagoon Complex did not show any clear trends between sampling stations. This is probably because wind induced mixing has lead to a very homogeneous water mass. Also, the fairly high carbonate content of the water would have effectively buffered any chances that could have resulted from biotic activity.

### 2.4.6.3 Conductivity, Salinity and Total Dissolved Solids

The values of conductivity, salinity and total dissolved solids are within the range for coastal lagoons in Ghana. Values range from almost freshwater to hyper-saline. Conductivity range from under 2m S/cm to over 80 m S/cm:

### 2.4.6.4 Dissolved Oxygen

The water column in the Keta lagoon is not saturated with oxygen. The reason for this is attributed to the absence of significant algal mats on the sediment. Dissolved oxygen ranged between 39.0 to 26.0 mg/l, the higher values being at the surface. Wind action seems to be the driving factor for oxygen in the lagoon.

### 2.4.6.5 Major

Sodium and chloride ions dominate the ionic composition of the water in the Keta lagoon. This is not surprising given the proximity of the lagoon to the sea. Table 1 presents average values, of and the range for the Keta lagoon in mg/l.

Table 1. Mean values of ionic concentrations of selected ions in Keta lagoon

	Mean	STD	N	Min	Max
Sodium	4373	1788	17	855	6900
Potassium	231	178	17	36	885
Calcium	384	422	17	78	1987
Magnesium	873	642	17	133	2888
Chloride	10207	8527	17	815	41300
Sulphate	1212	522	17	300	2460
Alkalinity	310	714	17	98	3080

## 2.5 Ecological

### 2.5.1 Flora in the Keta Lagoon Complex

The general area in which the site is situated was described by Taylor (1960) as lying to the south of the Coastal Scrub forest type. UNESCO (1978), on the other hand, classified the area to the north as belonging to the Tropical Semi-deciduous lowland forest type. However, the most recent studies of Hall and Swaine (1981) put the area within the

South-East outliers forest type of Ghana. The South-East Outliers are the driest of the forest types in Ghana with an annual rainfall of between 750-900 mm. The vegetation of the general area can be classified into:

#### **2.5.1.1 Sand Dunes or Beach Heads**

The vegetation here are normally subject to temperature extremes, high evaporative rates, sea sprays, windiness and unstable and unconsolidated substrates. The area is normally fringed by coconut (*Cocos nucifera*) plantations with the ground cover of mainly rhizomatous and straggling species. Dominant plant species include the herbaceous shrubs (*Ipomoea-pes-caprae*, *Canavalia rosea*); grasses. (*Paspalum vaginatum*, *Sporobolus robustus*, *S Virginicus*) the succulent forb (*Sessuvium portulacastrum*) shrubs (*Agave sisalana*, *Aloe buettneri*, *Opuntia sp*, *Euphorbia glaucophyll*, and the sodom apple (*Rauvolfia vomitoria*).

#### **2.5.1.2 Lagoon Margin and Saline Marshes**

These belong to the mud and salt flats in the frequently inundated area of the drawdown. Here the dominant flora include the forb (*Sessuvium portulacastrum*), grasses (*Paspalum vaginatum*, *Sporobolus virginicus*), sedges (*Cyperus articulatus*), reeds (*Typha domingensis*), shrubs (*Ipomoea-pes-caprae*, *Opuntia sp*). On the horizons are low specimens of white mangrove *Avecinnia africana* and *Laguncularia* especially towards Adina area whilst towards the more fresh water areas westwards from Dabala to Anyanui are extensive cover of *Rhizophora*. Isolated diminutive specimens of the branch Dum palm (*Hyphuene iJiehmni*) occur along the shores on drier ground with isolated tree of *Thespesia populnea*. Submerged but in larger areas of the southern end of the lagoon is an annual seagrass (*Ruppia sp*) cover.

#### **2.5.1.2 Inland Wet-Grasslands/Marshes**

These are dominated by grasses such as *Andropogon gayanus*, *Brachiaria mutica*, *Chloris barbata*, *Heteropogon contortus*, *Imperata cylindrinca*, *Vetveria fulvibarbis* and to a much lesser extend the herbaceous species *Cassia mimosoides*, *Croton lobatus*, *Indigofera sp.*, *Kylinga sp.* and *Vigna arnbacensis*.

#### **2.5.1.4 Grassland Thickets and Shrubs Zone**

This is a zone with small trees and climbers on drier and higher ground. The thickets clumps are usually associated with termite mounds. Common species of such areas include: *Allophylus africanus*, *Baphica nitida*, *Griffonia simplicifolia*, *Milletia thonningii*, *Securinega virosa* and prickly plants (*Parkinsonia aculeata*, *Zanthoxylum xanthoxyloids*), succulent-leaved hebs (*Aloe buettneri*, *Sansevieria liberica*) and trees (*Eleaophorbiu drupijera*, *Diospvros mespiliformis*). In addition are isolated trees of the tan palm (*Borassus uethiopiim*), savana date palm (*Phoenix redinata*), baobab (*Adansonia digitata*) silk cotton (*Ceiba penlandra*) and the introduced tree species. Indian almond



(*Terminalia catapa*), mango (*Mangifera indica*) and neem (*Azadirachta indica*) the latter being the most common of the introduced tree species.

#### 2.5.1.5 *Flora of Wetlands Along Permanent and Intermittent Streams and the Pools/Stagnant Water*

In such areas along the Tordzie river and tributaries, Aka and Belikpa streams, parts of the Volta river inlets, the principal tree species include *Baphia nitida*. Black Velvet tamarind (*Dialium guineense*), *Lonchocarpus* sp. and *Milletia thonningii*. The vegetation in and around water bodies include the rhizomatous sedge *Cyperus articulatus*, floating plants *Lemna paucicostata*, *Pistia stratiotes*, *Nymphaea lotus*, *N. micrantha*; emergents *Typha domingensis*, *Ludwigia hyssopifolia*, *L. erecta*, *Ludwigia stolonifera* and the water *ouaticca*.

### 2.5.2 Fauna

#### 2.5.2.1 Fishes

The lagoon supports a very important fisheries which is a major component of the socio-cultural and economic life of the riparian communities. Fifteen families of fin fishes comprising 18 genera and 20 species have been recorded (Shenker *et al.*, 1998) (Appendix 1). The most important species, which is also the mainstay of the fisheries, is the black chin tilapia (*Sarotherodon melanotheron*). Other important species are *Tilapia guineensis*, *Pellonula leonensis* and *Hyporhamphus picta*. Lagoon fisheries serve as an important source of employment, income and food. Some of the fish species especially, the tilapias are important for religious rituals.

#### 2.5.2.2 Macro-Invertebrate

The macro-invertebrates found in the area are listed in Appendix 11. Those of most commercial importance include the blue-legged lagoon crab (*Callinectes amnicola*), *Peneus notialis*, *Penaeus kerathurus* and *Parapenaeus atlantica* all of which are found in the main lagoon waters. The land crab *Cardiosoma armatum* are dominant on the flood plains while *Tympanotonus fuscatus* are common within the mangrove roots and on the mud flats.

#### 2.5.2.3 Mammals and Reptiles

The wetland is also a home to several species of common rodents, notably the commensals. Common mouse (*Mus musculus*), Common rat (*Rattus rattus*), Nile rat (*Mastomys*) and Giant rat (*Cricetomys gambianus*). Commercially important reptile inhabitants include Nile monitor (*Varanus niloticus*), Graceful chameleon (*Chamaeleo gracilis*), African python (*Python setae*), Royal python (*Python regius*), Puff adder (*Bitis arietans*) and Green turtle (*Chelonia mydas*), marine turtles and manates (see Appendix III). (Ameyaw-Akumii *et al.* 1998)

#### 2.5.2.4 Birds

The Keta Lagoon Complex Ramsar Site is ecologically important for the large numbers of water birds it supports. It accounts for over 59% of the bird populations that frequent the wetlands in Ghana especially, Coastal wetlands. It has a very high diversity of bird species (about 80% of all listed wetland bird species in Ghana - Appendix IV). Some of the important species that frequent the place include: Curlew sandpiper (*Calidris ferruginea*) Ringed plover (*Charadrius hiaticula*), Greenshank (*Tringa nebularia*), Spotted redshank (*Tringa erythropus*), Little stint (*Calidris minute*) and Black-winged stilt (*Himantopus*). These constitute 70% of the waders. The site is also known to have recorded the largest concentrations of ducks mainly White-faced tree duck (*Dendrocygna viduata*) as a quarry species for the local inhabitants. The highest population of Roseate tern (*Sterna dougalli*) the rare bird which was the genesis of the erstwhile Save the Sea shore Birds Project (SSBP) was recorded at Keta.(Ntiamoah-Baidu and Gordon, 1991)

### 2.6 Socio-Economic Setting of Keta Lagoon Area

Based on the results of a socio-economic survey undertaken in 1998, in the Keta area. (Shenker et al, 1998) about 88% of the people are engaged in fishing as a primary occupation. Eight (8%) percent and four (4) percent respectively were found to be engaged in farming and trading as a primary occupation. The eight percent engaged in farming are especially in the Anloga and Woe area where shallot and vegetable farming was a major component of their daily activities.

Most (70.3%) of the respondents at Keta also had secondary occupations to supplement their income. The remaining 29.7% earned their living solely by fishing. Low catch and the tendency of the lagoon to dry out during protracted dry seasons were the reasons given for considering a secondary occupation. Although mat weaving (11.11%), salt collection (3.7%) and other occupations were engaged by others, farming (33.3%) was the most common secondary occupation, according to the results of the survey.

Three major socio-ecological problems are apparent in the Keta wetland:

- Severe coastal erosion: over the past 50 years, the coastline in the area is reported to have receded by some 500 m (Dorbu, 1985) and the ruins of eroded houses are a common sight in Keta and the other settlement along the coast.
- periodic flooding of the lagoon and its surroundings which happen rapidly with the onset of the rains leading to destruction of farms, houses and property.
- Insufficient land, suitable for both farming and human settlement leading to high human population densities.

**Settlement:** The major settlements with population of over 5,000 are located along-the 40' k m stretch of the coastal sand has between Allao and Anyanui. There is some migration following the alternation of the hydrological regime which support the major

economic activities fishing and salt production. Accelerated sea erosion and periodic floods pose threats to social infrastructure.

several houses are built with cement block and roofed with asbestos; aluminum or zinc plated iron roofing sheets. Others are also built with mud or clay and have thatch roofs from reeds.

### 3.0 REVIEW OF EXISTING MANAGEMENT PLAN

#### 3.1. Staff Strength, Qualifications and Deployment

Staff strength, qualifications and deployment is illustrated in the table below.

Table 2 Staff Strength, Qualification and Deployment

Position	Qualification	No. of persons	Deployment
Site Warden (Northern Sector)	BSc. Natural Resources Management	1	Akatsi
Site Warden (Southern Sector)	BSc. Botany with Zoology	1	Anloga
Ranger	Diploma/A' Level	1	Anloga
Technical Assistant	O' Level, and S.S.S.	2	Anlo-Afiadenyiba and Akatsi
Labourer	J.S.S. and Middle School Leaving Certificate	3	Adutor and Anloga
Driver	JSS/Middle School	2	Akatsi and Anloga

Table 2 makes it clear that a large site such as the Keta Lagoon Complex Ramsar Site with two stations has inadequate staff. It would therefore be expedient if the staff numbers are raised up to two (2) Site wardens and at least twelve (12) of the other field staff (i.e. six for each of the two (2) stations). Support staff such as secretaries, accounting staff etc would be necessary.

#### 3.2 Job Description

The main duty of staff is to ensure conservation of the wetland. This involves community consultation education, facilitating the establishment of community woodlots, participation in water channel clearing, community clean up exercises, practical training in monitoring the fisheries, aquatic ecology and bird populations of the site. Additionally, field staff do weekly site patrols to inspect and advise the communities on activities that are environmentally friendly and to explore the possibility of developing potentially attractive tourist centres. Where necessary, nesting and roosting sites for birds were constructed Sign posts are mounted for all field projects. Table 3 gives details of Staff positions and their responsibilities.

Table 3. Staff Positions and their Responsibilities

Staff Position	Responsibility
Site Warden	<ul style="list-style-type: none"> <li>• runs the general administration of the site.</li> <li>• preparation of work programmes</li> <li>• preparation of monthly, quarterly and annual report</li> <li>• staff supervision</li> <li>• liaison-between project Management (i.e Wildlife Division - Head Office and the other field staff</li> <li>• Over-see the implementation of site</li> <li>• management decisions</li> </ul>
Ranger	<ul style="list-style-type: none"> <li>• Deputizes for Site Warden</li> <li>• Sees to day to day implementation of work programmes.</li> <li>• Preparation of mommy reports</li> </ul>
Technical Assistant	<ul style="list-style-type: none"> <li>• Mobilization of resources and equipment's for actual field work</li> <li>• Preparation of monthly reports</li> <li>• Assists the Ranger in all field work</li> <li>• Preparation of monthly report to Ranger</li> </ul>
Labourer	<ul style="list-style-type: none"> <li>• assists the Technical Assistant in all field works</li> <li>• preparation of monthly report to Technical Assistant</li> </ul>

### 3.3 Implementation of management measures

The management measures that have been put in place for effective running of the site are as follows:

- a) **Habitat Enhancement:** This has to do with improving upon the wetland environment by way of creating bird nesting and roosting sites, establishment of tree plantations, river/stream channel clearing, environmental clean up efforts, etc. These are meant to maintain the ecological character of the site.
  
- b) **Pollution Control:** Communities with acute sanitation problems were provided with sanitation units (K.VIPS). In all, thirty-two (32) sanitation units were constructed. Plans are under way to construct 12 refuse receptors for communities with acute refuse disposal problems

In an attempt to control pollution within the site, a number of community clean up exercises have been embarked upon. This will be continued for other communities.

As a means of promoting and sustaining environmental clean-ups within the site, a Tipper Truck and other sanitation equipments such as wheel barrows, rakes, shovels, Wellington boots, matchets and gloves have been provided by the Coastal Wetlands Management Project to the communities.

**C. Poverty Alleviation:** Poverty was found to be wide spread within the site. In view of this, the Community Investment Support Fund was put in place to reduce poverty and put a few micro-enterprises on a sound footing. In the light of this over eighty-five (85) community groups applied for the loans. Out of these, thirty-two (32) groups were identified, approved and were supported financially. The eligibility criteria for the loan were as follows:

- It is not meant for individuals but groups of at least ten (10) people.
- The group should have been in operation for at least one (1) year
- they should have 10% of the amount being requested for in cash or equipment/building
- be a well recognised group
- must have a bank account in the name of the group
- All beneficiary groups were supposed to carry out a biodiversity related activity eg. Establishment of tree plantations, community clean up exercises, and water channels clearing.

Training manuals were prepared and some training was given to site Wardens and other management staff to ensure efficient running of the programme. The groups that were supported have commenced repayment with an interest rate of 20% annually. Since some groups could not get the funding during the first batch of disbursement, it has been arranged that repayments would be recycled for the other groups so that the fund becomes a revolving one.

**d. Research and Monitoring:** The plan for research and monitoring, as contained in the project document (10690 - GH), was to accomplish the following:

- Finance baseline studies

The following baseline studies were carried out:

- terrestrial ecology
- aquatic ecology
- fisheries
- water birds ecology
- development options study
- soils and land use practices
- hydrology

- socio-economic studies
- Carry out regular monitoring of
  - Fisheries
  - Migratory bird populations
  - Aquatic ecology of the site.

Establish a research station at Songor which will cater for all the RAMSAR sites.

- Conduct environmental impact assessment.
  - this is to fund any additional studies required by the Coastal wetlands Management Project (CWMP) to assess the impact of proposed development schemes on the wetlands; eg. Keta Sea Defence Project or the Salo sewerage treatment plant project.

Baseline research studies and monitoring were contracted out to research institutions and the universities with the site wardens as counter pans.

### **3.4 Public Awareness and Education**

This aspect was initially given out on contract to the Ghana Wildlife Society (a local NGO) in 1993 and the contract was maintained for 5 year (up to December 1998). At the time, the Wildlife Division which was implementing the CWMP had not built up the institutional capacity to educate the people. At the moment, however, Wildlife Division Staff do the public awareness and education programmes. This involve organising seminars and workshops. At these workshops, posters hand bills and flyers are given out. Additionally we have the publication of magazines like the Wetland Neighbours, the NKO magazine and showing of documentary pictures on wildlife conservation. Organisation of school wildlife clubs is also being undertaken.

### **3.5 Community Participation in Site Management**

Communities live within and around the site. This approach has been adopted which gives local communities the liberty to make use of resources of the wetland area. It is only ensured that their mode of exploitation would not lead to the loss of any species of plant or annual.

Site Management Committees (SMCs), membership of which includes chiefs, opinion leaders, members of the District Assemblies, including the District Chief Executives and and representatives of all other stake holders have been put in place to ensure community participation, in the management of the site.

Members of the SMC are invited to workshops, seminars and study tour programmes to update their knowledge on wetland conservation.

The site's local communities show a large measure of participation in site management oy the release of land, provision of labour force and assisting in activities such as building of sanitation units, establishment of tree plantations, water channel clearing, etc. Formation of community task forces such as the Turtle Task Force at Anloga and the cornmitmeilt shown by the Community Rangers all indicate immense participation in site management on the part of local communities.

### **3.6 Community Infrastructure Development**

So far 32 sanitation units have been built for communities within the site. The communities provided labour and 10% of the capital cost was given by the District Assemblies. Plans are underway to provide twelve (12) more refuse receptors. Sixty-two (52) acres of community (62) acres of community woodlots have been established within the site; it is hoped that these, tree plantations would provide additional sources of wood for the construction of planks, boardwalks, for roofing of domestic homes and for the construction of summer hats for recreation and durbars. The woodlots would also provide shade for community meetings, recreation and meet the fuel wood needs of the respective communities.

Selected water channels have been cleared to facilitate water transport and two (2) observation posts have been provided for bird watching and site viewing

### **3.7 Management Stakeholder Collaboration for Sustainable Wetland Resources Exploitation**

The site management works with communities within the site. Efforts are being made to get them undertake a number of activities on their own. This measure is meant to generate community interest in wetland environmental issues.

It is becoming increasingly clear to all site communities that over fishing and fishing with mosquito nets is inimical to the fisheries. Devegetation of land areas by most land owners and their tenants is now being tackled with caution. Hunters are learning to hunt sparingly. All these citations show collaboration by different interest groups. Even though all the resources in the site belong to the traditional people, public education has brought about higher conservation consciousness.

Cooperation from the District Assemblies has minimised encroachment on wetland

### **3.8 Aesthetic and Cultural Values**

The Keta lagoon has a substantial aesthetic value. The huge lagoon separated by a sand spit from the sea provides a unique scenery. It is very interesting to visit the old Keta town that is almost lost to the sea through erosion. The lagoon could be a potential source for boating, surfing and angling. The large numbers of migratory birds which, flock the area between July and December every year makes the site pleasant for bird watchers. Some observation posts have been provided at Tegbi and Woe for this purpose.

There is a brisk trade in mangrove wood at Anyanui on every Wednesday but the rate of exploitation of this natural resource is a cause for concern.

Earlier idol worshipping and fetish practice have virtually given way to Christianity and Islam religions.



The indigenous people are predominantly farmers and fishermen. The farmers either employ the services of tractors or depend on local tools like hoes and machetes. Bush burning is a common practice for land preparation.

Fishermen use either cast net or drag nets, bottles, 'acadjas' traps, barriers and hands are used for fishing. The fishing crafts used are either dug out canoes or canoes made of wooden planks.

There could also be found a handful of craftsmen who engage in basketry, mat weaving pottery etc. Salt winning at the southern end of the site is a way of life to some individuals and families. This gets to its peak during the dry season.

### **3.9 Recreation**

The Avu Lagoon area which is located within the northern sector of the site presents a very beautiful natural environment for eco-tourism development. There is a mass of floating vegetation of about two metres depth in the water. The floating vegetation could provide a form of adventure walk for tourists. The 2km water channel could also give a boat cruise to the main Lagoon.

Within the environs of this lagoon could be found birds (local and migratory), monkeys, serval cats, leopards and the rare antelope referred to as the sitatunga.

Sport fishing, swimming and diving, boat cruising, turtle watching, bird watching and the use of the sandy beach for sun bathing all constitute a good deal of recreation.

## **4.0 REVIEW OF CURRENT INSTITUTIONAL ARRANGEMENTS FOR MANAGEMENT**

### **4.1 Wildlife Division**

The Wildlife Division has been the implementing agency of the Coastal Wetlands Management Project (CWMP) since its inception in 1993 to date. The project is being executed with a grant of US \$7.2m from the World Bank through the Global Environment Facility (GEF). There is also a US \$1.1m Ghana Government counterpart fund.

For the past seven (7) years, the Wildlife Division has been responsible for the following:

- project administration,
- Staff recruitment and training,
- Procurement and disbursement,
- Gazettement of the site
- Site establishment and management,
- Community development.
- public education and awareness,
- Research and monitoring; and

The Wildlife Division carries out its tasks by collaborating with certain government and research institutions. At the inception of the project, Environmental Protection Agency (EPA) was responsible for coordination and supervision including auditing, financial management, budgeting, disbursement of funds and procurement of logistics.

Close links were established with the University of Ghana and other research institutions who carried out baseline studies, identified parameters for monitoring, recommend guidelines for site management and publish research findings.

The Wildlife Division also collaborated with the Town and Country Planning Department and the Survey Department to establish the site. Other Ministries and agencies with which the Wildlife Division Collaborated included Ministry of Finance, Ministry of Lands and Forestry, Ministry of Environment, Science and Technology, Districts Assemblies and some Non-Governmental Organisation (NGOs).

### **4.2 District Assemblies**

The District Assemblies (DA's) by their nature as local government institutions serve as a liaison between government and the local communities. Through their various political organs and structures they help in bringing government policies to the doorstep of local communities.

Among other things, the (DA's) provided a platform for the discussion of wetland management strategies and the conservation of resources in general.

They facilitated the formation of the Site Management Committees. As an objective of the project, the DA's were mandated to promulgate bye-laws taking into account traditional norms and practices that conserve wetlands. The security taskforce of the DA's helped in the arrest of hunters, captors and traders in bush meat without licence. Another way the DA's helped in project implementation was by making available to the project various expertise in the assemblies who were needed to do special duties. Examples are the District Engineer, the Public Works Department (PWD) the District Environmental Health Officers (DEHO) etc.

#### **4.3 Non-Governmental Organisations (NGOs)**

NGO's involvement in wetland resources management cannot be over-emphasised. By their nature tend to be more flexible in their administration than government agencies. They are less bound by government rules and regulations, financial accounting methods and they enjoy a freedom of operation. Therefore, they are more likely to make more impact, given the chance in wetland management.

The design of the Coastal Wetlands Management Project made it obligatory to collaborate with only one local NGO, the Ghana Wildlife Society (GWS). By the design, CiWS was mandated by the project to carry out public education and awareness creation, this was done on contract basis and renewed from time to time. Meanwhile, every logistic support was given to the Society ranging from motorbikes, buses, and 4x4 cross-country vehicles to training and manpower development. The monopoly enjoyed by this NGO, (Ghana Wildlife Society) did not seem to have enhanced the smooth operation of the project.

Some of the international NGOs which collaborated with either the GWS or the Wildlife Department in their wetland conservation efforts were the Royal Society for the Protection of Birds (RSPB), Birdlife International, the International Conservation Union (IUCN) and Wetlands International.

#### **4.4 Traditional Authorities**

The main Keta Lagoon is owned by Anlo Traditional Council with Awomfia (the paramount Chief) of the Anlo Traditional area, holding it in trust for the people. However, the creeks and other smaller water bodies as well as land surround the lagoon are owned by individual families and clans.

The traditional authorities played a great role in the definition of community members, conflict resolution, making bye-laws for wetland resource management based on local knowledge of the ecological dynamics and instituting measures to deter local people from using wetland resources.

Some chiefs and community opinion leaders serve on the Site Management Committees where they contribute constructively to Site management decisions.

### **5.3 Major Stakeholders and Local Communities**

In this context stakeholders are taken to be bearers of separate interest and/or contributions for the management of the Keta Lagoon Complex Ramsar site with a particular focus on interest groups within the communities and the government agencies responsible for wetland management.

Within the communities whose activities have a direct impact on the wetland, the following stakeholders are identifiable:

- Fishermen
- Farmers
- Salt winners
- Sand/Stone winners
- Forest product exploiters
- Cattle and livestock herdsman
- Boat/canoe and net owners etc.

Also, the following government agencies play a role in the conservation of the wetland resources: the Forestry Department, Ministry of Food and Agriculture, the Universities, Research Institutions, District Assemblies.

### **4.6 Strategies for Improvement Towards Long-Term Participation**

The following strategies have been identified for long-term participation in wetland management.

- Involvement of more environmental NGOs in wetland conservation activities.
- Engagement of local people either as permanent or casual workers.
- Establishing participatory processes to involve local communities in the management of wetlands
- Organise fora, study groups and workshops to increase shared understanding of Ramsar principles especially the wise use principle and the value of resources being conserved.
- Engaging local stakeholders in site monitoring and process evaluation.
- Site monitoring to be made to take advantage of "marginal cost" approach: technical experts may be engaged from established institutions such as i.e. universities at minimal cost.
- Networking mechanism, such as regular meetings, newsletters, and radio programmes, to fulfil information exchange and educational purposes.
- Basic Ramsar concepts, stewardship principles and ecological values to be conveyed through the educational curriculum of local schools.

- Establishment of wetland centres to
  - \* catalyse active and informed participation of local people.
  - \* serve as demonstration sites for sustainable wetland management
  - \* support formal, informal and non-formal educational programmes that involve a wide range of stakeholders.
  - \* help to bring community concerns to the attention of decision-makers.
  - \* provide information and advice on wetlands and their management.
  
- Capacity building for government agencies in building participatory management approaches. • Stakeholder capacity building in
  - \* establishing and maintaining appropriate organisations,
  - \* effective relations with government agencies,
  - \* technical aspects of wetland management and Ramsar principles,
  - \* monitoring of wetland ecology,
  - \* evaluation of participatory processes.
  - \* organisation skills,
  - \* record keeping
  - \* financial accounts and
  - \* conflict management
  
- High-level political support, ideally from a number of appropriate Ministries (e.g. Lands and Forestry, Environment, Science and Technology, Finance etc) is important for maintaining government commitment to participatory management regimes
- Involvement of key individuals in the community and all sectors of the population, including women and the youth. In wetland management Developing local capacity including

## **5.0 LONG-TERM OBJECTIVES FOR SUSTAINABLE MANAGEMENT AND FACTORS INFLUENCING THEIR ATTAINMENT**

### **5.1 Long Term Management Objectives**

The conservation of the Keta Lagoon Complex Ramsar Site, like all the other Ramsar Sites in Ghana, was envisaged as a component of the Ghana Environmental Resource Management Project (GERMP). The initial management strategy proposed for the site tended to emphasise its importance as a bird habitat. However, as a result of the various studies undertaken for the Lagoon Complex, it is now evident that there are other important species associated with the site. Therefore, the management strategy needs to focus on the revised Ramsar Convention which emphasises the "multiple use" approach. Nonetheless, it is important not to de-emphasise the primary objective for the establishment of the Keta Lagoon Complex as a bird protection area and generally as a biodiversity conservation area.

The long-term management objectives for the Keta Lagoon Complex Ramsar site may therefore be stated as follows:

- i. To maintain and enhance the value of the wetland as a wildlife habitat and integrate wildlife conservation into the existing human use of the wetland.
- ii. To enhance benefits derived from the wetland and improve the quality of life for the local communities who live in the vicinity of the wetland and whose activities influence the wetland ecosystem.
- iii. To control, monitor and coordinate the activities which affect the coastal zone close to the Ramsar site (e.g. human settlement, industrial developments, salt production, agriculture, fisheries, recreation etc) so as to ensure the maintenance of the health of the coastal environment and sustainability of the wetland resources there in.
- iv. To create awareness about the rich ecological value of the Keta Lagoon and develop the infrastructural base requisite for the sustainable use of this heritage for education, recreation and tourism.

### **5.2 Constraints**

#### *5.2.1. Internal Natural Factors*

There are some internal natural factors that inhibit the attainment of long term sustainable management objectives which have been outlined above. It is known for example that the water level dynamics is a key environmental factor controlling the availability of food for birds and affecting fish breeding sites. The water depth also relates directly to salinity

and temperature of the water both of which influence wetland productivity. High water level is caused by fresh water input from the catchment. At high water levels, most of the food is no longer available as birds cannot reach them. Humans could get displaced with destruction of property if high water levels occur (flooding). This may lead to drainage considerations. With the relatively high "dry season flow" maintained downstream of the Akosombo dam as a result of the operation of the hydropower plant, the saltwater/freshwater interface is no longer able to penetrate further inland and this affects the breeding of some salt tolerant species that used to flourish on the river in the dry season. On the other hand, very low water levels in the lagoon itself will also adversely affect wetland productivity.

With respect to salinity most organisms found in the lagoons are salt tolerant. Excessive salinity will however prove lethal to most organisms. Salinity also seems to affect the germination and growth of *Ruppia maritima*.

Water temperature in the lagoon can be very high, especially when the water levels are low. Fish are found in higher densities within *ruppia* beds where temperatures during the day are slightly lower as compared to other parts of the lagoon. The exposed mud flat have very high temperatures and the only organisms that are able to survive these conditions is *Typhnodontomys*.

#### **5.2.1.1 Sediment Texture**

Sediments in the Keta lagoon area fall into three main categories (Piersma and Ntiamoa-Baidu, 1995). These are the very sticky, anaerobic mud of the Totokpoe type, the sand sediments found in the seepage areas along the dunes; and the unsorted sediments full of shells. The anaerobic muds harbour very little life while the unsorted sediments are hard, especially for bird feeding. It is the second category that is useful.

#### **5.2.2 Internal Human Induced Factors**

Human induced factors that are internal to the Keta Ramsar Site which tend to constraint the achievement of the long term management objectives listed for the Keta Lagoon Complex in Section 5.1 included pollution, land reclamation, unsustainable harvest of wetland products and catchment degradation.

Catchment degradation can result in siltation which will eventually lead to the destruction of the wetland. It can also adversely affect the quality of the water in the lagoon which has a direct bearing on the wetland productivity.

In recent times mechanised systems are being used for irrigation water abstraction. This is putting stress on the shallow groundwater resource. The construction of the Dabala – Srogboe road has also obstructed water flow into the Keta lagoon especially from the Lower Volta River.

Pollution is the result of inadequate waste management in the environs of the Ramsar site. Land reclamation at the lagoon side will decrease the area of the wetland and hence the wetland productivity.

About 80% of the refuse generated in the area is of domestic origin. Industrial waste, mainly sawdust, is generated by boat builders and carpenters and concentrated in the settlements near the littoral area. In certain parts of the lagoon refuse is used for reclamation. The use of agrochemicals is another potential problem though the amount in use is currently limited by high cost and unavailability.

Population pressure and poverty, over-exploitation of resources including the use of inappropriate methods especially, for fish, extension of hunting by groups of hunters from urban areas and expansion of infrastructure and industry such as salt wining and salt works are all threats to the attainment of the stated objectives.

Other internal human induced factors include: overgrazing

### *5.2.3 External Natural Factors*

External natural factors that limit the attainment of the stated management objectives include climate and hydrology. The climate of the Keta Lagoon Complex Ramsar site cannot be controlled by activities within the Ramsar site. In recent years the increase in green house gas emissions is inducing a global climate change. In the case of the Keta Lagoon Complex Ramsar site, studies have shown that the temperature of the area has increased by about 1<sup>0</sup>C over the last 40 years where as rainfall in the last two decades is about 15 to 20% lower than the previous two decades at a number of rainfall stations (Tumbulto, 1999).

There has also been some changes in the hydrological setting of the Keta lagoon over the years. Floods of the Volta river used to occur annually and carry with them alluvial material which is deposited in the Hood plains. This material is very good for agricultural purposes. It also brings nutrients which increase the agricultural productivity of the low lands. Also during the dry season, flows were generally very low, resulting in the propagation of the saltwater/freshwater interface created by tidal action further upstream. This, as has been mentioned earlier on, has the tendency to promote the production of some salt tolerant species of fish and other fauna.

Observations indicate that the annual mean flows on some tributaries of the Volta river are reducing (Gyau-Boakye. and Tumbulto 1999). Some of the reasons given for this state of affairs is that there is over extraction of groundwater upstream, rainfall may be decreasing, the catchments are being degraded and the Sudano-Sahelian drought is affecting the entire West African sub-region.



The lagoon and its surroundings are flooded periodically. This leads to destruction of farms and major losses to human property thus worsening the already poor living standards of the people. Besides this, the periodic inundation of the area highly influences changes in the bird

population. Birds virtually disappear when all the shallow margins and mud banks which form important feeding areas are inundated as a result of flooding. Their population increases as the water recedes (Ntiemoa-Baidu and Gordon, 1991)

#### *5.2.4 External Human Induced Factors*

Human induced factors that are external to the Keta lagoon include the Akosombo and Kpong dams that are located upstream of the lagoon. Other external human induced factors include settlements and farms upstream of the catchment feeding the lagoon.

The dams serve to regulate the flow of water downstream of where they are located. In the case of the Volta dam, flows in the Lower Volta Area used to vary significantly between a low of under  $30\text{m}^3/\text{s}$  and a high of over  $10,000\text{m}^3/\text{s}$ . This has changed drastically as relatively high flows are released daily in the operation of the hydropower plant. Therefore the advantage of the seasonal variation in water levels has been lost. This has reduced the contribution of fresh water from the lower Volta River to the Keta lagoon. As a result, there has been a reduction in the number of fish species in the lagoon.

Settlements and farms located upstream of the lagoon do affect the quality of water in the lagoon through waste generation which is not properly managed and also poor cultivation practices including the use of fertilizer and pesticides. Land clearing and bush burning tend to adversely affect the wetland status. Other external human induced factors include diversion of rivers upstream for other uses such as domestic and agricultural purposes

#### *5.2.5 Factors Arising from Legislation or Tradition*

These factors include traditional practices like group hunting and fishing. There are other factors arising out of the absence of legislation which are a form of constraint to the sustainable development of the Keta Lagoon Complex Ramsar Site. In particular, some of the positive traditional practices that support sustainable wetland management are not backed by any legislation. Some of these include restrictions on resource use and access to land. Urbanisation and migration has created a heterogeneous society with different cultural beliefs that disregard the local traditional norms,

#### *5.2.6 Physical Considerations*

The Keta lagoon Complex Ramsar Site is quite extensive and accessibility to some part of it is also very poor. Therefore it is difficult to know what is happening to the entire lagoon at any one time unlike Sakumo or Mim-Pomadze Ramsar sites. Some areas are accessible by boat only and this places restrictions on either infrastructural developments in such areas.

One of the serious problems facing the Keta area which has been attributed to the Construction of the Akosombo dam. among other factors, is excessive erosion. Erosion is a great threat to the survival of some communities especially. Keta, Vodza and Kedzi

For any sustainable management of the Keta Ramsar site, the problem of excessive erosion which impacts on the socio-economy of the people need to be solved.

#### 5.2.7 *A available Resources (Including Finance)*

Funds of the District Assemblies consist of local revenues, and central government contributions (common fund).

The wetland is an important source of revenue from the salt and fishing industry, vegetable farming, sugar cane production (and its eventual distillation into Akpeteshi), mangrove exploitation and coconut processing.

The Ramsar site has only recently been demarcated, and find little priority in competition with other uses. District environmental plans were prepared but there is the general complaint of lack of funds for the implementation of same.

### 5.3 Measures For Addressing Constraints

Traditionally, the local people value the Ramsar Site primarily for its contribution to their livelihoods and economic well-being. Economic activities within the Ramsar site include fishing, salt mining crop production, animal husbandry, fuelwood collection, crafts making, handicrafts from reeds, palms and special grasses.

With the growing population pressures, and intensification of agricultural and horticultural production, the local people can hardly forgo traditional livelihood enhancing activities for the sake of conservation. One must therefore be realistic to consider the practical opportunities for managing resources that take account of prevailing natural, institutional and economic constraints and forces.

Perhaps, conservation ideals at low intensity levels may not be incompatible with livelihood interests of the local people.

There is the need for intensive education and institution of legislation which would support those traditional methods which are useful to sustain the resources of the wetland. For example, closed areas and non-fishing days.

Any alternative economic activities which will ease the pressure on the exploitation of wetland resources is welcome. Also, education on the need for wise use of the resources is equally important.

The sea erosion problem can be solved partially by establishing structures and barriers on the sea side for protection and possibly reclaiming some of the lost land on the sea side. Some efforts are being made in this direction through the Keta Sea Defence Project.

The importance of water and the changes in its level with time in the Keta lagoon cannot be over emphasised. Measurements of water level variation on the channel under the bridge at Srogbe (Tumbulto. 1997) indicates that it is tidal. However, considering the distance between Anyanui (open to the sea) and the metering station, the daily variation in water level due to tidal effect is small.

In order to improve upon water availability in the Keta Lagoon, it is necessary to critically examine the various sources of fresh water input into the lagoon. An improvement in the conditions of the interconnecting channel linking the Keta lagoon to the lower Volta area through dredging would increase the interchange of water between the lagoon and the Delta, not only due to tidal effects but also in times of floods.

Land use management in the upper catchment that contribute runoff into the Keta lagoon is important in maintaining sufficiently high water levels to support the ecological functions of the wetland ecosystem. This will also improve the limited freshwater table and enhance farmine activities such as shallot farming. In this respect, emphasis should not only be placed on the demarcated part of the Ramsar site but on the entire catchment contributing runoff to the Lagoon complex.

The cultivation of woodlots to serve as sources of fuelwood in the upper catchments could greatly reduce deforestation especially, of mangroves, and general land degradation within the catchments. Improved water levels will ensure low salinity in the lagoon. With regard to the flooding situation in the Keta lagoon the proposed Keta Sea Defence project,"which is expected to open the lagoon to the sea with provision made for controlling lagoon water level, is a welcome idea.

In order to improve upon the water quality in the coastal environment, a waste management system needs to be put in place. Since the District Assemblies are currently collecting the waste to dumping sites what is needed now is the expertise to turn the waste into compost that could be used to improve upon agricultural output in the locality. Improvement in agricultural production will reduce the pressure on the exploitation of other wetland resources.

## 5.4 Operational Objectives

For ease of reference the long-term objectives have been restated below together with the specific operational objectives.

- i. *To maintain and enhance the value of the wetland as a wildlife habitat and integrate wildlife conservation into the existing human use of the wetland*

The specific operational objectives to achieve this long term objective are:

- Zonation of the site into major land use areas through pillaring, signposts education and guidance (on going)
  - To reduce the level of pollution caused by sewage, fertilizers and pesticide use in five years through proper waste management and education on the proper use of fertilizers and pesticides.
  - Restoration of mangrove stand through replanting to at least 50% of its original area and replanting of river banks as well as clearing of river channels feeding the lagoon within five years.
  - Control of over-exploitation of mangrove vegetation, fish and bird resources.
- ii. *To enhance benefits derived from the wetland and improve the quality of life for the local communities who live in the vicinity of the wetland and whose activities influence the wetland ecosystem.*

The specific operational objectives to achieve this long term objective are;

- Enforcing existing fishing regulations including traditional taboo days to prevent over-exploitation of the fishery resources.
  - Establishment of woodlots as an alternative sources of fuelwood to reduce the pressure on mangrove vegetation.
  - To establish the levels of wise use or sustainable use of wetland resources such as fish, crabs, fuelwood etc. in five years.
  - Financial support to groups to undertake biodiversity-related income generating activities.
  - Involve the local communities at all levels in the decision making process of the site
- iii. *To control, monitor and coordinate activities which affect the coastal zone close to the Ramsar site (e.g. human settlement, industrial developments, salt production, agriculture, fisheries, recreation etc) so as to ensure the maintenance of the health of the coastal environment and sustainability of the wetland resources there in.*

The specific operational objectives to achieve this long term objective are;

- To design a monitoring programme for the biological features e.g. fish stock, birds and pollution.
- To evaluate the regeneration of the mangrove ecosystem
- Research into sustainable limits of wetland resources.
- Banning of sand and stone winning activities at sensitive locations as well as prevention of sea erosion through structural measures.

*iv To publicise the rich ecological value of the Keta Lagoon and develop the infrastructural base requisite for the sustainable non-consumptive use of this rich heritage for education, recreation and tourism.*

The specific operational objectives to achieve this long term objective are:

- To develop educational programmes for the public regularly with immediate effect
- Increase the accessibility of the area for tourism and recreation by construction of roads, waterways, observation posts, hotels and restaurants in five years.

## **6.0 ACTION PLAN/PRESCRIPTIONS**

The Keta Lagoon Complex Ramsar Site (KLCRS) has been identified as a potmix involving succession and energy flow, and ecological interfaces, and hence provide a landscape with niches for high diversity, borrowing species from terrestrial and aquatic systems.

### **6.1 Activities Undertaken so far**

Like most wetlands. Keta Lagoon Complex Ramsar Site is typically environmentally fragile, requiring several interventions to ensure sustainability and ecological balance between production and conservation. The activities undertaken so far to maintain the ecological integrity of the site include the following:

- i. feasibility studies from 1991
- ii survey of the Lagoon Complex area by the Survey the Department.
- iii demarcation and gazettement of the Ramsar Site
- iv formulation of the Ramsar Site Regulations through a consultative process: from dialogue with local communities, district assemblies. Ministry of Land and Forestry. Legal Department of Government and gained approval of Parliament in December 1999.

### **6.2 Specific Recommendations/Action Plans**

Specific recommendations/action plans have been made under Table 4 for Habitat management (management of the open Lagoon, freshwater bodies and creeks, mangrove habitats, Beach/Coastline). Community Development. Public Education/Awareness. Research and Monitoring. Five Project for implementing a few priority areas have been appended with estimated costs.

### **6.2 Species Management**

#### **6.2.1 Floral Management**

The Keta Lagoon Complex Ramsar Site being a semi-arid zone is quite dry most of the year. There is therefore the need to plant trees to serve as vegetative cover.

The major threat to the mangrove forest is over-exploitation and the lack of interest to plant it after harvesting. Replanting of mangrove is strongly advocated coupled with a sustainable method of harvesting. The dredging of the Volta Estuary and also the canal linking the Volta River to the main Keta Lagoon would also contribute immensely to mangrove restoration by allowing a free flow of blackish water to those parts of the degraded mangrove further upstream.

The invasion of the mangrove swamps by' the bulrush, *Typha domingensis* and the fern *Acroslichum aureum* pose a serious threat to the survival of the mangrove forest (Rubin

and Gordon, 1997). There is the need to launch a campaign to destroy these plants before they take over and wipe out the mangroves.

Reeds are another plant species which are greatly harvested for crafts. Guidelines must be developed for their cultivation.

## 6.2.2 *Fauna/ Management*

### 6.2.2.1 Fish

The fish diversity in the Kcui Lagoon is quite high in spite of the damage caused by the damming of the Volta River at Akosombo. The main problem associated with fishing in the lagoon is over-fishing and the use of unprescribed fishing nets. Traditional practices, such as non-fishing days and closed seasons, which are significant methods to regulate fishing pressure and enhance conservation need to be promoted. The introduction of a low-intensity aquaculture industry to produce larger, more valuable tilapias and shrimps could help reduce the fishing pressure on the lagoon.

### 6.2.2.2 Birds

The high diversity of bird species and of habitat types in the Ramsar Site present a complex conservation task which could only be solved through community education and research and monitoring. Specific activities prescribed to management bird species included:

- Monthly population counts and identification.
- Monitoring of water quality and aquatic ecology to ensure sustained food source for the birds.
- A ban on hunting and trapping of birds.

### 6.2.2.3 Mammals

The most important terrestrial mammal is the sitatunga which is a protected species and monkeys. The threat sitatunga faces in the area is mostly hunting. This very important animal can be saved from extinction by banning hunting in its distribution range. The habitat can also be designated a protected area to forbid people from entering and thereby killing the animals. Public awareness and education need to be stepped up to conscientise the people about the need to conserve wild life.

The Volta River also harbours several manatees which are normally killed by people living along the river. Public education is proposed as a tool to arrest this situation.

**TABLE 4 RECOMMENDED ACTION PLANS/PRESCRIPTIONS FOR MANAGEMENT OF KETA LAGOON COMPLEX RAMSAR SITE**

<b>Habitat</b>	<b>Prescriptions/Action Programme</b>	<b>Implementing Agents</b>	<b>Time Frame</b>
Open Lagoon	Prevention of pollution resulting from improper disposal of waste (both solid and liquid); influx of chemical/pesticides into the lagoon water.	District Assemblies (DA's) Traditional Authorities EPA NGO's	Long Term
	Improvement of influx of fresh and marine waters into the lagoon.	Local Communities Water Resources Commission VRA Wildlife Division DA's	Long Term
	Control spread of weeds	Local Communities VRA EPA	Short to medium
	Enforcement of existing fishing Regulations	Fisheries Department Wildlife Division DA's EPA Traditional Authorities Law enforcement agencies	Short/Medium Term
Freshwater bodies and creeks	Desilting water ways and creeks to improve freshwater inflow and freshwater species into the lagoon.	Local Communities DA's Wildlife Division	Short/Medium Term
	Control spread of water weeds especially in the Abatsin and Aglon lagoons as well as creeks to ensure easy movement of fishing and transport boats.	Local Communities DA's Wildlife Division	Short/Medium Term
	Ensuring vegetation cover along creeks and river banks	Local Communities DA's Wildlife Division	Short/Medium Term



<b>Habitat</b>	<b>Prescriptions/Action Programme</b>	<b>Implementing Agents</b>	<b>Time Frame</b>
Mud Flat/Mangrove Habitats	Protection of roosting and nesting places for birds	Wildlife Divison Local Communities NGO's DA's EPA	Short/Medium
	Mangrove rehabilitation	Local Communities NGO's Wildlife Division	Short/Medium
	Development of woodlots	Local Communities Wildlife Divison NGO's DA's	Short to medium
Beach/Coastline	Conservation of turtle and turtle nesting sites	Wildlife Divison Local Communities NGO's DA's	Short/Medium Term
	Provision of coastal protection works	Law enforcement agencies EPA DA's Ministry of Works and Housing	Medium/Long term
	Establishment of beach vegetation To stablise coastline	DA's EPA Local Communities NGO's Wildlife Division	Medium/Long term
	Preventing of sand and shingles Winning	Law enforcemnt agencies DA's NGO Local communities	Short/Medium
Land Development	Shrt dry season farming for staple crops in tune	Local communities NGOs	Long term

Habitat	Prescriptions/Action Programme	Implementing Agents	Time Frame
Enhancing Agric potential Organic farming	<p>With hydroperiod mapped out; adopt new farming technologies; gree preference to fertiltizer use</p> <ul style="list-style-type: none"> <li>- Training – irrigation techniques and appropriate pesticides uses, (eg. Biological control methods)</li> <li>- Prevention of post-harvest losses</li> <li>- Practice minimum tillage of the bushed perimeter.</li> </ul>	MOFA (Agric. Extension) IDA	Medium
Land tenure	<ul style="list-style-type: none"> <li>• Oberve taboo culture in wetlands with conservation implications</li> <li>• Memorandum of understanding (MOU) useful in resolvoing land disputes</li> </ul>	NGO's Local Communities  DA's	Long term

<b>Habitat</b>	<b>Prescriptions/Action Programme</b>	<b>Implementing Agents</b>	<b>Time Frame</b>
<p>Communities Infrastructure Development</p> <p>Environmental Health</p>	<p>Provision of sanitation facilities (e.g. toilet facilities KVIPs, refuse receptors, potable water, roads, plank houses etc)</p> <p>Mitigate exposure to health risks through health training and sensitization</p> <p>Surveys for water-related diseases: Malaria diarrhea</p>	<p>DA's</p> <p>NGO's</p> <p>Wildlife Division</p> <p>Local Communities</p>	<p>Short/Long term</p>
<p>Recreation and Ectourism</p>	<ul style="list-style-type: none"> <li>provision of tourist facilities (e.g. Challets, Hotels, Guest houses, water ways, restaurants etc</li> </ul>	<p>Tourist Board</p> <p>DA's</p> <p>NGO's</p> <p>Local communities</p> <p>Wildlife Division</p> <p>Private Sector</p>	<p>Long term</p>

<b>Habitat</b>	<b>Prescriptions/Action Programme</b>	<b>Implementing Agents</b>	<b>Time Frame</b>
Public Awareness and Education	<p>Provision of education/visitor Centres for educating people on principles of wetland conservation</p> <p>Local capacity building for site Management</p> <p>Exchange of information and Experience through workshops, seminars and public for a</p> <p>Formation of Wildlife clubs</p> <p>Community consultation and education</p>	<p>Wildlife Division NGO's EPA DA's</p> <p>DA's Wildlife Division NGO's EPA</p> <p>Wildlife Division NGO's DA's</p> <p>Wildlife Divison NGO's</p> <p>Wildlife Division, DA's Information Services Department Press NGO's</p>	Long term

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<b>Habitat</b>	<b>Prescriptions/Action Programme</b>	<b>Implementing Agents</b>	<b>Time Frame</b>
Research and Monitoring	Monitoring ecological trends in the Lagoon complex area	Research Institutions NGO Universities EPA Wildlife Division, DA's	Short term

### 6.3 Marine Turtles

The area between the Volta Estuary and Togo boarder at Aflao serve as a good nesting site for these ancient animals. The following measures are advocated to conserve them.

- Formation of task forces and pressure groups to advance the cause for then conservation.
- Public awareness and education
- Enactment of bye-laws by District Assemblies to conserve marine turtles
- Non-pollution of beaches.

### 6.4 Land Management

Settlements are confined to sheltered grounds especially to the narrow coastal marine and sand dunes which separate the sea from the lagoon and associated marsh lands. There is some migration following the alteration of the hydrological regime which supports the major economic activities e.g.. fishing and salt production.

#### 6.4.1 *Compatibility of land Uses*

Enhancement of compatibility of land uses within wetlands as a whole emerged recently as a basic criterion for initiating sustainable land use development options for wetland ecosystems. In fact the Ram-sar Concept of multiple use approach to management embraces compatible human activities such as aquaculture development, fishing, forestry, ecotourism which have excellent potential to provide alternative means of income for local people.

Arable agriculture is characterized by fields of mix cropping. However. KLCRS like the other Ramsar sites, faces altered hydrological and physical environments

#### 6.4.2 *Major Land Uses*

The major land use categories described by Ametekpor (1997) are as follows:-

<b>Location</b>	<b>Activity</b>	<b>Remarks</b>
1. Coastal sand bar Upland	<u>Human settlement</u>	
2. Upland, Hydrozones uplands	Agriculture	- Shallot farming - Stables for subsistence; - Okro, pepper, maize cassava - Tree crops coconut Fallows

3.	Uplands lagoons Marshland	Forestry	- mangroves - Neem - Thickets
4.	do	Wildlife produce	- grass for thatching - Palms - Philoxerus
5	Upland hydrozones Seasonally flooded	Livestock Raising	Coats and Sheep Cattle
6.	Marine Lagoon	Fishing aquaculture	the major livelihood of KLCRS - low intensity
7.	Trapped saline waters saline waters	Salt collection	- next to fishing in economic importance
8.	-	Traditional cottage industries	- mats, bags, fish trap - weaving, local gin distillation fish smoking
9.	Beaches sea shore birds	Ecotourism	festivals

#### 6.4.3 *Drastic Changes in Hydrological Conditions of KLCRS*

The drastic change in hydrologic condition in the KICKS is caused by the construction of the Akosombo dam: subsequent y. marine tidal salt intrusions of the river valleys are now restricted to relatively short distance upstream compared to pre-dam era (before 1966). The network of trunk roads tend to act as barriers to the free flow of brackish water through the hydrological cycle which maintains the ideal soil and brackish condition for viability of the white and red mangrove, and associated fauna and flora i.e. decline in both fishing and mangrove development due to succession. Mitigative measures to rehabilitate mangrove areas are assessed.

Coastal erosion especially at Keta is a phenomenal problem attracting heated public debate and consequently massive sea-defence projects are in the pipe line.

#### 6.4.4 *Fertilizer Use*

*In* areas where applied fertilizers do dissolve in runoff plants and organisms in downstream water bodies may pro derate (culrophieaiion process).

- preferably, conduct training programmes on the production of green manure crops as a source of plant nutrients in preparation for Organic Framing.

#### **6.4.5 Pesticide use**

Pesticide use has numerous potential negative environmental impacts, including poisoning, destruction of non-target organisms, disruption of natural control, and development of resistant organisms. Training in irrigation cultivation should include lessons on appropriate pesticide use in wetland environments. Integrated pest management could be considered as a possible alternative and developed for various food crops, where realistic economic injury levels (thresholds) are used to determine the need for control actions.

#### **6.4.5 Environmental Health**

Wetlands are often recognised as unhealthy places to work: wetlands in close proximity to housing have often been used as the de facto refuse dumping sites. Additionally, urban runoff carrying human excrement poses other obvious hazards.

Prolonged flooding could increase incidences (if water-related diseases, which include diarrhea and malaria. Irrigation water may be a contaminated reservoir for transmittable diseases however, no cases of river blindness have been cited. Most development programmes can readily incorporate a health and sanitation component for complementary activities.

General environmental health and mitigation measures should include;

- incorporation of health education in training programmes.
- management of weed growth and fish populations. This should serve to reduce habitats for mosquitoes which prefer confined, stagnant waters.

### **6.5 Monitoring and Evaluation**

The overall rationale for monitoring and evaluation is to ensure that performance data is collected and used to monitor regularly, analyse, review and assess performance to:-

- inform management on decisions aimed at achieving immediate results (targets), strategic objectives and overall objectives;
- meet reporting and accountability requirements at all levels, enhance organisation learning.

#### **6.5.1 Monitoring**

Essentially, the monitoring programme should provide information to address impacts of activities/prescriptions, and their mitigation measures undertaken by respective implementing agents.

Base-line data/information should be collected for various sites recommended for development.



- i. Land-use:  
Present land use options during various hydro-periods.
  
- ii. Land Development:  
Farmer group composition/gender crop yield, slash and burn coverage within catchment area. effects of erosion, farming technologies, pest and diseases problems, pesticide uses.
- iii. Community Participation  
In various development activities and Gender issues addressed.
  
- iv. Water management practices:  
flow characteristics of streams, dry season, water table depth, down stream flooding frequency.
  
- v. Environmental Health  
Prevalence of water-related diseases
  
- vi. Biodiversity and Ecology:  
fish populations in streams lagoons, fish farming practices.

### **6.5.2 Guidelines**

Guidelines for developing a participatory monitoring and evaluation system will clarify institutional responsibilities for monitoring but should normally be implemented by team, including project staff and representation of interest groups who are involved in activities. Community members (eg. Extension staff etc) should be trained and compensated to collect and analyze data

### **6.5.3 Fragility of the wetland ecosystem**

The landscape of the region generally shows large areas of degraded vegetation and farmlands. Contributing factors to this state of affairs include the slash and burn and shifting cultivation methods employed in traditional farming, the poor nutrient nature of the soils and their erodibility is also a cause for concern.

Fuel wood harvesting, grass and sedge cultivating for thatch and mats weaving, encroachment for development (housing, roads, salt mining etc) have also invariably contributed to the degradation of the flora in the area.

The use of unauthorised fishing methods, use of illegal mesh sizes, over exploitation, lack of free flow of marine and fresh water into the lagoon poses a great threat to the fish fauna in the lagoon.

The greatest threat to the Ramsar site is perhaps the excessive erosion from the seaside.

- Destruction of farms, houses and other properties due to the periodic inundation of the lagoon and its surroundings.
- Inadequate land high enough to enable construction of houses which will be safe from the lagoon floods. The narrow sand ridge on which the towns and villages are built is only about 2.5km at its widest point and about 0.92km at the narrowest portion. (Dorbu. 1985).
- Direct disposal of both solid and liquid waste into the lagoon due to the absence of a proper waste management system.

#### **6.5.4 Rarity/Decline of Popular Species**

The current dominant species including the tilapias, shad, gobies, crabs and other species have always constituted important components of fish landings. Other species have declined or disappeared from the catches. Species such as the mullets, catfish (*Chrysichthys* spp.) and the mudfish (*Clarias* spp.) have become rare. The shrimp populations have also declined significantly. All the bird species found in the Keta Ramsar Site especially, the Caspian tern, are of special concern internationally.

### **6.6 Research**

Planning is data-dependent: thus several research efforts have been sponsored over the past decade to deepen knowledge and information about the KLCRS by several scientists on thematic areas such as soil classification and land use, stake-holder analysis, development options for the Ramsar site.

Additional researches needed for a better understanding of the KLCRS are indicated below:-

- i. changes in the hydrological cycle leading to disruption of native flora and fauna, resulting in degrading a rather vulnerable ecosystem.
- ii. Continuation of baseline studies on larger mammals, aquatic life needing migratory passages (fish) and any protected species.
- iii. Understanding of the wetlands hydro period; i.e. the pattern of seasonally fluctuating water levels; period of water availability, excess versus dry

- season, limited water as an aid in training farmers to schedule economic activities, select crops and decide on cultivation techniques.
- iv. Construction of basic landuse/land suitability maps for the area determination of liming, fertility rates for various crops.

## 6.7 Projects and Estimated Cost

Five specific projects have been outlined to help translate some action plans to be implemented for the benefit of selected sites within the complex:

- a. Mangrove forest development in the Keta lagoon Complex Ramsar site
- b. Improving upon water circulation in the Keta Lagoon Complex Ramsar site.
- c. Recreation and ecotourism at Avoto within the South Tongu District.
- d. Development of the flood plains of the Tordzie River into agricultural land.
- e. Fish monitoring within the Keta Lagoon Complex Ramsar site.

Summary- of Cost Estimates for Projects.

A	Mangrove forest development in the KLCRS	US\$40,000
B	Improving water circulation in the KLCRS	US\$77,000
C	Recreation and Ecotourism at Avoto within south Tongu District	US\$51,428
D	Development of the flood plains of the Tordzie River into Agriculture land.	US\$17,629
E	Fish monitoring within the Keta Lagoon Complex Ramsar site.	US\$60,268
	<b>TOTAL</b>	<b>US\$246,325</b>

6.8.1 A. Project Title

Mangrove Forest Development in the Keta Lagoon Complex Ramsar Site.

**B. Linkages to National Development Priorities**

The project is in tune with the National Forest and Wildlife Policy (1994) Sections 5.3.8 which states: "promotion of resource development aimed at reforesting suitable harvested sites, rehabilitating degraded mining areas, afforesting denuded lands, regenerating desired wildlife species and habitats.

**Project Rationale**

- i. Wholesale destruction of mangroves imperils coastline stability, Lagoon estuary fisheries habitat.
- ii. traditional sources of fuelwood from mangrove species for fish smoking is becoming scarce.
- i. Mangrove swamp habitats - highly saline, waterlogged soils with regular flushing with seawater or freshwater seepage and being destroyed through:
  - diversion of affluent river water for agriculture etc.
  - over cutting fuelwood for fish smoking
- ii. The satisfaction of firewood needs of communities is a major reason for rehabilitating the mangrove vegetation and associated resources.

**Project Objectives**

- i. To conserve remnants of mangrove resources.
- ii. Artificial replanting of degraded mangrove forests.
- iii. To revive mangrove swamp habitats which serve as spawning and nursery grounds for many species of fish, shrimps, crabs, clams etc.
- iv. To resuscitate mangrove site as feeding and nesting grounds for sea birds and other wildlife (hence a fulfillment of Ramsar primary site concept).
- v. To revive cottage industry such as tanning, durable timber for small-scale furniture.
- vi. Many communities indirectly draw their livelihood from mangroves as they are potential sources for agriculture.

*Stakeholders*

Local population

Fish smokers.

Small-scale tanning/wood working industry.

### *Expected Output*

- remnant populations of mangroves protected
- potential sites rehabilitated through either natural regeneration, artificial regeneration method
- Aquaculture marshland fishery industry revitalized.
- Income generated from fisheries and cottage industries.

### *Planned Activities*

- i. Individuals sensitized to participate in replanting programme on their own sites.
- ii. Natural Regeneration option

Manarove species is viviparous, the seed germinates while still on the tree and may drop the seed directly into the mud below or may be swept away by the tide to facilitate dispersal and natural regeneration.

- iii. Artificial Regeneration
  - a. Owing to the disappearance of mangroves in many areas, reliance on natural regenerate from tidal dispersal may be unreliable.
  - b. Set up mangrove Nursery
    - Set up propagation from seed - direct sowing.
    - Set up propagation by air-layering
  - c. Collect seeds of common species;  
Rhizophora racemosa (red mangrove)
  - d. Avicennia africana (white mangroves)
  - e. Rotation 5-10 year for fuelwood, small timber

### *Estimated Cost*

i.	Seed Collection	50 mand-day per ha. At	¢7,000
	Nursery formation Maintenance	50 mand@ ¢7,000	350,000
ii.	Site Preparation	50 mandays/ha	530,000
iii	planting and Beating-up		700,000
iv	Tending		105,000
			905,000
v.	Supervision (20% of establishment costs)		181,000

Cost of planting by 20 outgrowers year		21,720,000
Cost for 5-year project		108,600.000
		=US\$36,800.00
Incidentals 5%		US\$1,400
		US\$38,200
Total Cost 5-year off-year planting project	Or	US40,4000.00

### 6.8.2 **Project Title:**

Improving Upon Water Circulation in the Keta Lagoon Complex Ramsar Site.

### **Linkages to the National Development Priorities**

The water Resources Commission Act 522 of 1996 was passed by Parliament to facilitate and enhance the management of the resources of the country for socio-economic development as envisaged in the governments Vision 2020 document.

This project therefore in line with the policy of managed Ghana's water Resources in a sustainable manner for the socio-economic development of the people.

### **Project Ractionnlc**

Most of the water ways through which water (lows within the complex are silted up This impedes water circulation. It also prevents the use of the water ways as a channel for transporting people and goods across the complex.

Poor water circulation in the lagoon complex also adversely affects wetland productivity and threatens the very existence of the wetland.

### **Project Objective**

- To improve upon water circulation within the Keta Lagoon Complex Ramsar Site
- To improve upon (he productivity of the ecosvstem.
- To enhance riser Iransportation within the complex for the socio-economic well being of the people living within the complex.
- To promote trade within the complex
- To improve upon the general socio-economic well hem, of the residents within the complex.

### **Stake holders**

The various groups of people who will have interest in this project – stakeholders shall include:

Local population fisherman  
Canoe owners and operators  
Trader within the complex  
District Assemblies

### **Expected Output**

- 1) Improve channels for water flow within the lagoon complex
- 2) Improved Water transportation withing complex and hence easier makerting of wetland products

- 3) Better water circulation in lagoon complex and hence potentially better productive capacity.
- 4) Increased incomes through increased wetland products and better marketing opportunities.

**Planned Activities**

Start up workshop to sensitive communities on the need for clearing and desilting small channels in and around communities through communal spirit.

Provision of implements for channel clearing and desilting.

**Bigger-Channels**

- Cutting of weed
- Dredging of water channels
- Disposal of dredged material
- Preparation local landing sites
- 

**Estimated Cost**

Seminar/workshop to educate, sensitize and encourage community participation in river channel clearing

	<b><u>US\$</u></b>
Lump Sum	2000
Provision of equipment	3000
Dredging cost	
Targe; 12.5 km at	US\$4,000/km
	\$50,000
Development of local landing sites: Lump sum	2000
Sub Total	57,000
Projeci Administration	<u>20,000</u>
Grand total US\$	<u>US\$77,000</u>



### 68.3 Recreation and Ecotourism Development at Avuto within the South Tongu District

#### **Project Rationale:**

If there could be any meaningful recreational or ecotourism development within the Keta Lagoon Complex Ramsar Site, then the Avu Lagoon and its environs, stands out as the first place to be considered. It is imperative to spell out the unique features of the area in question.

The main pool of the Lagoon water is surrounded by evergreen vegetation. "I here are grasses and woody species of plants in which could be found fauna such as monkeys, birds, serval cats, leopard, bushbuck and the rare antelope, the sitatunga. It is also worth noting that the surrounding vegetation is floating over an average of 2m depth of water column. There are two water channels leading to the main lagoon. These channels are clogged with weeds. At the moment one channels is being cleared from the Avuto community to the lagoon. The other close by channels is yet to be cleared. This is where work on developing the place into a tourist attraction centre could really be carried out

The clearing of the water channel, rehabilitation of the access road, the development of other visitor infrastructure such as a restaurants, guest houses, observation posts, ear park, museum and giving appointment to centre management staff would augment the naturally attractive scenery there. When these are achieved, we could bring people close to wildlife without disturbing them.

#### **Project Objectives:**

The objectives of the project are:

- 1) To promote the development of a tourist centre without destroying the natural wetland environment.
- 2) To education the general public about the various resources available within and around the wetland area.
- 3) To give adequate information on managing the various resources on sustained yield basis.

#### **Project Phases**

PHASE 1: Rehabilitation of the access road and clearing of the water channel are paramount. Landing base creation for boats and an acquisition of an interim number of four (4) boats is also essential. For purposes of security, a caretaker's accommodation facility could be created. These would open the place up to visitors and tourism development agencies. An enabling environment will be created through seminars for the private sector to invest in the above activities.

PHASE 2: Building of two (2) observation posts, guest houses with a restaurant, car park and an education centre with a museum will become necessary as tourist/visitor numbers to the centre swells up. It stands to reason that a number of persons with requisite academic or vocational background would have to be employed to see to the

management of the centre Five (5) more shallots could be put up as further development.

**STAKEHOLDERS:** Once it is a wetland area with wild species of flora and fauna the Wildlife Department in collaboration with governmental and non-governmental organisation should see to the running of the centre. Funding for the creation of the centre could come from donor agencies like DANIDA, World Bank/ Global Environment Facility (GEF) and Private Companies (foreign and local). The District Assemblies connected with the Avu Lagoon could also give some financial assistance through the District Assemblies Common Fund. Various experts as well as local people could be employed as workers of the centre. The local people, could also give voluntary services to the centre.

The table below indicates the various activities. The expected output and the estimated costs.

<b>NO</b>	<b>ACITIVITY</b>	<b>OUTPUT</b>	<b>BUDGET (¢)</b>
1	Rehabilitation of 1.4km access road (laterite only)	Good access road to centre	72,000,000
2	Clearing of 2km water channel	Cleared 2km water channel	17,000,000
3	Creation of landing base for boats	Cleared 6m x 5m rectangular area	4,200,000
4	Encouraging the Acquisition of four (4) cruise boats	Cruise boats	2,000,000
5	Encouraging the Construction of care takers residence (2 bedroom Quarters)	Care-taker's residence	5,000,000
			<b>US\$27,714</b>

<b>NO</b>	<b>ACITIVITY</b>	<b>OUTPUT</b>	<b>BUDGET (¢)</b>
1	Buidlign of two(2) observation posts	Two (2) observation	78,000,000
2	Encouraging the construction of guest house with a restaurant museum and an education centre	Tourist centre	5,000,000
3	Encouraging the building of two (2) hectares car port	Car port	
4	Encouraging the construction of care five (5) shallots	Five (5) chalets	
	<b>Total</b>		<b>US\$23,714</b>

#### **6.8.4 PROJECT TITLE: Development of the floodplains of the Tordzie River into Agricultural Land.**

##### **2. Linkages to National Development Priorities**

##### **3. Project Objectives**

- a. To put the Tordzie River to effective and efficient use for socio-economic development.
- b. To create job opportunity for the youth.
- c. To increase food production and hence attain food security.
- d. To prevent flooding of the flood plains hence making it.
- e. To ensure food production all year round.
- f. To tap the water resources in the area for socio-economic development.
- g. To enhance women involvement in agriculture.

##### ***Stakeholders***

Local Communities, Ministry of Food and Agriculture (MOFA), Irrigation Development Authority (IDA). District Assemblies, Water Resource Commission. Water Resources Institute (WRI), Formers,

##### **6. Expected Output**

- about 5 hectares of land put under cultivation on pilot basis, and extended to 15-20 hectares subsequently.
- Living standards of local communities raised by about 65%.
- About 100-150 new jobs to be created.
- Increased income levels will many communities undertaking development projects e.g. schools, clinics, portable water, electricity etc.
- An opportunity for investment into the area by NGOs and donor agencies.
- Source of regular income for the people.

##### **7. PLANNED ACTIVITIES**

- Construction of embankment along the river to prevent flooding.
- Tube well irrigation system development.
- Purchase of pumps.
- Land development (weeding, construction of furrows etc)
- Cultivation of fields
- Construction of wooden access bridge across river to link opposite banks
- Purchase of power tillers and ploughs.
- Monitoring and Evaluation

## Cost Estimate

	<u>Activity</u>	<u>Responsibility</u>	<u>Cost</u>
1.	Tube well irrigation System development	Project unit/donor	
	a. Purchase of pumps		¢1.5m
	b. Development of tube well	Local developer	¢1.5m
2.	Construction of embankments	Local communities	
3.	Land development: Weeding and Construction of furrows	Local communities	
4.	Cultivation of fields	Local communities	
5.	Purchase of 5 fields	Project unit/Donor	30m
6.	Purchase of 5 pumps For farmers	project Unit/donor	20m
7.	Monitoring and Evaluation	Wildlife Dept. MOFA, WRC. WRI.	
8.	10% Contingence		8.7
	total Estimate		66.7m
		=	US\$17,628.00

## **6.8.5 FISH MONITORING FOR 2 YEARS**

### **Introduction**

Development of a fishery monitoring and analysis program is required for a complete understanding of the population dynamics, growth patterns and productivity of the lagoon fisheries. The Sampling programme for a period of at least 2 years will help to evaluate the responses of populations to the changing environment as well as annual estimate of population abundance and dynamic parameters.

### **Sampling Strategy**

The study area should be demarcated into appropriate sampling areas. Based on previous Studies this could be 4 basic areas. The eastern region near Afiedenyiba or east of Keta the northern region near Anyako, the northwest near Alakple and the southwest area near Analogue.

### **Gears**

- 50-75 m long x 2 m high bag seine with 1cm mesh.
- 15-20m x 2-3 m hand bag seine with 2mm mesh.
- 4-6m diameter cast nets with different mesh sizes

Fishermen's catches should be sampled to supplement experimental catches.

### **Sampling Frequency**

Each site should be sampled once every month.

### **Data to be Collected**

#### **Abiotic Data**

Water quality at each site should be analysed with respect to temperature, dissolved oxygen, salinity conductivity, total dissolved solids, phosphates and nitrates. Similarities and differences between communities and the influence of environmental factor on seasonal changes of fish abundance could be assessed with multivariate analysis of CCA and Cluster analysis.

#### **Biotic Factors**

Fish species

Length measurement (SL/TL)

Body weight

Gonad development stage and weight for selected commercially important fishes

Stomach Contents  
Fecundity studies

Catch per unit of effort (CPUE) in terms of weight and number for each mesh size and for each gear should be calculated for each individual species for each month. This will indicate seasonal as well as relative abundance and size composition of each species. The total CPUE for all species should be calculated for each month to follow for each month to follow seasonal changes in catches

Using length base data the following can be estimated or predicted (using FISAT)

Growth Parameter K, to and  
Natural and Fishing Mortalities  
Exploitation rate  
Recruitment patterns of species

**Budget for Fish Monitoring for 2 yrs**

	US\$
Per diem in Field of 1 Scientist \$45 x 7 days x 1 Scientist x 24, 24 months	7,560
Per diem in field for 1 Technician \$36 x 7 days x 1 Technician x 24 months	6,048
Per diem in field for 1 driver \$36x7days x 24months	4,200
Transport hire @ SI 20 for 168 days	20,160
Fuel and lubricants	3,000
Field hands @ \$50 x 7 days x 24 month	8,400
Laboratory cost/chemical etc	1,000
Miscellaneous field equipment	2,000
Report writing	500
Fixed honorarium for 1 Scientist @\$500 /week/for 12 weeks	6,200
fixed honorarium for 1 technicians @\$200 week for 6 weeks	1,200
<b>Total</b>	<b>\$60,268</b>

## 7.0 ADDITIONAL INFORMATION

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### 7.3 List of Species

#### Appendix 1. Fish Species in the Keta Lagoon

<b>FISHES</b>
<i>Cichlidae</i> <i>Sarotherodon melanotheron</i> <i>Tilapia gunieensis</i> <i>Hemichromis fasciatus</i> <i>Hemichromis bimaculatus</i> <i>Oreochromis niloticus</i>
<b>Clupeidae</b> <i>Ethmalosa fimbriata</i> <i>Pellonula leonensis</i>
<b>Belonidae</b> <i>Strongylura senegalensis</i>
<b>Hemiramphidae</b> <i>Hyporhamphus piarti</i>
<b>Gobiidae</b> <i>Porogobius schlegelii</i>
<b>Gerreidae</b> <i>Gerres melanopterus</i>
<b>Eleotridae</b> <i>Dormitator lebretonis</i>
<b>Mugilidae</b> <i>Mugil curema</i>
<b>Pleuronectidae</b> <i>Citharichthys stamipflii</i>
<b>Lutjanidae</b> <i>Lutjanus sp</i>
<b>Prototeridae</b> <i>Protopterus annectens</i>
<b>Gymnarchidae</b> <i>Gymnarchus niloticus</i>
<b>Family Characidae</b> <i>Bycinus nurse</i>
<b>Family Osteoglossidae</b> <i>Heterotis niloticus</i>
<b>Channidae</b> <i>Parachanna obacura</i>

Source; Shenker, et al., 1998)

**Appendix II. Macro-invertebrates in the  
Keta Lagoon**

<b>SITE</b>
<p><b>Annelida</b>            Polychaetes</p> <p style="padding-left: 100px;">Small* Large**</p> <p>Oligochaetes</p>
<p><b>Mollusca</b>  <i>Gastropoda</i>  <i>Hydrobia accrensis</i>  <i>Tympanotonos fusecatus</i>  <i>Bolinus cornutus</i>  <i>Neritina adansoniana</i></p>
<p><b>Bivalvia</b>  <i>Brachidontes niger</i>  <i>Congeria Ornatat</i>  <i>Congeria Ornatar</i>  <i>Corbula trinat</i>  <i>Tellina nymphalist</i>  <i>Gastrana multangulat</i>  <i>Tivela tripla</i>  <i>Loripes aberranst</i>  <i>Melanoides tuberculatat</i>  <i>Pachymelania byronensis</i></p>
<p><b>Crustacean</b>  <i>Amphipods<sup>a</sup></i>  <i>Isopod<sup>aa</sup></i>  <i>Parapeneopsis atlantica</i>  <i>Penaeus kerathurus</i>  <i>Penaeus notialis</i>  <i>Callinectus amnicola</i>  <i>Cardisoma armatum</i>  <i>Occypode Africana</i>  <i>Sersarma huzardit</i>  <i>Uca tangeria</i></p>
<p><b>Insecta</b>  <i>Isoptera (Macrotermes spp.)</i>  <i>Dermaptera</i>  <i>Odonata (nymphs)</i></p>

Source; (Finlayson, et al., 1998)

### Appendix III. List of Mammals and Reptiles

Common Name	Scientific Name
Pygmy mouse	<i>Mus minutoides</i>
Common mouse	<i>Mus musculus</i>
Multimammate mouse	<i>Mastomys natalensis</i>
Nile rat/kusu	<i>Arvicathis niloticus</i>
Common rat	<i>Rattus rattus</i>
Giant rat	<i>Cricetomys gambianus</i>
Cane rat	<i>Thryonomys swinderianus</i>
Nile monitor	<i>Varanus niloticus</i>
Agama lizard	<i>Agama agama</i>
Graceful chameleon	<i>Chameleo gracilis</i>
Royal python	<i>Python regius</i>
African python	<i>Python sebae</i>
Puff adder	<i>Bitis arietans</i>
Green turtle	<i>Chelonia mydas</i>
Common frog	<i>Rana galamensis</i>
Common toad	<i>Bufo regularis</i>
White-toothed shrew	<i>Crocidura oliveri</i>
Bottego's shrew	<i>Crocidura bottegi</i>
Kemp's gerbil	<i>Tatera kempii</i>
Bushbuck	<i>Tragelaphus scriptus</i>
Olive baboon	<i>Papio anubis</i>

Source ; Amjeyaw-Akumfi et al., 1998; Ryan and Ntiamoa-Baidu. 1997)

#### Appendix IV List of bird species in Keta Lagoon

Fulvous tree duck
White-faced tree duck
Kittlitz's plover
Ringed plover
Grey pover
Common sandpiper
Redshank
Black-tailed godwit
Bar-tailed godwit
Curlew
Knot
Sanderling
Little stint
Curlew sandpiper
Marsh snadpiper
Spotted redshank
Black-winged stilt
Avocet
Little egret
Reef heron
Great white egret
Grey heron
White pelican
Little tern
Common tern
Sandwich tern
Royal tern
Caspian tern
Whiskered tern
Black tern
Gull-bulled tern
Lesser black-backed gull
Collared pratincole
Ruff
African jacana
Glossy ibis
Senegal wattled plover
Purple heron
Black heron
Squacco heron
Long-tailed cormorant

(Source, Ntiamo-Baidu and Gordon 1991)

#### 7.4. Budget for Selected Projects

A	Mangrove forest development in the KLCRS	US\$40,000
B	Improving water circulation in KLCRS	US\$77,000
C	Recreation and Ecotourism at Avuto within South Tongu District	US\$51,428
D	Development of the flood plains of the Tordzie River into Agriculture land	US\$17,629
E	Fish monitoring within the Keta Lagoon Complex Ramsar Site	US\$60,268
	Total	US\$246,325

## 7.5 Profile of the Keta Lagoon Ramsar Site

<b><u>Location:</u></b>	Volta Region
<b><u>Longitude:</u></b>	0 <sup>0</sup> 40'E- 1 <sup>0</sup> 08'E
<b><u>Latitude:</u></b>	5 <sup>0</sup> 45'E- 6 <sup>0</sup> 5'E
<b><u>Local Authorities:</u></b>	Keta, Ketu, Akatsi and South Tongu
<b><u>Surface Area:</u></b>	300km <sup>2</sup> shrinking to 200km <sup>2</sup> in the dry season
<b><u>Catchment Area:</u></b>	2900km <sup>2</sup>
<b><u>Average Depth:</u></b>	3 meters
<b><u>Total Coastline:</u></b>	40km

Lagoon separated from sea by harrow coastal ridge – 2.5km at widest point and 0.9km at narrowest.

<b><u>Annual Rainfall:</u></b>	740-910mm
<b><u>Total Population:</u></b>	544,130 (1994)
<b><u>Population Density:</u></b>	167/km <sup>2</sup>

### **Faunal Reseources:**

72 species of shorebirds, NO 100,000 birds, fish fauna, 38 species; including Tilapia, Mudfish 14 species of crabs, prawns and mollusks

**General Flora:** Red/white mangrove, reeds, grasses

### **Environmental Threats:**

Drought, siltation, agricultural runoff, solid wsaste/refuse mangrove cutting- 'not regenerated; bush fires. Land reclamation/residential development Lrosion control works/Sea Defence Reclamation Over exploitation of shellfish. Crustacea and fish.

<b><u>Agricultural Dependence:</u></b>	58
<b><u>Poverty Index:</u></b>	140(1994)
<b><u>Fisheries Dependence:</u></b>	4-13%
<b><u>Taboos:</u></b>	No fishing on Thursday