
**A REVIEW OF ENVIRONMENTAL IMPACTS OF THE SALT MINING INDUSTRY ON
THE COASTAL AND RIVERINE LAGOONS IN GHANA**

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1. INTRODUCTION

The Trade and Investment Program (TIP) is a USAID/Ghana Government initiative designed to address the constraints that limit private sector investments and production for exports. In particular, the program seeks to strengthen the necessary policy and institutional framework; improve the financing and incentives available to the private sector, and improve the capability and capacity of individual firms and entrepreneurs to export. The TIP is designed to shift the dependence of Ghana's economy on a few principal exports by increasing and diversifying export earnings. In order to achieve this, the TIP will increase the private sector capacity for the production and marketing of non-traditional exports such as Pineapples, Yams, Shellfish, Wood products and Salt.⁽¹⁾

One of the requirements expected of USAID in the final preparations for the TIP, is to conduct an overview of the potential long term environmental impacts related to the proposed projects and develop a plan for monitoring, evaluating and mitigating those impacts. Salt mining has been identified as one of the projects which require evaluation in terms of the likely adverse environmental impacts.⁽²⁾

Much of the salt mining and production in Ghana occur in coastal wetland habitats, where the low lands near the sea are developed into salt pans and the brackish lagoons are exploited for salt when they dry up in the dry season. The coastal wetlands are valuable ecosystems, serving a variety of functions and providing essential resources for the local communities. Wetland habitats also support diverse array of plant and animal species, whose long term survival depend on the maintenance of the ecological integrity of the wetland.

Ghana is signatory to three international conventions that relate to the conservation of wetlands and the fauna and flora they contain (See Appendix 5). Ghana therefore has an obligation to the international community to promote wise use of her wetlands, and is expected to demand proper assessment of environmental impacts before development projects in wetland areas are approved, provide continuing evaluation during project execution, and implement appropriate environmental conservation measures.

This report presents an overview of the environmental impacts of salt mining industry on coastal wetlands. Section 2 reviews the salt industry; potential impacts of the development of the industry on the environment with particular reference to the biological value of the coastal wetlands are discussed in section 3. Suggestions on measures to minimize adverse impacts are provided in section 4 and activities for monitoring of such impacts are outlined in section 5

2. THE SALT INDUSTRY

2.1 SALT PRODUCTION IN COASTAL GHANA

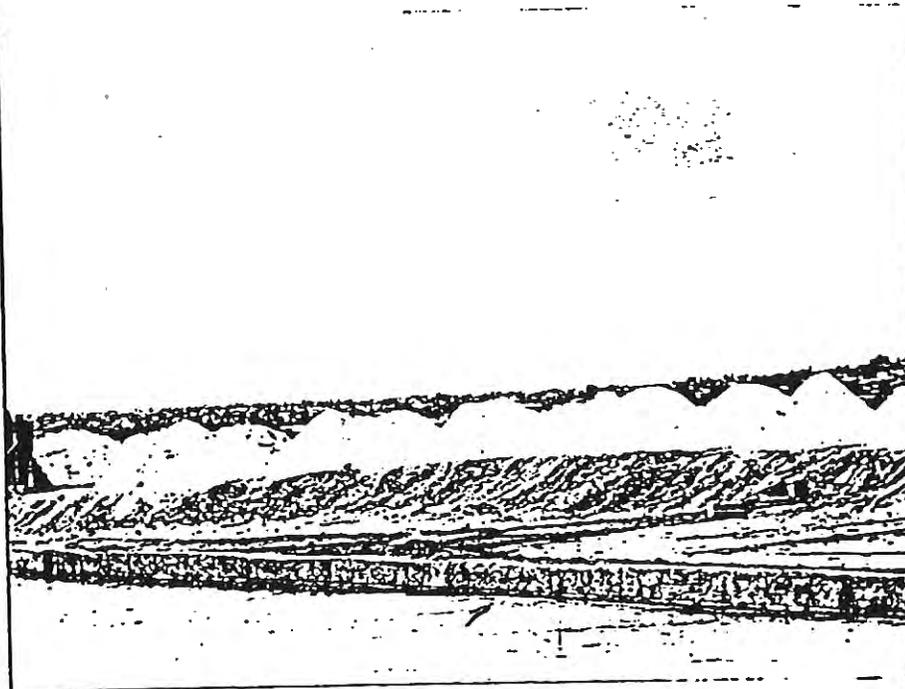
Salt in Ghana is obtained mainly by solar evaporation of saline water. Two sources are currently used for salt production along the coast:

The brackish lagoons: In the dry season, (November to March) large areas of the lagoons dry up depositing large quantities of salt crystals on the lagoon bed, which is scraped up by people living around the lagoons. This is the traditional method of salt winning common around the Songor and Keta lagoons. Quantities of salt available for collection each year depend on the duration of the dry season and intensity of sunshine. Songor lagoon is the most important traditional salt mining area on the Ghana coast. Salt mining is a major commercial activity and majority of the people who live around the lagoon derive their livelihood from salt collection. Seven Salt Mining Cooperatives with membership of about 6,400 (comprising local people) currently operate in the area. In addition to the cooperatives, four salt companies owned concessions in the Songor area: Vacuum Salt Production Ltd., Star Chemical Industries, Ada Traditional Council, and Solar Chemicals and Allied Enterprises. Only Vacuum Salt Production Ltd. was operational. Ownership of the lagoon and salt mining rights have in the past been a source of serious conflict between the local people and outside private salt mining companies.

Salt Pans: Low lying flat lands in estuarine and lagoon habitats are enclosed in low mud walls and filled with sea water, which is evaporated, leaving salt crystals at the bottom. The crystallising pans may be concrete or mud. At the low technology level, the pans are filled with saline water by gravitation or manually with buckets of water collected directly from the sea, lagoons or backwaters which are filled at high tide. This method is used by small scale artisanal salt miners, mainly individual holdings, particularly at Nyanyanu and Adina. It entails practically no operational costs but only small quantities of salt can be produced. At a slightly higher level of technology, the sea water is pumped into reservoirs using diesel or petrol driven or electrical pumping machines. This is then pumped into concentration ponds, from where the concentrated brine is fed into crystallising pans. The crystallised salt is scraped into mounds, and carried (mainly by women) to storage points ready for bagging and sale (Plate 1). This method is used by the salt producing companies. (A list of the salt producing companies identified during this study is given in Appendix 6). Salt production takes place during September-May, but the peak season is November-March.



a



b

PLATE 1. Salt production at Panbros Salt Company Ltd.
a) Lay out of pans b) Salt production

2.2 PRODUCTION LEVELS

There are no reliable data on the salt produced by the Cooperatives at Songor but annual production is estimated at 40,000-45,000 metric tonnes. Quantities of salt collected annually from the Keta lagoon is also unknown. Data on production levels from the small scale salt pan operators were not readily available. Appendix 1 gives production figures provided by the main salt companies. Records available to the Ghana Export Promotion Council (GEPC) give annual production since 1988 from the nine major salt companies and co-operative societies as 145,000 metric tonnes. Even without the development of any new infrastructure (e.g. such as the one proposed for Songor) it is estimated that the country has the capacity to produce c.250,000 metric tonnes of salt annually if the existing production facilities were put into full operation.

The salt produced in Ghana presently is unprocessed. Three grades are available; the top grade is used for human consumption as table salt and fish processing; grade two is used in industry especially for tanning, and grade three is used for animal feed production.

2.3 MARKETING

Much of the salt produced is sold on the site to middlemen, who either resell on the local markets or export to neighbouring West African countries. Salt exports increased significantly from 39,590 mt in 1988 to a maximum of 75,480 mt in 1990, but dropped in 1991 (Appendix 2).⁽³⁾ The 1990 figure valued at US\$ 7,002 represented 21.15% of the manufacturers sub-sector export earnings. Salt exports go to six main countries Niger, Burkina Faso, Togo, Cote d'Ivoire, Nigeria and Benin, with Niger and Burkina Faso taking 75% of the exports. The GEPC projects annual growth of 9 - 53% in salt exports between 1992 and 1995.

2.4 PROPOSED DEVELOPMENTS

Proposals contained in the Economic Development Policy of the Keta District Assembly include allocation of 12,600 ha. of the lagoon for salt production. The proposed area is more or less rectangular, between Alakple, Anyako, Kedzi, and stretching along the coast to Kpotaputa. A feasibility study undertaken for the Minerals Commission in 1991 advocates the development of a large scale industrial salt complex at Songor, with estimated production level of 1.2 million tons yr⁻¹.⁽⁴⁾ The project proposes construction of pans at the west, east and northern edges of the lagoon and sea water inlets at Lolonya and Totokpe. Sea water will be pumped into the lagoon, using the entire lagoon area (with the exception of the portion carved out for the local fetish) as concentration ponds to feed concentrated brine into the pans. Fresh water inflow and run-off within the Songor basin will be diverted from the natural courses and channelled into the sea. The project proposed a total crystallizing area of 1,709.00

ha. distributed between the interested parties as follows:

Vacuum Salt	7,690,000 m ²
Star Chemicals	3,461,300 m ²
Ada Traditional Council	2,700,000 m ²
Solar Chemicals	1,462,000 m ²
Co-operative Societies (Traditional Miners)	1,776,800 m ²

A recent Government directive took over the leasehold interest of the Vacuum Salt Company and Star Chemicals Company with effect from 24th April, 1992. It is not clear how this move will affect the proposed expansion of the salt industry at Songor.

2.5 CONSTRAINTS

The major constraint on the salt industry presently is lack of finance and access to credit facilities. The problem is particularly acute with the small scale producers, who complained of lack of money to purchase even basic pumping machines and to repair pans.

Another constraint is the lack of facilities for refining the salt. The salt produced currently is unprocessed and has a high content of water and unacceptable levels of impurities.⁽³⁾ There is also the problem of decolorisation during storage. Provision of a refinery will greatly increase the quality of the salt and also facilitate supplementation with essential materials such as iodine. The iodine content of salt marketed in Ghana is presently very low.⁽⁵⁾

Disputes over land ownership has affected salt production in the major traditional salt production area, Songor lagoon, and there is an urgent need to resolve the issues involved.

3 ENVIRONMENTAL CONSIDERATIONS

3.1 ENVIRONMENTAL CHARACTERISTICS OF THE SALT PRODUCTION SITES

Keta Lagoon: The Keta lagoon forms part of the Anlo-Keta wetland situated to the east of the Volta river estuary (Fig.1). The wetland comprises open lagoons, (Avu, Angaw and Keta), extensive flood plain, marshland and mangroves. Keta lagoon is a brackish lagoon covering c.250 km² and stretching for 40 km along the coast. The Keta lagoon is heavily fished; the lagoon fishery is a major commercial activity and the main source of livelihood for many of the people living around the lagoon. Tilapia and mudfish are the main species caught. The extensive shallow water, mud banks and mud flats within the lagoon habitat provide good feeding grounds for sea- and shore- birds. The site is the most important site for water birds along the Ghana coast, supporting an estimated population of 110,000 water birds, including eight species which occur in internationally significant numbers (Appendices 3 & 4).^(6,7)

Songor Lagoon: Songor lagoon is situated to the west of the Volta river estuary, and extends 20 km along the coast and 8 km inland behind a narrow sand dune. The vegetation around the lagoon consists of saline marshes, water logged grassland in the lowlands, scattered patches of secondary growth mangroves, riverine woodland along the streams feeding the lagoons and scattered thickets, shrubs, climbers and small trees on the higher ground. Fish is available in the lagoon only during the wet season; in the dry season the lagoon becomes hyper-saline, causing the death of many fish. Species caught were mainly tilapia and lagoon crabs. Songor lagoon supports spectacular concentrations of water birds comprising terns, waders, herons and ducks. There is evidence that Songor serves as a stop-over point for migrant shorebirds. Its importance, therefore, in terms of the populations of migratory birds it supports, is much higher than what is portrayed by the site's estimated bird population of 110,000 (Appendix 3). Songor lagoon is the most important site on the Ghana coast for terns, and it also supports internationally important populations of seven species of waders (Appendix 4).

Ningo: The lagoon is separated from the sea by palm-fringed dunes. Much of the lagoon and adjoining low lands has been developed into salt pans (total area of pans is approx. 30 acres). Surrounding vegetation is grassland dotted with neem trees. Small numbers of birds feed on the edges of the lagoon.

Prampram: The salt pans are situated on the north eastern edge of the Laiwi lagoon. This is a narrow lagoon with well developed mangroves along its edges. The vegetation surrounding the pans is mainly grasses with scattered thickets. The pans and the banks of the lagoon are used as feeding grounds by shorebirds. The site is also important as nesting grounds for White-faced tree duck Dendrocygna viduata.

Densu Delta (Weiija): The Densu delta wetland situated 11 km west of Accra, is the site of Panbros salt pans. The wetland is fed mainly by the Densu river which is dammed upstream (the Weiija dam) for water supply. Freshwater inflow from the river into the wetland is controlled by the management of the Water Works. The Panbros Salt Company has a concession of 2,792.53 acres. Approximately 80% of this area has already been developed for salt production and the Company has plans to develop the remaining area. In addition to the salt pans, four other habitat types are recognisable in the wetland, namely: sand dunes, brackish lagoon, freshwater marsh and coastal savanna grassland and thickets. Despite the habitat fragmentation resulting from the construction of the salt pans, substantial areas of open lagoon and freshwater marsh still remain in the wetland. Scattered stands of mangrove are found in some areas around the lagoon. Imperata sp. and Typha sp. are the dominant plant species within the less saline areas. The Densu delta wetland has a record of 57 species of water birds and an estimated bird population of 35,000 (Appendices 3 & 4). The site is the second most important site for terns. The species of terns using the site include the threatened Roseate tern Sterna dougallii: the Roseate population at this site is equivalent to 20% of the European breeding population. In addition to the extensive feeding sites provided by the wetland, the site is also important as nesting grounds for Black-winged stilt Himantopus himantopus (Plate 2b), Little tern Sterna albifrons (Plate 2c) and Pratincole Glareola pratincola. Wooden pegs within the salt pans and the mud walls delineating the pans are favourite roosting sites. (Plate 2a).

Nyanyanu: The lagoon forms a series of tidal creeks fringed with mangroves. Salt pans have been developed upstream in the flat areas (total area of pans c. 1.5 km²). A total of 92 salt miners operate in the area, each owning a small plot. The surrounding vegetation is a carpet of grasses with patches of shrubs. Small numbers of birds, mainly herons feed along the lagoon banks.

Apam: Most of the area around the lagoon has been developed into salt pans operated by eight small companies. Vegetation in the area consists of grasses, neem trees, a few coconut trees and a few secondary growth mangroves on the north eastern side of the pans. Total bird population at the site is under 1,000.

Iture (Cape Coast): The narrow tidal lagoon passes under a bridge on the Cape Coast-Takoradi road to connect with the sea. The lagoon is fringed with dense mangrove. The eastern side of the lagoon has been developed into salt pans, but these are no longer used and most are overgrown with grasses. Small numbers of shorebirds feed in the area.

Elmina: Almost all the suitable flat areas along the Benya lagoon between Elmina town and Bronyibima village has been developed into salt pans. Approximately 30 companies/individual enterprises operate in the area, of which the Edinaman Salt Industries is the largest. Parts of the lagoon and river banks

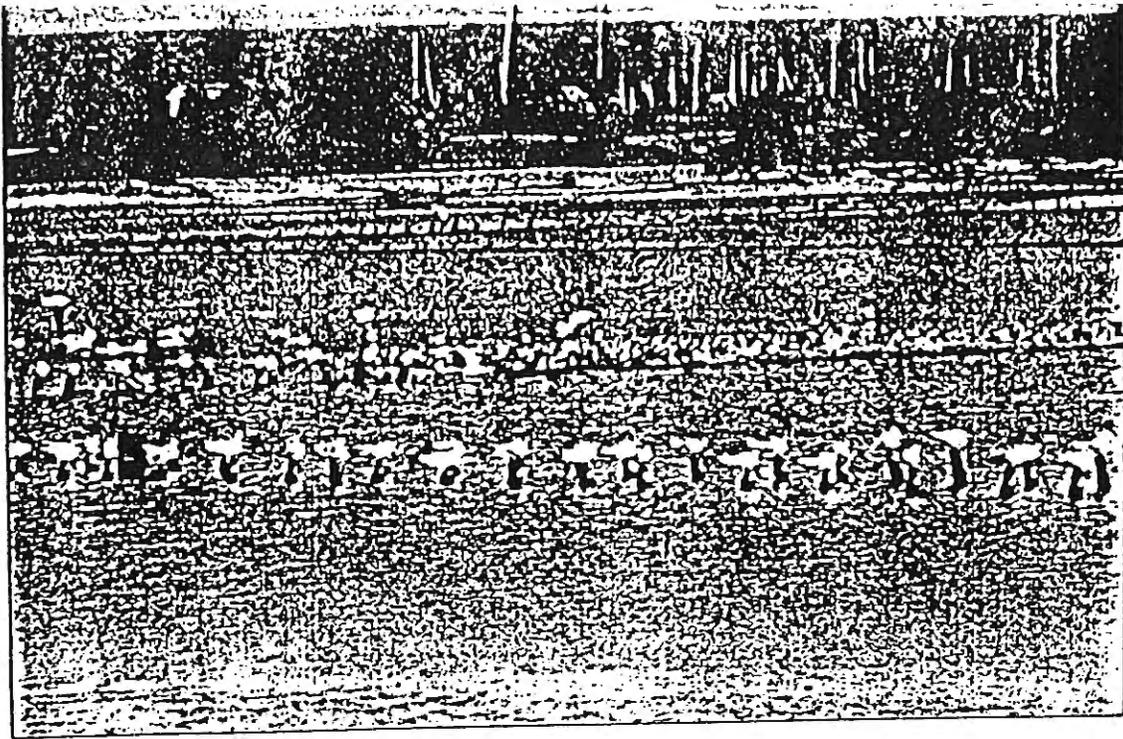
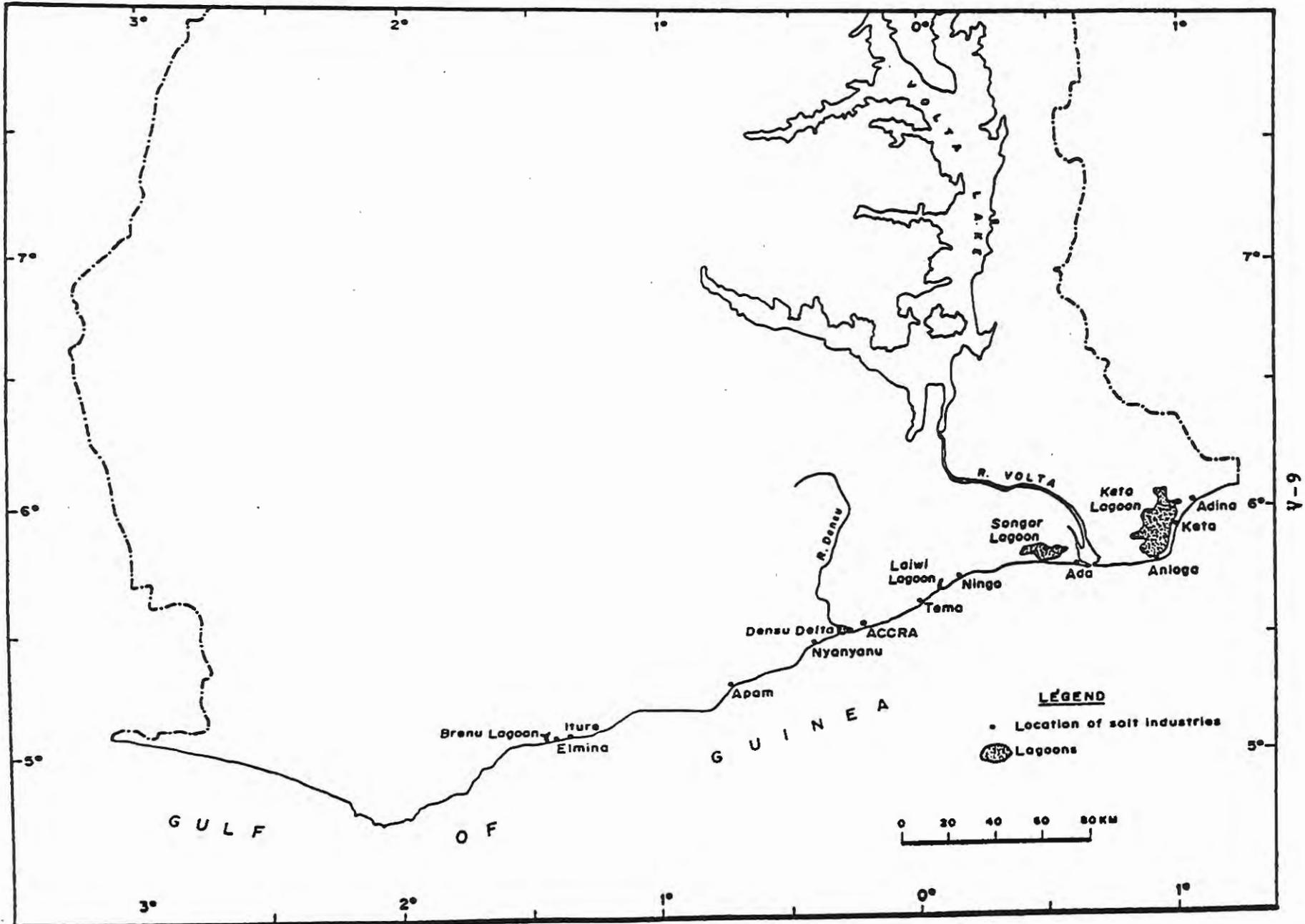


PLATE 2. Use of salt pans and surrounding marshland by birds.
a) Terns roosting on wooden pegs in a pan at Panbros
Nest and eggs of; b) Black-winged stilt, c) Little tern

Fig. 1 MAP OF COASTAL GHANA SHOWING LOCATION OF SALT INDUSTRIES



are covered with dense mangrove, mainly Rhizophora sp. At low tide, significant numbers of shorebirds feed in the exposed muddy areas under the mangroves and along the edges of the river. Large numbers of herons and egrets also roost in the mangroves. The site is internationally important for three species of waders (Appendix 4).

Nana Brenu (Brenu Akyenu): The lagoon is small and irregularly shaped, and is bordered by patches of mangrove forest. The surrounding vegetation consists of grasses, bushes and a few palm trees. A small area in the north-eastern border of the lagoon has been developed into salt pans. The site supports very small numbers of shorebirds.

3.2 IMPACTS OF PROJECT ACTIVITIES

The existing salt mines and areas targeted for development of the salt industry are within coastal wetland habitats. These wetlands are important in terms of the ecological functions they perform e.g. flood control and storm protection, the products they provide e.g. wildlife, fisheries and forest resources, and their biological diversity. In view of the lack of knowledge on the functioning of the Ghanaian coastal ecosystem, and the processes that maintain the ecological integrity of the wetlands, developments that are likely to affect the wetland ecosystem must be critically assessed. The major potential impacts of the development of the salt industry on the environment are wetland habitat destruction ; and hydrological changes which will affect the functional integrity of the wetland ecosystem.

3.2.1 HABITAT DESTRUCTION

Destruction of habitat in salt mining operations result from the construction of pans, and also from construction of access roads and other infrastructure such as offices and storage facilities. Habitat destruction leads to direct loss of vegetation and biodiversity, loss of bird habitats, and potential decrease in fish yield.

Loss of Vegetation and Biodiversity: Sensitive plant communities within Ghana's coastal zone include the mangrove forests. The two main species occurring on the coast are the red mangrove Rhizophora sp. and the white mangrove Avicennia sp. (Plate 3). Mangrove forests have peculiar adaptations that enable them to grow in the rather unstable difficult environments within wetlands. They form a major food base of the complex food web encompassing hundreds of estuarine and marine organisms such as microbes, invertebrates, reptiles, fish, birds and various mammals and ultimately, man. Destruction of mangroves and other wetland vegetation will therefore adversely affect a whole lot of organisms which depend on them. Loss of biodiversity can also arise from destruction of benthic communities as a result of scraping material from the bottom of the lagoons during pan construction to form the bunds, and also to create the right

slope for water to flow from one pond to the other. Data on animal life in the coastal wetlands, other than the avifauna, are very scanty and there is a need for baseline data which will form the basis for future monitoring.

Much of the original mangrove forests on the Ghana coast have been destroyed through heavy exploitation (mainly for fuelwood and building poles); and various developments. Whatever natural vegetation existed in the salt mining areas within Brenu Akyenu, Elmina, Iture, Apam, Nyanyanu and, to a lesser extent, Laiwi and Ningo has already been destroyed through the construction of the salt pans, and only scattered patches of mangroves exist in these areas. There is also not much flat lowlands left in the areas for expansion of the pans. Activities for increasing production in these areas, therefore, are likely to concentrate on provision of inputs and finances to make the existing infrastructure fully functional. This should have no significant impact on the existing habitats. The existing traditional method of salt mining within the Songor and Keta lagoons is compatible with the conservation of the ecology of the lagoon. The proposed expansions and new salt pan developments planned for Songor and Keta, however, could cause severe destruction of the wetland habitat and associated fauna.

Loss of Important Bird Areas: The ornithological importance of the salt mining sites as feeding, roosting and nesting sites for sea- and shore- birds has been outlined in section 3.1. Loss of feeding and nesting sites can result directly from pan construction or from flooding of exposed mud flats and islands, and increases in depth of the lagoon, to the extent that available food becomes inaccessible to small waders. The two areas, Songor and Keta lagoons, where the planned increase in salt production is likely to involve development of salt pans and additional infrastructure, together constitute the most important bird area along the Ghana coast. The two sites support over 70% of the total water bird population on the Ghana coast and constitute the fourth largest known concentrations of migratory water birds along the West African coast (Table 5).^(7,8,9)

The two, sites together with the Densu delta and Panbros Salt complex, Sakumo Lagoon, and Muni Lagoon have been proposed for designation as Ramsar¹ sites by the Ghana Government. The fact that the Densu delta and Panbros Salt Complex still holds a large population of water birds despite the extensive development of salt pans, suggest that salt pan development can be compatible with the conservation of the ecological integrity of wetlands. Survival of birds on these sites depends on availability of prey items as well as nesting and roosting sites. The planned developments for Songor and Keta lagoons and the extensions at Panbros should take cognisance of the extreme importance of the sites for shorebirds, and institute measures which will maintain and enhance the value of the sites as bird habitat.

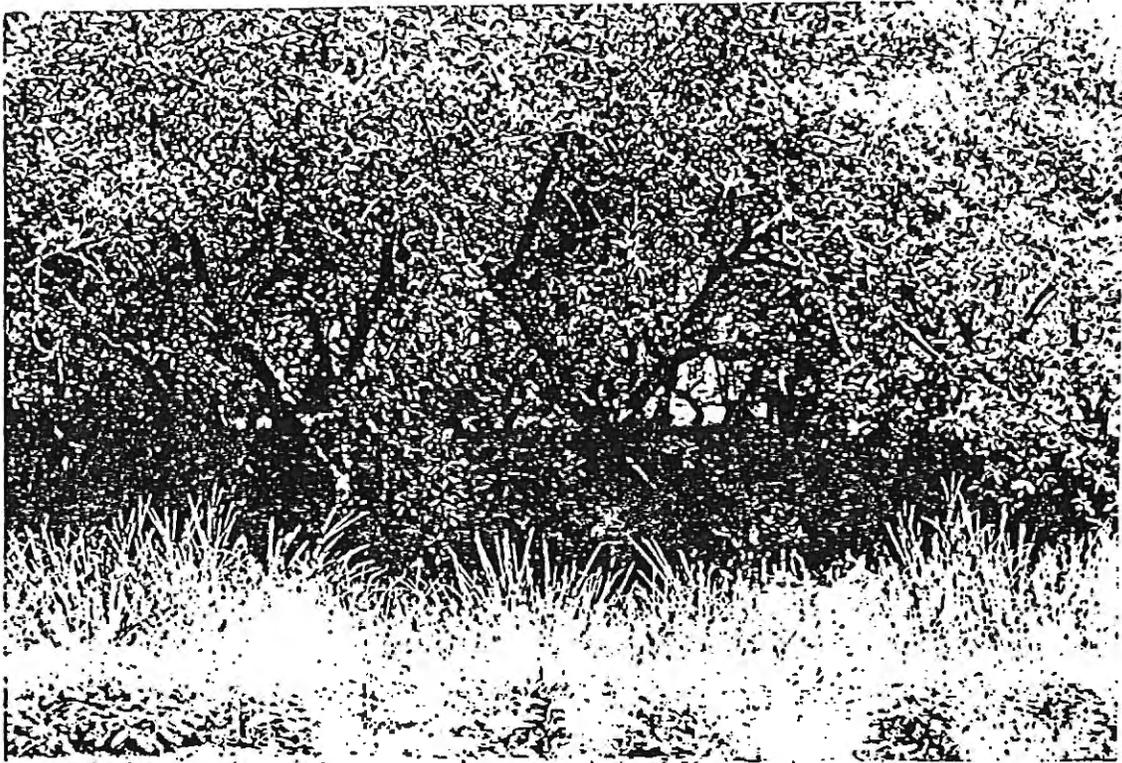


Plate 3. Mangrove forest

Potential Decrease in Fish Yield: Fish provides an important source of protein in the Ghanaian diet, accounting for some 30% of the estimated protein requirement.⁽¹⁰⁾ Available records indicate that the country's marine and lagoon fish resources are declining rapidly.^(11,12) Coastal wetlands provide nutrient rich, sheltered habitats used by fish for spawning and as fish nurseries and are known to be vital for the survival of the marine fishery industry. It is estimated that two-thirds of the fish we eat depend upon wetlands at some stage of their life cycle.⁽¹³⁾

There are few data on the role of healthy coastal wetlands in maintaining lagoonal and marine fisheries in Ghana, but the evidence in other countries is enough to demand judicious use of our coastal wetlands for the sustenance of fisheries, and makes it imperative that developments do not destroy the ecological integrity of the wetlands.

Table 5. Major Concentrations of Migratory Water birds on the West African Coast.^(7,8,9)

Country	Site	Estimated Total Bird Population
Mauritania	Banc d'Arguin	2,038,000
Guinea-Bissau	Arguipelago dos Bijagos	980,000
Dem. Rep. Guinea	Entire coast	400,000
Ghana	Volta delta and lagoons	200,000+
Sierra Leone	Sierra Leone River	50,000
Liberia	Entire coast	35,000

3.2.2 HYDROLOGICAL CHANGES

The main impacts result from pan construction, i.e. the building of bunds and embankments needed for the pans; and the operation of the pans which causes changes in salinity gradients. Instead of the natural gradual change from saline to fresh water in the estuary and lagoon, there is a series of abrupt changes from one concentration pond to the other. The bunds act as barriers, preventing free movement of fish within the habitat. Tidal influences are minimized and also areas of mud-flats which used to be exposed at low tide and provided good bird feeding grounds are lost. Another hydrological change which could have profound effects on the natural drainage and fresh water inflow into the wetland habitat is the diversion of freshwater and surface run

¹ Ramsar site is a wetland which qualifies as important under the criteria of the Convention on wetlands of international importance especially as waterfowl habitat (see Appendix 5).

off from the catchment to avoid dilution of the brine. These changes are bound to result in the loss of fauna.

3.2.3 DISTURBANCE

Construction works and other activities associated with the salt works operation could cause disturbance to feeding, roosting and nesting birds. Severe disturbance to feeding birds can lead to inadequate food intake which can affect survival and fecundity, while prolonged absence of incubating birds from nests as a result of disturbance can lead to reduced hatching success, high predation on eggs and nestlings and general low reproductive success. Losses in egg clutches could also result from collection and trampling by salt pan workers.

3.3 POLLUTION OF SALT BY OTHER DEVELOPMENTS

The only pollutants which could possibly contaminate the salt produced in the coastal areas of the country are heavy metals. Industrial effluent containing non-biodegradable substances arise from a variety of sources, e.g. petro-chemical, ore mining and metal refining, and can contain a wide range of metals such as mercury, lead and cadmium.⁽¹⁴⁾ Possible sources of threat along the coast, particularly the Densu delta, are metal industries and agro-chemicals. Although the levels of metals in Ghana's coastal waters presently are insignificant,⁽¹⁵⁾ there will be a need for continuous monitoring.

4. MITIGATING MEASURES

4.1 BIODIVERSITY CONSIDERATIONS

The extent of pan development and siting of pans could be restricted to ensure that the wetland habitats are not completely turned into pans. In many cases, the salt pan industry can be compatible with the conservation of the wetland habitat if measures are taken to maintain adequate natural areas within the habitat.

In Songor and Keta, some improvements to the existing technology could increase productivity and benefit the local communities without necessarily destroying the ecological value of the wetlands. The dimensions of the large scale industrial salt complex proposed for Songor lagoon and the proposal to channel fresh water input from the Songor catchment is particularly disturbing. Such scale of operation could cause major changes in the ecological integrity of the lagoon and affect its value as a wildlife habitat. A detailed environmental impact assessment (EIA) should be undertaken before any developments proceed at Songor. The Minerals Commission has commissioned the Institute of Aquatic Biology and the Department of Geography and Resource Development (Legon), to collect baseline data on biological resources and land use in the area. This is not an

EIA. A complete EIA is required and it should evaluate the multiple uses and values of the lagoon and recommend measures which ensure that developments are compatible, and will not destroy the ecological value of the Songor wetland.

Particular efforts should be made during the selection of sites for pan construction to identify areas of high biodiversity and sensitive habitats for exclusion. Areas of special concern are mangrove forests and nesting habitats for birds.

Habitat enhancement and restoration: Specific efforts should be made to improve the habitat within salt producing areas. Some of the habitat lost can be compensated for through mangrove forest rehabilitation and restoration programmes; and the creation of new brackish areas using the fresh water diverted from the salt pan areas and saline water from the sea water inlets. This will require detailed engineering studies. Extent of areas required to be created will depend on species requirements and size of populations using a particular site. It should also be possible to create islands and structures for roosting birds (eg. the wooden pegs within some pans at Panbros) and provide additional nesting grounds.

4.2 PROTECTIVE MEASURES AND CONSERVATION EDUCATION

Disturbance to breeding birds can be reduced or completely avoided by imposing restrictions on access to known nest sites during the breeding season. Major construction works should be restricted to the period of year when most of the migrant bird species are absent from the site and bird populations are generally low. Fortunately this period coincides with the lean season for salt production.

There will be a need for education of the salt pan workers, visitors to the site and communities living around the area, about the conservation importance of the area and the measures instituted to protect particular flora and fauna. Without this kind of education it will be impossible to obtain their support and participation in the protective work. It should be possible to get the Save the Seashore Birds Project and the Department of Game and Wildlife to undertake the education activities.

4.3 AQUACULTURE DEVELOPMENTS

Apart from ensuring that the salt industry developments do not destroy the coastal wetland habitats and subsequently decrease fish yields, positive measures should be taken to use the salt pans to enhance fish production through aquaculture. Concentration ponds and reservoirs constructed for salt production have great potential for use as shrimp farms.⁽¹⁶⁾ With very little or perhaps no modification, the primary reservoirs of the salt works can be ready-made ponds for farming of mullets

or euryhaline tilapia. Fisheries in the lagoon and reservoirs at Panbros salt complex currently provide livelihood for a substantial number of fishermen and their families (Plate 4)

4.4 POLICY

There seem to be no specific guidelines related to environmental health as it pertains to the salt industry operations. The Minerals Commission is currently working on general guidelines on environmental monitoring in the mining sector in conjunction with the Environmental Protection Council. The salt industry should be included in the exercise.

4.5 CHEMICAL INDUSTRY

Presently there seem to be no immediate plans for the production of caustic soda. Should the salt industry develop in that direction a full EIA must be undertaken and adequate safety precautions should be instituted. The EIA would include, among other things, a risk assessment which will identify the specific hazards, potential exposures and effects on population.

5 MONITORING AND RESEARCH NEEDS

5.1 MONITORING

The IEE prepared for the TIP stresses the importance of instituting programs to monitor the effects of the TIP activities on the environment.⁽²⁾ Indicators and parameters required to be monitored for effective assessment of the impacts of the salt industry are given below.

Hydrological: water budgets, ground water, sediment transport.

Water quality: (with particular reference to sources of water pumped into the pans): physico-chemical parameters, biological parameters, pollutants.

Ecosystem change indicators: invertebrates, fish (stocks, catch, fishermen numbers); Birds (particularly water birds, species and populations; the Save the Seashore Birds Project regularly monitors sea- and shore-birds in all the coastal sites where salt mining industries are situated).

In some cases the baseline data are not available and it will be necessary for these to be collected. The projects outlined below should address research needs and provide requisite data.



a



b

**PLATE 4. Fisheries in the storage reservoirs and concentration ponds.
a) Man with cast net, b) fish processing by women**

5.2 PROJECTS AND RESEARCH NEEDS

5.2.1 Project area: COASTAL WETLAND RESOURCES EVALUATION AND ENVIRONMENTAL MONITORING

(1) Project title: Mangrove forest ecology.

Rationale: Data are not available on the role of mangroves in maintaining the fisheries in Ghanaian waters. Data are required on the species of fish dependent on the mangroves, the role of mangroves in maintaining fisheries and the ecological balance of the coastal wetland ecosystem.

Implementing Agency: Botany Department, University of Ghana(UG) Oceanography and Fisheries Unit of the Zoology Department, UG.

Budget/Time Schedule: US # 200,000, 3 yrs.

(2) Project title: Coastal Wetland Ecology

Rationale: Data on the fauna (particularly invertebrate) and flora of the coastal lagoons are limited. There has also been no detailed studies of the interactions and interdependence of the various biological components of wetlands and the processes which ensure the health and functioning of the wetland ecosystem. Without such information it will be impossible to detect any changes resulting from the salt industry developments and initiate management measures.

Implementing Agency: Zoology Department and Botany Departments, UG, Institute of Aquatic Biology.

Budget/Time Schedule: US # 300,000, 3 yrs.

(3) Project Title: Limnology of coastal lagoons and estuaries.

Rationale: Baseline data on water characteristics of the coastal lagoons and estuaries are required to provide basis for assessment and detection of pollution resulting from developments along the coast.

Implementing Agency: Institute of Aquatic Biology: The IAB already has a programme for monitoring water quality along the Densu river. Additional assistance will be required to enable the institute expand the activity to the estuaries and lagoons where salt industries are situated.

Budget/Time schedule; US # 25,000 p.a, long-term.

5.2.2 Project area: MITIGATING MEASURES AND COMMUNITY DEVELOPMENT

(i) Project title: Mangrove rehabilitation and restoration.

Rationale: Mangrove forests in coastal Ghana have been severely degraded as a result of heavy exploitation for fuelwood and developments in the coastal area. Data are required on the extent of mangrove forests remaining in the country, the current usage of mangroves and levels of exploitation. Such data will provide basis for projections on requirements for mangroves and establishment of community based pilot projects for mangrove rehabilitation and restoration.

Implementing Agency: Botany Department, UG; Soils Research Institute; Ministry of Agriculture Agroforestry Division.

Budget/Time Schedule: US # 600,000, 5 yrs.

(ii) Project title: Lagoon fisheries, productivity and contribution to socio-economic life of coastal communities.

Rationale: There are currently no statistics of lagoon fisheries, although there is ample evidence of the immense contribution of this fishery as a source of livelihood for coastal communities. The study will collect data on species and stocks of fish in the lagoonal areas where salt industries are planned, determine the number of fishermen dependent on the resource, and estimate productivity levels. Such data will provide a basis for planning aquaculture alternatives to compensate for any losses in fisheries incurred as a result of the salt development.

Implementing Agency: Fisheries and Oceanography Unit of the Zoology Department, UG; Fisheries Department.

Budget/Time Schedule: US # 200,000, 3 yrs.

5.3 INSTITUTIONAL LINKAGES

The data required for monitoring the impacts of developments along the coast and management of the coastal wetlands are cross-sectoral and requires a multidisciplinary approach. The role of the Environmental Protection Council in coordinating all the studies and ensuring that data on indicator species are readily available for management purposes is extremely essential. Assistance should therefore be given to EPC to strengthen its capacity to perform its coordinative role effectively.

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APPENDIX 1: PRODUCTION LEVELS (METRIC TONNES) OF MAJOR SALT PRODUCING COMPANIES IN COASTAL GHANA

Company	1990		1991		1992
	Target	Actual	Target	Actual	Target
Panbros Salt ^(a)	50,000	50,000	70,000	39,000	100,000
Modern Salt Industries		7,500 ^b			
Apaman Council Salt Industries		150 ^b			
Edinaman Salt Industries		2,450 ^b			
Vacuum Salt ^c	-	-			
El-Din Salt ^c	-	-			
Mill					

- a. Year runs April - March, therefore figure under 1990 is actually for the period April 1990 - March 1991.
- b. Average annual production
- c. Data on production levels unavailable

APPENDIX 2. PROJECTIONS AND PERFORMANCE IN SALT EXPORTS (1987-1995, Source: GEPC, 1991)

Year	Target		Actual	
	Vol ('000)*	Value ('000) ^a	Vol ('000)*	Value ('000) ^a
1987	-	701	-	1,918
1988	11.13	764	39.59	2,494
1989	12.13	868	51.41	3,134
1990	13.78	-	75.48	7,002
1991	92.00	8,500	53.36	3,929
1992	101.00	9,350	-	-
1993	132.00	12,200	-	-
1994	144.00	13,300	-	-
1995	221.00	20,500	-	-

* Metric tonnes, @ US\$

APPENDIX 3. ORNITHOLOGICAL IMPORTANCE OF SALT MINING SITES IN COASTAL GHANA⁽⁷⁾

Site	Estimated water bird population	Total No. of species recorded	No. of species occurring in internationally important numbers*
Keta Lagoon	110,000	72	8
Songor	111,000	57	7
Ningo	3,500	23	1
Laiwi (Prampram)	12,500	54	3
Densu Delta (Panbros)	35,000	57	4
Nyanyanu	150	16	-
Apam	800	21	-
Iture (Cape Coast)	100	13	-
Elmina	8,500	39	3
Brenu Akyenu	100	15	-

APPENDIX 4. SPECIES AND PEAK COUNTS OF WADERS OCCURRING IN INTERNATIONALLY IMPORTANT NUMBERS ON THE SALT MINING SITES.^(6,7)

Species	1% of estimated East Atlantic population*	Peak counts recorded at					
		Keta	Songor	Ningo	Laiwi	Panbros	Elmina
Spotted redshank	300	7,940	10,060	650	980	-	330
Greenshank	500	6,790	4,770	-	550	-	610
Ringed plover	2,000	2,860	3,010	-	-	-	-
Curlew sandpiper	4,500	14,810	6,920	-	-	4,700	-
Sanderling	1,000	-	-	-	-	-	-
Little stint	2,000	4,200	2,530	-	-	2,610	-
Black-tailed godwit	1,500	1,270	-	-	-	-	-
Avocet	700	1,560	3,740	-	-	-	-
Black-winged stilt**	60	12,080	4,400	-	220	310	1,010

* 1% criteria based on Altenburgh et al. (1982); Smith & Piersma (1989).

** Partial migrant, numbers recorded comprise c.55% palaeartic; 45% residents.

APPENDIX 5. RELEVANT ABSTRACTS FROM INTERNATIONAL CONVENTIONS
RELATED TO CONSERVATION OF WETLANDS AND THEIR
FAUNA AND FLORA WHICH GHANA IS SIGNATORY TO.

**1. Title: African Convention on the Conservation of Nature and
Natural Resources ("African Convention")**

Date Signed By Ghana: 1968

Relevant Provision:

This convention obligates signatories to:

"manage aquatic environments, whether in fresh, brackish, or coastal water, with a view to minimising deleterious effects of any water and land use practice which might adversely affect aquatic habitats." (Art. VII, Sect. 1a).

"In the formulation of all development plans, full consideration shall be given to ecological, as well as economic and social factors." (Art. XIX. Sect. 3).

"The Contracting States recognize that it is important and urgent to accord a special protection to those animal and plant species that are threatened with extinction, or which may become so, and to the habitat necessary to their survival." (Art. VIII, Sect. 1).

**2. Title: Convention on the Conservation of Migratory Species
of Wild Animals ("Bonn Convention")**

Date Signed By Ghana: 1988

Relevant Provisions:

"The Parties acknowledge the need to take action to avoid any migratory species becoming endangered." (Art. II, Sect. 2).

"Parties that are Range States of a migratory species listed in Appendix I [endangered] shall endeavour:

a) to conserve and where feasible and appropriate, restore those habitats of the species which are of importance in removing the species from danger of extinction." (Art. III, Sect. 4)

**3. Title: Convention on Wetlands of International Importance
Especially as Waterfowl Habitat (Ramsar Convention)**

Date Signed By Ghana: 1988

Relevant Provisions:

"Each Contracting Party shall designate suitable wetlands within its territory for inclusion in a List of Wetlands of International Importance... The boundaries of each wetland shall be precisely described and also delimited on a map and they may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water...lying within the wetlands, especially where these have importance as waterfowl habitat.

"Wetlands should be selected for the List on account of their international significance in terms of ecology, botany, zoology, limnology or hydrology... in the first

instance wetlands of international importance to waterfowl at any season should be included." (Art. II, Sec. 1 and 2).

"The Contracting Parties shall formulate and implement their planning so as to promote the conservation of the wetlands in their territory.

"Each Contracting Party shall arrange to be informed at the earliest possible time if the ecological character of any wetland in its territory and included in the List has changed, is changing or is likely to change as the result of technological developments, pollution or other human interference." (Art. III, Sect. 1 and 2).

"Each Contracting Party shall promote the conservation of wetlands and waterfowl by establishing nature reserves on wetlands, whether they are included in the List or not, and provide adequately for their wardening." (Art. IV, Sect. 1)

"The Contracting Parties shall encourage research and the exchange of data and publications regarding wetlands and their flora and fauna. (Art. IV, Sect. 3).

Specific criteria for using waterfowl to identify wetlands of importance adopted at the Regina Conference are:

"A wetland should be considered internationally important if: (a) it regularly supports 20,000 waterfowl, or; (b) it regularly supports substantial numbers of individuals from particular groups of waterfowl indicative of wetland values, productivity or diversity, or; (c) where data on populations are available, it regularly supports 1% of the individuals in a population or subspecies of waterfowl."

The expanded definition of "wise use" adopted at the Regina Conference is:

"The wise use of wetlands is their sustainable utilization for the benefit of humankind in a way compatible with the maintenance of the natural properties of the ecosystem."

Relevant guidelines for "wise use" adopted at Regina include:

" (d) proper assessment of environmental impact before development projects are approved, continuing evaluation during the execution of projects, and full implementation of environmental conservation measures which take full account of the recommendations of this process of environmental assessment and evaluation.

APPENDIX 6. LIST OF SALT COMPANIES AND COOPERATIVES IDENTIFIED DURING THE STUDY.

Accra (Weija)

1. Panbros Salt Company Limited

Apam

2. Universal Salt Industries
3. Assin Salt Industries
4. Coastal Salt Limited
5. Apaman Council Salt Industries

Brenu Akyenu

6. Bridgedo Salt Works

Elmina

7. Edinaman Salt Industries
8. Tetelem Salt Works
9. B/S Salt Industry
10. Tsiaba Salt Works
11. Yebedan Egya Salt Industry
12. Eake Salt Industry
13. Danfo Salt Industry
14. Divine Wisdom
15. Nyankopa Salt Industry
16. Onua Pa Salt Industry
17. Gyapea Limited
18. Kofi Kyereboa Salt Industry
19. Benya Lagoon Products
20. J.K. Thomford Salt Industry
21. Ampah Salt Industry Limited
22. P.K. Mensah Salt Industry
23. Nitts Enterprise
24. Jonannes Salt Industry
25. Shepherd Amantem-Prah Salt Ind.
26. Nana Amaye Eduabo Salt Ind.
27. K & K Salt Industry
28. Holy Salt Industry
29. Kweku Tawiah Salt Industry
30. Sofo Anthony Salt Industry
31. Nana Anowie Salt Industry
32. Williams Salt Industry
33. Bantumaman Salt Industry
34. Kojo Sam Salt Industry
35. Oko Salt Industry
36. Nyame Asem Salt Works

Old Ningo

37. Modern Salt Industries

Prampram

38. El - Din Salt Mill

Songor

39. Vacuum Salt Industries
40. Ada Songor Salt Miners Soc. Limited
41. Ada Noryami Co-op Salt Miners and Marketing Soc.
42. Goi Salt Miners Co-op.
43. Sege Narkomkope United Salt Mining and Marketing Co-op.
44. Oboade Co-op. Salt Miners and Marketing Soc. Ltd.
45. Lolonyia Co-op Soc.
46. Okor Co-op. Salt Winners Soc.