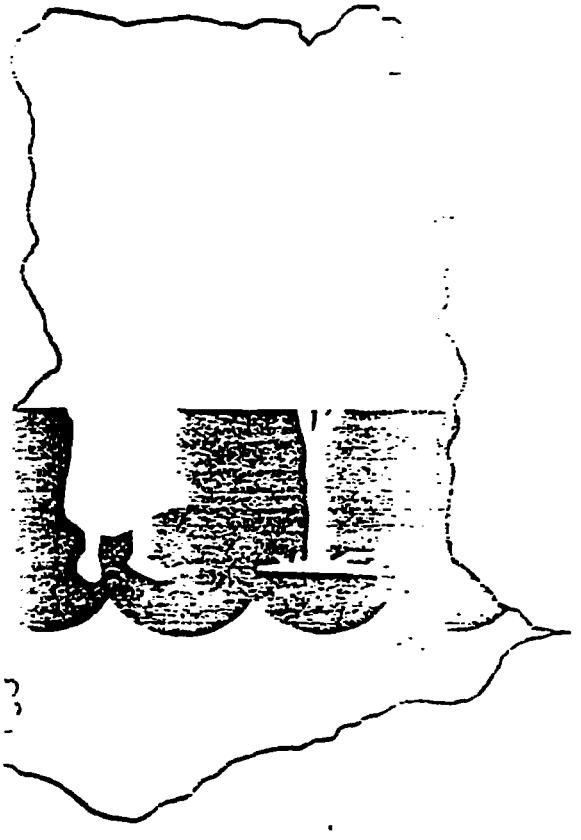
GHANA

ENVIRONMENTAL ACTION PLAN

(VOLUME 1)



Environmental Protection Council
P.O. Box M-326
Accra - Ghana

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TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

ABBREVIATIONS

ADRA - Adventist Development and Relief Agency

AESC - Architectural and Engineering Services Corporation

AMA - Accra Metropolitan Authority

CEC - Community Environmental Committee

CCFI - Community Collaborative Forestry Initiative

DA - District Assemblies

ECOWAS - Economic Community of West African States

EEZ - Economic Exclusive Zone

EIA - Environmental Impact Assessment

EMC - Environmental Management Committee

EPC - Environmental Protection Council

EIA - Environmental Impact Assessment

ERP - Economic Recovery Programme

GAEC - Ghana Atomic Energy Commission

GDP - Ghana Domestic Product

GIC - Ghana Investment Centre

GIS - Geographic Information System

GSB - Ghana Standards Board

GWD - Game and Wildlife Department

GWSC - Ghana Water and Sewerage Corporation

IAB - Institute of Aquatic Biology

IDA - Irrigation Development Authority

IPCP - Inter-Departmental Pesticide Control Programme

IRNR - Institute of Renewable Natural Resources

MSD - Meteorological Services Department

NEB - National Energy Board

NEIS - National Environmental Information System

NDPC - National Development Planning Commission

NGO - Non-Governmental Organisations

NRC - National Redemption Council

OAU - Organization of African Unity

OCP - Onchocerciasis Control Programme

PAMSCAD- Programme of Action to Mitigate the Social Cost of Adjustment

PNDC - Provisional National Defence Council

PIP - Public Investment Programme

PPP - Polluter Pays Principle

PTA - Parent-Teacher Association

UNDP - United Nations Development Programme

UNEP - United Nations Environment Programme

UNIDO - United Nations Industrial Development Organization

UST - University of Science and Technology

VIP - Ventilated Improved Pit

VRA - Volta River Authority

WRC - Water Resources Commission

WRRI - Water Resources Research Institute

EXECUTIVE SUMMARY

BACKGROUND

Ghana is endowed with abundant natural resources. These served as the spring-board for the country's industrialisation effort after the attainment of independence and they remain the fundamental endowment from which the nation's people derive their livelihood. In the process of exploiting these resources to meet socio-economic needs, however, adequate care has not been taken to guard against the depletion of the resources. This has given rise to a host of problems, including deforestation, desertification, and soil degradation. Also many problems associated with industrialisation, such as pollution of air and water, have surfaced. A point has now been reached when it is necessary to balance national development effort and the quest for economic growth with a rational exploitation of the resource base. This must be done to ensure that economic development can be sustained in the long term.

In March 1988, the Government of Ghana initiated a major effort to put environmental issues on the priority agenda. The exercise has culminated in the preparation of a strategy to address the key issues relating to the protection of the environment and better management of renewable resources. The objective of what has become known as the Environmental Action Plan (EAP) is to define a set of policy actions, related investments, and institutional strengthening activities to make Ghana's development strategy more environmentally sustainable.

ECONOMIC DEVELOPMENT AND ENVIRONMENT IN GHANA

Prior to the launching of the Economic Recovery Programme (ERP) in 1983 the economy of Ghana was in decline due to the combined effects of poor weather, institutional rigidities, inappropriate economic policies and internal and external shocks. The ERP has led to a positive growth performance in the economy, however at some social cost. It has been noted that the sustainability of Ghana's economic and social development depends ultimately on proper and responsible management of the natural resource base and the environment in general.

An attempt has been made to estimate the costs imposed on Ghanaians and the economy from environmental degradation in sectors such as agriculture, forestry, hunting, industry and mining. The willingness to pay by Ghanaians to avoid such negative impacts has been estimated using market prices where available, or our best estimates where market information is unavailable or inappropriate.

The picture is incomplete in a number of respects. Nevertheless, and conservative as these estimates may be, the costs of environmental degradation are significant. The total estimated annual losses in 1988 amounted to 41.7 billion cedis, the equivalent of 4 per cent of total GDP. The magnitude and pervasiveness of the losses impose a strong case for taking effective action to reduce the losses via the EAP. The incentives facing users of Ghana's environment almost all encourage its exploitation, degradation and destruction. The Action Plan seeks to neutralise or reverse these incentives, and to do so cost-effectively.

ENVIRONMENTAL POLICY

A National Environmental Policy is to be adopted to provide the broad framework for the implementation of the Action Plan. The policy aims at ensuring a sound management of resources and the environment, and to avoid any exploitation of these resources in a manner that might cause irreparable damage to the environment.

Specifically, the policy provides for:

- maintenance of ecosystems and ecological processes essential for the functioning of the biosphere;
- sound management of natural resources and the environment;
- protection of humans, animals and plants and their habitats;
- guidance for healthy environmental practices in the national development effort;

- integration of environmental considerations in sectoral structural and socio-economic planning at all levels;
- common approach to regional and global environmental issues.

Appropriate incentives and sanctions will be put in place to ensure compliance with the provisions of the Policy.

The fundamental aims of the Policy will be pursued and achieved through harmonisation and enforcement of relevant laws and treaties on the environment, and through the implementation of the EAP.

ISSUES

Land Management

The strength of Ghana's economy, and hence the integrity of the environment, is related to the efficient use and management of available land. The need for efficient management of land is the more urgent in the face of an ever-increasing population and the growing demands in all the various activities based on land. Land resources and the processes of their development and use, however, have varying consequences on the environment.

A major aspect of the land management problem in Ghana has to do with ownership and tenure. There is also no land use planning and therefore optimal land use is not attained. The situation has led to land use conflicts and degradation all over the country. The issue of land management is recognised as a central point in any efforts to address environmental and resource problems in Ghana.

Forestry and Wildlife

One estimate indicates that only about 2 million hectares of Ghana's closed forest actually remain. Of this only about 0.4 million hectares lies outside land legally constituted as Forest Reserve. This situation has arisen largely as a result of the progressive conversion of forest lands to other forms of land use, particularly agriculture, without any control. Logging and bushfires have also exerted their toll on the forest. The extraction of woodfuels, both for domestic and industrial use, further contributes to deforestation in Ghana.

The depletion of forest resources is significant not only in terms of wood. Wildlife habitats have been destroyed through various economic activities, including agriculture and logging, not to mention the effects of the high incidence of bush fires. Wild animal populations are also severely depleted as a result of the excessive exploitation for meat. And a wide range of important non-wood forest products important as sources of food, raw materials for rural industries, medical treatment, etc., are becoming increasingly scarce.

Water Management

In its natural form water is fairly abundant in Ghana, although seasonal shortages are quite common. Such shortages are due primarily to poor management and inadequate use of available technologies. From an environmental stand point, a primary principle, should be that water should be available in a potable form for the entire population with minimal effort, and that its availability on a sustainable basis should be guaranteed. This unfortunately is not the case. Only about 30% of the population of Ghana can be said to have ready access to potable water.

Water pollution, on its part, poses significant threats to many people both in the rural areas as well as the urban centres. The problem arises from the discharge of all kinds of wastes into water bodies without any form of treatment. Wastes from agricultural activities also enter various streams and rivers each year all over the country. Water-borne and water-related diseases are common in the rural areas.

Problems of water management in Ghana include the paucity of data on the resource itself, and also on related factors. For instance, the absence of suitable maps and necessary relevant data hamper comprehensive assessment of available water resources.

Marine and coastal ecosystems

The over-concentration of industries in the coastal zone has aggravated the environmental stresses normally associated with industrialisation. Prominent among the problems are industrial and urban pollution and over-crowding. Infrastructure is stretched to break-down point. All of these constitute a serious threat to fragile and sensitive coastal ecosystems.

Uncontrolled agricultural activities in the zone also have degradational effects. Of particular concern is the discharge of agricultural chemicals and wastes released into the environment through run-off and direct discharges into the drainage catchments in the zone.

The most readily apparent environmental problem of the coastal area is erosion. The most well known areas suffering serious erosion are the Keta Coast, the Ada-Foah Beach, the Labadi Beach, the Nkontompo Beach, and the Axim Shoreline. The rate of erosion in all these cases exceeds 1.5m per annum. There are other less known areas where the rate of erosion is about the same.

Industrial pollution

The forms of pollution most commonly associated with industrial activity are air, water, and noise pollution. Fortunately, the problems have not yet assumed very serious dimensions in Ghana. However, there is cause for concern, particularly in the industrial concentration area of Accra-Tema. Over the years the quantity and diversity of industrial wastes have increased, and there are hardly any waste recycling or proper management practices in the country.

Improper siting of industrial installations in relation to other activities and residential housing also poses considerable problems.

Mining

The main problems associated with surface mining in Ghana include land devastation, soil degradation, water and air quality changes. Gold processing also has deleterious environmental effects. The use of cyanide as the main chemical for processing eventually leads to the pollution of rivers and water bodies. The roasting process also results in the discharge of large quantities of arsenic into the atmosphere.

Underground mining has, on its part, given rise to problems with water quality change and potential for subsidence, especially if underground mine water is pumped to the surface. The health and safety hazards to miners are numerous and may include accidents (rock falls, mine fires, haulage accidents, shaft accidents etc.), gas poisoning, high temperature and humidity effects, and various occupational diseases.

Hazardous chemicals

For many years the importation, manufacture, distribution, handling and use of potentially toxic chemicals in Ghana has proceeded without much consideration to the possible environmental consequences. This poses considerable hazard to human health. The problem is the more serious because the quantities and types of chemicals in the country are not fully known.

Human settlements

Rapid population growth coupled with the concentration of infrastructural facilities and job opportunities in the urban areas has resulted in the movement of rural people into urban centres. The influx of people into cities and other urban centres has brought considerable stress on the already inadequate urban infrastructure, including the shortage of suitable housing and other basic amenities. The situation has led to the development of slums and the consequent degradation of the urban environment, causing deterioration of large areas in urban centres.

The environmental problems associated with urban settlements in Ghana are those that have direct bearing on human health, such as basic sanitation and disposal of waste, the shortage of essential facilities, and rampant disregard of approved land use allocations. Other serious problems associated with urban life are noise, overcrowding, poor and inadequate transportation. Town

planning processes seem unable to keep pace with the rate of expansion, with the result that rational land use becomes extremely difficult or even impossible.

Problems of rural settlements are relatively simple and are concerned mainly with basic sanitation and good adequate water supplies rather than the proper management of space. It is a sad commentary that despite the enormous contribution of rural production to the national economy, the benefits of national development do not reach rural settlements and their inhabitants. They have poorer share of services, infrastructure and public investments generally.

POLICY ACTIONS

The EAP provides a coherent framework for interventions deemed necessary to safeguard the environment. Government will undertake the following policy actions, among others that may be deemed essential:

Resource Management

Land Management

- Establish a body to be responsible for policy, planning, co-ordination and monitoring of land-based development programmes and projects in Ghana;
- institute land use planning to ensure harmony in the allocation and use of land for different purposes;
- adopt land tenure/ land management policy and establish appropriate institutional framework;
- strengthen the legal and administrative machinery for land acquisition and tenure, including proper maintenance of land title and transaction records;
- review, enforce, update, and approve a stronger anti-bushfire law;

Forestry and wildlife

- Adopt forest management policy;
- establish protected woodlands;
- adopt revised conservation laws and regulations;
- adopt range management policy;
- register Charcoal burners and commercial wood producers.

Water management

- Establish the proposed Water Resources Commission;
- adopt proposed Water Law;
- adopt policy framework for the extraction of water for the different uses, integrated planning for river basins, and the control of waste discharge into water bodies;
- establish watershed protection areas;

Marine and coastal ecosystems

- Adopt fisheries management policy;
- adopt proposed legislation and regulations on coastal zone management;
- establish protected areas in coastal wetlands;

Human settlements

- Adopt human settlements policy law to provide a general framework for planning and managing settlements;

- establish a Human Settlements Unit to act as the central authority for the planning, development, improvement and management of human settlements;
- review, update and approve the National Physical Development Framework;

Pollution Control

- Prepare and adopt regulations for environmental control of mining operations;
- prepare and adopt regulations for environmental control of industrial operations;
- adopt proposed legislation to control the import and use of pesticides and other hazardous chemicals;
- adopt revised Factories, Offices and Shops Act;
- adopt revised incentive system for siting of small scale industries.
- adopt incentive system for greater energy efficiency in industry.

POLICY INSTRUMENTS

For the successful implementation of the National Environmental Policy, necessary steps will be taken to develop appropriate instruments geared towards:

- improving the scientific base of environmental policy, among other things, through appropriate research programmes;
- the assessment of the potential impacts of certain public and private projects on the environment, and the integration of the environmental dimension in national policies;
- establishment and implementation of appropriate standards and guidelines so as to ensure an acceptable level of public health and environmental protection;
- harmonisation of appro- priate legal instruments;
- improved access to information on the environment.

Legislation will be enacted to prescribe the necessary environmental quality standards and guidelines for mining and manufacturing industries. To this end Environmental Impact Assessments (EIA) will be required for all new investments that would be deemed to affect the quality of the environment.

Penalties and incentives will be instituted to encourage the adoption of environmentally sound production technologies to discourage pollution.

INSTITUTIONAL STRENGTHENING

To enhance the effectiveness of the EPC -- as the custodian of the national environment, the co-ordinator of all activities relating to the environment, and the lead agency for the implementation of the Action Plan -- Government will review the

status of the Council, including its placement within the administrative machinery of the country. The EPC will be entrusted with the responsibility for setting environmental quality standards as well as for ensuring the enforcement of these standards. In addition other agencies to be involved in the implementation of the EAP will be strengthened to ensure the efficient performance of their assigned roles.

IMPLEMENTATION

The EAP is to be implemented over a ten-year period, from 1991 to 2000. The necessary policy instruments and structures will be put in place during the 1991-1992 start-up phase. A variety of individual projects will be implemented by various national agencies.

CHAPTER 1

INTRODUCTION

Background

Ghana abounds in natural resources which have played a very important role in the agricultural and industrial development efforts of the country since the attainment of independence. However, a point has been reached when it is necessary to balance economic growth with rational management of the resources to ensure that the resource base is not eroded in the process of development.

Public concern about environmental degradation in Ghana climaxed during the long dry spell and ravaging bushfires of 1983/84. Ironically this was the single environmental event that set the stage for a concerted national effort to check environmental degradation.

Several efforts had, however, been made in the past to address the problems of the environment. Of specific relevance to the present initiative are the following activities:

Preparation of a National Oil Spill Contigency Plan (1985);

Preparation of a National Plan of Action to Combat Desertification (1986);

National conference on Resource Conservation for Ghana's sustainable development (1987);

Draft National Environmental Protection Programme (1987) based on priorities identified through a series of regional and district fora organised over the period 1986-87.

A Sustainable Development Strategy for Ghana

All over the world, people and nations are starting to recognize that environment and development issues are inextricably interlinked. World attention was first focused on environmental issues at the 1972 Stockholm Conference on the Human Environment, in which Ghana took an active part. In 1973, Ghana created its own Environmental Protection Council (EPC), the first governing body in Africa to focus on issues of environmental management. Through the leadership of the EPC, with support from a broad base of local participants, this Environmental Action Plan has been formulated.

The Plan addresses itself to issues of sustainable development as defined by the World Commission on Environment and Development in 1987. "The concept of sustainable development provides a framework for the integration of environment policies and development strategies... Sustainable development seeks to meet the needs and aspirations of the present without compromising the ability to meet those of the future. Far from requiring the cessation of economic growth, it recognizes that the problems of poverty and underdevelopment cannot be solved unless we have a new era of growth in which developing countries play a large role and reap large benefits."

Ghana has achieved a remarkable success in reversing the process of economic decline through the Economic Recovery Programme of 1983 and its successors. However, this success has not been without its environmental as well as social costs. The present strength of the economy derives principally from export earnings in agriculture, mining and forestry. Food crop and livestock production must continue to grow in order to feed a population of 15 million people, growing at 3% per year. Limits on the capacity of remaining agricultural land to absorb this growing population imply that future growth must provide employment opportunities in domestic manufacturing and services, and that the population will come to be increasingly concentrated in urban centres.

These projected patterns of development offer both opportunities and constraints with respect to the environment. Intensive use of savanna land through high-input irrigation, and extensive use for grazing and cropping on marginal lands, are helping to create massive problems of soil and water degradation and even desertification in the north. Ghana's rich forest and wildlife resources are rapidly diminishing and may disappear entirely if their management is not drastically improved. Water and mineral resource development projects bring in their wake problems of environmentally-related disease and social disruption. Improper use of hazardous chemicals in both agriculture and industry

creates additional threats to human health and safety. Fishery resources and sites of historical and cultural importance are negatively affected by uncontrolled development in the sensitive coastal zone.

The Environmental Action Plan is intended to address these problems, not by calling a halt to development, but by redirecting development efforts into more environmentally sustainable programs and practices. Implementation of the EAP will help to protect and preserve the resource base for use by future generations as well as the present one. Assessment of the potential environmental impacts of development projects and planning in advance to mitigate or enhance these impacts will decrease environmental costs to the economy and make more cost-effective use of the country's human and financial capital. Evaluation of alternative uses for the country's land and water resources and planning for multi-purpose use will maximize the efficiency of future investments. Finally, the promotion of popular participation in planning, evaluating, and implementing environment and development initiatives will help to create a sound social and political climate for sustained economic growth in the future.

SCOPE AND PROCESS

In March 1988, the Government tasked a group of experts to review existing policies related to environmental protection in Ghana, and to propose a strategy to address the key issues, including deforestation, deterioration in soil quality, and better management of renewable resources. The Task Force's work evolved into the preparation of an Environmental Action Plan to put in place a comprehensive and integrated national strategy to deal with the identified environmental problems of the country. For the preparation of the EAP, Working Groups were set up in July 1988 to address areas of concern under the following sectors:

- land management;
- forestry and wildlife;
- water management;
- marine and coastal ecosystems;
- mining, manufacturing industries and hazardous chemicals;
- human settlements.

A seventh group, made up of the leaders of the sectoral working groups, addressed legal and institutional issues, cross- sectoral, environmental education, and environmental data systems and monitoring.

The groups were tasked to undertake the following activities within each sector:

a) Assess the state of knowledge;

b) Identify data gaps and additional research needs;

c) Review existing legislation and policy recommendations that have been made in the past, and proposing a set of needed policy actions;

d) Make proposals for monitoring environmental change in relation to development activities;

e) Review projects under the 1988-1989 PIP and making recommendations on their environmental suitability or otherwise; and

f) Review institutional arrangements for the implementation of recommended policies, identifying gaps, overlaps, and inadequacies, and making recommendations for appropriate institutional strengthening.

A draft strategy for action on the environment was drawn up by the working groups. In January 1989, a two-day review work-session was held to discuss the drafts. Following this the working groups reconvened to revise the drafts in the light of the suggestions and comments emanating from the work-session. The suggested revisions were effected during the second phase of the EAP process, which culminated in a national conference in June 1989 to discuss the draft proposals and to seek a wider public participation in the Plan preparation. Some 200 participants representing a wide

cross-section of interests, including members of district assemblies, representatives of non-governmental organisations and government functionaries, took part in the conference.

The conference adopted the Action Plan in principle and charged the EPC with the responsibility of finalising the document, taking into account the views expressed at the conference and any that would be submitted to it later. A major task for the third phase of the EAP preparation was the incorporation of economic dimensions into the draft Plan, particularly with regard to national overall economic strategy, and sectoral development strategies. It was necessary to identify specific projects for implementation and to estimate the total cost for the Plan implementation. There was also need to identify and assign institutional responsibilities, and to revise or draft essential legislation and regulations to make the implementation of the plan effective.

The Environmental Action Plan will be presented in four volumes. The current volume presents critical environmental issues in Ghana and actions recommended under the Plan. The Plan includes adoption of the proposed National Environmental Policy (Chapter 3), action to address legal and institutional issues (Chapter 4), actions in the areas of natural resource management (Chapter 5), and in managing the built environment (Chapter 6). It also includes the implementation of comprehensive programs in environmental education (Chapter 7) and environmental monitoring (Chapter 8). A summary of the Action Plan is given in Chapter 9, and the proposed implementation strategy in Chapter 10.

The second volume of this report presents the draft legislation which is recommended for Government to adopt as part of the Plan. This volume includes the following documents:

1. Restructuring of EPC
2. Environmental Impact Assessment (EIA)
3. Revised Forestry Policy
4. Revised Conservation Legislation
5. Revised Factory, Shops and Offices Act
6. Legal Framework for Coastal Zone Management
7. Legislation to Control Pesticides
8. Legislation to establish a Water Resources Commission

The third volume, to be published in February 1991, will present the details of the proposed investment program. A fourth volume, to be published together with Volume III, will present the reports of the various working groups and other background material.

In addition, several studies have been completed as part of Plan preparation. They include:

Evaluating the Costs of Environmental Degradation in Ghana.
Report on Land Management Systems in Ghana
Coastal Zone Indicative Plan
Environmental Guidelines for District Assemblies
Guidelines for Environmental Impact Assessment
Remnant Woodlands Recommended for Protection
Environmental Education Curriculum for Primary and Secondary Schools.

These reports are available for consultation at EPC.

CHAPTER 2

ECONOMIC DEVELOPMENT AND ENVIRONMENT IN GHANA

Current State of the Ghana Economy

During the period 1970-1983, poor weather, institutional rigidities, inappropriate economic policies, and internal and external shocks all combined to result in a persistent decline in Ghana's economy. GDP fell at an average rate of 1.3% per year. During these years, all key sectors, agriculture, industry, and services, registered negative average annual growth rates.

Population, however, grew at a rapid rate during this period. An intercensal growth rate of 2.6% per annum was recorded for the period 1970-1984. Unofficial sources indicate that the growth rate was in fact between 2.9% and 3.1% per annum – the result of declines in the mortality rate combined with a high fertility rate. The combination of very rapid population growth and prolonged decline in aggregate economic performance resulted in a continuous and severe decline in average per capita incomes. At the same time, the mounting population pressure on the country's natural resource base and the absence of incentives for prudent and sustainable management of these resources combined to fuel an accelerating degradation of the environment – both natural and man-made.

In April 1983, the Government launched an ambitious program of economic policy reforms designed to arrest the decline and to put the economy on a positive growth path. The Economic Recovery Program (ERP) was given both financial and technical support by the World Bank, the IMF, and other donors. The components of the reform efforts involved a broad constellation of stabilization and growth-inducing measures; viz.: i) depreciation and floating of the cedi to about one tenth of its 1983 value to stimulate exports and to narrow the differential between the parallel and official rates respectively; ii) privatization of and introduction of cost-recovery schemes in parastatal enterprises to enhance their efficiency and profitability; iii) reduction in the size and scope of the public sector as well as an expansion of the role of the private sector in the production and marketing of goods and services; iv) liberalization of credit and monetary arrangements; and v) creation of an enabling environment for foreign and domestic investment.

With these measures firmly in place, real GDP, for the first time in a long period, registered a positive growth rate of about 8.6% in 1984. For the period 1984-88, GDP recorded an average growth rate of about 5% per annum. Positive overall annual GDP growth continued in 1989 (6.1%) and so far in 1990 (forecast at 4%).

GDP growth projections for the next decade are on the order of 5% per annum.

The positive growth performance brought about by the ERP has, however, entailed its social costs. Because of the Government's concern about the impact of economic reforms on the poor and the sustainability of reforms, the Program of Actions to Mitigate the Social Costs of Adjustment (PAMSCAD) was introduced. PAMSCAD involves projects with a strong poverty alleviation focus aimed at specific target groups: i) rural households, particularly in the northern regions; ii) urban poor (unemployed/underemployed) and iii) retrenched workers.

Economic Development and Environmentally Sustainable Growth

The sustainability of Ghana's economic and social development depends ultimately on proper and responsible management of the natural resource base and on the environment in general. The environment is complementary to economic growth but requires a broader appreciation of the synergism between forces which generate growth and those that involve conservation of the natural resource base.

The widely held view that there is an inevitable tradeoff between growth and environmental degradation is misleading. There are such tradeoffs in the short run – but in the longer run, the factors which induce growth must be reconciled with the integrity of the natural resource base if growth is to be sustained and to benefit future generations. In Ghana, economic growth has been based primarily on the use of its renewable and non-renewable natural resources: forests, soil, water, biomass, and

other elemental resources. Proper management of this "natural capital" contributes significantly to regenerative growth and the long-run maintenance of consumption levels consistent with healthy and productive lives. Irresponsible attitudes to the natural resource base result in environmental degradation which is likely to have grave consequences on the future welfare, if not actual survival, of human civilization, animal, and plant species.

The pressures on natural systems in Ghana are significant. It is likely that if adequate interventions are not made now, pressures could build up to result in a breakdown in such natural systems, thereby ensuing in irreversible poverty. At present, the problems confronting the natural resource base are numerous: the loss of productive soil and biomass due to inappropriate agricultural practices; the loss of forests as a result of farmer encroachment, extensive logging, fuelwood extraction and charcoal production; the degradation of range and pasture lands due to overgrazing; the irresponsible release of pollutants into the air and water; the pressures of population growth on a limited carrying capacity; and the overburdening of urban systems as a result of rural to urban migration and natural increase, thereby resulting in air and water pollution, congestion, poor sanitation, and disease.

Sustainable growth and development in Ghana will depend on the degree to which the rate of natural resource extraction is balanced against the rate of resource replenishment. Individual Ghanaians must be made to realize that it makes economic sense to conserve the environment from which they derive their livelihood.

Economic Justification for an Environmental Action Plan

In Ghana, environmental degradation affects production in agriculture, industry and services. It arises as a -- neither desirable nor unavoidable-- by-product of the processes of resource extraction and utilization in the production of goods and services in the various sectors. An attempt has been made to estimate the costs imposed on the Ghanaian economy by environmental degradation in the different sectors. The willingness to pay by Ghanaians to avoid or prevent such negative impacts has been estimated using market prices where available, or using some proximate estimates where market information is not available. The picture is incomplete in a number of respects. Nevertheless, even using very conservative assumptions, the costs of environmental degradation are clearly significant. Table I at the end of this section gives the ranking and sectors in terms of priorities for intervention and the associated costs imposed on the economy in the absence of any remedial or preventive action[1]. Degradation related to crop and livestock production activities imposes the greatest cost to the Ghanaian economy, with a total estimated annual cost of at least 28.8 billion cedis. These costs are largely attributable to productivity losses arising from soil degradation, soil erosion and loss of tree cover, and to a lesser extent costs resulting from rangeland degradation due to the grazing of livestock.

The next economic activity that suffers a significantly high environmental cost is forestry. The total cost borne by the country as a result of the loss of forests through fire, logging, fuelwood extraction, charcoaling and agricultural encroachment has been estimated at 10.8 billion cedis per year. There are other costs which arise from the disappearance of rare species of animals and plants, the loss of non-wood forest products, the reduced benefits from research on sources of medicine, etc. Significant costs also arise from the disturbance of watersheds which lead to siltation and drying of water bodies and the consequent desertification. These costs have not been estimated, but localized evidence suggests that such costs are significant.

Unfortunately, it has not been possible as yet, for lack of adequate data, to quantify the costs of environmental resource degradation arising out of mining and manufacturing activities. Estimates based on observation of damage to humans, animals, vegetation and water bodies support the case that such costs are substantial. A matrix has been developed to describe the impact of these and other economic activities on the receiving media (animate and inanimate resources). Some efforts

1 These estimates were developed for 1988, the most recent year for which sufficient data are available.

have been made, however, to estimate the costs of environmental degradation from such activities as mining, manufacturing, and urbanization by evaluating their impacts on human health. These costs have been captured in terms of lost earnings, cost of medical resources (doctors, nurses, technicians, equipment, etc.), and cost of drugs. The total cost is estimated to be as high as 3.8 billion cedis (if not more) per annum. This estimate obviously understates the true cost of illnesses arising from environmental degradation, because secondary effects (e.g. impacts on pregnancies, etc.) and the number of environmentally related premature deaths are not accounted for. Moreover, even the direct costs estimated above are an understatement because it has not been possible to capture the costs incurred by all persons affected. It should also be noted that longer-term costs to the economy attributable to environmentally induced health problems – especially long-term losses in labour productivity– have not yet been quantified.

What emerges clearly from this analysis is that Ghana's economy sustains losses due to environmental degradation that amount to a minimum of 41.7 billion cedis annually – equivalent to 4% of total GDP in 1988. It is important to note that it is only since 1984 that GDP growth rate has attained an average of about 4% per year. If nothing is done to arrest the processes which degrade the environment, Ghana loses at least 4% of the potential output of its economy each year. In other words, Ghana's economic growth, even when it has been clearly positive as measured by conventional methods of national income accounting methods, has been achieved almost entirely by "mining" the country's natural resource base and thereby gradually destroying the foundation for future sustained growth and development. The significant magnitude, persistence, and pervasiveness of environmental losses provides a strong case for taking action to reduce the damage through the Environmental Action Plan.

Towards a Remedial Incentive Framework

Environmental assets are conserved or destroyed for a variety of reasons, but an important - often the most important-reason is that it is in the immediate self-interest of individuals, communities, agencies and firms to conserve or destroy. When it is in the short term interest of users to destroy Ghana's environmental endowment, it is very difficult for positive policy to prevail. What is necessary to redress and reverse the severity of the problems of environmental degradation is not necessarily more laws, regulations and enforcement mechanics, but greater reliance on incentive mechanisms that will induce the users of natural resources to perceive that it is in their self-interest to manage this resource base in a sustainable way.

Economic incentives which promote environmentally sound production and consumption activities are superior to approaches that rely on regulatory measures. The former are far more cost-effective and easier to administer than the latter, moreover, they are largely "self-enforcing". The use of incentives will encourage individual Ghanaians to manage voluntarily and wisely the environment on the basis of prospective rewards, whereas regulatory and enforcement schemes rely on involuntary (if not "coercive") measures which are prone to generate adversarial outcomes.

An important element in environmental policy must therefore be to determine whether, and to what extent, the incentives facing those using the environment encourage them to destroy it, and if so, how to redirect incentives so that conservation is encouraged. On a positive note, a serious attempt to provide an effective incentive framework for a benign management of the environment will have to address the issue of ownership, control and use of resources, the transparency of rules and claims, the existence of effective functioning of markets and the issue of externalities.

The Role of Ownership

It is one of the axioms of economics that, if resources are not owned, economic efficiency will not be maximised; the incentives encourage over-use, and ultimately destruction of the resource. Ownership in this context can be defined as the ability and willingness to limit use and/or access. Ownership can be exercised equally by the private and the public sector, by individual or group.

Clear, undisputable rights of ownership, usufruct rights, etc. to productive assets, especially to land resources, including the right to bequeath to one's descendants, to sell, to otherwise transfer ownership or certain rights of use to others (including wives, widows, children, parents, business partners, strangers) are incentives which ensure responsible management of the resource.

The transparency of the rules and claims which govern resource use can also induce proper or improper use of the resources. When farmers and communities are certain about the extent of their plots and communal lands and of their rights to these, they will more likely assume responsibility to prevent abuse than if there is confusion with respect to the rules. Transparency of rules and claims enables owners of land or natural resources to exercise the "territorial imperative" and to protect these assets against abusive encroachers as well as to safeguard the integrity of these resources in perpetuity.

Functioning Markets

The existence and access to functioning markets for land, labour, capital/credit, inputs and outputs are important for proper management of resources. If markets for factors of production do not exist or are imperfect, then there are no right signals as to the use of the factor, such as land. This could lead to misuse.

Access to these markets, unrestrained by factors, such as membership in a particular community, gender or administrative barriers such as input or output marketing monopolies or price controls enhances the incentive structure towards conservation. If particular groups of people, such as females do not have access to technology or credit then they might undertake agricultural practices which are environmentally destructive. If farmers could have remunerative reward for their activities, then it could enhance their choices for environmentally friendly practices.

EXTERNALITIES

It may be economically and financially beneficial for an individual producer or consumer to deplete or pollute an environmental resource because the cost of this depletion or pollution is borne by someone else or by society at large or by future generations. These externalities arise because individual economic agents face different time horizons. While factories which pollute water bodies or the atmosphere care about the short-run maximization of profits or minimization of costs, society which cares about a sound environment takes both a short-and long-term view at what happens to the environment.

When such externalities occur, public policy that seeks to ensure environmental resource conservation and integrity over the long run will need to consider ways to deal with them. This might take a variety of forms: regulatory and enforcement mechanisms are only one possible set of instruments that can be applied. Other incentives could be instituted. For instance tax breaks could be given to factories that institute new benign technologies or taxes increased for alternative technologies that pollute the environment. For instance Achimota Brewery that pollutes the Odaw river could enjoy such a facility if they were to install technologies that could reduce its effluents significantly or treat their pollutants. Sometimes, temporary subsidies could be given to activities which use alternative and more resource-friendly technologies up to the point where it is no longer necessary or direct compensation paid to certain resource users for foregoing specific types of resource exploitation. For instance, tobacco industry that uses a lot of wood in the Brong Ahafo area and hence causes a lot of deforestation could enjoy such subsidy if they were to undertake a method of tobacco curing without using wood. They could also be encouraged through subsidies to establish their own woodlots or taxes placed on them for using existing wood to enable the villagers reafforest.

With regard to cleaning up lagoons - Korle and Chemu - which are now virtually dead, it would be possible to institute a system of tradable permits, which would work as follows: The inputs which the lagoons could absorb without environmental damage - say 50% of the existing levels - would be determined. Each emitter would be given "license" to emit up to 50% of their existing levels (to be achieved over, say, a 2 year period). Thereafter, if any of the existing firms want to exceed their current allocation, or if new firms want to set up, and use the assimilative capacity of the lagoon, they will have to "buy out" the equivalent in pollution rights from existing holders. Thus a market in pollution rights is created, the total loading is stabilised. A particular industry can increase its loads, but only at a price, and the system tends to be efficient and largely self-regulating.

Examples of how incentives affect the environment in various sectors of the economy are indicated below:

Agricultural Land

The land tenure system in Ghana covers a spectrum of arrangements, including outright private ownership, long-term lease, short-term rental (including share-cropping), community and open-access. Although there is an extensive - and generally highly legalistic - literature on this subject, none of it addresses the central environmental issues: to what extent do the tenure arrangements allow effective ownership - the ability and willingness to limit access - to be exercised?

Tenurial security is perhaps the single most powerful incentive to prudent management of land resources. Conversely, insecurity of tenure inevitably results in abuses and/or misuses of land. Also directly relevant to conservation is the question of the duration of tenure. Tree and soil conservation requires that the custodians of the land have an incentive to invest in the long-term future; to plant trees, to build terraces and conserve water demands sacrifice today so that benefits will be yielded in the future.

It is most unlikely that the confusing amalgam of tenure arrangements now prevailing will result in resource conservation. The deficiencies are perhaps most striking in the Northern grazing lands, where relatively open-access conditions prevail, but the problem - and the associated destructive incentives - appears to be widespread.

Deforestation

Incentives which cause this problem range from the non-competitive pricing of wood, to inappropriate and ineffective tenurial arrangements. The State is the legal owner of the forests, but ownership has only been sporadically enforced, to a substantial extent, the forests have, de facto been open-access resources. Logging is undertaken by private companies on a concession basis; the terms of the concession (and the associated enforcement) have not encouraged resource conserving behaviour, and neither have the very low prices charged. Incentives to remedy the problem could include raising the silvicultural and royalty fees to competitive levels, encouraging the use of improved technologies in extraction and/or processing of wood, through tax incentives to wood-based processing industries and charging for incidental destruction of trees in the process of extraction.

The conservation of the unique flora and fauna of Ghana is important for the global community, because it keeps options open - for genetic enrichment of food crops, for medicinal value, for basic research - for the future. However, unless such biota have immediate value for food, medicine, etc. their conservation will not be of interest or concern to local dwellers; thus, the incentive facing the local custodians differ from that of the world community.

Wildlife Loss

In Ghana hunting of wildlife is mainly for meat. Therefore, factors which result in this problem arise from lack of alternative sources of protein/meat or wildlife by-products and/or ignorance of better techniques of hunting. Individuals who engage in activities which promote livestock production should be given incentives through tax concessions to produce more so as to reduce the demand for wildlife.

Water Contamination

The problem of externality leads to misuse and abuse of water. Incentives, such as creation of market for pollution right outlined above could be used to reduce pollution by industries, mining, and households.

Human Settlements

Factors which cause environmental degradation arising from human settlements are unplanned population growth along with inappropriate or inadequate spatial planning. Incentives should be created to reverse the tide of rural to urban migration through the provision of comparable social amenities in rural areas and creation of access to markets by rural dwellers. Fiscal measures (eg. property tax, gasoline taxes, selective leases) could be used to induce better town planning and fines imposed on irresponsible disposal of solid/liquid wastes into common property (eg. lagoons, streets, park, etc.)

PRIORITIZATION OF INVESTMENTS IN THE ENVIRONMENTAL ACTION PLAN

The investment projects in the EAP have been grouped under broad sectors of Agriculture, Urbanization, Water Resources and Industry. There are two sets of matrices; Annex A and B. Annex A shows the impact of economic activities on receiving media, such as people, animals, vegetation, water (fish) and air. Annex B tables show investment projects, their objectives, activities, implementing agencies and duration of investment.

The following criteria have been used to list all the projects in order of priorities.

1. Where projects are in sectors which have been found to be experiencing the highest environmental degradation and the extent to which such projects can reduce the cost of degradation.

2. Where projects are well identified in terms of clear-cut objectives and activities.

On the study of the cost of degradation to the economy by Convery and Tutu, the order in terms of sectors with greater cost of degradation to the economy was agriculture (soil and nutrient loss through erosion, grazing), forestry, health effects from urbanization, mining and industry and tourism. Thus, the projects are considered from sectoral level, namely, agriculture, urbanization, water resources, and industry.

Agriculture

On agriculture including forestry and wildlife, projects which prevent wind and soil erosion are considered as very important. There are a total of 18 projects out of which 6 are in the 1990-92 Public Investment Programme (PIP). These projects can be grouped broadly into a) soil protection and soil nutrient replenishment, reafforestation and energy saving technologies b) monitoring and management of forest resources including trees and wildlife. The projects in a) are the priority ones since they go to reduce the largest component of the cost of degradation. The projects in b) generally could be undertaken through the institutional strengthening that are on-going. Projects will be indicated by their code as they appear in either the EAP or PIP. The few projects that are in the PIP will be indicated as such. The projects are ordered in order of top priority. Thus if only one project has to be undertaken the first one goes. The first 10 projects can be seen as very important.

The investments in order of priority are as follows:

1. Program for soil fertility regeneration and maintenance(RCMO2).

2. Soil fertility and productivity (RCM 03)

3. National Agroforestry project (DCS 011/88) PIP.

4. Utilization of straw and other agricultural waste products for dry season feeding (AHP 010/88) PIP.

5. Charcoal production study (STR 05).

6. Feasibility study of wood saving technology (STR 07).

7. Subri industrial plant project (FOR 012/89) PIP.

8. Establishment of Strip Plantation (FOR 008/88) PIP.

9. Drought resistance/tolerance in cocoa (CMB 005/89) PIP.

10. Soil conservation, education and training (STR 15)

11. Forests and woodland monitoring system (ESS 04).

12. Improvement of classified forests (RCM 08)

13. Desertification control plan of action (RCM 12).

14. Wildlife monitoring system (ESS 05).

15. Wildlife management project (FOR 007/90) PIP.

16. Range monitoring program (ESS 03).

17. Range management program (RCM 04).

18. Improved managed of parks and reserves (RCM07).

Industry

Although it was not possible to put costs to the environment due to lack of data as to the extent of pollution taking place, industry which mainly constitute mining and manufacturing as far as pollution is concerned has cost to the environment as depicted in one of the matrices. Projects in order of priority are those which can assess the extent of pollution, technologies which reduce pollution and awareness creation. Those that emphasize control are least priority since they already have institutions charged to do so. They may only need strengthening. The first set of five projects are the most important.

1. Environmental impact assessment (ESS 12).

2. GIS-based environmental monitoring system (ESS 02).

3. Air quality monitoring system (ESS 03).

4. Environmental aspects of mining activities (POC 01).

5. Strengthening local training institutions (ESS 15).

6. Environmental awareness programme (Public awareness to protect natural resources) (ESS 13).

7. Incentive systems for greater energy efficient industry (MBE 07).

8. Strengthening of factory inspectorate (POC 02).

9. Industrial chemicals control system (POC 04).

10. Air pollution control programme (POC 06).

Urbanization

There are 11 projects out of which 2 are in the 1990/92 PIP. Projects which deal with urban waste management and decongesting of cities are top priority because they tend to improve sanitation which will reduce disease and hence cost of health. In this sector there are lots of projects which span over work that is already being undertaken or where the activities are such that it cannot be accomplished at a reasonable time. The first five projects are the most important.

1. Improvement in the solid waste and nightsoil disposal systems in Accra (MBE 05).

2. Preparation of 1/25,000 scale maps (ESS 01).

3. Urban II and other district projects (DUR 002/89) PIP.

4. Accra district rehabilitation project (DUR 001/89) PIP.

5. Reduction in energy consumption in urban transportation (STR 08).

6. Improvement of infrastructure in secondary cities (MBE 08).

7. Structure plan for regional capitals and special areas (MBE 03).

8. District structure plans (MBE 01).

9. Street and market foods protection policy and study (STR 10).

10. Appropriate technology for waste disposal and treatment (STR 12).

11. National physical development plan (MBE 02).

Water Resources

There are 7 projects with one in both the 1990/92 PIP and the EAP. Projects that reduce pollution or that improve water quality, or assess extent of pollution are top priority. The first three projects are most important.

1. Water quality monitoring system (ESS 08) EAP and PIP.

2. Environmental impacts of water based activities (STR 13).

3. River basin water master plan (STR 02).

4. Impact of inland drainage and land based pollution source on costal zone (STR 03).

5. Monitoring of marine pollution (ESS 11).

6. Coastal protection works (RCM 13).

7. Coastal zone management (STR 04).

CHAPTER 3

NATIONAL ENVIRONMENTAL POLICY

A. PREAMBLE

Attempts over the years to address environmental problems in Ghana have been largely ad-hoc and cosmetic, or at best sector-oriented and therefore limited in scope. It has become evident that the body of existing legislation on the various aspects of the environment is inadequate and unimplemented, and many provisions have no bearing on present-day realities as well as the aspirations of the people of this country. There is clearly the need for a new direction and thrust in national development efforts to ensure that plans aimed at improving the standard and quality of life take due cognizance of environmental considerations.

The economic prosperity of Ghana depends on the maintenance of a high quality environment. The losses being sustained at present reduce the living standards of the present generation. If the urban and rural environments are degraded to the extent that Ghana is not an attractive location for the growth industries of the future - information-led technologies, high quality food production, tourism - then the prosperity of future generations will also be prejudiced by today's irresponsibilities.

B. DEFINITIONS

In the context of this document "Environment" is understood as comprising the whole set of natural or biophysical and man-made or socio-cultural systems in which man and other organisms live, work and interact.

By "environmental protection" is meant all the interventions that may be deemed necessary to maintain a high level of environmental quality, and which at the same time enhances sustainable socio-economic development.

C. OBJECTIVES

The ultimate aim of the National Environmental Policy of Ghana is to improve the surroundings, living conditions and the quality of life of the entire citizenry, both present and future. It seeks to ensure reconciliation between economic development and natural resource conservation, to make a high quality environment a key element supporting the country's economic and social development.

Specifically, the policy seeks to:

- maintain ecosystems and ecological processes essential for the functioning of the biosphere;
- ensure sound management of natural resources and the environment;
- adequately protect humans, animals and plants, their biological communities and habitats against harmful impacts and destructive practices, and preserve biological diversity;
- guide development in accordance with quality requirements to prevent, reduce, and as far as possible, eliminate pollution and nuisances;
- integrate environmental considerations in sectoral structural and socio-economic planning at the national, regional, district and grassroots levels;
- seek common solutions to environmental problems in West Africa, Africa and the world at large.

D. PRINCIPLES

For the effective implementation of the National Environmental Policy the following principles will be applied:

- optimum sustainable yield in the use of resources and ecosystems;
- use of most cost-effective means to achieve environmental objectives;

- use of incentives in addition to regulatory measures;
- delegation of decision-making and action to the most appropriate level of government;
- polluter pays for the cost of preventing and eliminating pollution and nuisances caused by him;
- public participation in environmental decision-making;
- international co-operation.

E. POLICY STATEMENT

Environmental protection in Ghana should be guided by the preventive approach, that is, with the recognition that socio-economic developments must be undertaken in such a way as to avoid the creation of environmental problems.

Specifically, the Government will:

a) commit itself to the environmentally sound use of both renewable and non-renewable resources in the process of national development;

b) create awareness among all sections of the community of the environment and its relationship to socio-economic development, and of the necessity for rational resource use among all sectors of the country.

c) develop procedures for the utilisation of land resources in a manner that will ensure the maximum degree of economy in the use of land and avoid or minimise conflicts;

d) institute and implement an environmental quality control programme by requiring prior environmental impact assessments of all new investments that would be deemed to affect the quality of the environment;

e) the appropriate measures, irrespective of the existing levels of environmental pollution and extent of degradation, to control pollution and the importation and use of potentially toxic chemicals.

f) take appropriate measures to protect critical eco-systems, including the flora and fauna they contain against harmful effects, nuisance, or destructive practices;

g) develop and maintain a professional cadre within the country to supervise, co-ordinate, implement and enforce procedures and legislation essential for safeguarding the environment and maintenance of sound ecological systems;

h) oblige all concerned to provide the appropriate agencies with the relevant information needed for environmental protection and for the enforcement of relevant environmental regulations and legislation;

i) promote and support research programmes aimed at better understanding of the different ecozones and the factors affecting them, as well as health-related environmental problems, and the development of appropriate technologies for environmentally sound management and use of local resources, including renewable energy resources;

j) establish an adequate legislative and institutional framework for monitoring, co-ordinating and enforcing environmental matters;

The fundamental aims of the National Environmental Policy shall be pursued and achieved through the harmonisation and enforcement of relevant laws and treaties on the environment, and the implementation of an Environmental Action Plan. The Plan is intended to provide a coherent framework for the various interventions necessary to safeguard the environment.

ISSUE-SPECIFIC POLICY ORIENTATIONS

The environment represents an asset, though finite with a limited carrying capacity, which must be utilised and managed in the best possible way. It must be recognised as an essential factor in the organisation and promotion of human existence and progress. The resources of the environment

must be managed such that they exert the maximum contribution to the long-term economic and social well-being of Ghanaians.

1.0 Management of Environmental Resources

Conservation of forest, fishery and wildlife resources:

The need to protect nature and habitat, landscape, flora and fauna from the threat of further degradation and depletion is an area of concern to many Ghanaians. There is an increasing awareness of the direct economic benefits of forests and wildlife to the people. and the linkages between these resources and the total environment. These concerns shall be translated into an action plan which will ensure nature conservation.

Protection of the soil:

The protection of the soil has been recognised as an important action in the management of resources in Ghana. This arises from the recognition of the growing threats to the soil as a result of increasing agricultural, mining and manufacturing activities.

The threats to the soil can be categorised as follows:

a) contamination by harmful substances of various origins;

b) degradation of the chemical, biological or physical structure;

c) misuse and waste as a result of space-consuming activities.

In order to tackle these principal threats, existing policies and activities shall be co-ordinated and re-enforced to ensure that soil protection is more effectively taken into account especially in agricultural and other development policies and activities. Steps shall also be taken to encourage the development of innovative soil protection techniques and the transfer of available know-how.

Coastal regions and highland areas:

The development and ecological management of Ghana's coastal regions is of major importance. Because of the peculiar and fragile nature of these areas it is of the utmost interest to the country to manage these on a sustainable basis.

It is also recognised that a commonly agreed upon action plan will provide the appropriate framework for an environmentally- sound and comprehensive approach to coastal area development in the West African sub-region. In this direction, Government will lend its full support to the programme activities under the Regional Seas Programme of the United Nations Environment Programme (UNEP) appropriate to the needs of West and Central Africa (WACAF); within this regional framework Government will prepare and implement a Coastal Zone Management Plan.

The highland areas in Ghana fulfill several, often conflicting functions. They guarantee the economic well-being of the local population serving as farm lands and at the same time, protect the watersheds and habitats for wildlife. The ominous destruction of vegetation on hill sides threatens the stability and beauty of these areas. Local authorities will prepare and enforce appropriate bye-laws and massive public education programmes will be carried out.

Energy Resources:

Woodfuels constitute the primary energy source for most Ghanaian households, whiles the industrial sector is almost entirely dependent on hydro-power. This situation poses a serious threat to economic development and to the environment. Efforts to develop the country's indigenous energy resources will be pursued in such a manner as to reduce the possible adverse impacts of energy development on the environment.

To reduce the pressure on forests for woodfuels the development of renewable energy sources will be promoted, while the efficiency of production, conversion and use of woodfuels will be improved. Industries will be given the appropriate incentives as a means to promote the use of renewable energy sources.

Water Resources:

Water is used for various purposes, including domestic, industrial, agriculture, recreation and transportation. The necessary measures will be instituted to ensure that conflicts between the different uses of water are avoided or reduced to the minimum. In particular efforts will be made to protect the various watersheds and also employ environmentally sound methods of disposing waste water as well as to prevent pollution of fresh water bodies.

Also efforts will be made to reduce land-based pollutants from various sources entering the sea. The National Oil Spill Contingency Plan will be implemented to reduce the risk of pollution from oil spills and ensure timely intervention in case of such spills. Ghana will co-operate with all countries in the West and Central African sub-region in the event of a serious oil spill in the region.

Urban areas and waste management:

The volume of wastes generated in the urban centres is rapidly increasing. Although a substantial percentage of the urban waste in Ghana is readily biodegradable and therefore potentially re-usable or recyclable for raw materials or energy, the appropriate technology and necessary resources are not readily available. A small but increasing proportion of urban waste in Ghana is toxic or dangerous and deserves special handling. Much of the urban waste is disposed of on the land and some are dumped into the sea with little or no treatment before disposal.

A more comprehensive policy for waste management shall be adopted to encompass prevention, reclamation and disposal. This policy shall focus on three broad themes: the reduction of the volume of waste, the increase of recycling and reuse, and the safe disposal of unavoidable wastes.

2.0 Prevention and Control of Pollution

A pollution problem might, to varying degrees, be classified as:

a) acute or chronic;

b) localised or geographically dispersed;

c) related primarily to a single pollutant or a combina- tion of pollutants;

d) concentrated in one medium (air, water or land) or affecting several and/or involving the movement of pollutants between media;

e) point-source(s), diffused, fixed or mobile, and may be linked with one or several industrial sectors.

The approaches to pollution control in practice will therefore differ in their emphasis, depending on technical, administrative and legal possibilities for control measures. It is recognised that the first stage in the control of a pollution problem is research and detailed study to investigate the factors involved and their inter-relationships.

When a problem has been identified and investigated, an appropriate control strategy can be decided upon. The control strategy may include the use of biological standards, exposure limits, environmental quality objectives or standards, emission standards, process or operating standards, product standards, limits on total emissions or a range of preventive controls, for example, the application of Environmental Impact Assessment (EIA) procedures, or some combination of these.

Control action may be directed towards any one or more of the following:

- the pollutant;
- pollutant sources;
- receiving and/or transporting media;
- target organism or environment.

Comprehensive Pollution Control:

The control of the emission of pollutants from many sources into a single medium will be based on emission limits or on environmental quality standards set for that medium. It is recognised that one inevitable consequence of the sectoral approach to pollution is that, as standards are tightened in one area, so the pressure may increase in another area. To avoid this situation, emphasis will be placed on stricter environmental standards in all sectors.

Substance-oriented Controls:

In order to be able to assess the exposure by a particular pollutant through the various pathways (air, water, soil) of a particular target, assess the effects of such exposures, including risks for health and the environment, and set standards designed to limit the impact of pollution, where appropriate an integrated substance-oriented approach to chemicals will be adopted. This approach will:

- consider the occurrence of a particular substance from any source;
- proceed towards an integrated risk assessment, taking into account the different routes through which people and the environment are exposed; and
- lead to choices regarding the most effective and efficient solution to the problems caused.

Source-oriented Controls:

Environmental management should ideally take into account interaction between sources of pollutants. In some cases, however, it may be reasonable to focus controls on a single type of source. A source-oriented control approach, aimed at individual industries or target groups of industries, and covering all discharges to air, land or water and including the generation of solid as well as liquid or gaseous wastes, may be adopted where deemed appropriate.

To ensure effective support for such an approach, a better, more comprehensive knowledge of the emissions into air, water and to soil in the form of wastes from major sources of such emissions is required. Emission inventories will be set up and kept up to date and the state-of-the-art technologies to control emissions will be regularly maintained and disseminated to those concerned and to the public together with the costs entailed.

Product Standard Emission Limits and Environmental Quality Objectives and Standards:

Environmental regulations are already in existence although scattered, which set standards for products emissions. These are based on the technical characteristics of the industry, the product, and/or on a formally specified quality objective or standard for the receiving environment. A more comprehensive regulation will be enacted for the control of, for example, gaseous emissions from motor vehicles, pollution of soil and water through sewage discharges, et cetera.

3.0 Action in specific areas

Atmospheric Pollution:

The atmospheric pollution control strategy under the national environmental policy is geared towards an overall long-term objective to reduce air pollution within the country as well as beyond Ghana's boundaries.

The main objectives of the strategy will be to:

a) identify the atmospheric pollutants which are currently and potentially of greatest concern for the protection of human health and the environment;

b) determine the most appropriate means (substances and/or source oriented) for handling the pollution problems identified, without transferring air pollution to water or soil;

c) set and implement national standards for specific sources discharged into the air;

d) reduce, in the longer term the ambient air concentrations of the most crucial pollutants to levels considered acceptable for the protection of sensitive ecosystems;

e) define and implement preventive measures against indoor pollution;

f) develop relevant instruments which can assist in achieving these objectives, including:

i) an inventory of emissions and major source categories;

ii) an inventory of best available pollution abatement technologies and costs,

iii) new non-polluting technologies;

iv) monitoring networks;

v) economic instruments to prevent pollution.

Water Bodies:

The environmental policy on water is aimed at sustainable development and use of water resources. In this regard, particular quality standards will be set for:

a) specific uses of water;

b) pollution caused by the discharge of certain dangerous substances to the aquatic environment.

In addition, programmes will be mounted to:

- introduce in all water resource development schemes effective measures to control or avoid distortions of the ecological balance which affect the health and quality of life of the people;
- generally monitor and control activities with a view to improving water quality in general and reduce pollution;
- protect watersheds through the control of deforestation.

The marine environment will be accorded special attention through:

a) the implementation of the conventions and protocols of relevant international bodies dealing with marine pollution, especially in the West African region;

b) the reduction of land-based pollutants into the seas through the dumping of raw sewage and untreated liquid industrial wastes;

c) control and prevention of pollution from oil spills;

d) improvement of national capabilities for dealing with oil spills.

Chemicals:

The increasing number of chemicals used in the country deserves control. A procedure will be established for:

a) regulating potentially dangerous chemicals by enacting appropriate legislation regarding the export, import, marketing and use of chemicals that are banned or severely restricted in other countries or where local experience makes such control necessary;

b) gathering information, requiring testing, and evalua- ting the risks to humans and the environment;

c) undertaking a continuous review of the classification systems, testing requirements and test guidelines.

Noise:

Noise is a by-product of industrialisation and modernisation. However this is an avoidable problem given the present-day state-of-the-art industrial technology. Appropriate standards and legislation on noise control, both ambient and industrial, will be enacted and enforced to prevent the worsening of the noise problem as the national economy gathers momentum and the standard of living for a large cross-section of the population improves. Public education will be a key component of noise control efforts within communities.

4.0 Development of Appropriate Instruments

For the successful implementation of the National Environmental Policy, necessary steps will be taken to develop appropriate instruments geared towards:

a) improving the scientific base of environmental policy, among other things, through appropriate research programmes;

b) the assessment of the potential impacts of certain public and private projects on the environment, and the integration of the environmental dimension in national policies;

c) establishment and implementation of appropriate standards and guidelines so as to ensure an acceptable level of public health and environmental protection;

d) harmonisation of appropriate legislative instruments;

e) improved access to information on the environment.

To ensure the greatest economy in land resource utilisation and to minimise land use conflicts a landuse policy will be formulated and an action plan adopted to provide a comprehensive and integrated framework for the development of land resources.

Legislation will be enacted to prescribe the necessary environmental quality standards and guidelines for mining and manufacturing industries. To this end EIA will be required for all new investments that would be deemed to affect the quality of the environment.

Positive and negative incentives will be instituted to encourage the adoption of environmentally sound production technologies and to discourage pollution. Programmes will be developed to ensure the availability and wise application of cost-effective technologies for the exploitation of resources.

5.0 Environmental Education

The success of an environmental policy presupposes that all sections of the population understand the functioning of the environment and the problems thereof, and contribute to the protection and improvement of the environment. To this end continuous and detailed educational programmes will be implemented at all levels so that every Ghanaian becomes aware of the problems and fully assumes his responsibilities in safeguarding the environment.

Environmental education will form an integral part of the educational system. Sustained efforts will be made to promote awareness among policy makers, provide training for resource managers at appropriate levels, and promote greater public awareness and motivation for environmental action.

6.0 Environmental Monitoring

Monitoring constitutes an essential activity in the solution of environmental problems. Human activities and the environment in which they occur are in a constant state of flux, therefore the process of environmental monitoring must necessarily include the need to describe change. Monitoring must be designed to provide a sound knowledge about the resources themselves, that is their spatial distribution, their quantity and quality, and of all the interacting elements within the framework of development. There is also the need to know the extent to which the environment is being modified as a result of the various human use systems. This will ensure that rational choices will be made among alternative development strategies.

7.0 International Co-operation

It has become increasingly obvious that environmental problems hardly respect national boundaries. Some of these problems, such as drought, atmospheric pollution, climate change, and marine pollution are, by their very nature, international or even global in character. It is therefore essential that they should be tackled at those respective levels. Ghana will participate actively in international efforts towards the protection of the environment.

Ghana will maintain and where necessary, increase her participation in the activities of the United Nations agencies, other multilateral organisations and non-governmental organisations, and observe the numerous international agreements to which Ghana is a party.

At the regional and continental levels, Ghana's environmental policy will operate in the context of an increased effective participation in (including where appropriate, financial contribution to) the protocols of the Organisation of African Unity (OAU), Economic Community of West African States (ECOWAS) and sub-regional groupings such as West African Sub-West and Central Africa (WACAF) Regional Seas Programme of UNEP.

CHAPTER 4

LEGAL AND INSTITUTIONAL ISSUES

ISSUES:

a) Need for a National Environmental Policy

Attempts over the years to address environmental problems in Ghana have been largely ad-hoc and cosmetic, or at best sector-oriented and therefore limited in scope. It has become evident that the body of existing legislation on the various aspects of the environment is inadequate, and many provisions have no bearing on present-day realities as well as the aspirations of the people of this country. There is clearly the need for a new direction and thrust in national development efforts to ensure that plans aimed at improving the standard and quality of life take due cognizance of environmental considerations.

The economic prosperity of Ghana depends on the maintenance of a high quality environment. The losses being sustained at present reduce the living standards of the present generation and may affect future generations if the present trend is allowed to continue. The proposed National Environmental Policy is presented in Chapter 3.

b) Present Legal and Institutional Framework

Long before the establishment of the Environmental Protection Council in 1974, many legal enactments existed in the country empowering various official bodies which actually exercise executing powers as far as the care and protection of the environment are concerned. However these powers are widely scattered among these bodies and no one of them can be said to enjoy exclusive oversight of the whole of the environment or even of significant portions of it.

In the face of this highly confused state of affairs, it is extremely difficult at the present time to determine exactly the responsibilities specifically assigned to the various organs of government with respect to the environment. Besides, many of the sectors with executing powers are unable to exercise these powers effectively. It is evident that there are a number of problems relating to the environment which have not received the attention they deserve because they have not been seen as falling clearly within the sphere of responsibility of any particular body or because so many different bodies are officially entrusted with responsibility for them. In the event, none of them has taken the initiative in attending to them.

The question at issue is one of administrative and legal failure to demarcate clearly the responsibilities of the various bodies concerned with the environment and ensure that these responsibilities are properly carried out.

c) Proposed Policy Agenda

i) EPC restructuring

The Environmental Protection Council was established by NRC Decree 239 of January 23rd, 1974. The Council is primarily an advisory and research organisation, which is expected to co-ordinate the activities of other bodies concerned with environmental matters but without the power to enforce any measures for improving the environment or preventing damage to it. It serves as a meeting point for the bodies that actually exercise power with regard to various sectors of the environment and so facilitate the co-ordinating role of the Council.

Membership of the Council is made up of Ministries of Health, Agriculture, Foreign Affairs, Lands and Natural Resources, Industries, Science and Technology, Local Government, Finance and Economic Planning and Works and Housing.

The EPC also maintains networks through its expert committees on education, natural ecosystems, toxic chemicals, human settlements, among others. There is however an urgent need for restructuring

the Council to provide it with the necessary political backing as well as a minimum level of enforcement powers to enable it carry the additional responsibilities that the EAP imposes on it.

ii) Role of NDPC

The National Development Planning Commission which was set up under National Development Planning Law, 1989 is charged with the following responsibilities:

1. Formulate and advise government on comprehensive National Development Strategies and ensure that the Planning and Development Strategies including consequential policies and programmes are effectively carried out;

2. (a) undertake studies and make recommendations to the Government on development issues and on national development goals and objectives;

(b) issue for the guidance of both public and private sectors approved development policies as directed by government;

(c) integrate and synthesise all macro-economic sectoral and territorial policies and ensure that such policies are compatible with the national development goals;

(d) ensure that all development strategies and programmes are in conformity with sound environmental principles;

(e) monitor and evaluate national development plans, programmes and projects and report progress to the government from time to time;

(f) prescribe the content and format of national development plans and

(g) perform such other functions as the government may assign to it.

3.Keep under constant review national development plans in the light of prevailing domestic and international economic, social, political conditions and recommend to the government necessary revision of existing policies and programmes.

4. Deliberate and advise government on such alternative strategies as there may be to attain the national development goals and present such viable alternative strategies together with the assumption upon which they are based including the advantages and disadvantages of each option to the government.

Although it has been established by law and indeed maintains a physical existence the NDPC is yet to take off from the ground. It needs to be strengthened to become operational and effective. Its lead role in the national planning process must be asserted with particular emphasis on human settlements for which a special unit is required.

(iii)E I A Process

Doubtless, the gover- ent and both public and private sectors of the economy are committed to the need to consider, carefully, environmental issues before making a decision on the future of a development action. The PNDC Law 116 establishing the Ghana Investment Code of 1985 requires that the Ghana Investment Centre (GIC), which is the government agency for the encouragement, promotion and co-ordination of private investment (except for mining, petroleum and cottage industries) in the Ghanaian economy, must in its appraisal of enterprises, "... have regard to any effect the enterprise is likely to have on the environment and the measures proposed for the prevention and control of any harmful effects to the environment." Currently the discharge of this requirement is met by sending information on the enterprise to the EPC for review. Comments are expected within 21 days.

Environmental Impact Assessment is a method used to identify a project's probable impacts on the environment. It is carried out in order to influence project design and the choice of project alternatives.

There is no EIA procedure in Ghana at present. There is only a systematic environmental review procedure in which EPC is the focal point deciding whether an environmental grant, an Environmental Impact Certificate can be issued or not. Clearly, EPC cannot be expected to cope indefinitely with the demands placed upon it by existing practice, hence the need for a formal EIA procedure within which responsibility for consideration of environmental effects is more dispersed among various

"actors" in the development process but which maintain EPC input at critical stages. Also the cost of undertaking the work would be distributed, more equitably as the project proponents would be responsible for preparing Environmental Impact Statements for their own projects and meeting the costs of the work.

At present such Environmental Impact Statements are produced by some proponents, particularly in the mining sector, but on an adhoc basis and frequently only where there is a sizeable foreign investment.

(iv) Land Management Legislation

To date the non-existence of a co-ordinated and comprehensive land use/management policy is seen as the most critical problem in environmental management. Another problem is the multiplicity of agencies responsible for various aspects of land management; there are twenty such agencies. Various experts have indicated that the situation if not rectified would seriously impair any efforts to address environmental problems in the country, no matter what their nature.

The lack of integrated policy and planning lies at the heart of the land management problems at the national, regional, district and farm levels in Ghana. The Ministries of Local Government and Education together with U.S.T. and the Dept. of Town and Country Planning are currently preparing a Land Use Planning Policy for the country.

(v) Water Management Legislation

a) Abstraction of Water

In Ghana at present there are no procedures requiring organisations and agencies wishing to abstract water to submit their request to an authority responsible for the overall management of water resources, so that the right to abstract water without any detrimental effect can be granted. It is only in the case of the Volta River Authority (VRA) and Irrigation Development Authority (IDA) that would be users of the Volta Lake or Volta River and reservoirs for irrigation are required to obtain permission from these bodies, which seem to have conferred on them ownership rights to their facilities. There is therefore an urgent need to streamline and rationalise the right to abstract water for various uses in the country.

b) Water Quality

The question of water quality is a matter of great concern. The setting of minimum quality standards is an inescapable responsibility of all agencies concerned with the provision of water for human use and especially of any national body charged with the care and protection of the environment. There can therefore be no justification for the present diffusion of authority and the implied acceptance of a multiplicity of standards within the country. As things stand now this aspect of water management is too diffused, with the Ghana Water and Sewerage Corporation, the Water Resources Research Institute and Aquatic Biology Institute, IDA, VRA and the EPC, to some extent, all exercising or claiming responsibility for various aspects, not to mention the authority exercised by local communities and even individuals with regard to water rights and use.

With regard to the environmental impact of water utilization, the situation seems to be diffused. The VRA, IDA, GWSC, Minerals Commission and the EPC have various provisions in the legislations establishing the respective institutions to ensure that the water bodies over which they have jurisdiction are not polluted or that they also do not cause pollution. However, it is only VRA which has been asked to take measures to protect downstream users and the water regime.

Though laws prohibiting pollution of water bodies exist, the lack of enforcement of these laws is detrimental to national water management. There is a need for an agency (Water Resources Commission) to coordinate matters related to water. This body will formulate a comprehensive national water policy and make regulations to control and manage water resources in the country. Existing institutions should also be strengthened.

(vi) Forest Policy

The major environmentally-related deficiency in the Forest Policy of 1948 was the absence of any perceived permanent role for trees in land use outside the reserved forests. In practice the Policy permitted the progressive utilization of forest resources in areas outside the legally constituted permanent forest estates without replacement. This practice has led to the destruction of forest lands outside reserves through conversion to other farms of land use without control.

Efforts are however being made to reverse the situation. The proposal for the revision of the policy departs from the former perception and focuses on the overall management of the national forest estate to ensure sustainability of the resource and environmental preservation. The relevant provisions in the revised National Forest Policy will include:

- protection of soil and water rescurces;
- protection of critical hilly areas and water courses;
- conservation of flora and fauna - indigenous species;
- control of desertification;
- controlled exploitation of forest resources based on principles of sustainable yields, environmental preservation and enhancement of bio-diversity.

vii) Conservation Legislation

Wildlife populations are severely depleted as a result of excessive exploitation for meat. In 1969 a report to Government pointed out that unless a much larger and urgent effort was made to restore wildlife the "rapid destruction of animal resources and habitats would rule out forever the possibility of faunal regeneration in habitats which are still capable of giving necessary food and shelter."

In addition animal habitats outside the reserves both in the forest and savanna ecosystems continue to be under siege from various economic activities including clearing for agriculture, logging and timber extraction, human caused fires, mining and road construction. The destruction of wetland ecosystems also reduces the biodiversity of this unique wildlife habitat.

There is a need to shift emphasis from preservation of useful animals to the conservation of wildlife. Existing laws and regulations on wildlife conservation need to be amended to reflect this changed emphasis and to make it possible for flora also to be listed as endangered.

viii) Human Settlement Policy

The geographic distribution of population and human settlements pattern of the country pose formidable constraints to effective national development and equitable distribution of development benefits. Unfortunately, successive natural development policies and strategies hardly ever addressed this spatial issue.

The wide dispersal of the country's population into numerous scattered settlements has been the cause for rural deprivation. Only a small percentage of the rural population has access to wage employment, electricity, potable water and health facilities.

Urban degradation is another problem associated with our human settlements. There is an explosion in lawlessness and uncontrolled urban growth in the rapidly growing urban areas. The absence of new infrastructure within the last decade, including inadequate sanitation and drainage facilities, as well as rampant disregard for approved land use allocations and inadequacies of provision of basic services have a direct bearing on human health.

ix) Industrial Legislation

There is growing concern in the country about industrial waste and pollution, health and safety hazards to industrial workers, public health problems due to adverse environmental changes, and the misapplication of hazardous chemicals.

Evidence and stark reality show that efforts so far made towards control and prevention of the adverse effects have been inadequate and ineffective. This is in spite of the fact that the level of industrial development in the country is relatively low. If proper industrial environmental controls are not put in place, environmental pollution will be quite significant in the near future, especially since increased industrial activities are expected due to the Economic Recovery and Structural Adjustment Programmes.

At present in Ghana most of our laws on the environment which date back to the colonial era are rule-oriented and as a result, in spite of their existence, abuses are common.

For environmental legislation to be effective, it must be management oriented. Environmental legislation demands a new orientation to law making. It requires fresh concepts, policy options and strategies for implementation that would cater for the management of future environmental problems. In Ghana, some of the major constraints to environmental legislation are:

(a) the inadequacy of laws and their enforcement, and

(b) the lack of standards and controls for maintaining environmental quality.

x) Need for Legislation to Control Hazardous Chemicals

For many years the importation, manufacture, distribution handling and use of potentially toxic chemicals in Ghana has proceeded without much consideration to the possible environmental consequences. This has resulted in considerable hazard to human health. It is more serious in the sense that the quantities and types of chemicals in the country are not fully known.

Despite obvious gaps and laxities there have been some attempts to institute controls to curb the possible hazard posed to the environment and health through indiscriminate use and misapplication of toxic chemicals in Ghana.

A draft legislation meant to control the importation, distribution, sale and use of pesticides and other toxic chemicals has been prepared and is being considered by the EPC committee on toxic chemicals.

xi) Need to Establish a Legal Framework for Coastal Zone Management

The management and conservation status of the coastal zone of Ghana is low. This is particularly true in terms of planning, co-ordination and monitoring. Present management is sectoral, and although a number of measures have been put in place these have not been enforced by the appropriate agencies. There is hardly any agency that co-ordinates the developmental activities of the various sectors. Data for planning and management is limited and scattered.

The situation is unsatisfactory in the light of the increasing population and economic activity in the zone, the large potential of the zone in terms of production and amenities and the ecological fragility of the zone as a whole.

Need to set Standards for Air Quality, Water Quality and Noise Levels in Urban Areas

To be able to judge whether the level of pollution caused by any impact is acceptable or not, safe or dangerous depends on the minimum quality standards which are considered acceptable at any particular time and place having regard to the knowledge, technology and resources that are available.

These standards which serve as guidelines for industrialists, importers and the monitoring agencies are generally lacking in Ghana.

Need to Prepare and Implement Environmental Regulations for Water Management, Mining and Industry

The major pollutants of water in the country are derived from agricultural, mining and manufacturing activities and from human settlements. Once water quality standards are established, it will be necessary to establish and enforce regulations concerning water abstraction and pollution.

Furthermore, mining and industrial regulations will be needed to limit the discharge of emissions, effluents and solid wastes and to regulate the use of hazardous chemicals in accordance with the established environmental standards and provisions for occupational health and safety. To ensure the effective observance of these regulations, the institutions legally responsible for enforcement may also need to be strengthened.

Role of Sectoral Agencies

Prior to the establishment of EPC as an umbrella body responsible for all activities and efforts in the protection and improvement of the quality of the environment, sectoral agencies were in existence charged with specific responsibilities in the area of the environment. Over the years the mandate of these agencies have proved inadequate to cope with the problems or they have run down in terms of personnel, equipment and enforcement powers.

Under the EAP these sectoral agencies will be the implementing agencies for specific EAP components and supply of information to EPC who would co-ordinate the activities of these agencies. With the present state of most of these sectoral agencies, they cannot fulfil this expected role without being strengthened in their areas of weakness to ensure successful implementation of the EAP.

Role of District Assemblies

In line with the governments policy of decentralisation within the District Assembly the concept of local institutional arrangement under PNDCL 207 of the Local Government Law, Assemblies will have a central role to play in the implementation of the Environmental Action Plan.

The Local Government Law makes the District Assemblies responsible for the development, improvement and management of human settlements and the environment in the district. They also under the law have responsibility for monitoring the impact of projects on people's development, the local, district or national economy, and the environment. The assemblies also have the responsibility of enforcing legislations and making bye-laws.

It has been recommended that each assembly should have a District Environmental Management Committee made of assemblymen and representatives of government decentralised departments charged with a broad responsibility for monitoring and co-ordinating environmental protection and improvement activities in the District.

It is difficult for the Assemblies to fulfil these roles at the moment as they are not strong enough and the decentralised departments are not yet firmly established in the districts due to problems of office space and housing for the officials. The District Assemblies especially the key departments would have to be strengthened to enable them discharge these responsibilities.

Role of NGOs and Community Groups

In recent years, religious groups, professional associations and other groups especially concerned with the promotion of environmental practices have gained prominence at both local and national levels. A number of such groups have given active support in the implementation of programmes by both EPC and that of other agencies like the Forestry Department especially at the local level where they have proved most effective. Some examples of NGO participation in environmental projects are the afforestation programmes of the Amasachina, an indigenous NGO and the Community Collaborative Forestry Initiative (CCFI) Project being implemented by Adventist Development Relief Agency (ADRA) with support of US Peace Corps and other Government agencies.

NGOs with the advantage of freedom from bureaucratic problems facing government agencies, they are able to gain easy access to grassroot level to engage in developmental activities. With this rich experience of the NGOs, they could play a valuable role through involvement in sensitizing the local population in environmental issues and environmental restoration and enrichment programmes. Prior to the implementation of the EAP it would be necessary to bring all these NGOs together to explore their full participation in the plan.

ACTIONS

Legal

1. National Environmental Policy

A National Environmental Policy will be adopted by government to provide the broad framework for the implementation of the Action Plan.

2. Policy Agenda

Action will be taken by government for the adoption of a policy agenda on:

(a) Legislation
- (i) Restructuring of EPC
- (ii) Establishment of EIA procedures
- (iii)Revised forestry policy
- (iv) Revised conservation policy.
- (v) Revised Factory, Shops and Offices Act
- (vi) Legislation for Coastal Zone Management
- (vii)Legislation to Control Pesticides
- (viii) Establishment of a Water Resources Commission

The draft text for this legislation is provided in Volume II

(b) Prepare and Adopt Sectoral Policies

- Agricultural land management
- Range management
- Fisheries management
- Water management

(c) Prepare and Adopt Standards and Regulations

- Air quality standards
- Water quality standards
- Noise Standards
- Regulations for water abstraction
- Regulations for discharge of pollutants into water bodies
- Environmental regulations for mining
- Environmental regulations for industry

3. Institutional Strengthening

a) Strengthen EPC

The EAP calls for EPC to assume a number of additional responsibilities and also expand the scope of its activities in several of its present programmes. The Plan also implies increased responsibilities and work loads for EPC staff and expansion of programmes in environmental education and environmental monitoring. In the implementation of the EAP, EPC has a crucial role in co-ordinating the activities of various other ministries and agencies responsible for implementing specific components of the Plan. To enable EPC carry out these responsibilities, it has to be strengthened in terms of its institutional structure, completion of programme of establishing regional offices with staffing and logistics.

b) Strengthen NDPC

The NDPC which is a crucial role in the national planning process should be strengthened so that staff required for all levels of planning process are in place in addition to required logistics with set time frame to ensure the effective functioning of all planning units. The establishment of the Human Settlements Unit in the NDPC should be a matter of priority.

c) Create an Institutional Structure for Integrated Land Use Planning.

With the absence of a comprehensive landuse/management policy and the presence of a multiciplicity of agencies responsible for various aspects of land management, it is imperative to create an institutional structure for land use planning. It is worthwhile taking a look at the proposal for an integrative institutional framework for environmental management and policy put forward under a study on Land Management Systems in Ghana commissioned as part of the EAP preparation process for adoption.(Fig. 3)

(d) Strengthen Selected Sectoral Agencies

Strengthen AESC to carry out water-related data collection

Strengthen WRRI to carry out water-related research

Strengthen IAB to carry out water-related research

Strengthen Factory Inspectorate to implement revised

Factories, Shops and Offices Act.

Strengthen National Energy Board to carry out energy-related research.

Strengthen third cycle training institutions to carry out programs of environmental education.

(e) Strengthen Interagency Coordination.

- Improve cooperation between EPC, Ministry of Industry, Ghana Investment Centre, Town and Country Planning Department, and local authorities to ensure that zoning regulations are adhered to in siting industries.
- Re-activate EPC's Environmental Education Committee to coordinate the planning and implementation of nonformal environmental education programmes.
- Joint data collection for environmental monitoring

(f) Support District Assemblies

Provide a programme of environmental education for district assembly members.

Set up District Environmental Management Committees.

Encourage District Assemblies to establish and monitor protected areas.

Encourage District Assemblies to control woodcutting for commercial purposes and to licence charcoal producers.

Encourage District Assemblies to improve sanitation services and to enforce zoning regulations in urban areas.

(g) Involve Community Groups and NGOs

Provide a programme of nonformal environmental education for local authorities and community groups.

Set up Community Environmental Committees.

Support tree planting and agroforestry initiatives by community groups and NGOs.

CHAPTER 5

NATURAL RESOURCE MANAGEMENT

ISSUES

Ghana's economy derives its strength mainly from agriculture which accounts for more than 40% of gross domestic product, accounts for some 70% of total export earnings, and provides employment for 60% of the labour force. Export earnings from forestry and mining activities are also significant contributors to the national product. The strength of the economy and, by extension, the integrity of the environment, is therefore related to the efficient use and management of available land, vegetation, wildlife, water, and mineral resources. The need for efficient management of land is the more urgent in the face of an ever-increasing population and the growing demands in all the various activities based on land.

LAND MANAGEMENT

Land is a complex commodity of fundamental importance to the people of Ghana, the management of which involves several intricately woven facets. At the base-level is a traditional system that holds land in trust for the use and welfare of the community as a whole; whatever system of management that is evolved must take cognizance of this. Superimposed on this complex base are the demands of a modern state seeking ways to use land and its resources to improve the well-being of its peoples. Then there are the private developers. The result, unfortunately, is that perceptions and actual use of land conflict tragically and create a serious problem in defining a structure for any land management system. Yet, all the different "land users", although having different and often divergent sets of values, objectives, intentions and development targets and strategies, aim at using the land to the advancement of society. Problems arise in the pursuance of the different objectives, leading to non-conforming uses of the land, conflicts, over-use, and sometimes even under-use of the land.

Land resources and the processes of development and use have varying consequences on the environment as a result of bio-physical extraction, increment and waste generation. The environmental effects are effects on the quality of the land. The effect may be limited to a particular site as, for example, in increasing soil acidity. Often, however, they are transmitted beyond the immediate confines of the process as, for example, in deforestation which leads to increased runoff and erosion in the immediate area and stream siltation in distant areas.

The issue of land management is recognised as a central point in any efforts to address environmental and resource problems in Ghana. This has long been recognised and over the years considerable efforts have been made to streamline the interlocking facets of land management in the country. A major attempt at this was the work of the Land Use Planning Committee set up in 1978. The Committee was to:

1. collect land resource information in a form suitable for planning;

2. elaborate land resource use policy aimed at:-
   a) resolving conflicts in resource use;
   b) achieving multiple uses consistent with ecological requirements of the resources;
   c) projecting major user requirements in the long term, e.g. urban, agriculture, forestry, etc.
3. make recommendations to Government.

The findings and recommendations of the Committee (May, 1979) are still valid. The report brought together in one volume useful information including the following:

- categories of land resources, including size and potential of inland water bodies, major land forms, ecosystems, soil types and capabilities, mineral resources, and existing land use;
- population trends and potential impacts;

- land supply and demand, patterns of land ownership and tenure, and factors determining land values and land policies in the country;
- urban land use system, development and policy, and conflicts;
- rural land use with respect to agriculture, forestry, game and wildlife, and mining, and the conflicts that arise.

To date the non-existence of a co-ordinated and comprehensive land use/management policy is seen as the most critical problem in the sector. Another problem is the multiplicity of agencies responsible for various aspects of land management; there are twenty such agencies. Various experts have indicated that the situation, if not rectified would seriously impair any efforts to address environmental problems in the country, no matter their nature. However, the issues below focus primarily on key land issues with regard to agriculture and its related land uses. Other elements of land management problems are taken up under the appropriate sectors elsewhere in this document.

Population Pressure

Ghana has a mean population density of 51 persons per square kilometre. The limited estimates of the bio-physical carrying capacity of the land indicates that the human carrying capacity of many parts of the northern savannas may be no more than 108 persons per square kilometre under present systems of land use and standards of living. No such estimates are known for the forest areas but the forest lands are likely to have high capacities. Evidence of population pressure on the land is however widespread and extensive in the northern savannas, where most documentation has been done and plans envisaged to combat the ultimate form of land degradation, that is desertification. Pressure is localised around the large settlements in the forest areas.

Land Ownership and Tenure

The problems of land acquisition arise because ownership boundaries are not clearly marked or mapped, title is not well documented and registered. In the case of group ownership there may be problems as to who may grant title. The net effect is considerable expense in land acquisition and uncertainty of title. The effectiveness of any conservation measures is likely to be reduced under these conditions.

Land Use Planning

Some data exists to plan the use of land for optimal agricultural and related production especially at the regional scale. Data for local and farm planning however, seem inadequate. This among others seems to have hampered effective planning of the use of land. Optimal land use is therefore not attained and land is under-used, over-used and mis-used. Degradation results from this situation and is widespread in all environments in Ghana.

The overall impression of land use and management in Ghana is one of lack of co-ordinated policy and planning. The management process is here interpreted in a broad sense to encompass:

(a) Policy formulation

(b) Planning:
- (i) Survey
- (ii) Evaluation
- (iii) Plan formulation

(c) Implementation

(d) Monitoring:
- (i) Environment
- (ii) Economic
- (iii) Social

(e) Feedback for resurvey and re-planning.

The lack of integrated policy and planning lies at the heart of the land management problems at the national, regional, district and farm levels in Ghana. Survey and evaluation have proceeded more or less independently of any planning. There appears therefore to be gaps in data and information in terms of the type of data.

The land user is seldom guided as to the environmental effects of his activities. The overall effect of this situation is the inability to attain production objectives and also the threatened ecological status of land and the environment.

Agricultural Land Use

Soil Quality:

Declining soil quality seems to be a general problem in the country. This is evidenced in reduced vegetation cover which leads to widespread accelerated erosion, reduced crop yields and increasing desertifying conditions especially in the savanna areas. Quantitative data in terms of crop yield are however not available.

Mechanisation:

Mechanisation in agricultural land use has numerous advantages. However, its effects on land quality, if uncrontrolled, may be disastrous causing accelerated erosion, sub-soil compaction, reduced water infiltration. This is considered important in the light of increasing population and the need for increased agricultural production from an increased hectarage of land.

Agro-chemical Residues:

There is a general lack of data and studies on the effect of agro-chemicals on soil quality. From the limited studies that have been conducted under laboratory and field conditions, evidence seems to suggest that the response of micro-organisms in the soil may vary according to the kind of pesticide, its concentration and the type of soil. Uncrontrolled use of some fertilisers may lead to soil acidification and salinisation in the drier parts of the country.

Shifting Cultivation:

Though the traditional bush fallow system of cultivation has proved efficient in the regeneration of soil fertility, its deficiency in the light of increasing population and the need for more intensive use of land makes it necessary to find viable alternative systems of cultivation. Agro-forestry and no-till cultivation systems offer good prospects at the moment. There are however still, gaps in the knowledge and practice of these systems especially with respect to the selection of suitable tree and shrub species and of spatial relationships.

Agriculture in the Coastal Zone:

Crop production is not the major traditional occupation of the people within the coastal zone. Peasant agriculture is the dominant form of arable farming where it occurs. However, irrigation schemes have in recent years promoted commercial production of vegetables and rice. Animal rearing consisting of household piggeries, sheep and poultry along various points on the coastline, is also important. There is some cattle rearing in the Accra plains. Uncontrolled, these activities have degrading effects on coastal zone resources and environments. Of particular concern is the pollution caused by agricultural chemicals and wastes released into the environment through run-off and direct discharges in the coastal zone drainage catchments.

In the past official emphasis has been on the cultivation of cash crops especially cocoa. Whilst there is a diversity of crops, both cash and subsistence, in this country, official attention has mainly been drawn in the past to cocoa. This has led to serious economic consequences when demand for cocoa has fallen.

There is need for sufficient attention to the other crops, as a means of diversifying agricultural production and ensuring crop ecological stability and the effective use of land resources.

Range Lands:

Estimates indicate a low carrying capacity of the natural grasslands in terms of Tropical Livestock Units (TLU). A range of 2.0 ha to 7.6 ha per TLU is indicated. Over-grazing occurs in localised areas around watering points or in areas where tenure conditions restrict herders movements. Dispersed agriculture and settlement in certain areas of the north also lead to over-grazing in the immediate vicinity of settlements.

In Ghana there is no conscious management of available pasture land and the distribution of pasture varies within the different ecological zones due to different land use practices. There is also very limited information on the utilisation of native forage species, but much information is available on introduced species. Unfortunately planting material is not easily available. Different grassland areas have different capacities and since agricultural practices differ this affects the availability of pasture for animals. Browses and tree species are not widely used as for ge due to lack of information on them.

Bushfires

Bush fires occur widely in Ghana but are more extensive in the savannas. Fires are set for varied purposes but may be set unintentionally. Most observations have been made in savannas and indications are that the most noticeable effect of burning is the reduction in the composition and density of the vegetation. The effect on soil micro-organisms and chemistry have not been systematically studied. Bush fires have become, in recent years, the most degrading environmental factor in Ghana.

FOREST RESOURCES

Forests and forestry have important environmental and ecological linkages. They are linked to the micro- macro-climate, water and soil resources, genetic resources of plants and animals, food production and food security, and to energy resources. Forests, forestry and wildlife are important also to the economic and socio-cultural environment of local communities and of the nation.

Ecologically about 8.22 million hectares of Ghana is made up of closed forests (34 per cent of the country; Table 1). However, much of the original vegetation has been removed or considerably modified through conversion to various forms of land uses. According to one estimate (Owusu, 1989) only about 2 million hectares of the closed forest, made of about 1.7 million hectares within Forest Reserves and 0.3 - 0.5 million hectares outside the legally reserved forests, actually remain.

In all there are more than 280 forest reserves scattered around the country in the closed forest as well as the savanna areas; there are 13 Wildlife Reserves, some of which coincide with Forest Reserves. These constitute the remnants of an extremely valuable heritage for which concrete steps must be taken to protect, defend and conserve.

Table 1: Major Ecological Zones of Ghana

Zone	Area (million ha)	% Land Area of Ghana
Closed Forest	8.2258	34.47
Savanna	15.6280	65.53
Total	23.8538	100.00

Deforestation

The threat to the forest resources of the country arise from demands for more agricultural lands to feed an ever-increasing population, increasing incidence of bush fires, logging and the extraction of woodfuels to meet energy demands of households and cottage industries. Deforestation is occurring at an alarming rate. One critical aspect of the problem is that the country has no adequate system for monitoring the exact rate of deforestation or forest destruction. A deforestation rate of about 22,000 hectares per annum was projected by FAO/UNEP for the period 1981-85. This figure has not been updated and is still being used for planning the rate of deforestation all around the country.

Apart from the physical disappearance of forest cover the integrity of remnants forest is also threatened. Both inside and outside the forest reserves, Ghana's forest estate is increasingly being degraded. Forest degradation consists in the interference with the forest that leads not only to a quantitative diminution in areas under forest cover but also to a qualitative decrease in, or on impairment of, the ability of the forest to perform all or some of its functions.

Within the Reserves, degradation arises especially from selective logging which is resulting in the over-exploitation of the better known timber species, and from selective removal of the best looking individuals. However, the most serious forms of degradation are taking place in the forest and savanna ecosystems outside the Reserves. Here repeated attacks on the vegetation by farming and fires are increasingly resulting in the substitution of simpler, less diverse ecosystems for more complex systems.

Woodfuels

The woodfuel factor is a very critical issue with regard to the depletion of forest resources. The economy of Ghana is based on agriculture, which relies principally on wood as its non-human energy source. Fuelwood is also the backbone of cottage and rural industries and provides nearly all the household energy. It has been estimated that woodfuels, mainly in the form of fuelwood and charcoal, make up 75 per cent or more of total national energy consumption.

The concern over woodfuels arises from the fact that the wood for fuel is derived almost exclusively from natural ecosystems, with very little coming from plantations or woodlots. Because the supply of fuelwood and charcoal has become highly commercialised there has been a shift from the dependence on deadwood and wood from farm land clearing to the cutting of standing trees for use as fuel.

Furthermore, most large scale charcoal production and, to a lesser extent, commercial fuelwood production takes place in the wood deficient savanna, derived savanna and the dry semi-deciduous forest zone. Growth in rural industries will certainly exacerbate the situation although the problem is not confined to the rural areas. The landscape in peri-urban areas is also systematically being depleted of woody biomass. These and land management are the major environmental problems in Ghana.

Wildlife

Each of the three main ecological zones of Ghana, viz. forest, coastal savanna, and the interior savanna, have its unique wildlife. Although wildlife has many economic and social values to national life the most popular form of its use is generally as a source of protein ("bushmeat"). Currently bushmeat is the most expensive form of meat in most population centres in the country. One market in Accra is estimated to have bagged over 50 million cedis from bushmeat sales in 1986 (Convery and Tutu, 1990). The demand continues to increase.

Wild animal populations are severely depleted as a result of the excessive exploitation for meat. In 1969 a report to Government pointed out that unless a much larger and urgent effort was made to restore wildlife the "rapid destruction of animal resources and habitats would rule out forever the possibility of faunal regeneration in habitats which are still capable of giving necessary food and shelter." Curry-Lindahl, 1969).

In addition animal habitation outside the reserves both in the forest and savanna ecosystems continue to be under siege from various economic activities including clearing for agriculture, logging and timber extraction, human caused fires, mining, and extension of electricity through transmission lines and road construction. The destruction of wetland ecosystems also reduce the biodiversity of this unique wildlife habitat.

ENERGY RESOURCES

Energy production, supply and utilisation have serious implications for Ghana's economy and environment. As an oil importing country, Ghana spent about 50% of her foreign exchange earnings on crude oil imports during the oil crises of the 1980s. Though this figure dropped to 16% in 1988 and 24% in 1989, crude oil imports still constitute the single largest consumer of the country's export

earnings. The volumes of petroleum needed to run the economy are set to increase rapidly in the years ahead as the ERP continues to record success. The high degree of uncertainty associated with the international oil market further increases Ghana's vulnerability to external pressures. It is against this background that efforts to explore and develop indigenous oil resources are worth the emphasis they are receiving. It must be noted nevertheless that petroleum provides only 13% of the energy consumed in Ghana.

The bulk (over 80%) of our national energy consumption is derived from woodfuels, which is the sole cooking fuel for a great majority of households. With the rapid growth in population and the existing woodfuels production and utilisation technologies this continued dependence on woodfuels is sure to destroy the ecology.

Energy bills have become prominent parts of household budgets, especially for the urban poor whose cooking fuel (charcoal) is the most expensive on per unit useful energy basis.

Energy production and utilisation constitute the most pervasive source of environmental pollutants in Ghana. Though reliable statistics are not available to indicate the precise levels of energy-sector contributions to atmospheric ecological degradation in the country, professional assessments indicate that woodfuel production and use make up the third major cause of deforestation after agriculture (coupled with bush fires) and logging. With respect to atmospheric pollution, energy is perhaps the largest culprit.

Considering that shifting cultivation/bush fallow and slash and burn are fertilisation and energy use practices, it may be right to consider energy as the major cause of environmental degradation in Ghana.

Woodfuels constitute about 80% of the energy consumed in Ghana. Firewood accounts for over 90% of rural energy use, while in urban Ghana, charcoal makes up about 70% of energy consumption. At current trends of utilisation, estimates indicate that by 1992 Ghana will begin to consume more woodfuel than the forests are able to regenerate. Although it can be assumed that charcoal and firewood will continue to provide the bulk of the country's energy needs for the foreseeable future, the long term prospects for sustained supply of firewood and charcoal is threatened by the visible and worsening problems of deforestation and desertification in all parts of the country.

In the coastal and northern savanna zones agricultural residues (cowdung, corn cobs, millet stalks) and other biomass materials, such as palm fronds, coconut branches and husks have come into increased use as cooking fuels. Continued use of these fuels is likely to deprive the soils of these areas of the natural organic nutrients these residues provide.

Solar Energy

Solar energy is used on a massive scale in Ghana for drying agricultural produce, export commodities, forest-industry products, brick and tile, and laundry. The exact quantities consumed in these operations have not as yet been measured. With regard to technologically converted solar energy over 300 communications installations in the country are solar-based. Studies to identify and standardise solar Photovoltaic (PV) systems and models suitable for Ghana are almost completed. Also work has begun on a pilot scale to substitute solar for fuel oil in large scale crop drying and storage.

This notwithstanding, Ghana has barely begun to utilise the vast energy potential from technological conversion and use of her enormous solar energy resources. Indeed solar energy could prove to be the core energy resource for achieving improved living standards for the majority of our population who dwell in the rural areas.

Hydropower

Hydropower provides almost all of Ghana electricity supply, domestic and exported. Electricity, however, constitutes a paltry 7% of national energy production. Besides Akosombo and Kpong which have been harnessed, two more medium and about 40 mini-hydro sites have been identified. These untapped hydro resources constitute more than 50% of the national potential.

Petroleum

Ghana is known to have commercial quantities of oil deposits. Exploration is on-going, and it is still hoped that Ghana may develop this potential when the economics of it prove beneficial. Currently imported petroleum makes up 13% of the nation's energy production, consuming up to 24% of export earnings.

Environmental Impacts of Energy Development

Ghana's heavy dependence on woodfuels coupled with the rapid population growth and poor forest management practices pose a serious threat to the environment. The depletion of our forests not only reduces size of the carbon sink but also contributes to carbon emissions, loss of biodiversity, soil erosion, etc. The major forces driving energy-sector contributions to deforestation are:

- the need to meet the increasing energy requirements of a rapidly expanding population;
- inefficient production and use of charcoal and firewood;
- failure to regenerate forest resources more quickly than they are used; and
- the persistence of inefficient and soil-degrading shifting cultivation and slash and burn methods as the major agricultural and firewood production system.

The rapid increase in the use of petroleum products and the projected rise of up to 10% in the next decades ahead are pointers to the rise that are set to occur in the contributions fossil fuels will make in degrading Ghana's environment. Besides greenhouse gases, petroleum products utilisation in Ghana pollutes land and water bodies through improper handling and disposal of waste oil and oil losses.

Hydro dams for power generation bring in their wake environmental problems such as destruction of forest, waterlogging of lake shores, public health hazards, siltation of deltas, and destruction of some aquatic lifeforms.

The environmental impacts of energy sector operations are obviously all pervasive, affecting both natural and the man-made habitat.

Energy Policy

With the framework of the ERP and in the context of ensuring environmentally sustainable development, the energy-sector institutions have committed themselves to the following strategic policy objectives in the energy sector:

a) Strategic Objectives

To ensure sustained provision and security of energy supply to all sectors of the economy and all parts of the country by:

- restoring improved productivity and efficiency in the procurement, transformation, distribution and use of all energy sources;
- reducing the country's vulnerability to short-term disruptions in the energy resources and supply bases;
- ensuring the availability and equitable distribution of energy to all socio-economic sectors and geographical regions;
- consolidating and accelerating the development and use of the country's indigenous energy sources, especially woodfuels, hydro-power, petroleum and solar energy; and
- securing future power supply through thermal complementation of the hydro-based electricity generation system.
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b) Renewable Energy

In the short-term the objectives that will guide the development of the nation's renewable energy resources are:

- to improve the efficiency of production, conversion and use of woodfuels in all the socio-economic sectors; and
- to promote the development of renewable energy industries that have strong indigenisation prospects over the short and medium terms.
- In the medium- to long-term, the objectives will be:
- to demonstrate and evaluate renewable energy technologies with the potential to meet the needs of prioritised socio-economic and welfare objectives.
- to provide support for research, development and demonstration on renewable energy technologies with the greatest potential to increase and diversify the country's future energy supply base.

c) Biomass

In the area of Biomass energy a number of projects and programmes are either planned or are being implemented to ensure better and sustainable use of existing bio-energy resources. These projects are aimed at:

- conserving forest resources through improved methods for charcoal and firewood production;
- decreasing consumption of firewood and charcoal by using more efficient cooking devises;
- expanding the productivity and use of existing bio-energy such as biogas, and the production of charcoal briquettes from logging and wood processing residues;
- conversion of municipal waste and domestic garbage into biogas and electricity;
- planning for the future security of biomass supply through the implementation of a sustained programme of forest regeneration and afforestation; and
- substituting LP Gas and other fuels such as electricity for firewood and charcoal.

d) Solar Energy

Activities on solar energy are focused around a strategy whose principal objectives are:

- to evaluate the technical and economic viability of proven solar technologies to meet the prioritised socio-economic and developmental needs of the country;
- to demonstrate appropriate solar energy technologies for selected applications;
- to concentrate support for research, development and demonstration on renewable energy technologies with the greatest prospects for operation within local technical and user absorption capacities.
- to promote the development of solar energy industries that have strong indigenisation prospects over the short to medium term;
- to exploit the country's enormous solar resources to pump irrigation water, improve communication and health facilities, and provide opportunities for access to modern recreational and educational facilities.

e) Power Sector

Policies and actions in the power sector that relate to the environment have to do with two areas of operation, namely:

- assuring future security of power supply by developing complementary power generation capacity from other energy sources and improvement of existing hydro-power sources; and
- extension of the reach of electricity to all parts of the country, especially the northern part of the country and the rural areas.

These have implications for higher consumption of petroleum and other fossil fuels, as well as more work on hydro-dams. The potential environmental consequences are serious.

f) Petroleum Sector

The consumption of petroleum is set to increase rapidly in the decades ahead. It is also planned that exploration of Ghana's oil resources would be intensified, both on-shore and off-shore. As a corollary of these two policy decisions refinery capacity in Ghana is also scheduled to increase. Essential petroleum products, such as bitumen, lubricants are also to be produced locally. Further actions in the petroleum sector include bulk transportation and storage of petroleum products. These definitely have serious environmental implications which need to be addressed in the EAP.

g) Energy Conservation

Policy objectives and actions in energy conservation seek to:

- create a higher level of awareness of the opportunities and benefits of energy conservation among all energy users;
- achieve savings in per capita energy consumption in all areas of energy use through the application of appropriate energy conservation measures;
- develop indigenous Ghanaian professional capability for identification and implementation of energy conservation measures; and
- develop the institutional capability and implementation strategies required for the realisation of the potential efficiency improvements in all sectors of the economy.

By achieving these objectives the energy conservation programme would make significant savings on the rate of environmental degradation that arise from the energy sector.

WATER RESOURCES

It is estimated that fresh water resources of Ghana amount to about 40 million acre-feet. This is derived from the following sources:

- rainfall
- rivers, streams, springs and creeks
- natural lakes
- impoundments
- groundwater from various aquifers

Thus in its natural form water is an abundant resource in Ghana, even though seasonal shortages due to the nature of the rainfall regime, especially outside the forest zone, are quite common. To a large extent, however, such shortages are due more to poor management and inadequate use of available technologies than to the absolute paucity of water itself in its various forms of natural occurrence.

A primary principle, from an environmental standpoint, should be that water should be available in a potable form for the entire population with minimal effort, and that its availability on a sustainable basis should be guaranteed. Then comes its availability for agricultural, industrial, and other uses in such quantities and in such forms as will promote maximum human well-being.

The critical issues in the management of water resources in Ghana relate in the main to the following areas:

Inadequacy of Water Cycle Data

The following have been identified as key issues:

i) There are gaps in the available time series data. The situation was most serious during the 1981-1983 drought. This applies both to hydro-meteorological and hydrological data.

ii) Available data on water quality, soil moisture, groundwater fluctuations and sediment transport is on ad-hoc basis.

iii) There are serious national weaknesses in the areal assessment of water balance components.

Fortunately, some of the data is available and the situation can be corrected. The following on-going projects have been put in hand to correct the situation:

a) Development of an operational sediment sampling network;

b) Development and implementation of surface water quality networks for Ghana;

c) Development of groundwater networks;

d) Groundwater assessment of the various regions of Ghana;

e) Collection and compilation of all water quality data.

The water quality monitoring network is shown in Fig.4 . It is being executed in 3 phases:

- Phase I: monitoring at gauging stations of the Architectural and Engineering Services Corporation (AESC) on all the major rivers. The parameters being monitored are Colour, Turbidity, Odour, Temperature, pH, Conductivity and Dissolved Oxygen (DO).
- Phase II: study of water quality problems associated with activities in the river basins, viz., urbanization, mining, manufacturing, farming, deforestation, etc.
- Phase III: study of the water quality of natural and man-made lakes and reservoirs.

The full range of physico-chemical parameters including heavy metals will be monitored in Phases II and III. Biological and microbiological parameters will be monitored, but these will be determined by the specific problems to be encountered in the basins, lakes or reservoirs.

A national network for groundwater monitoring (level and quality), is under design at the WRRI.

Regarding the types of biological species, the problem areas include the lack of data on the weeds of reservoirs, impoundments and rivers in the northern half of the country. There is even a need to update the data on weeds in all reservoirs, lakes and rivers in the southern half of the country as most of the existing data are more than a decade old. The continued surveillance and monitoring of the spread of the exotic weed, water hyacinth (Eichhornia crassipes), and the watch for the possible introduction of other equally problematic exotic aquatic weeds is important. Also important is the need for in-depth studies on aquatic weeds in all areas earmarked for water resources development, especially those for reservoirs, irrigation canal complexes, etc.

The continuous collection and assessment of water cycle data as discussed above will provide the basis for monitoring change in rainfall, runoff, sediment load and groundwater recharge.

Water Resources Assessment

The absence of suitable maps and necessary data hampers comprehensive assessment of water resources. In the areal assessment of water balance components, a lot remains to be done in respect of hydrological mapping. In most cases the data for mapping may be available. The situation with rainfall runoff and groundwater models, is not any better. There is work to be done to establish relationships between time series parameters and physiographic characteristics.

Areal assessment seems to be a weak area in the country's water resources assessment activities. Early steps will have to be taken to produce the requisite maps.

Ineffective Water Resources Planning

In Ghana at the moment only about 30% of the population can be said definitely to have access to good drinking water. Over the years much effort has been concentrated on the supply of water for domestic uses in municipal areas where it is estimated that 93% of the population have potable water. The situation in rural areas, however, leaves much to be desired:

(i) Only 70% of the people residing in rural communities of population between 500 and 5000 have access to safe drinking water, and

(ii) only 15% of the communities with population below 500 have access to potable water. The population in this category constitutes 30% of the country's population and contributes significantly to the natural wealth.

Under the circumstances many useful man-hours are wasted daily by the rural population in the search for water. Also water-borne, water-related and water associated diseases like cholera, guinea worm, typhoid, diarrhoea, dysentery, malaria, schistosomiasis still plague the rural dwellers.

Problems of Water Management

(a) Abstraction of water

There are no procedures requiring organisations and agencies wishing to abstract water to submit their request to a responsible authority for the overall management of the water resources, so that the right to abstract water without any detrimental effects can be granted. It is only in the case of the Volta River Authority (VRA) and Irrigation Development Authority (IDA) that would-be users of the Volta Lake or Volta River and reservoirs for irrigation are required to obtain permission from these bodies, which seem to have conferred on them ownership rights on their facilities.

There is therefore an urgent need to streamline and rationalise the right to abstract water for various uses in the country.

(b) Negative Impacts of Water Management

Presently, the following environmental problems are known to have arisen from various water development activities:

(i) Human Settlements

The Akosombo project was the first major project in which a large number of people (80,000) had to be moved and resettled. Some serious problems were encountered with regard to suitability of housing; water sources; land for farming and other economic activities, tribal groupings; compensation for land acquired, etc. The VRA was responsible for resolving the problems for many years until it decided in 1971 to cease being responsible, and for the Local Councils, where people have been resettled to take over. The problems are not completely solved.

Since then, a number of lessons have been learnt and subsequent projects like Barikese, Kpong Tono/Vea and Weija have profited from the Akosombo experience.

(ii) Health Impact

Another urgent issue is the control and prevention of water borne and water-related diseases. The health impacts of water resource development activities have arisen from water-borne and parasitic diseases like schistosomiasis, malaria, trypanosomiasis, onchocerciasis, guinea worm, etc. The VRA has a unit to deal with the problems connected with the Volta Lake. In the other projects, the Ministry of Health is expected to provide services for the control of the diseases. In view of the limited resources available to the Ministry, progress is not as can be expected.

(iii) Land Use

The major water projects generally do not seem to have been affected by land use activities within the catchment areas of the projects, with the exception of the Vea/Tono project. Present indications

are that farming activities in the Tono river catchment is increasing erosion which is causing siltation of the two reservoirs. Their capacities are feared to be reducing as a result.

(iv) Flora and Fauna

Presently weeds problems have emerged on the Weija and Barikese Reservoirs. They are becoming a threat on the Kpong reservoir. Downstream the Kpong Dam in the Volta River, weeds have appeared at the Tefle bridge and are now a nuisance. In the same stretch of the river, river fish which used to thrive before the dam was constructed can no longer be found. Also badly affected is the economically important Volta clam and its industry. On the other hand the prawn fishery is on the increase in the area below the Kpong dam.

(c) WATER POLLUTION

Waste is an inevitable by-product of the socio-economic development process and water is one of the means by which it can be disposed of. Also when wastes are disposed of in other ways they eventually find their way into surface and groundwater bodies.

The wastes come firstly from domestic and municipal use of water, secondly from agricultural uses and, thirdly, from industrial uses. Fourthly, the inappropriate use of land, which leads to erosion, creates water quality and sedimentation problems. It must be noted that the sanitation and pollution problems that are created by using water to dispose of wastes are aggravated during periods of floods and droughts.

Disposal of Domestic and Municipal Wastes

The wastes of concern here are garbage, excreta, dry season liquid wastes and storm water. It is obvious that with the increase in population at an annual average rate of 2.6% the volume will increase over the years.

(a) Disposal of Garbage

The capability to handle household and municipal garbage deteriorated except in Accra where a programme of assistance to the Accra City Council from the Federal Republic of Germany is helping to contain a serious situation. Disposal is by incineration or by land filling. In areas where the land filling is not properly done leachates are washed into water bodies whenever it rains thereby causing pollution. In the coastal areas, these find their way into the sea usually through lagoons where polluted waters are used by downstream settlements.

(b) Excreta Disposal

In the case of excreta, there is a deterioration in sanitary disposal. In the urban settlements where the bucket system is widely used, the collection system has broken-down in many places, as it has become difficult to hire labour to collect night soil. In the better planned areas like the Airport Residential Area in Accra, the residential areas in Kumasi and Takoradi, septic tanks are widely use. Open defecation is resorted to in parts of the urban fringes.

Central sewerage systems exist only in Tema, Akosombo and parts of Accra. The system in Accra is not being patronised because of the connection cost which individual house owners are called upon to bear. A central sewerage system planned for Kumasi has not been implemented. Because of the difficulty of recruiting labour to remove night soil and the cost involved in construction and operating modern excreta disposal system Ventilated Improved Pit (VIP) Latrines are being resorted to and the various city and urban councils are actively promoting their use.

The promotion of this system (VIP) latrines is being taken up vigorously in the rural settlements where by far the largest majority resort to indiscriminate defecation and about 10% of the population use pit latrines. This effort is being linked with drinking water supply projects. Along the coast, the sea is used as a disposal medium. In the hinterland, both treated and raw excreta eventually found their way into water bodies (surface or underground). The extent of contamination is not known.

(c) Disposal of Liquid Household Wastes

The disposal of liquid wastes from households and commercial houses in both urban and rural settlements is worsening, posing serious sanitation problems. In places where concrete drains by the side of roads and streets are also used as disposal channels, the drains are failing for lack of maintenance, thus creating standing water which is quite unsanitary. Natural drains also used for disposal which are similarly not maintained create worse sanitary conditions in some areas. Quite apart from the health hazards that they create in the immediate surroundings (mosquito breeding) they add to the pollution of water bodies.

(d) Disposal of Storm Water

In the case of storm-generated waste water disposal by open lined drains and natural drains in the urban settlements is the most common. In the rural settlements, practically all storm generated waste waters are discharged by natural drains. There are practically no major storm drainage works in the country at present. The exception is in Accra where a few like the Nima, Kaneshie and Clottey drains are being lined in accordance with the Master Plan for the drainage of the city.

The widespread breakdown of the waste disposal system in both urban and rural settlements has led to debate about sanitation standards and the appropriateness of the technology being used.

YEAR	1982	1983	1984	1985	1986	1987
Fertilizer Imports (mt)	46,500	-	38,350	29,999	20,100	120,000*

* Estimated

Source: Statistical Services, Accra

Disposal of Agricultural Wastes

As stated earlier wastes from agricultural activities contribute to contaminating water bodies. These come from the use of agro-chemicals like fertilisers, insecticides and herbicides. These chemicals continued to be used for crop production during the period. This was particularly so in the northern and upper regions where soils are poorer in quality. They are used on both rain-fed and irrigated farms. One of the main receiving waters are the rivers of the Volta system.

The table below gives an indication of the magnitude of environmental problems, in terms of impact on the quality of water bodies, arising from the use of agro-chemicals.

The decrease in yearly imports between 1982 and 1986 may probably be due to foreign exchange difficulties. The estimated import for 1987 of 120,000 tonnes shows that the national needs are more (about 6 times the 1986 imports) than the available foreign exchange makes it possible to order.

Ad-hoc monitoring of the effect of the fertilisers on the quality of water bodies has been carried out since the 1970's, but there has been no systematic programme for continuous monitoring. Pesticides have been used under the Onchocerciasis Control Programme (OCP) to control the larvae of the simulium fly, responsible for the spread of river blindness. The effect of the pesticides on water quality and aquatic life in the programme area has been monitored by the Institute of Aquatic Biology.

Another growing area of waste production from agriculture is that from livestock. Presently livestock are known to be drinking from the same sources from which humans fetch water. In the case of borehole supplies excreta from animals drinking from the borehole heads have been discovered to be contaminating groundwater in a few cases.

Disposal of Industrial Wastes

Effluents from industries are discharged into water bodies without treatment. The major industries in this respect are the breweries, textiles, mining, chemical, plastics and rubber industries. The effluents contain various kinds of chemicals and compounds.

As of now, many of the industries are still discharging effluents into water bodies which are creating serious pollution problems. In the mines, the level of arsenic and cyanide effluents discharged into receiving waters are many times higher than what is permissible for human health.

Watershed Protection

In the area of land utilisation, land degradation still continues. No improvement of the adverse effects of land degradation on the water resources can therefore be expected. Though the need for proper land use planning is recognised, most of the efforts have not gone beyond the preparation of policy documents and recommendations for action.

The main land degradation practices continue. Examples are inappropriate farming systems, such as shifting cultivation. Others are bush-burning for the purposes of land preparation and hunting; over-grazing by livestock; felling of forest trees for timber to increase exports; removal of vegetation for fuelwood to meet household energy needs in both the rural and urban areas. All these have the effect of baring the land and thereby enhance the chances of erosion by wind and water. The result is that desertification has set in in parts of the country like the Upper East Region.

Also changes in the relationship between the water balance components, viz. rainfall, evaporation, runoff and infiltration are expected to arise. Unfortunately, the extent of these changes has not been studied.

Soil erosion carries away nutrients thus leaving the land impoverished. These nutrients are washed into water bodies and thereby affect the quality of the receiving waters. In addition, the eroded soils cause sedimentation in water conservation structures like dams, dug-outs, etc., as reported in parts of the northern and upper regions.

Monitoring to assess the changes in the water balance components or the changes in water quality, or the rates of erosion and sedimentation as a result of the land degradation practices is yet to receive sufficient attention. Studies and plans have however been made to tackle aspects of the problem like the preparation of the National Plan of Action to Combat Desertification (EPC, 1987).

Again the extent to which pollution and sanitation problems are aggravated during periods of floods and drought is yet to receive attention. The Plan of Action to combat desertification is still valid and should be implemented with commitment and vigour.

MARINE AND COASTAL ECOSYSTEMS

The coastal zone is the band of dry land and adjacent ocean space in which land ecology and use directly affect ocean space ecology, and vice versa. Landward the area includes the lagoons, lagoonal depressions, marshes and estuarine swamps together with the intervening interfluve areas. The 30m contour encloses most of the zone. Seaward the boundary is determined as the limit of the continental shelf, 200m depth of water. The zone is about 550km long.

The zone is ecologically unique because of its transitional nature, between land environments and the open seas. The distinctiveness lies in the unique flora and fauna, physical processes and land use. Although fragile it is an area of dynamic biogeochemical activity with materials, energy and humans in constant movement across it in both directions. The zone has limited capacity to support arable agriculture because the soils have less organic matter content, are saline, may be sandy and droughty or poorly drained. On the other hand the biogeochemical exchanges that take place in that environment are vital for the biological productivity of the adjoining wetlands and marine environments.

The full and sustainable exploitation of the physical, biological and human resources of the zone presents a number of opportunities and challenges. There are important resources for tourism, fishery, industry and mineral development. For instance, the lagoon, estuary and delta ecosystems provide suitable environments for oyster and fish culture. The zone also provides feeding, roosting and nesting sites for thousands of birds and marine turtles. The beaches, cliffs, lagoons, wildlife, cultural and historical sites and the coastal landscape all provide an immense potential for tourism development. Salt, deposits of limestone, silica, feldspar and other minerals have been identified within the coastal belt, not to mention the possibility of oil. Copra production has been an important

economic activity over a number of years while more recently irrigation agriculture is also assuming some importance in the zone.

The development of these resources, however, requires very careful choices, a full recognition of their linkages, and a commitment to overcome some of the inherent limitations of a fragile ecosystem. Current development trends and pressures exerted on the coastal zone and the marine environment not only conflict with resource utilisation, but also lead to degradation and interference with the various components of the zone. This situation is further aggravated by the lack of reliable and consistent scientific data to ensure meaningful management practices. It is necessary to reconcile conflicting demands on coastal resources in such a way that their full use will be realised without destruction of the natural processes required to renew them.

Marine Fisheries

Fishing is by far the most common and the most important agricultural activity in the coastal zone. However fish stocks have been badly stressed in recent years with the coming into force of the Economic Exclusion Zone (EEZ) concept which constrains fishermen from fishing in the waters of other countries. Another problem is the non-enforcement of management measures aimed at rationalising our rather limited fish stocks. For instance, it is known that fishermen use under-sized mesh to catch juvenile fishes. Also explosives and poisonous materials are used.

The success of the industry in the long term depends upon the successful maintenance of stable ecological conditions of both aquatic and terrestrial environments. Disturbance in wetland and lagoon ecosystems also pose a potential threat to the productivity of these areas which have been shown to provide nesting environments for large numbers of animal species including fish.

Coastal Erosion

The hydraulic action of ocean waves on the coast, combined with the abrasive action of materials they carry, is able to break and dislodge rock, sand and pebbles. Areas most susceptible to wave action, and hence areas of most rapid erosion, are the well-jointed and the unconsolidated rocks and beach materials found extensively along various parts of the Ghanaian coastline. The problem is most pronounced along the eastern coastline where erosion rates exceed 1.5m per annum. There may still be other areas which are not known because of poor accessibility. In some of the eroding areas, particularly in the Keta area, persistent net loss of land has occurred over the years leading to loss of property and crops.

Apart from geology the causes of persistent erosion and net loss of land are only broadly determined as due, among other factors, to:

- reduction in the material supply by the Volta River to the longshore drifting zone as a result of the dam;
- generally low silt content of the Volta;
- seepage of lagoon water into the shore zone;
- obstructions in the drifting zone due to construction works such as jetties;
- material collection, e.g. sand winning, from the shore zone;

The success of protection works along the coast has been limited. It is doubtful if engineering options can provide long-term solutions. Observations indicate that the longshore drift mechanism is such that action in one section of the coast may trigger erosion in an adjoining section. Protection of the coast from erosion should therefore be part of the planned and comprehensive development of the entire coastal zone to achieve lasting results.

MINERAL RESOURCES

The mining industry is one of major sources of foreign exchange earnings for Ghana. It is one of the key sectors to receive a lot of attention under the Economic Recovery Programme. Without gainsaying the importance of the sector to the economy the issue of environmental quality should be brought to the fore and steps taken to address them while there is still an opportunity to prevent despoilment as a result of the exploitation of the nation's abundant mining potential.

Mining and mineral processing can cause serious environmental and conservation problems if not properly controlled. The main problems associated with surface mining in Ghana include land devastation, soil degradation, water and air quality changes. Underground mining has, on its part, given rise to problems with subsidence, visual intrusion, and water quality change, especially if underground mine water is pumped to the surface. The health and safety hazards to miners are numerous and may include accidents (rock falls, mine fires, haulage accidents, shaft accidents etc.) gas poisoning, high temperature and humidity effects, and various occupational diseases.

The conservation problems caused by processing of mineral resources are two fold (Acquah, 1987). The first is the problem associated with the actual beneficiating of the minerals and the second (indirect) involves the use of the minerals in manufacturing.

Impact of Mining

The environmental impact of surface mining may be classified as:

(a) Visual intrusion,
(b) Solid waste disposal,
(c) Aerial Pollution,
(d) Water Pollution,
(e) Noise and Vibration and
(f) Soil and land degradation.

The extent of these various aspects of the (potential) environmental impact largely depends on the occurrence and mineralogy (whether non-metallic or metallic ore) of the mineral deposit.

Non-Metallic Ore

Non-metallic ores are generally less polluting than metallic ores. However, like metallic ores, they can only be worked where they naturally occur. They must be extracted from the ground; consequent environmental problems arise which require remedial action. The various (stone) quarries in Ghana fall under this classification.

Visual Intrusion

The sources of visual intrusion include pit faces and floor, waste disposal areas, stockpiles, mobile equipment, fixed plant and buildings, rail and access points and dust plumes. Methods for reducing visual intrusion is best considered during the planning stages of mine development.

Soil and land degradation

Soil and land degradation usually begins with the deterioration or destruction of the vegetative cover. Once the plant cover is disturbed, soil degradation occurs - in the form of accelerated water erosion, soil compaction or surface soil crusting - with a resultant loss of soil fertility. Thus badly controlled mining methods can destroy soil and living resources leaving behind a barren, denuded and eroded wasteland.

Solid Waste Disposal

Spoil consisting of tips, production waste, substandard and unmarketable material, and overburden can cause dustblow, contamination of runoff water and sterilisation of land. Spoil tips can also present visual intrusion problems and hence require careful siting and landscaping.

Air Pollution

This mainly results from dust produced by the mining industry.

Water Pollution

The main problem is likely to be run-off from tips and workings containing significant amounts of sediment entering streams and rivers.

Noise and Vibration
Noise levels within and outside the mine site may give rise to nuisance to nearby people. The sources of noise and vibrations at the mine include air blast, blasting vibrations, mobile equipment noise, fixed plant noise, etc.

Land Use
Minerals are mined where they are found; there is rarely any choice in site selection. Hence competing claims on the land would require that careful consideration is given to land use.

Metallic Ore
The major environmental problems of metal mining are related mainly to the residual metal levels of especially heavy metals, the presence of other uneconomic minerals in the ore, notably pyrite, and the water discharged from mining and milling operations. The mining of gold, bauxite and manganese in Ghana falls under this classification. However, whereas the mining of bauxite and manganese is by the open-cut (surface) method, gold mining in this country involves both open-cut and underground mining.

The environmental problems of surface mining of metallic ores are similar to those of the non-metallic ores described above, except that in some cases the negative impacts are more pronounced.

Air Pollution
Metal mining can cause local problems of dust blow and toxic particle deposition. Since the dust may contain metallic compounds, widespread contamination of land and watercourses can result. All dust, whether toxic or not, present a serious nuisance for nearby communities and industrial machinery and has damaging effects on vegetation, by blocking plant pores and reducing light penetration and photosynthesis.

Water Pollution
This form of pollution is likely to be the most troublesome impact of a mine. Metallic mine effluents consist of a complex of chemicals many of which have deleterious effects on river life, irrigation water, drinking water and farm animals. The major hazards are heavy metals, suspended solids and activity.

The extent of pollution likely from these sources depends upon the mineralogy of the ore, climate and geography of the site, ore processing technology, water disposal practices and nature of the receiving watercourses.

Land Pollution
Pollution of land may result from fall out of toxic dust from contaminated mine water or from flooding of land by polluted streams. Death of vegetation, crops and livestock can result and the effects on public health can also be serious.

It is generally accepted that surface mining has a greater negative impact on the environment than underground mining. In the case of the latter, the main environmental concerns may comprise land subsidence (if improper mining methods are used), water pollution (if underground mine waters pumped to the surface are not analysed and treated), visual intrusions (e.g. surface installations), and production waste. However the major concerns of underground mining are the health and safety hazards to miners.

Mineral Processing
The major impact of mineral processing or smelting on the environment are likely to be through air and water pollution.

Air Pollution
The common forms of air pollutants associated with processing are sulphur dioxide, nitrogen oxides (N_2O and NO_2), carbon dioxide, and particulates (smoke, dust). Other important air pollutants,

commonly associated with the processing of Ghana's gold-sulphide complex, are arsenic and antimony oxide.

The oxides of nitrogen and sulphur affect both the environment, largely as precursors of acid deposition and photochemical oxidants, and human health, as notable respiratory irritants. The deleterious effects of arsenic and antimony oxides are well known.

Water Pollution

The main potential water pollutants from processing plants/smelters are heavy metals like copper, zinc, lead, iron, manganese and mercury (in the case of gold processing). Other identifiable pollutants include high levels of total dissolved solids (soluble salts) and/or suspended solids. Pollution is also caused by carbon dioxide, turbidity, spilled oils, excess nutrients (particularly nitrogen and potassium) which cause extensive algal growth with resulting oxygen deficiencies and lack of oxygen in receiving waters.

Organic reagents commonly used in beneficiation and which occur in mine effluents do not generally pose environmental problems when they occur in small concentrations. Typically they are present at less than 2 ppm.

It is well known that cyanides, used in the processing of gold, are very toxic but decompose naturally with time.

Waste Management

Good management of (total) mine waste involves careful planning of the eventual land-use even before active mining commences. Predictive final plan(s) formulation on the eventual land use are essential for determining the procedures adopted through the active part of the mine. Detailed reclamation planning should also start before the mining begins so that plans for final topography and intended land use can be followed and potential pollutions minimised. It is rather unfortunate that these prerequisites are largely ignored in the country principally due to the fact that there is no legislation which requires Environmental Impact Assessments for major projects and the implementation of such proposals.

ACTIONS

Land Tenure

The current land registration exercise is in the right direction and should therefore be speeded up and broadened.

In particular, to solve the problems of improper records of land transactions, documentation of title, and the correct identification of who should grant title, the following are proposed:

(a) undertake land mapping at a scale not less than 1:25 .0. Boundaries will be adequately determined to be identifiable on the ground. Disputed territories will be marked out. Families and other groups that own land should have the responsibility of mapping their boundaries within stool lands.

(b) undertake land assessment and resource inventory, and identify land degradation, desertification, etc. Scattered data in agencies involved in land resources will be collated and synthesized in a national computerized data bank for land resources.

(c) educate the public as to what the law is regarding land acquisition and

(d) strengthen the legal and administrative machinery for land acquisition and tenure.

Bush Burning

Bush burning has both positive and negative effects. The recommended approach to bushfires is control and use as a tool in agriculture, soil conservation, forestry, game and wildlife management. Recent legislation and control organization needs to be sustained and enforced.

Soil Conservation

To solve the problem of soil fertility, it is necessary to put in place an overall programme to ensure the conservational use of soils. Such a programme may involve mechanization, agro-chemicals, and techniques for regenerating soil fertility.

Control of Pesticides

An Inter-Departmental Pesticide Control Programme (IPCP) comprising the EPC, the Ministry of Agriculture, the Ghana Standards Board, the Universities and other Research Institutions and the Ghana Medical School, has been set up by Government.

Under this programme the Ghana Standards Board (GSB) which is responsible for product quality control will undertake the monitoring of the quality of all pesticides to be used in the country. The Ministry of Agriculture will provide training for the farming communities on safe and effective applications of pesticides. The Ministry of Health will monitor the health impacts of pesticides used in the country and in addition educate the public on the health aspects of pesticides. The EPC co-ordinates all these programmes and will advise government on the environmental impact of the programme. Government should continue to support this programme.

Agro-forestry

Government has identified agro-forestry as an acceptable land use system that enables food and/or animal production to be undertaken without denuding the land of tree cover. Agro-forestry offers a possibility also for maintaining/restoring soil fertility and restoring tree cover on denuded lands. It is noted that several actions on agro-forestry are provided for under the Forest Resources Management Project.

To reinforce steps already taken agro-forestry will be introduced into the curricula of all agricultural training and educational institutions. Agro-forestry is already being taught at the technical level at the Sunyani School of Forestry and at the undergraduate and post-graduate levels at the Institute of Renewable Natural Resources. There is therefore sufficient knowledge and educational materials for the subject to be taught at all levels in the educational system.

Private and Community Forestry

Private and community forestry will be encouraged through:

- public education;
- involvement of local people and NGOs in forestry decision making and implementation of programmes;
- assistance to individuals, organisations and communities to grow, protect, manage and utilise their own tress and forests;
- provision of incentives for the development of private and community plantations.

Fuelwood

Industries that rely or intend to rely on natural woodlands for their fuelwood will be required to demonstrate sustainable regeneration of the woodlands or be required to meet their wood requirements from tree plantations established by the industry or woodlots established in the vicinity by outgrowers with the support of the industry.

The activities of commercial charcoal burners and commercial firewood producers, especially in the fragile savanna and savanna/closed forest ecotone (Dry Semi-Deciduous forest zones) will be controlled through, among other things, licensing at the District level to make it possible for tree cutting to be directed to designated, preferably non-critical, and specified trees and tree species. It will be obligatory for part of the revenue derived from such licences to be paid into a District Forest Fund and applied to tree planting and related activities.

Water Cycle Data

Gaps, weaknesses and inadequacies exist in the collection of water cycle data on which the indicators of environmental monitoring are based. It is therefore recommended that projects be put in hand to ensure that gaps are filled, weaknesses removed and the range of data being collected expanded to cover all relevant environmental indicators. These should address particularly groundwater, water quality, sediment transport and biological data.

Water Resources Assessment

Some work on water resources assessment has been done. However, in order that this will be comprehensive, it is recommended that the present knowledge about water resources (surface and groundwater) be updated and expanded both quantitatively and qualitatively to cover all river basins.

River Basin Development

The absence of comprehensive plans for water resources development for the river basins, can lead to irrational use of water. In order to avoid this and assure sustainability of Ghana's development it is recommended that water master plans should be prepared for all the river basins of the country.

A watershed management programme should be initiated to control the land degradation process within river basins. Landuse planning will be a critical tool in this regard.

Marine and Lake Fisheries

Implement measures for the rational management of fish stocks.

Protected Areas in the Coastal Zone

The following lagoons (Fig.5) and their immediate catchments will be set aside as Protected Coastal Zone Areas. They have been selected on the basis of scenic characteristics and potential for recreation/tourism, biological productivity, floral and faunal uniqueness, landuse, and education.

1. Anhusam Beach - Songaw lagoon and catchments
2. Sakumo lagoon and catchments
3. Cape Three Points and adjoining forest
4. Densu Delta and Panbros Salt Pans
5. Muni lagoon and catchments
6. Srogboe - Ada Beach.

It is recognised that these areas, as all other areas along the coast, have long been settled and used to varying degrees of intensity. Possible sources of conflict include:

- potential in compatibilities between existing resource activities and processes, and the objectives of protection and conservation;
- established rights and privileges of ownership, and use of coastal zone communities;
- control of settlement development.

The approach to these problems will be based on **multiple use management** and **local participation.**

Control of Pollution for Critical Ecosystems

Control agricultural development and practices in the coastal zone, particularly in respect of the use of agricultural chemicals and soil conservation.

Implement the National Oil Spill Contingency Plan.

Research

A systematic study of the non-beneficial effects of mechanization on agricultural land use will be undertaken in order to recommend types of machinery practices and the management capability of the land users.

Data and information on the short-term and long-term effects of the use of agro-chemicals on soil quality, vegetation and crop yields will be collected to aid in planning soil conservation programmes.

In view of the possible increase in stock numbers in the country in the future and in view of the fact that rangelands are hardly developed, rangeland studies and development will receive urgent attention.

Agro-forestry Research

Research will be promoted to study the indigenous agro-forestry systems and to help identify suitable tree species, especially indigenous, for different ecological zones, crops and objectives. Hedgerow inter-cropping (alley farming) may not be a suitable mode in all situations. Therefore different models of agro-forestry and farm forestry, including farm boundary planting, will be tried.

Wildlife Research

In view of the value of wildlife species as environmental indicators, and the dearth of information on Ghana's wild animal populations, appropriate mechanisms will be established for baseline data collection and long-term monitoring of wild animal populations; and assessment and long-term monitoring of the effects of pollution (from industrial and domestic wastes) and agro-chemicals on wildlife.

Water-Related Research

It is recommended that studies be undertaken into the following areas to identify the sources and types of the degradation:

- degradation by wastes from households and municipalities, industries, mines and agriculture;
- impacts on human settlements, health, landuse, and ecological systems (flora and fauna) of water resources development projects;
- siltation of water bodies resulting from the use of inappropriate farming techniques, such as shifting cultivation, use of fire for land clearing and hunting, and removal of vegetation for timber, household fuel, medicine and food.

Appropriate measures should then be instituted to abate or eliminate the degradation.

Energy Research and Development

Ghana needs to intensify research and development in the following priority areas of the energy sector:

- Solar end-use devices suitable for crop drying and cooking in rural and urban poor households;
- Energy-saving technologies in small-scale and informal industries and also in the home;
- Appropriate and cost-effective electricity network extension for rural electrification;
- Small-scale hydro power technology.

CHAPTER 6

MANAGING THE BUILT ENVIRONMENT

ISSUES

COASTAL ZONE MANAGEMENT

The management and conservation status of the coastal zone of Ghana is low. This is particularly true in terms of planning, co-ordination and monitoring. Present management is sectoral, and although a number of measures have been put in place these have not been enforced by the appropriate agencies. There is hardly any agency that co-ordinates the developmental activities of the various sectors. Data for planning and management is limited and scattered.

The situation is unsatisfactory in the light of the increasing population and economic activity in the zone, the large potential of the zone in terms of production and amenities, and the ecological fragility of the zone as a whole.

HAZARDOUS CHEMICALS

The presence in the environment, and use, of hazardous substances for various purposes affect the quality of air, water, soil and ultimately life itself. Industry uses a wide variety of chemicals for various purposes, while agricultural productivity has come to depend on the application of different types of chemicals. The need for health protection and to make our daily lives comfortable have also resulted in the increased dependence on chemicals. However, there is a price the country pays in terms of human health and the quality of the environment. This could escalate unless vigorous action is taken to control their use.

Hazardous chemicals refer to those chemicals which pose a risk or danger, through poisoning to those who come into contact with them through the handling, application, use, etc. The inherent poisonous potency of chemicals under exc- nental conditions is referred to as toxicity. Hazard depends not only on toxicity but also on the c..ance (probability) of exposure to toxic amounts of the material. Poison is defined here as any chemical or agent that can cause illness or death when eaten, absorbed through the skin, or inhaled by humans or animals.

For many years the importation, manufacture, distribution, handling and use of potentially toxic chemicals in Ghana has proceeded without much consideration to the possible environmental consequences. This has resulted in considerable hazard to human health. It is more serious in the sense that the quantities and types of chemicals in the country are not fully known.

Hazardous chemicals may broadly be divided into two main groups, namely:

(a) Elements and their derivatives, for example mercury and mercury-based compounds; chlorine and organochlorine compounds, and

(b) Radioactive compounds and/or elements.

Exposure to hazardous chemicals may occur at any stage from their initial production to their eventual use by man. Often it is through the food chain. Consequently measures for prevention and control of exposure should include good manufacturing practices, the observation of environmental measures to limit the exposure, health education, etc.

Control of hazardous chemicals in Ghana

Despite obvious gaps and laxities, there have been some attempts to institute controls to curb the possible hazards posed to the environment and human health through indiscriminate use and misapplication of toxic chemicals in Ghana:

Toxic Chemicals Committee

Following the establishment of the EPC one of the major expert committees set up to assist the Council was the Toxic Chemicals Committee. The main function of the Committee was to control the use of toxic chemicals in the country.

Clearance for Chemicals

Over the past years the EPC, as an interim measure and in collaboration with the Ministry of Agriculture, has been examining application for the importation of agro-chemicals into the country. This is to ensure that only safe and effective chemicals are used in the country. The clearance procedure has now been extended to cover all chemical importation into the country.

The examination of the application for importation of pesticides is undertaken by a five-member Sub-Committee of the Toxic Chemicals Committee. All applications for clearance are accompanied by technical data available to the applicant on the formulations to be considered. After examining all the data, a decision is reached by the sub-committee and those applicants whose formulations meet the requirements are given temporary clearance by the Council through the Ministry of Agriculture. All approvals by Council are subject to review after a period of use in the country when further investigations are expected to have been undertaken into the impact of the chemicals on the environment.

Draft Legislation on Pesticides

Legislation to control the importation, distribution, sale and use of pesticides and other toxic chemicals has been drafted and is being considered by the committee on toxic chemicals.

The main areas covered by the proposed legislation package can be summarised as follows:

i) Administration

ii) Registration of Chemicals (Pesticides and Other Agro-Chemicals)

iii) Enforcement of legislation

(iv) Public and Occupational Health Safety regulations.

(v) Monitoring.

Administration of Legislation

For effective performance of the Council's role as a regulating and monitoring organisation, the EPC considers it expedient to have collaboration among all agencies whose activities are related to pesticides use and control so that all aspects of pesticide control are dealt with under a single set of requirements. To this end a proposal for setting up an Inter-Departmental Pesticide Control Programme (IPCP) comprising the EPC, the Ministry of Agriculture, the Ghana Standards Board, the Universities and other Research Institutions and the University of Ghana Medical School, has been made to Government.

Under the proposal the Ghana Standards Board (GSB) which is responsible for product quality control will undertake the monitoring of the quality of all pesticides to be used in the country. The Ministry of Agriculture will provide training for the farming communities on safe and effective applications of pesticides. The Ministry of Health will monitor the health impacts of pesticides used in the country and in addition educate the public on the health aspects of pesticides. The EPC performing its statutory role will co-ordinate all these programmes and advise government on the environmental impact of the programme.

MANUFACTURING INDUSTRIES

One of the basic premises for sustainable development is the recognition that environment and development are not exclusive of one another but are complementary and inter-dependent and, in the long run, mutually reinforcing. Often, however, industrial development compromises the environment. Although the problems arising from industrial development in Ghana has not yet assumed very serious dimensions there is increasing evidence that in some parts of the country excessive demands are being made on limited resources and the carrying capacity of the fragile ecosystems. These have led to soil and land degradation, air and water pollution, and public health problems.

Concern about industrial pollution is growing. The quantity and diversity of industrial wastes have increased over the years, and there are hardly any waste recycling or proper management practices

in the country. Improper siting of industrial installations in relation to other activities and residential housing poses considerable problems.

There are over 4,000 'manufacturing' industries in the country. Half of these are classified as medium to large scale, and about 60 are located in the Accra-Tema metropolis covering less than 1% of the total area of the country. Such a situation has led to the migration of people from the rural area to Accra/Tema, thereby aggravating the environmental stresses usually associated with industrial activity.

These industries have had a tremendous impact on the economy of the coast and the country at large. However, the concentration of industries in such a small area has aggravated the environmental stresses caused by industrial activities. Without the due environmental considerations industrial development has brought in its trail a number of problems, prominent among which is the problem of pollution, particularly air and water pollution. In the Accra-Tema metropolis, for instance, two lagoon systems, the Korle and Chemu, can hardly support any biological productivity.

Another problem that is often glossed over is the issue of siting and space. While most of the modern industries are found in the industrial estates provided for industrial development, small-scale and/or cottage industries are increasingly located in the residential and commercial areas as well as open spaces. Their locational and space needs have generally not been catered for by planning. This results in nuisance, incompatibility and pollution problems.

With the efforts currently being taken by Government to attract investment and accelerate economic development in the industrial and other sectors, it is important that measures be instituted to forestall the potential environmental problems that could arise.

POLLUTION

The major producers of industrial pollutants in the country are textile industries, food manufacturing industries, petroleum refining and handling, and finally mineral exploitation and processing. A UNIDO study (UNEP, 1984) which investigated the sources of industrial effluents and their probable pollutant inputs reported that for the zone between Cote d'Ivoire and Benin, the main producer of industrial pollutants by weight is the textile industry whose wastes contain 30% of all polluting substances. The manufacture of food products contributes 25% while petroleum refining and handling contribute 20%. Mineral exploitation and processing are also responsible for about 10%. Thus these four activities contribute up to 85% of the pollution load. Minor sources include the following industries - soap and detergents, wood, cement, rubber, plastics and steel. However, in Ghana the UNIDO survey may be taken only as guide especially since mining activities are more pronounced than in the neighbouring countries.

There is a growing concern in the country about industrial waste and pollution, health and safety hazards to industrial workers, public health problems due to adverse environmental changes, and the misapplication of hazardous chemicals. Evidence and the stark reality show that efforts so far made towards control or prevention of the adverse effects have been inadequate and ineffective. This is in spite of the fact that the level of industrial development in the country is relatively low. If proper industrial environmental controls are not put in place, environmental pollution will be quite significant in the near future, especially since increased industrial activities are expected due to the Economic Recovery and Structural Adjustment Programmes.

Air Pollution

The major sources of air pollution from manufacturing industries in the country are the aluminium smelter, oil refinery, cement-asbestos product plants, steel works, cement works, sawmills and wood processing mills, alumina conveyance and automotive exhaust emissions.

Atmospheric pollution associated with Ghana's industrialisation/ modernisation activities result mainly from combustion processes. These pollutants tend to be in the form of particulate matter, smog, odours and 'nuisance' gases. These emissions contain varying amounts of gases such as oxides of sulphur, nitrogen and carbon, and some hydrocarbons, etc. Apart from the health problems caused

by these gases they also contribute to the problem of acid rain. In recent years hydrocarbons have been identified as substances contributing to the global ozone depletion problem.

The effect of particulate matter depends on the size of the particulate as well as the nature. Coarse particulates lead to material damage to clothing, buildings, eye irritation or injury and reduce visibility. They could also damage plants. Fine dust (of the order of 0.5 micrometre or less) may enter the respiratory tract and get retained in the alveolar tissue. Prolonged exposure can cause various lung diseases. Particulates such as asbestos and compounds of fluorine, lead and arsenic are toxic to humans.

Water Pollution

The major pollutants of water in the country are derived from the food processing, material processing, cooling and mining industries.

Food processing industries, including the breweries, for example, have, as their commonest effluents, fruit and vegetable juice pulp, mineral acids, sugar, dirty washings and slops containing yeast and residue from alcoholic fermentation and these are often discharged into surface streams. In 1976, Accra Brewery's waste load alone was 25 million litres/month and most of this ended up in the Korle Lagoon (Sam & Ayibotele; 1988)).

Textile industries in the country discharge hydroxyl, sodium carbonate, silicates, chloride and sulphide ions and a wide range of different dye stuffs, bleaching agents and detergents, in considerable quantities. In addition to the 'waste' load that is usually discharged, water used for cooling and discharged with the waste tends to increase temperature of the receiving waters within some distance downstream. The increased temperature can threaten aquatic life and destroy the quality of water.

COASTAL POLLUTION

Pollution in the coastal zone of Ghana has been cited since the early 1970s. The major pollutants identified include solid wastes and various types of contaminants. Along the whole coastline of Ghana discharges into the environment including industrial, mining, agricultural and human wastes, are, to a large extent, untreated and unregulated. There are also considerable mine-source pollutants including heavy metals and suspended solids transported down the coastal zone through the major drainage catchments. The areas of accumulation of the pollutants from the immediate coastal zone and from further inland are the estuaries, the marshes, the lagoons and lagoonal depressions, the beaches and the open marine environment.

In addition liquid tar and tar balls occur extensively along the entire coast of Ghana. These come from oil tankers plying the coast, discharging in the ports or clearing their holds further out at sea.

The offshore basin along the whole coastline of Ghana is an area where oil and gas accumulations are most promising. Petroleum development activities may increase the level of employment and expand community facilities. However, petroleum operations pose a severe environmental hazard, including spillage on the high seas during transit.

Pollution, in whatever form, has a degrading effect on coastal zone habitats and on the tourist and recreational potential of the zone. It also poses considerable risks to population concentrations in the zone.

INDUSTRIAL SOLID WASTES

The identified industrial solid wastes produced by manufacturing industries in the country are categorised as follows:

Metal and Metallurgical Industries

Metallic wastes may be divided into three groups:

(a) the ferrous,

(b) the non-ferrous wastes, and

(c) miscellaneous wastes.

Sources of ferrous wastes include the mines, railways, automobile shops, metal industries, the dry docks and canneries. Scrap generation in the country has been estimated to be 30,000 tons/year. This scrap is not being fully utilised.

The non-ferrous wastes identified include bronze, brass, aluminium, silver and copper. They usually occur with ore and are found incorporated in ferrous wastes. Aluminium wastes are obtained as dross and cuttings from the aluminium processing companies.

The miscellaneous wastes defined as non-metallic wastes of metal industries include slag and refractories from smelters. Other wastes are pallets, drums, spent oil and graphite rods.

Textile and Garments Industries

There are about 150 medium-to-large scale and about 230 small-scale registered textile and garment industries in Ghana. Solid wastes generated include floor wastes, yarns, wax cotton fluffs, fents (improperly printed fabrics), off-cuts etc.

Paper and Printing Industries

The solid wastes comprise cuttings, soiled off-cuts, trimmings, exposed photographic films, etc.

Rubber and Plastic Industries

These industries include those that produce containers, toys, construction materials, household ware, tyres etc. The identified waste produced in the rubber industry include unrefinable rubber, defective tyres, fabric and waste synthetic rubber. In the case of the plastics industry, the wastes generated comprise defective canisters, sachet wrappers, waste plastic as chaff, damaged containers from manufacturing companies.

Plastics industries in Ghana produce about 70,000 tonnes of plastic waste per year (Yawson, 1988).

Food Processing Industries

These industries include the breweries, canneries, oil palm processing, meat processing factories, gari making 'factories', etc. The organic solid wastes identified in the country include oil palm sludge, peels, pineapple waste, tobacco waste.

Other Sources of Solid Wastes

The following industries also generate varying amounts of solid wastes:

Paper and printing;

Building and construction;

Wood processing;

Chemical processing.

Data and Information

There is a general paucity of information in Ghana on the effects of industrial activities and the use of hazardous chemicals on the environment due to insufficient institutional support for sustained research and monitoring of the environment. This has meant that baseline data for virtually all the monitoring indicators are non-existent in this country.

Very little work has so far been done in Ghana to assess environmental changes due to industrial activities. The following problems have been identified with regard to data and information availability:

Lack of baseline data

There is no baseline data for all the monitoring indicators for air, water, soil, vegetation etc. This means that the effective monitoring of changes in air quality, water quality, soils, vegetation, wildlife and public health due to industrial activities and hazardous chemicals is not possible since the requisite background information (data) is lacking.

Lack of Standards
Standards to serve as guidelines for industrialists, importers and the monitoring agencies are generally lacking.

Pollution Sources
Sources of environmental pollution are not well defined. For example, it is well known that there are many sources for the high level of pollution in the Korle Lagoon. However, there is no work done to determine the nature and quantity of pollutants contributed by each identifiable source.

Quantitative Data
Generally, there is no data on the quantity of industrial effluents available, even where the nature of the pollutants is known.

Classification of Solid Wastes
Types and quantities of solid wastes discharged by industries have not been classified for the purpose of planning a recycling programme of such wastes.

HUMAN SETTLEMENTS

Ghana has over 47,000 towns and villages, where its 14 million inhabitants (1984) pursue their economic, social and cultural life. Generally settlement sizes are small. According to the 1984 census no single human settlement in Ghana has a population that reaches a million. In all there are 189 settlements whose population sizes reach or exceed 5,000 persons, the size that is statistically and officially classified as urban. About one-third of the population live in over 40,000 settlements with less than 500 persons. Accra, the national capital with a population of 984,000 (1984), is the only settlement whose population exceeds 500,000. With the adjoining sea-port of Tema, the twin settlements of Accra and Tema have a population of approximately 1.2 million persons.

One hundred and ten of the 189 urban settlements are district capitals with ten of them also serving as regional capitals, of which three, including the national capital, are statutorily declared cities.

Population Distribution and Human Settlement Pattern

The geographic distribution of population and human settlements pattern of the country pose formidable constraints to effective national development and equitable distribution of development benefits. Unfortunately, successive national development policies and strategies hardly seldom ever addressed this spatial issue.

i) The wide dispersal of the country's population into numerous scattered settlements has been cause for rural deprivation. It accounts for the tragedy that although it is rural production that sustains the national economy, rural areas and rural populations have a poorer share of services, infrastructure and public investments generally.

ii) There is a concentration of urbanisation in the Accra-Tema metropolitan area and in two or three other settlements. These centres are rapidly growing to attract and accumulate population and development to the deprivation of other settlements of the country.

iii) The development of intermediate and lower level urban centres is weak. This gives rise to inadequate presence and supply of the essential urban-based facilities required to support rural development and to attract part of the flow of urban investments and population going into the primate city.

iv) Northern Ghana, characterised by widely scattered settlements and generally lacking medium sized settlements, is at a comparative disadvantage in terms of its attraction for provision of services to support and promote economic and social life.

v) The general consequence of rural-rural migrations is the creation of spontaneous settlements in frontier regions in response to continuing immigration and vibrant economic activity.

vi) Rural-urban migration has generated, and continues to intensify, problems of urban primacy, urban unemployment, congestion, slums and squatter settlements in the face of ineffective and

inadequate policies to address and direct the development of settlements. The situation denudes the rural settlements of the youth, educated and vibrant leadership, therefore of the vital productive labour.

The foregoing issues act as constraints to national integration. What is happening is not shifting the basis of the national economy from the rural areas to the urban centres. It is rather paralysing the roots of the national economy without offering a viable replacement.

Urbanisation

The present of modern industry has been a major contributory factor in the rapid urbanisation of the major coastal towns in recent times. By no coincidence the largest urban agglomeration in the country, that is, the Accra-Tema Metropolitan Area, Sekondi-Takoradi and Cape Coast, are located on the coast. The fastest growing towns along the coast can be found in the Greater Accra region where population more than doubled between 1960 and 1984. The construction of a modern port at Tema served as the major pull factor for industry and population in the area.

Besides the large population centres there are over a dozen other urban settlements (population more than 5,000) along the coast. As with other urban settlements in Ghana the concentration of people in the zone has brought severe pressures on housing, the already inadequate urban infrastructure and utility services. One result is a deterioration of environmental quality, particularly in respect of domestic and human waste disposal. Along the coast almost all the waste finds its way onto the shore and into the sea without any form of treatment. This poses serious risks of pollution and epidemics, and severely reduces the tourism potential of the area.

Another issue associated with rapid expansion in population is urban sprawl and the expansion in land use for all types of socio-economic activities. These have had great impact on the environment. In particular the expansion of urban land use into rural areas has not only reduced the amount of land available for agriculture, particularly in the environs of Accra and Tema, but has also threatened the habitats of both land-based fauna and aquatic resources.

The trend has bred a cultural dualism in which the national capital city and other cities comparatively boom with innovation, capital investments and facilities, while the remaining large centres and small towns remain inert and deprived. It constrains progress and modernisation to economically and lagging areas.

Rural Deprivation

Despite the enormous contribution of rural production to the national economy, the benefits of national development do not reach rural settlements and their inhabitants. They have poorer share of services, infrastructure and public investments generally:

(a) Wage Employment

Over 80% of wage employment is located in the three cities (Accra-Tema, Kumasi, Sekondi-Takoradi).

(b) Electricity

Over 76% of non-industrial consumers of generated electricity are resident in the same three cities. Thus, the rural settlements and other towns together share the remaining 24% of the supply.

(c) Potable Water

95 per cent of the urban population are served with good drinking water against but only 39.5 per cent of the rural population with access to potable water. For the rural communities in settlements with populations under 500 people, the percentage is as low as 15 per cent.

Handpumps and boreholes provide the only source of safe water to settlements of 500 - 2000 inhabitants. 85 per cent of the 4 million inhabitants living in 40,400 villages and cottages with populations of less than 500 people depend on unsafe water sources that are reached often after long distances of walk.

In all, about 5 million rural inhabitants, representing about 40.8 per cent of Ghana's population do not have access to good drinking water.

(d) Health Facilities

8.36 million inhabitants living in 47,000 rural settlements do not have any or ready access to the basic government-provided health facilities which are largely urban based. Generally, mission hospitals and clinics are located to be more accessible to rural populations in contrast to the Government facilities.

For obvious reasons, the increasing number of private clinics run by industrial and institutional establishments and private practitioners are not attracted to rural locations.

Service Centres and Production Support Services

Rural areas further suffer from inadequate basic production infrastructure services, especially agricultural and technical services, storage and marketing facilities and roads. The situation is further worsened by the absence of strong, well distributed, easily accessible rural service centres for extending both economic and social services to support and promote rural production and social life.

Urban Degradation

(a) Urban Sprawl

It is common knowledge that our human settlements are not properly developed and well managed Accra, Kumasi and a few other urban centres are rapidly growing to accumulate population and development.

There is an explosion in lawlessness and uncontrolled urban growth in the rapidly growing urban areas. The expanding urban fringes are filled with new shelter, but without proper access roads and adequate community services. Reservation of lands made for streets and other utilities are taken over by uncontrolled private buildings before public authorities are able to organise resources to open up the roads and connect the services.

(b) Infrastructure

The last decade and a half has seen virtually no new service roads being made by public authorities to rapidly sprawling shelter in the over expanding urban fringes. Town and cities have ceased to have programmes to make new roads and streets. Existing roads and streets have fallen into a bad state of disrepair. Pedestrian side-walks are broken, non-existent or trespassed over by parked motor vehicles.

(c) Zoning

Sites set aside for the provision of community and other essential (waste disposal/collection, primary schools, recreation, drainage channels, etc.) are plundered and encroached upon with impunity, because public authorities leave the sites fallow without signs of developing and delivering the services many years after private shelter development and habitation. City centres are choked with unauthorised trading activities and structures that conflict with pedestrian and vehicular traffic. The big urban markets are crowded places of filth, squalor and seasonal mud.

(d) Sanitation and Drainage

In urban areas because of inadequate public and private services and also unhygienic habits of some of the inhabitants, excreta disposal creates serious health hazards.

Drains are broken and choked. Refuse collection and street clearing systems are unable to cope with mounting refuse and filth in parts of urban settlements. Collection and cleansing lack requisite personnel. Workshops do not have the resources and capacity to maintain available few vehicles. Other equipment and logistics are grossly inadequate.

Refuse is often piled up and dumped two or three times before being delivered to final disposal points. Several parts of large urban settlements do not receive any form of collection service. As a result, many uncontrolled private dumps exist, creating high risks of rodent infestation and disease outbreak. House drains (except in the very few first class residential areas), and especially in newly developing residential areas, have developed into stagnant, meandering, offensive pools of sullage around houses in mass residential areas.

(e) Services

In spite of the gross inadequacies of provision of basic services, it is rampant for the installation of one infrastructural service to disrupt another at great financial losses and public inconvenience. The basic services are usually narrowly planned, carried out as separate activities outside the stream of general town planning, and so are uncoordinated in space and time with each other and with other physical developments.

ACTIONS

Coastal Zone Management

- Environmental reviews (post-audits) will be required of existing industries in the coastal zone that have been identified to be contributing to environmental damage.
- Appropriate penalties will be brought against industrial installations that do not comply with set standards and regulations on:

* waste water discharges
* air emissions
* disposal of solid and other wastes.

In all cases the defaulting industrial concern will be required to pay the full cost of corrective measures.

- The on-going waste management programme of the Accra Metropolitan Area will be consolidated; District Assemblies and townships in the coastal zone will be supported to implement waste management programmes focusing on the following:

* reduction of the volume of waste
* increase of recycling and re-use.
* safe disposal of unavoidable wastes.

- Improve urban drainage
- Improve the siting of industries and enforce zoning regulations; demarcate areas which can be preserved for agricultural use to save suitable land for agriculture;

Regulation of Chemicals

A National Register of Potentially Toxic Chemicals has been compiled. This includes data profiles and legal mechanisms for control of all chemicals in use in the country, their importers and/or their distributors. In order to bring chemicals that may constitute a potential risk to the environment under better control the on-going National Programme on Chemical Safety should be supported. The objectives of the Programme are to:

a) Monitor the importation, manufacture, distribution, handling and use of hazardous industrial and agricultural chemicals;

b) Disseminate evaluations of the risk to health from exposure to chemicals;

c) Promote research on the effect of exposures to chemicals on human health;

d) Disseminate information on methods of coping with chemical accidents.

Activities under the programme include:

1. Screening and approval of chemicals to be imported into the country for industrial and agricultural purposes;

2. Gathering and compiling information on hazardous chemicals that are actually imported into the country, their importers, quantities and end-use; similarly for those that are manufactured in the country;

3. Compiling and regularly up-dating the list of distributors of chemicals that may be classified as hazardous;

4. Obtaining data on the actual use and mode(s) of application of chemicals in the manufacturing industry and agriculture;

5. Enforcing the ban on the importation of potentially toxic waste into Ghana.

Spatial Development Framework

The first and only National Physical Development Framework was prepared by the First Republic in 1962/63, on the initiative of the Town and Country Planning Department. This will be reviewed or updated under the direction of the NDPC.

The Framework will:

(a) delineate and analyse the major resources and uses of land and their potentials for national development.

(b) identify geographic areas of the country with great productive potentials and employment opportunities.

(c) map out national population distribution and elaborate the pattern of settlements to show the functionality and relative potentialities of settlements as production centres and as service and cultural centres for aiding and diffusing progress, and modernisation to rural hinterlands.

(d) identify regions or areas requiring special attention - those that are particularly deprived or lagging, those that offer unique potential, those which need special protection.

(e) outline the principal infrastructure network and the broad distribution of social services nation-wide;

(f) establish a national physical planning framework:-

- identify the locations of anticipated major economic activities;
- propose economic and equitable distribution of projected infrastructural and social services;
- propose economic and equitable distribution of projected infrastructural and social services;
- propose an efficient settlement pattern;
- identify urban and service centres which have great assets and potentials to support and contribute to national development.

Land for Development

In pursuance of a national human settlements policy and in anticipation of future growth, the government will acquire lands at specific, appropriate locations well in advance of actual development.

Service Centres for Rural Development

As a policy to decongest the metropolitan areas, a number of selected settlements will be strengthened to serve as rural service centres to support and facilitate agriculture and rural development.

Sanitation

- District development units will be established and strengthened to do the task of environmental protection at the district levels.
- Public places of convenience will be provided at vantage areas in Accra and other town centres.

- All commercial houses will be obliged to provide public places of convenience for their customers.

The Korle Lagoon, Marine drive, Bakaano (Sekondi) and other coastal resources will be developed into recreational grounds. Appropriate legislation to control land use and the development of human settlements will be enacted. Landscaping and Urban Forestry will be regularised and supported by legislation, adequate funding and staffing.

CHAPTER 7

ENVIRONMENTAL EDUCATION

ISSUES

The success of an environmental policy presupposes that all sections of the population understand the functioning of the environment and the problems thereof, and contribute to the protection and improvement of the environment. To this end continuous and detailed educational programmes will be implemented at all levels so that every Ghanaian becomes aware of the problems and fully assumes his responsibilities in safeguarding the environment, particularly at the local and grassroot level.

Environmental education will form an integral part of the educational system. Sustained efforts will be made to promote awareness among policy makers, provide training for resource managers at appropriate levels, and promote greater public awareness and motivation for environmental action.

Environmental education is necessary both at the formal and non-formal levels. The activities of individuals in the community in terms of self-discipline and also in terms of positive actions for the improvement of the environment go a long way in promoting a healthy environment. Any environmental education programme must therefore emphasise these areas.

Since large sections of the population are not in receipt of formal education, it is important, in drawing up any environmental programme, that due provision be made for the non-formal sector. Non-formal education should reach the youth and adults, individually or collectively, and all the segments of the population, from the worker to the manager and the decision maker. It must also be aimed at the family and all those who are responsible for bringing up the young.

Formal education should not only include the objectives of informal education but also provide pupils with the basic, technical and scientific knowledge required for the protection of the environment.

To support both formal and nonformal programs in environmental education, there is a need to develop additional training materials that are appropriate to the situation in Ghana, and to make environmental data and information more generally available to the public.

NON-FORMAL ENVIRONMENTAL EDUCATION

OBJECTIVES

The objectives of non-formal environmental education can be summarised as follows:

1. Awareness: To help individuals and social groups to develop an awareness and sensitivity to the total environment and its allied problems.

2. Knowledge: To help individuals and social groups to acquire a basic understanding of the total environment, its associated problems and humanity's critically important role in it.

3. Attitudes and Habits: To help individuals and social groups to acquire social values, a strong feeling of concern for the environment and the motivation to participate actively in its protection and improvement.

4. Skill: To help individuals and social groups to acquire the skill for solving environmental problems.

5. Decision Making: To influence decision-making bodies and agencies in developing and strengthening national environmental programmes.

6. Participation: To help individuals and social groups to develop a sense of responsibility and urgency regarding their roles in the solution of environmental problems.

7. Evaluation Ability: To help individuals and social groups to evaluate environmental measures and education programmes in terms of ecological, economic, social, aesthetic and educational factors.

CONTENT
Public Health

(a) Home Environment:

- Health and Hygiene in the Home
- Home Safety and Accidents
- Consumer products and drugs (chemical)
- Traditions, beliefs and customs in relation to health in the homes.
- Storage and handling of hazardous chemicals, particularly pesticides.

(b) School Environment:

- Healthful school living
- School safety and accident prevention
- Handicapped children

(c) Community Environment:

- Community Health
- Good neighbourliness and avoidance of nuisance
- Refuse and human waste disposal.

(d) Work Environment:

- Industrial diseases and occupational hazards.
- First aid and Medical care at work places
- Storage and handling of hazardous chemicals.

(e) Environmental Health Surveillance and Monitoring:

- Environmental Health management (public health standards and legislation, policy and planning etc.)

Natural Resources

Management of natural resources in general:

- acquisition, allocation and management of land;
- agricultural practices and their effects on the environment; soil conservation; actions to combat desertification;
- sustainable utilisation of forest resources; management of forest reserves;
- types, uses, conservation and management of wildlife;
- sources, distribution, conservation and management of water;
- nature, modes of exploitation and conservation of mineral resources;
- energy types, sources and methods of energy conservation.

Population Dynamics

- Population structure, growth and trends and associated problems.

Human Settlements

- Communities and their planning – infrastructure and housing;

- Urbanisation and its problems: water supply, refuse and waste disposal, pollution, traffi recreational facilities (Parks, and play grounds);
- Environmental practices to mitigate coastal and marine pollution.

Industrialisation

- Proper siting of industries and their effect on the environment;
- Industrial waste disposal.

Environmental Management

- Environmental policy, environmental quality control, integrated planning and develop ment, environmental ethics and laws.

METHODS OF DISSEMINATION

1.The Mass Media

(a) Radio and T.V. discussions, talks and drama

(b) Film Shows and videos

(c) Articles in Newspapers, periodicals and magazines.

2. Interpersonal Communications

(a) Public lectures, symposia and seminars.

(b) Workshops.

(c) Plays and skits.

(d) Discussion groups.

(e) House visits by:

(i) Public Health Authorities.

(ii) Extension Officers.

(iii) Voluntary Leaders.

3. Specific written material.

In the past, EPC has taken a leading role in promoting and coordinating nonformal environmental education in the country. Many other groups have also become involved. Future programs in this area will involve even more groups, including the Nonformal Education Unit of the Ministry of Education, the Ministry of Information, the Department of Community Development and Social Welfare, District Assemblies, Extension Officers, NGOs and community groups. There is a need to coordinate the activities of all these groups and to focus attention on the environmental education of district and local authorities.

FORMAL EDUCATION

A detailed program for environmental education in the primary, middle, junior secondary and senior secondary schools has been prepared and adopted by the Ministry of Education in collaboration with EPC and other agencies.

Environmental education will not be taught as a separate subject in schools but rather through the interpretation of the syllabuses for the different subjects. For example, the concept and function of ecosystems can be explained in the teaching of relevant aspects of agriculture, geography, biology, soil science, etc. Such an approach helps pupils to understand that environmental protection is part of the normal activities of life.

Pupils will also be encouraged to join the various Environmental Clubs in schools. Parent-Teacher Associations (PTA) will be encouraged to participate in practical environmental protection activities with the pupils.

A. PRIMARY LEVEL
OBJECTIVES

The objectives of Environmental Education at the Primary Level will include the following:

1. To help children to acquire a basic understanding of the environment (physical, cultural, aesthetic and man-made).

2. To help children develop an appreciation of the environment.

3. To help children acquire a concern for the environment and its allied problems.

4. To help children acquire positive attitude to and develop a sense of responsibility towards the environment.

5. To encourage children to contribute to the preservation of a clean environment.

CONTENT AREAS/SUBJECT EMPHASIS
Concept of the environment:

Natural, physical, cultural, aesthetic and man-made.

Environmental Problems:

- Home and the school:

- Refuse and human waste disposal
- Source and storage of water
- Preparation and preservation of food.

- The community - (Village, Town, City):

a) Pollution of the environment - land, rivers, lakes/dams, lagoons, sea, drains, etc.:-
- Refuse and solid waste disposal
- Pesticides
- Other chemicals
- Noise
- Traffic

b) Environmental Diseases:-
- Malaria
- River Blindness
- Bilharzia
- Influenza, etc.

c) Effects of degradation of land and forest:-
- Soil erosion
- Degradation of forest; effects on wildlife
- Indiscriminate bush burning

d) Avoidance of waste in the use of resources:-
- Water
- Electricity
- Fuel
- Food

METHOD OF INSTRUCTION

The topics indicated above will be treated during science and environmental studies classes. Pupils will be exposed to the possible solutions for keeping the environment safe and pleasant to live in. Emphasis in treatment will be on what the individual child can do to ensure personal health and preserve his surroundings from destruction and deterioration.

Topics will be selected and treated based on the background of the pupils and the particular environment in which they live.

B.MIDDLE AND JUNIOR SECONDARY SCHOOLS

OBJECTIVES

Environmental education at the Junior Secondary School levels will aim at helping pupils in the following:

1. To understand the meaning of the term environment in its totality, i.e., physical, human, social, cultural and psychological aspects;

2. to appreciate the relationship between man and the environment;

3. to be aware of the limitations which the environment imposes on man's actions and activities as well as the opportunities which it offers to man for the improvement and enhancement of the quality of his life;

4. to understand the special problems of the local and the national environment and the most effective ways of dealing with these problems;

5. to appreciate the relationship between environmental science and other sciences and disciplines e.g.. biological, physical and social sciences;

6. to understand and appreciate the fact that the environment as a resource is heritage for all mankind, present as well as future generations, and it is therefore the responsibility of every generation to ensure that it is not needlessly depleted or abused.

CONTENT AREAS

Concept of the Environment:

- Natural physical environment, human additions and modifications; natural environment and man-made environment.

Components of the Environment:

- Lithosphere, hydrosphere, atmosphere and biosphere: Structure, composition and workings of each, man in relation to the rest of the biosphere, ecological interrelationships.

Natural Resources:

- Nature, use and conservation of natural resources.

Pollution and Environmental Degradation:

- Problems arising from poverty, ignorance and underdevelopment:
  - insanitary conditions, lack of potable water and its consequences;
  - human pollution of rivers;
  - improper exploitation of natural resources;
- Problems associated with advancement and modernisation:
  - industrial pollution and abatement methods;
  - over-exploitation of natural resources;
  - special problems of urbanisation – noise, transport, housing, social maladjustment, waste disposal, etc.

Environmental Policy and Practices:

The roles of EPC and other bodies, for example, the Factory Inspectorate, City and District Assemblies, Town Development Committees, Ministry of Health, Department of Game and Wildlife, Department of Forestry, Schools and Individuals; environmental management tools, e.g., Environmental Impact Assessment, environmental quality standards, etc.

Agriculture, Forestry and Land Use:

(a) Impact of agricultural practices, good and bad, burning of grass and bush, rotation of crops, mechanisation, the use of biocides (insecticides, herbicides, etc.) fertilisers, new seed varieties;

(b) effect of changes in land use patterns, population density and redistribution;

(c) advantages and disadvantages of dams and irrigation.

(d) erosion and soil degradation resulting from improper methods of land use;

(e) importance of forest reserves and vegetation cover and conservation of the ecosystems.

(f) agricultural waste disposal.

(g) land tenure.

Urban and Rural Environment:

Problems of rural and urban environment viewed in relation to different kinds of human activities and varying levels of population concentration; role of local government. Problems of social inter-relationship and social responsibility:

(a)Urban:

Role of local government (District and Metropolitan Assemblies): town planning, housing, traffic, refuse and human waste disposal, markets, schools, recreational facilities, open spaces; services and infrastructural facilities, for example, water supply, electricity, transport and communications; limits to urban growth; problems of social interrelationships and social responsibility.

(b) Rural:

Advantages and disadvantages of rural life; effects of rural-urban migration on the rural areas; lack of services, recreational and other infrastructural facilities; problems created by customs, traditions and values; lack of good drinking water, transportation and communication; ways of improving quality of rural life; role of local government (town and village committees) and town planning.

Diseases associated with the environment:

Water borne diseases, e.g., river blindness, malaria, trypanosomiasis, helminthic diseases, gastro-enteritis, cholera; occupational diseases and diseases associated with industry e.g. silicosis and asbestosis.

Energy Resources:

Fossil fuels, firewood, charcoal biogas, wind, solar and nuclear energy; effects of exploitation and pollution; air pollutants from fossil fuels; thermal pollution of water, land pollution from wastes, ash and other residue; energy availability in relation to demand; conservation practices and policies.

METHODS OF INSTRUCTION

i) In addition to classroom lessons, simple experiments can be carried out in the laboratory and in the field. Lessons will be reinforced with audio-visual materials, field visits to sites and areas as well as to places of scenic, aesthetic or scientific interest, simple dramas and plays.

ii) The programme of instruction will start with basic concepts of what constitutes the environment, pollution and conservation. After the basic concepts have been taught, topics can be selected in any order from section II depending on the background of pupils in related subjects.

C. SENIOR SECONDARY SCHOOL
OBJECTIVES

The objectives of Environmental Education at the Secondary level will be to help students in the following respects:

1. to acquire a deeper understanding of the environment and its associated problems;

2. to gain a variety of experience with different environmental situations and problems;

3. to develop a keen and informed concern for the environment and the motivation for actively participating in environmental protection and improvement;

4. to develop a sense of responsibility and urgency regarding environmental problems and to ensure appropriate action towards solutions;

5. to acquire the ability to evaluate the effects of measures taken to preserve and improve the quality of the environment;

6. to appreciate the relationship between environmental science and other sciences and disciplines e.g. biological, physical and social sciences.

CONTENT AREAS AND METHOD OF INSTRUCTION

Content areas for the Senior Secondary School level are indicated in the following tables. It is recommended that the topics should be treated in the context of the appropriate subject areas as stipulated by the relevant sylabuses. For example, the concept of natural ecosystems should be treated as part of the sciences (biology, soil science, chemistry, physics, geography, agriculture, etc.).

D. THIRD CYCLE INSTITUTIONS

The need for training middle-level as well as specialist personnel in the various sectors of natural resource management has been recognised by all the universities in the country. New departments and institutes have already been created to address this need, while in other cases course contents have been modified to reflect the growing concern about resource management and environmental conservation. Other third cycle and senior management training institutions have indicated their readiness to organise tailor-made courses to meet specific needs in environmental education and training.

ACTIONS

1. EPC will reactivate its Environmental Education Committee. This Committee will develop a coordinated program of nonformal environmental education to be implemented over the Plan period.

2. EPC will prepare and implement a program of nonformal environmental education directed at the district and community level, through the use of mobile teams to be established in the EPC regional offices. EPC will also prepare and disseminate training materials including posters, songs, drama scripts, videos, etc.

3. EPC will establish and maintain an Environmental Information Centre to provide documentation and referral services to the general public on environmental matters. In particular, data on the efforts that have already been made at agro-forestry and social forestry in the country by several institutions and agencies including NGO's will be collated, documented and disseminated.

4. EPC will prepare and publish, starting in 1992, an Annual State of the Environment in Ghana. EPC will also initiate publication of a monthly newsletter and a quarterly environmental journal.

Audio-visual materials aimed at raising the environmental consciousness of the general public and to provide information support for environmental education programmes will be developed. A Public Information Desk will be maintained to prepare dossiers and other releases for the media periodically.

Also, a permanent exhibition on the environment will be maintained for the general public and particularly for schools and colleges.

5. The Ministry of Education will implement the proposed program of formal environmental education at the primary, middle, junior secondary and senior secondary levels.

6. Third cycle institutions will be strengthened with respect to equipment, staffing and logistic support in order to train personnel locally and also to address local problems more effectively. Land management, forestry, wildlife, and water management agencies should liaise with these training institutions to develop appropriate courses to address their needs in the solution of local problems.

7. To increase the effectiveness of environmental education, programmes will be initiated to train teachers with the view to increasing the multiplier effect of the environmental awareness campaign. Teaching methods of environmental education will be emphasised in all Teacher Training Colleges in the country. Conservation Education Officers will also be trained at local institutions. Agroforestry will be introduced into the curricula of all agricultural training institutions. Training on environmental aspects of human settlements will be provided in polytechnics and technical institutions.

8. Baseline studies on people's perceptions and knowledge of Ghana's environmental problems should be conducted, to serve as a basis for future evaluation of the effectiveness of environmental education programmes.

SECONDARY SCHOOL LEVEL

CONTENT AREAS/GUIDELIENS

CONTENT	GUIDELINES
1. Concept of the environment natural, physical, cultural and man-made.	The Ecosystems concept: Climate; animals; plants; man; soil.
2. Natural Ecosystems a) Land Ecosystems	Local, country and world 1) Flora and Fauna: the concept of succession and climax; forest Utilization 2) Soil: Nature and types of soil in agriculture; Plant nutrients and the Biogeochemical cycle
3	3) Minerals: Nature and types of mineral wealth
b) Freshwater Ecosystems	Rivers, springs, lakes in their natural state and the effect of man on them; water pollution
c) Estuarine Ecosystems	Special features of estuaries, e.g., tidal flows and myxohaline conditions; estuarine pollution, ecology of estuaries.
d) Marine Ecosystems	Marine environment, physical chemical and biological, marine pollution.
3. Atmosphere	The air around us components and balance
4. Population Dynamics	Structure, growth and trends and associated problems; age distribution; labour force, rural vrs. urban; problems associated with over-population; population policy.

5. Land Use and Conservation a) Agriculture	Farming practices (e.g. shifting cultivation; crop rotation, mechanization) and their effect on the environment e.g., erosion and soil degradation, residual effect of fertilizers (eutrophication), effect of pesticides, effect of land clearing in water resources.
b) Forest	1. Forest and game reserves, the need for them and the associated conservation practices. 2. Indiscriminate utilization of forest resources and the effect on the environment.
c) Minerals & mineral aggregates	Exploitation and its effects on the environment; control measures.
d) Effect of degradation	Erosion, desertification, effect of open cast mining
6. Communities and their planning	Town Planning; infrastructure and housing; water supply; refuse and human waste disposal; urbanisation and its antecedent environmental problems. Rural life and its effect on the environment e.g. air pollution, noise, etc.
7. Industrialization	Establishment and development of industries; effect on the environment, e.g., pollution and population movement, exploitation of natural resources, industrial waste disposal.
8. Public Health	Health facilities, superstitious beliefs and practices in relation to health hazard resulting from misuse and pollution of the components of the environment industrial diseases and occupational hazard; drig addiction.
9. Environmental Management	Integrated planning and development, pollution and environmental quality control, public policy, environmental ethics and laws.
10. Project work by students	Clean-up campaigns, maintenance of sources of water , tree planting, prevention of soil erosion.

CHAPTER 8

ENVIRONMENTAL MONITORING

Human use systems are in a constant state of flux. The need to obtain information about the environment, involving a three-dimensional space, time and an imprecise fourth dimension perceptions, and about environmental processes, both man-made and natural, therefore, includes the need to describe change. There is need for a sound knowledge about the resource factors themselves – where they are, how much there is, and in what state – and of all the interacting elements within the frame-work of development. There is also the need for knowledge about how the environment is being modified as a result of the various human use systems. This is necessary to ensure that resource exploitation does not exceed the natural resilience of the environment.

Effective environmental control requires a "holistic" knowledge reflecting a synthesis of the biological and physical factors. Environmental assessments must also include social and economic factors within an institutional arrangement that permits appraisal of alternatives in terms of anticipated consequences. Although the needs and desires of people may vary from one place to another, the national data base on resources and environmental quality, even if dispersed, must be responsive to that variation.

ISSUES:

DATA AVAILABILITY

A fair amount of environmental data already exist in the country. However, these are scattered and to a large extent not co-ordinated, having been gathered by different organisations for specific purposes. Water quality data, on the whole, appears to be quite adequate, although gaps exist in the time series data as a result of the problems enumerated above.

It is therefore recommended that projects be put in hand to ensure that gaps are filled, weaknesses removed and the range of data being collected expanded to cover all relevant environmental indicators. These should address particularly groundwater, water quality, sediment transport and biological data. Also, the EPC will collaborate with the Meteorological Services Department to collect and analyse precipitation data on a more frequent basis. Routine measurement of pH, nitrate, sulphate etc., (in rainfall) will also be undertaken.

Generally an extensive monitoring of the air and water quality is required in Ghana so that a base period can be set to serve as basis for comparison in the future. On a long-term basis, the research institutions and the universities in the country will be involved in monitoring of environmental change. Quality assurance results and uncertainty estimates will be included in the reporting in order to establish the reliability of the data.

A major short-coming of the overall monitoring system is the lack of a common framework. Also the scope of data collected does not provide information on the social, cultural and economic aspects of the human environment in a method which permits determination of inter-relationships. The environment is the summation of what exists in an area. Thus, an assessment of the human environment or an analysis of environmental suitability for animals and plants requires consideration of all factors which affect their existence, and vice versa.

DATA GATHERING

Over the years a number of agencies and institutions have been set up to gather data on a routine basis about natural resource factors and various environmental phenomena in Ghana. In addition a large amount of project-oriented data also exists in the files of several organisations. However, the general economic decline that the country experienced in the recent past has greatly affected the operations of all the institutions that gather data. All the lead institutions responsible for data collection in the area of land and water resources lack the very basic facilities for efficient operation. Most observation and ancillary equipment have broken down or are non-existent.

Also mechanisms for archiving the data gathered, whether manual or automated, have also broken down. This has led to difficulties of retrieval and serious gaps in the data. Other problems include inadequate funds, lack of requisite manpower, and poor remuneration for staff at post.

Some amount of duplication also exists. Often the same types of data are gathered by different agencies. One reason for this is that most of the time programmes being carried out by agencies are not known to others. In some cases, too, the strict requirements for a particular project-oriented end use may not be adequately met by the existing network and systems. In such circumstances data have been collected and held by the organisation commissioning the project. Such a situation leads to inefficient use of scarce resources.

RECOMMENDED ACTIONS:

1. Monitoring Networks

The Environmental Protection Council will not be a data collection agency. Various agencies have been charged with the responsibility of gathering environmental data in Ghana. It is only where no agency collects a specific data that EPC will undertake or commission an institution to do so. These agencies will serve as nodes of the environmental data base network. The real need now is to strengthen the networks with the provision of the required needs. Government will designate, as appropriate, and support lead agencies in the various data categories. Inter-agency co-operation will be strengthened to promote co-operation in joint programmes in data gathering at sites of common interest.

The monitoring programme (system) to be established will support the different environmental management programs of EPC. The support will be extended to the whole network to ensure that the data is made available to all users.

Under the overall co-ordination of the EPC additional nodes will be established for the routine monitoring of the following areas:

- Land cover/land use
- Industrial environment
- Human Settlements
- Energy development and use
- Agriculture
- Critical ecosystems.
- Socio-economic situation.

The objectives for setting up these networks and those already in existence will be to:

i) Generate a time-series of baseline data for the measurement of change, to predict future status, and for setting standards, where these do not already exist;

ii) Provide a database for planning programmes for the prevention and control of pollution;

iii) Provide a database for policy formulation, regulations, guidelines, and the development of public education programmes;

iv) Assess compliance with environmental regulations and legislation;

v) Assess the success of environmental improvement programmes.

In locations where there are existing monitoring stations, the operator agencies will be required to include parameters that may be of interest to other users. Appropriate contractual agreements will be made to enable agencies to collect specific data on behalf of others. Under this arrangement institutes of the Council for Scientific and Industrial Research, the Mines Department, the metropolitan authorities and university departments, will be asked to carry out measurements for the EPC according to specifications and formats developed in consultation with the Council. There is therefore a need for a technical advisory committee to assist the monitoring programme. The committee will comprise experts from the different nodes of the network to look at data format, specifications, compatibility of the data layers etc.

2. **Levels of Monitoring**

Two broad levels of monitoring are proposed:

a) **Synoptic Monitoring**

The following aspects of the environment will be monitored:

- changes in forest cover (deforestation/afforestation);
- ecotone dynamics;
- vegetation stress;
- land use;
- bushfire;
- impacted areas;
- surface water (areal extent);
- lake eutrophication;
- urban areas;
- land degradation.
- Climate

Field data will be supplemented with and integrated into remote sensing data. A complete set of land resource satellite imagery will be acquired for the entire country to be used to obtain information about the current status of natural resources and the environment. The information will serve as the baseline for future monitoring. After this initial assessment detailed studies will be made of areas that may be found to have been affected as a result of environmental deterioration. The assessment will be complemented with systematic aerial surveys and ground checks.

To facilitate this, efforts being made by the EPC and the Department of Geography and Resource Development of the University of Ghana to build a national remote sensing capability will be further supported. In addition, all Geographic Information Systems and remote sensing activities in different parts of the country will be considered when data collection for monitoring is being considered eg. NDPC, Forestry Department, Soil Research Institute, Cocoa Services Division etc.

(b) Health-related Monitoring Programme

(i) Water Quality Monitoring

This aspect of the monitoring programme will concern itself with the impacts of usage on water quality. It will draw on the network of monitoring stations operated by the Meteorological Services Department (MSD), Architectural and Engineering Services Corporation (AESC), Water Resources Research Institute (WRRI), Institute of Aquatic Biology (IAB) and the Water and Sewage Corporation (GWSC). Of particular interest will be stations near settlements in order to measure the quality of water used, as well as the impact of various pollutants on the quality of water resources. Specific details of the water monitoring programme are indicated under the Water Management section of Chapter 5.

Selected stations will report basic water quality data and data on toxic substances such as heavy metals and pesticides in rivers, streams, lakes, reservoirs and in groundwater. These reports will be collated by the EPC and analysed together with other relevant data. The objective will be to assess the suitability of water for various uses in order for appropriate measures to be put in place.

(ii) Air Quality Monitoring

The air monitoring programme of the EPC will be expanded. Two monitoring networks will be established:

- Ambient air pollution (air mass stations):-

: Background monitoring

: Baseline monitoring

- Impact air pollution (special source stations)

Baseline monitoring will assess levels of pollutants in areas which are not directly influenced by anthropogenic sources. This will help in determining what exists naturally and in identifying "new" pollutants. The monitoring stations will be established away from major settlements. Background monitoring will be for the major pollutants known to exist in Ghana to study trends, set standards and to monitor the effect of control measures.

Impact air pollution monitoring in the environs of major industrial establishments will be undertaken. Industries that will be given priority attention include the gold mines, aluminium processing and cement works. The pollutants to be monitored will include sulphur dioxide, oxides of nitrogen, oxides of carbon, (total) suspended particulates, acid deposition, heavy metals (mercury, lead, and cadmium), respirable and settleable dust.

Monitoring of occupational exposure to dust, toxic particulates, particularly lead, asbestos and other toxic pollutants in industry will be carried out in co-operation with Factory Inspectorate. The objective will be to obtain information about levels in workers, and to correlate these with levels in the environment. Occupational exposure of mine workers to dust, arsenic and other toxic particulates will also be monitored in co-operation with the Mines Department.

(iii) Emission Inventory

Assessment of quality and nature of pollutants actually emitted by industry before dispersion into environmental media is essential for regional environmental management. This will enable the EPC to ascertain the contribution of each source to the overall pollution load. It will make it possible to determine in real terms the level of financial responsibility of industry in pollution control measures based on the Polluter Pays Principle (PPP).

In this regard a listing and description of air pollution sources, including an estimated pollutant emission quantification, will be compiled. For this purpose the following data will be gathered:

- Geographical and geophysical data;
- Production data;
- Data on traffic;
- Data on point sources;
- Data on the size of the emissions or emission factors;
- Data on the nature of the emitted pollutants.

The compilation will be carried out by the EPC in collaboration with the Ministry of Industries, Science and Technology. The inventory will be computerised to allow for quick up-dating as new data or new sources appear.

(iv) Noise Monitoring

Problems of noise have not received any serious attention in Ghana and information, even on background levels, is seriously lacking. Preliminary studies conducted by the EPC in Accra indicate that noise levels in several parts of the city are generally higher than the permissible levels recommended by the relevant international agencies.

Noise is a by-product of industrialisation and modernisation. However, this is not an unavoidable problem given the state of present-day technology. Urgent action will be taken to prevent the

worsening of the situation as the national economy gathers momentum and the standard of living for a broad cross-section of the population improves.

A programme on noise will involve the following:

1. Noise level surveys with the view to drawing noise maps for the major urban areas and cities to aid in planning and siting facilities;

2. Assess outdoor noise with respect to community response with the view to establishing "acceptable" levels for the purposes of setting standards for ambient noise;

3. Develop national standards and legislation on outdoor noise;

4. Enact and enforce legislation on industrial noise comparable to international standards;

5. Create awareness of the nuisance and hazards of noise among the general public;

6. Establish a network of stations to monitor trends.

(v) Food Contamination

Food is a good indicator of the quality of the environment in which it is produced. Chemical contaminants present in food may arise from industrial pollution in the environment, from agricultural practices, and from food processing. In addition, some chemical contaminants may originate from natural geological formations or from fungal contamination. These represent a potential hazard for human health as well as an impediment to the exportation of food.

The EPC will initiate a programme to monitor the levels of chemicals in food. The programme will involve, among others, the Ghana Standards Board, the Food Research Institute and the Biochemistry Departments of the universities. The objectives of the programme will be to:

a) Establish a baseline and determine changes in the levels of a food contaminant with time;

b) Give an indication of the effectiveness of measures introduced to reduce food contamination;

c) Check that levels of contaminants in food do not exceed established standards or guidelines;

d) Assist in the development of a system of food control capable of protecting the consumer from health hazards and commercial fraud;

e) Control and monitor environmental pollution from industrial and agricultural chemicals generally.

A priority list of contaminants to be monitored will be established based on chemicals known to be in use in the country by industry, agriculture, and from urban centres, and also based on the persistence, ubiquity, and abundance of identified contaminating agents in the environment, as will be established by the initial surveys.

DATA MANAGEMENT AND SYNTHESIS

Efficient information flow is absolutely critical within any network, and for decision making. This will be particularly important for a decentralised monitoring network comprising autonomous entities. To facilitate the effective management of the environment a National Environmental Information System (NEIS) will be established within the EPC.

All the institutions participating in the monitoring network and those gathering other natural resource and environmental data will be required by legislation to furnish the EPC with prescribed data periodically. The functions for the system will be to:

1. Provide an information referral service on a wide range of environmental subjects;

2. Serve as a readily accessible archive of homogeneous data sets on environmental quality;

3. Provide organised data and information on the state of the environment and to serve as information support for development planning;

4. Provide a means for early warning and evaluating the impact of development activities and environmental improvement initiatives;

5. Provide inputs for environmental education programmes.

The system will offer the following services:

(a) Referral Service

The referral service will locate sources of environmental data and information without having to move them, and assist potential users to have access to them. To this end a register of national sources of environmental information will be compiled and published. The original sectoral data will be maintained by the agencies generating them. Potential users of the wide range of environmental information that would be made available through the system would be able to access the information directly using the register (directory) of sources, or through the services of NEIS.

(b) Data Bank

A computer-based archiving and retrieval of raw environmental data will be set up. For the monitoring network stations operated by other agencies, only summaries and syntheses of the original data will be held at the EPC. These data sets will be held and provided on "as is" basis. The aim will be to build up a base of substantive information to facilitate their dissemination and use by the wider public and for planning applications. Data bases will also be established for the air, water and food monitoring programmes.

Where appropriate, data received from the various agencies will be processed into a geographical information system (GIS) format for ease of comparison and synthesis. The data base will thus contain environmental data items described by their attributes (i.e.., what they represent), geographic location (by longitude and latitude, or any reference system that may be deemed appropriate), and their variation in space.

(c) Data Synthesis

The databases will be used for assessments and analyses of environmental problems and the state of natural resources. It will offer information support to researchers and resource managers, assist in preparing forecasts, environmental policy development and in environmental monitoring and impact analyses.

(d) Publications and Information Support

The following publications will be issued periodically:

- information bulletins and newsletters;
- fact sheets;
- technical bulletins;
- technical reports.

In addition, and in collaboration with other agencies, an annual National Environmental Data Report series giving indications of the quality of the environment will be published.

INDICATORS OF ENVIRONMENTAL CHANGE

For effective monitoring of changes in the quality of land, baseline data and information will be systematically collected for existing and future research studies.

Change, positive or negative, is determined in relation to some previously existing state. Monitoring systems are intended to give an indication of changes in an ecosystem, or the environment as a whole, and in particular to give a warning of possible deterioration.

To monitor changes in the quality of the environment the following characteristics and parameters indicative of change will be assessed and measured:

LAND AND LAND COVER

Soil Quality Change

- Alkalinity
- Salinity
- Organic matter
- Erosion (sheet, rill, gulley and wind erosion)
- Surface cover of iron pans
- Surface cover of rocks
- Vigour of crop growth
- Appearance and frequency of indicator species
- Crop yields

Forests

- Canopy cover
- Openness
- Frequency/density of fire tolerant species
- Humidity and soil moisture
- Change in regeneration of common species

Savanna

- Density/frequency/cover of annual species
- Canopy cover of wood species
- Frequency/density of fire resistant species
- Reduced overall cover
- Frequency/density of indicator species

Rangeland

- Frequency/density of palatable species
- Frequency/density of toxic species

An interesting indicator of vegetation change may be the presence or absence of various wildlife species. Just as some species are exclusively savanna and some forest species so some forest species prefer or are more abundant in closed forest than in secondary forest. With better knowledge of our wildlife populations, therefore, it may be possible to relate the presence of absence of certain species of wildlife to various degrees of disturbance or changes in the vegetation.

Climate

- Temperature
- Rainfall
- Humidity
- Soil Temperature

- Evaporation
- Radiation
- Sunshine hours

An indicator of savanna woodland degradation which unsophis- ticated people may understand may be amount of fuelwood obtained from farm land clearing. The situation of farmers digging tree roots for fuel during farm land clearing is a good indicator of deforestation approaching desertification conditions.

Land Use Change

- Proportional acreages under the different land use systems
- Introduction of new uses of land.

WILDLIFE POPULATIONS AND HABITATS

In view of the value of wildlife species as environmental indicators, and the dearth of information on Ghana's wild animal populations, appropriate mechanisms will be established for the following:

a) long-term monitoring of wild animal populations; and

b) assessment and long-term monitoring of the effects of pollution (from industrial and domestic wastes) and agro-chemicals on wildlife.

In the dense closed forests and in most of the savanna woodlands, except during the dry season when the grass has been burnt, animal populations will be monitored from the ground.

The following indicators of endangerment will be used:

- numbers of the different species recorded;
- composition and condition of species in relation to the size and nature of the habitat;
- pressure from hunting, export, etc. as indicated by licences, market surveys and other observations.

Changes in habitat will be monitored by way of vegetation changes and changes in other habitat factors such as water, predators, etc.

WATER QUALITY

- microbiological indicators;
- particulate matter;
- organic pollution indicators;
- temperature;
- salinity and specific ions;
- inorganic micro-pollutants;
- organic micro-pollutants;
- pesticides.

MARINE AND COASTAL ECOSYSTEMS

The following indicators will be used for monitoring the marine and coastal environments:

Coastal processes

(a) Meteorological indices, e.g. wind. wave characteristics, temperature.

(b) Sediment budget i.e., river sediment discharges, longshore and onshore/offshore sediment movement.

(c) Beach profiles

(d) Frequency of use of beaches for recreation.

Marine Pollution

(a) Oil slicks and tarballs (petroleum hydrocarbon pollution)
(b) Coliform bacteria (faecal pollution)
(c) Pesticides (agricultural and industrial pollution)
(d) Shore flora and fauna }
(e) Trace elements } domestic, industrial and
(f) Nutrients } agricultural pollution
(g) Dissolved oxygen }
(h) Acidity }

Wetland Ecosystems

(a) Hydrological indicators: water levels, inflow/outflow rates, sediment transport;
(b) limnological indicators: pH, transparency, colour, conductivity, dissolved oxygen, biochemical/chemical oxygen demand;
(c) biological indicators: algae, macrophytes, invertebrates, fish, birds and mammals.

Marine fishing resources

(a) Daily beach temperatures at selected stations;
(b) weekly bathythermograph traces;
(c) length frequency measurements of fish species of economic importance.

Impact of offshore oil development

(a) Offshore activities:

- biological communities;
- physical characteristics of the seabed;
- hydrocarbon contamination;
- levels of trace metals;
- radioactivity in sea water.

(b) Onshore activities:

- Tarballs and trace levels of various metals in fauna and flora.
- oil pollution.

Impact of urban development

(a) Human activities:

- rate of immigration into the coastal zone;
- impact of beach structures, e.g. harbours, buildings, etc.;
- frequency of beach recreational activities;
- rate of beach sand and clay extraction.

(b) Environmental indicators:

- limno-chemical properties;
- sediment transport with respect to rate of erosion inland;
- air quality;

- *levels of toxic substances in coastal food webs;*
- numbers of pathogenic bacteria.

Social-Economic Situation

Characteristics of settlement systems
- demography
- housing conditions
- characteristics of occupants and levels of living
- regional socio-economic system
- origin of the people and migratory characteristics
- local land tenure system
- trends of the traditional husbandry systems.

CHAPTER 9

ENVIRONMENTAL ACTION PLAN SUMMARY

The following actions will be taken by Government:

1. Adoption of a National Environmental Policy;

2 Adoption of a policy agenda consisting of:

a) Passage of draft legislation on:

1. Restructuring of EPC.
2. Establishment of EIA procedure.
3. Revised forestry policy.
4. Revised conservation legislation.
5. Revised Factory, Shops and Offices Act.
6. Legal framework for coastal zone management.
7. Legislation to control hazardous chemicals.
8. Establishment of a Water Resources Commission.
9. Revised human settlements policy.

This draft legislation is presented in Volume Two.

b) Preparation and subsequent adoption of draft legislation on the following:

1. Land management policy. (To be prepared by land management structure to be established - see Inst. Strengthening.)

2. Range management policy (Ministry of Agriculture)

3. Fisheries management policy. (Ministry of Agriculture).

4. Water management policy (To be prepared by Water Resources Commission).

c) Preparation and subsequent adoption of environmental standards and regulations to implement those standards:

1. Air quality standards (EPC)
2. Water quality standards (EPC)
3. Noise standards (EPC)
4. Regulations for Water abstraction (To be prepared by WRC)
5. Regulations for the discharge of Pollutants into water bodies. (To be prepared by WRC)
6. Mining regulations (Under Preparation by Minerals Commission).
7. Industrial regulations (To be prepared by MIST in consultation with EPC and Ghana Standards Board).

3. Implementation of the proposed investment program together with financing of the associated recurrent costs over a ten-year period. The details of this investment program will be presented in Volume Three. A summary description is given below:

a) Natural Resource Management

1. Speed up and broaden the current land registration exercise (Lands Commission).

2. Sustain and enforce current bushfire legislation and strengthen control organisation (District Assemblies).

3. Implement a soil conservation program with a focus on restoring soil fertility. (Ministry of Agriculture.

4. Continue support the Interdepartmental Pesticide Control Programme (EPC).

5. Support current agroforestry programmes, and encourage the development of private and community forests. (Agroforestry Unit., Min. of Agriculture).

6. Assure sustainable supplies of fuelwood by requiring industries to meet fuelwood needs from plantations, and by licensing charcoal burners and commercial fuelwood producers. (District Assemblies).

7. Improve the collection of water cycle data (AESC-Hydro).

8. Expand and update water resources assessment (WRRI).

9. Prepare Water Master Plans for all the river basins of the country. (Ongoing WRRI).

10. Implement measures for the rational management of fish stocks. (Fisheries Department).

11. Establish protected areas to be managed for multiple use in the coastal zone (District Assemblies /NGOs).

12. Control agricultural development in the coastal zone, with particular reference to the use of agrochemicals and the implementation of soil conservation programs. (District Assemblies).

13. Implement the national Oil Spill Contingency Plan (Energy Board).

14. Conduct additional research on:
- effects of mechanization on agricultural land (Soil Research Institute).
- effects of agrochemicals on agricultural land (Soil Research Institute).
- rangeland degradation (Min. of Agriculture).
- agroforestry, especially with reference to indigenous species and indigenous agroforestry systems. (I.R.N.R)
- Effects of pollution on wildlife (Univ. of Ghana, Zoology Dept.)
- water-related research including:

water pollution; environmental impacts of water resources; siltation resulting from deforestation, soil degradation; and erosion. (Institute of Aquatic Biology).

- energy-related research including:

household energy use; charcoal production (Energy Board).

b) Managing the Built Environment

1. Conduct post-audits on industries in the coastal zone that appear to be contributing to environmental damage (EPC).

2. Enforce standards and regulations on waste water discharges, emissions, and disposal of solid wastes, especially in the coastal zone. (District Assemblies).

3. Support ongoing waste management programmes of the Accra Metropolitan Area, District Assemblies, and townships in the coastal zone.

4. Improve urban drainage in the coastal zone. (Ongoing under the Second Sector Pro.) (AMA/District Assemblies).

5. Improve the siting of industries and enforce zoning regulations in the coastal zone. (NDPC).

6. Develop selected sites in urban areas for recreation and tourism, particular in the coastal zone. (AMA).

7. Implement an appropriate strategy for coastal protection, taking into account the efforts of other countries in the West Africa sub-region. (AESC-Hydro).

8. Implement a coastal zone management plan. (NDPC).

9. Continue support for the National Programme on Chemical Safety (EPC).

10. Review and update the National Physical Development Framework. (NDPC).

11. Acquire government lands in advance of anticipated development needs. (NDPC).

12. Reinforce selected settlements to act as rural service centres; reduce congestion in the Accra Metropolitan Area by promoting the development of secondary centres in the coastal zone. (NDPC).

13. Implement an urban sanitation programme in Accra and other urban centres. (Ongoing under Second Urban Sector Prog.) (Min. of Works and Housing).

14. Require commercial houses to provide public places of convenience for their customers. (District Assemblies).

15. Implement urban landscaping and urban forestry programmes. (Parks and Gardens).

16. **C. Environmental Education**

(1) Prepare and implement a program of nonformal environmental education directed at the district and local levels, including the preparation of training materials. (EPC).

(2) Establish an Environmental Information Centre to provide documentation, information and referral services to the general public. (EPC).

(3) Prepare and publish an annual report on the State of the Environment in Ghana (EPC).

(4) Implement the formal environmental education programme in primary, middle, junior secondary and senior secondary schools. (Ministry of Education).

(5) Implement environmental education in teacher training institutions (Ministry of Education)

(6) Introduce agroforestry in the curriculum of all agricultural training institutions. (Ministry of Education).

(7) Provide training in environmental aspects of human settlements in polytechnics and technical institutions. (Ministry of Education).

(3) Conduct baseline studies on people's perceptions and knowledge of the environment. (ISSER).

d) Environmental Monitoring

(1) Establish data collection networks for land use (NDPC).

(2) Establish a computerised data bank of environmental information in the country (EPC).

(3) Implement a monitoring programme consisting of: (a) synoptic monitoring of environmental indicators at the national level; and (b) health-related monitoring of water quality, air quality, emissions, and noise at selected sites (EPC).

(4) Collect baseline data and monitor changes in wildlife populations. (GWD/NGOs)

(5) Monitor the level of chemicals in food (Food Research Institute).

(6) Prepare and publish an annual report on National Environmental Data.

4. Strengthening of the institutions needed to implement the Plan at the national, regional, district and local level; and creation of an enabling environment for community, private sector and NGO initiatives in support of the Plan.

(a) Strengthen EPC to carry out its central role in EAP implementation.

(1)Strengthen EPC's capacity to implement programs in environmental impact assessment, environmental monitoring, nonformal environmental education, and public information.

(2) Complete decentralization of EPC to the regional level, with mobile teams to reach the district and community level on demand.

(b) Strengthen NDPC to carry out its role in Plan implementation (NDPC to prepare proposals).

(1) Strengthen NDPC's Spatial Planning Division through the establishment of a Human Settlements Unit.

(2) Establish District Development Planning Units.

(c) Establish an institutional framework for integrated land management and land use planning. (EPC).

(d) Strengthen selected sectoral agencies.

(1) Strengthen Forestry Department and Game and Wildlife Department (Forestry Research Management Project).

(2) Strengthen AESC-Hydro to implement water management regulations.

(3) Strengthen Factory Inspectorate to implement revised Factories, Shops and Offices Act.

(4) Strengthen Dept. of Mines to implement revised mining regulations (UNDP-Financed On-going).

(5) Strengthen third cycle training institutions to carry out programs of environmental education (EPC).

(6) Strengthen institutions involved in data collection for environmental monitoring (Survey Dept.).

(e) Strengthen interagency coordination/

(1) Improve cooperation between EPC, Min. of Industry, Ghana Investment Centre, Town and Country Planning Dept., and local authorities to ensure that zoning regulations are adhered to in siting industries/

(2) Re-activate EPC's Environmental Education Committee to coordinate the planning and implementation of non-formal environmental education programs.

(3) Promote joint programmes in environmental data gathering at sites of common interest.

(f) Establish and support District Environmental Management Committees and Community Environmental Committees.

(g) Encourage environmental initiatives by community groups and NGOs.

CHAPTER 10

IMPLEMENTATION STRATEGY

The Environmental Action Plan is to be implemented over a ten year period from 1st January 1991 to 31st December 2000. The first two years, 1991-1992 will be the start up phase to be devoted to mobilization of resources and support and assistance from the Donor Community. There would be a mid-term review at the end of 1995 to take stock, assess progress or otherwise and plan redirection.

It is expected that Government will adopt the National Environmental Policy and the proposed policy agenda as listed under EAP Action Plan Summary and that this agenda will be carried out during the start up phase.

The Environmental Protection Council, the Government institution that advises and co-ordinates all environmental related issues in the country, will be the overall co-ordinating body for Plan implementation. However, other institutions and bodies like the National Development Planning Commission and the District Assemblies will play very important roles.

The Role of the EPC

To enhance the effectiveness of the EPC as the custodian of the national environment, and the co-ordinator of all activities relating to the environment, Government will review the status of the Council, including its placement within the administrative machinery of the country. Specifically, the EPC will be strengthened technically, administratively and legally for the purpose of facilitating its tasks as regards the following:

- establishment of standards and guidelines relating to the pollution of air, water, land and other forms of environmental pollution including the discharge of wastes and the control of toxic substances;
- authority to request co-operation from any governmental ministry or other institution;
- authority to perform monitoring, inspection and ensure law enforcement in co-operation with other law enforcement agencies.
- implementation of the EIA process;
- implementation of the environmental monitoring system;
- implementation of a programme of nonformal environmental education;
- implementation of a public information programme.

Some specific implementation programmes/projects by NDPC

- Review and update the National Physical Development Framework.
- Implement a coastal zone management plan (collaborating with DAs and NGOs).
- Reinforce selected settlements to act as rural service centres; reduce congestion in the Accra Metropolitan Area by promoting the development of secondary centres in the coastal zone.
- Improve the siting of industries and enforce zoning regulations in the coastal zone (collaborating with DAs).

The Role of Sectoral Agencies/Institutions

Various ministries and agencies who manage some sector of the natural and built environment will implement some actions in the Plan's implementation. Notable among these are the Ministry of Agriculture, Forestry Dept., National Energy Board, the Lands Commission and some research institutions.

Ministry of Agriculture:

- Implement a soil conservation programme with a focus on restoring soil fertility.
- Continue to support the Interdepartmental Pesticide Control Programme (collaborating with EPC/GAEC)
- Support current agroforestry programmes and encourage the development of private and community forests. (Agroforestry Unit with support from Forestry Department)
- Implement measures for the rational management of fish stocks.

Lands Commission:

- Acquire government lands in advance of anticipated development needs (collaborating with NDPC).
- Speed up and broaden the current land registration exercise.

National Energy Board:

- Implement the National Oil Spill Contingency Plan (collaborating with EPC and Ministry of Transport/Navy)

Ministry of Works and Housing:

- Implement an urban sanitation programme in Accra and other service centres.

Department of Parks and Gardens:

- Implement urban landscaping and urban forestry programmes (with NGOs)

AESC - Hydro:

- Implement an appropriate strategy for coastal protection, taking into account the efforts of other countries in the West African Sub-region.

Role of Research Institutions:

Under the Plan's implementation, some research institutions will conduct studies/research into various practices and problems on the environment.

The following institutions will research into:

Soil Research Institute:
-effects of mechanization on agricultural land
-effects of agrochemicals on agricultural land

Ministry of Agriculture:
-rangeland degradation

Institute of Renewable Natural Resources:
-agroforestry; especially with reference to indigenous species and indigenous agroforestry systems;

Zoology Dept., University of Ghana:
-effects of pollution on wildlife.

Institute of Aquatic Biology:
-water related research including:

- water pollution
- environmental impacts of water resource development projects.

- siltation; resulting from deforestation, soil degradation and erosion.

National Energy Board:

-energy related research including

- household energy use
- charcoal production

Water Resources Research Institute:

- Prepare water master plans for all river basins of the country.
- Improve the collection of water cycle data (collaborating with AESC-Hydro and Institute of Aquatic Biology)

The Role of the District Assemblies:

In line with the government's policy of decentralization, District Assemblies have a central role to play in the implementation of the Environmental Action Plan. This is in recognition of the fact that national policies and programmes on the environment can best be translated into action at the local and district levels.

To this end, District Environmental Management Committees (EMC) with the broad responsibility for monitoring and co-ordinating environmental protection and improvement activities in the Districts will be established within each District Assembly.

Some specific actions to be implemented by the District Assemblies are:

- Sustain and enforce current bushfire legislation and strengthen control organization. (training by National Fire Service and monitoring by EPC).
- Assure sustainable supplies of fuelwood by requiring industries to meet fuelwood needs from plantations, and by licensing charcoal burners and commercial fuelwood producers. (guidelines from NEB & EPC).
- Establish protected areas to be managed for multiple use in the coastal zone (collaborate with NGOs).
- Control agricultural development in the coastal zone, with particular reference to the use of agrochemicals and the implementation of soil conservation programmes. (technical support from District Agricultural Officers)
- Enforce standards and regulations on waste water discharges, emissions, and disposal of solid wastes, especially in the coastal zone.
- Develop selected sites in urban areas for recreation and tourism, particularly in the coastal zone (collaborate with NGOs and AMA).

The Role of Community Groups:

It is proposed that Community Environmental Committees (CEC) be established to be the organs through which the environmental programmes of the District Assemblies will be carried out at the community (town and village) level.

In addition to the programmes established by the District Assembly, each CEC may have the responsibilities of mobilising the people and resources in the community, provide fora for discussions on the environment, promote energy conservation and generally serve as a local environmental watch-dog and report to the appropriate authority in the district any activity deemed to violate the integrity of the local environment.

The Role of the Non-Governmental Organisations (NGOs)

The role NGOs have played in the past and continue to play in the area of environmental management is greatly appreciated. Some NGO's are undertaking tree planting and community forestry projects. In the implementation of this Plan, the participation of NGO is greatly encouraged.

On the international scene, international NGOs participation in programmes related to global climatic change, combating desertification and protection of biodiversity will be greatly encouraged.

Locally, apart from specific projects and programmes they may undertake jointly with the District Assemblies and the Community Environmental Committees, NGOs are encouraged to promote urban beautification, non-formal environmental education programmes, afforestation and agroforestry projects and projects for the management of woodlands, watersheds and wildlife in collaboration with local authorities and community groups.

LIST OF TABLES AND FIGURES

.ig. I GHANA: ADMINISTRATIVE REGIONS

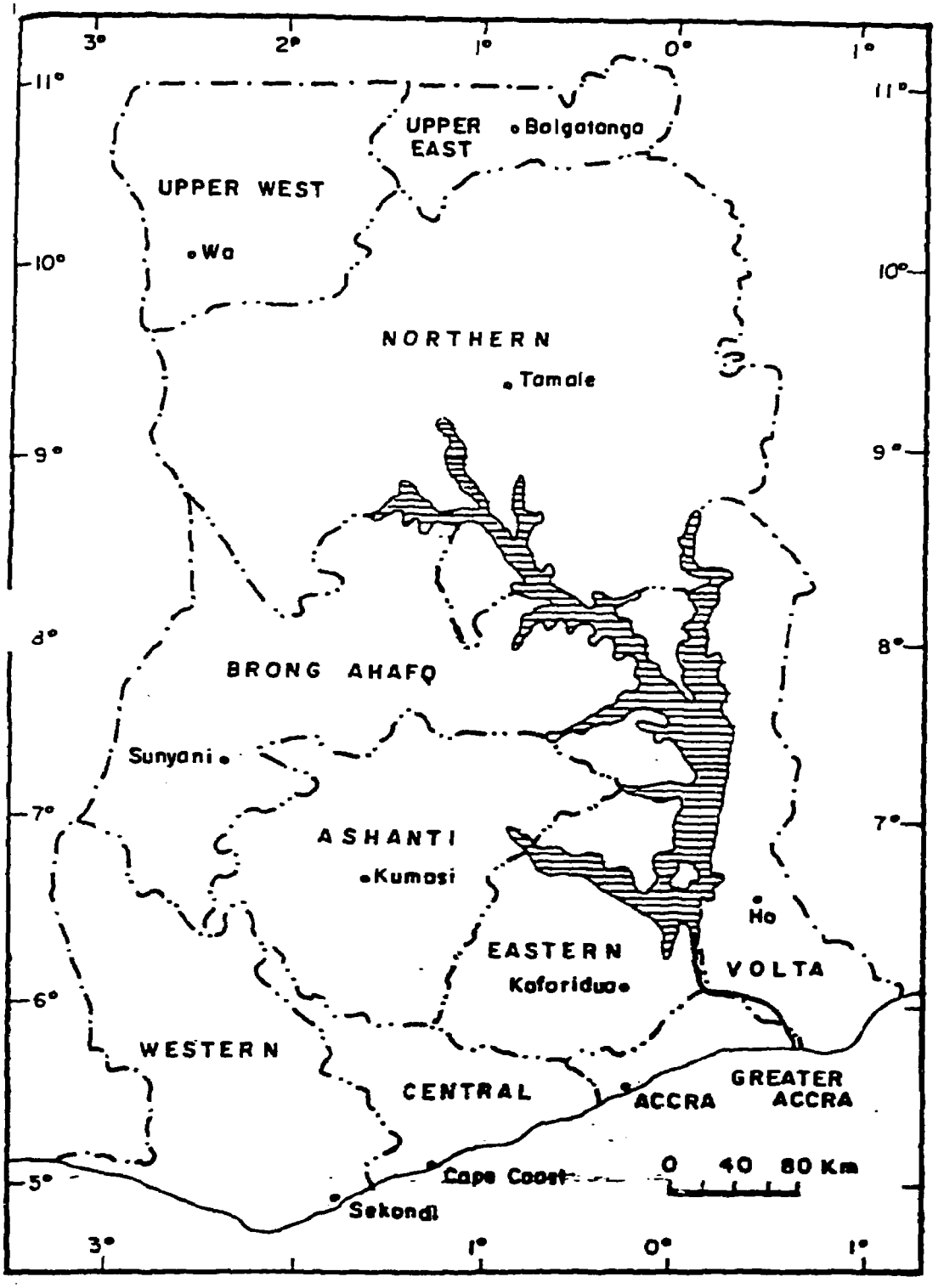
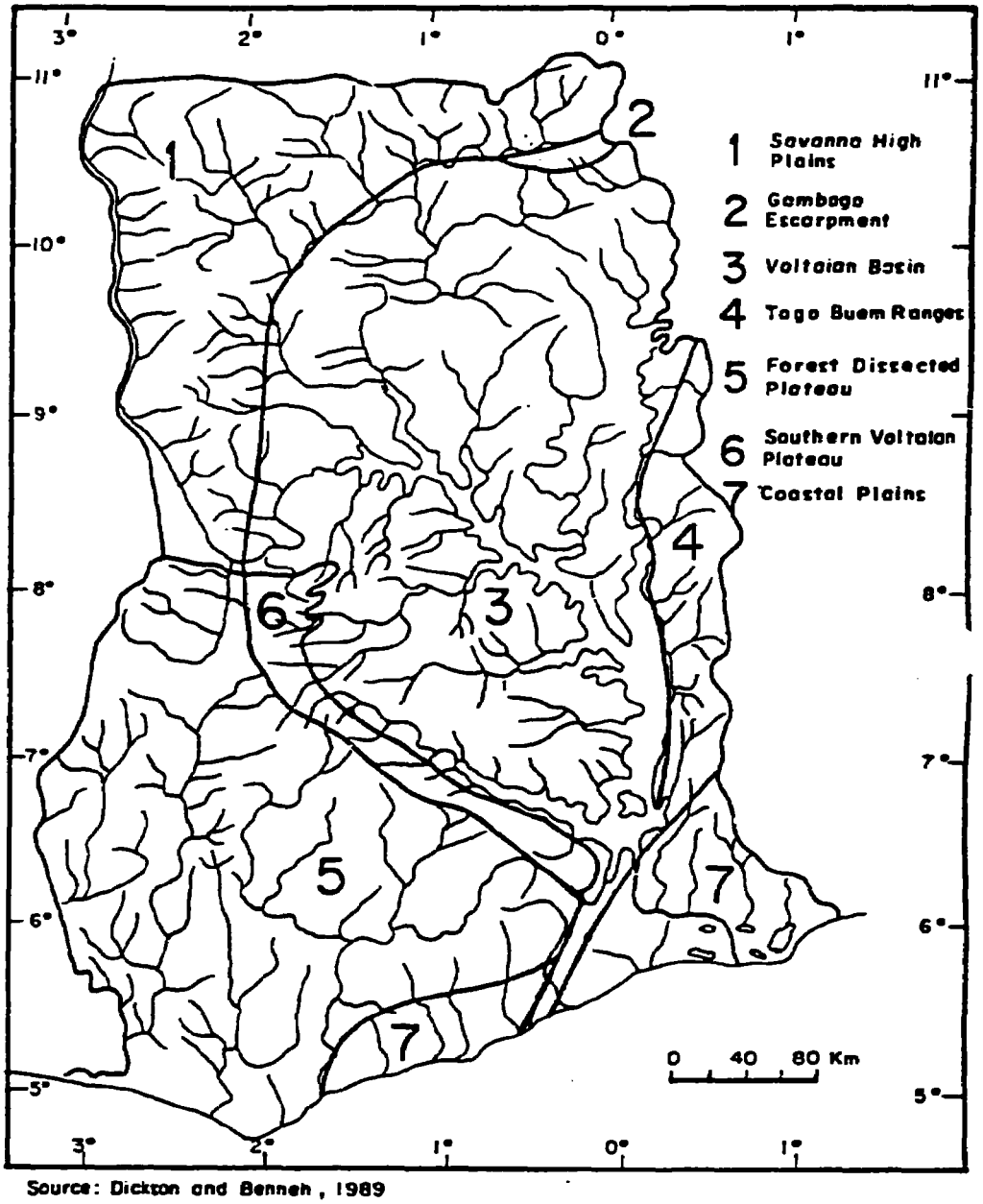


Fig.2 GHANA:
DRAINAGE AND PHYSIOGRAPHIC REGIONS



Source: Dickson and Benneh, 1989

Fig. 3 AN INTEGRATIVE INSTITUTIONAL FRAMEWORK FOR ENVIRONMENTAL MANAGEMENT AND POLICY

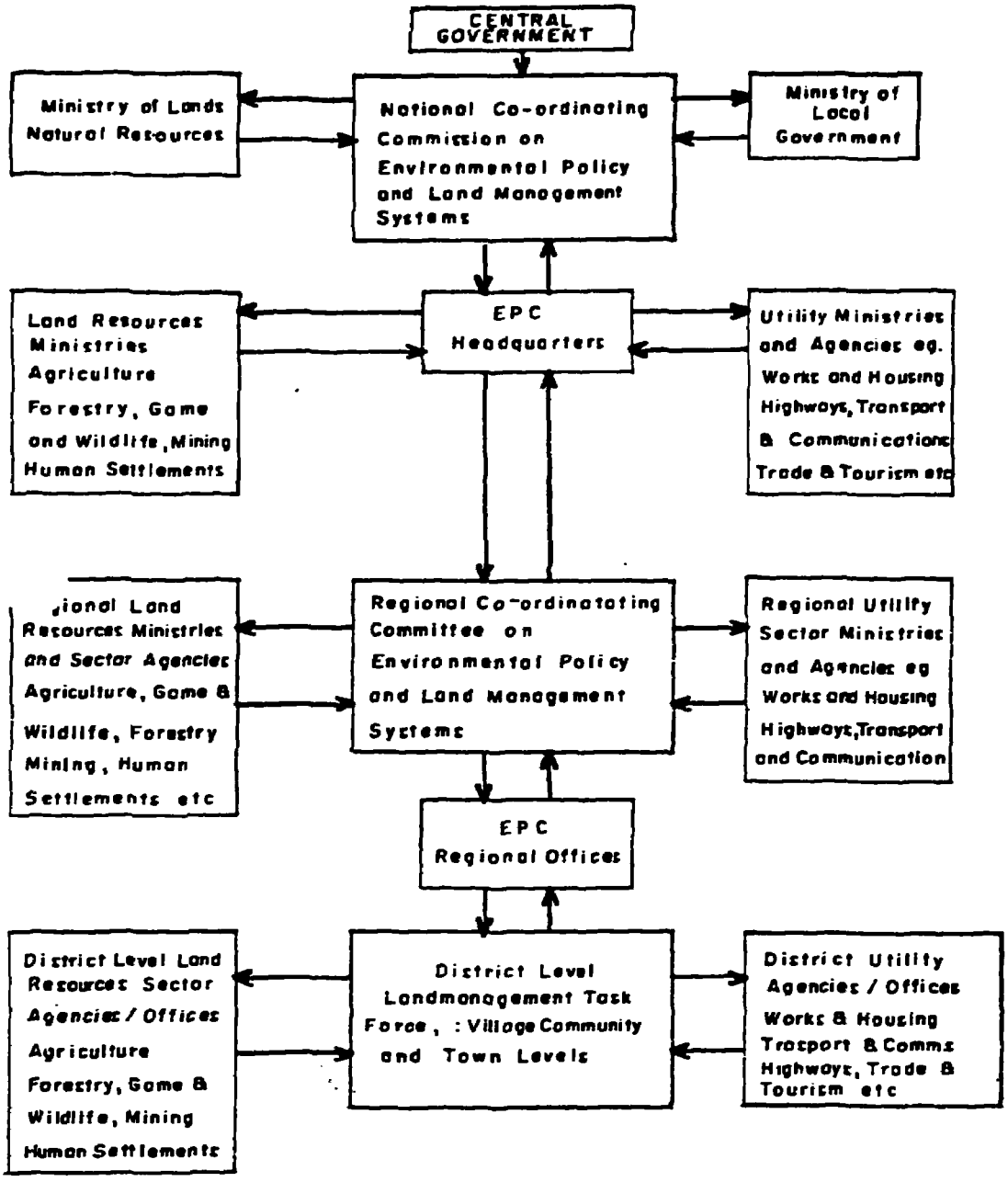
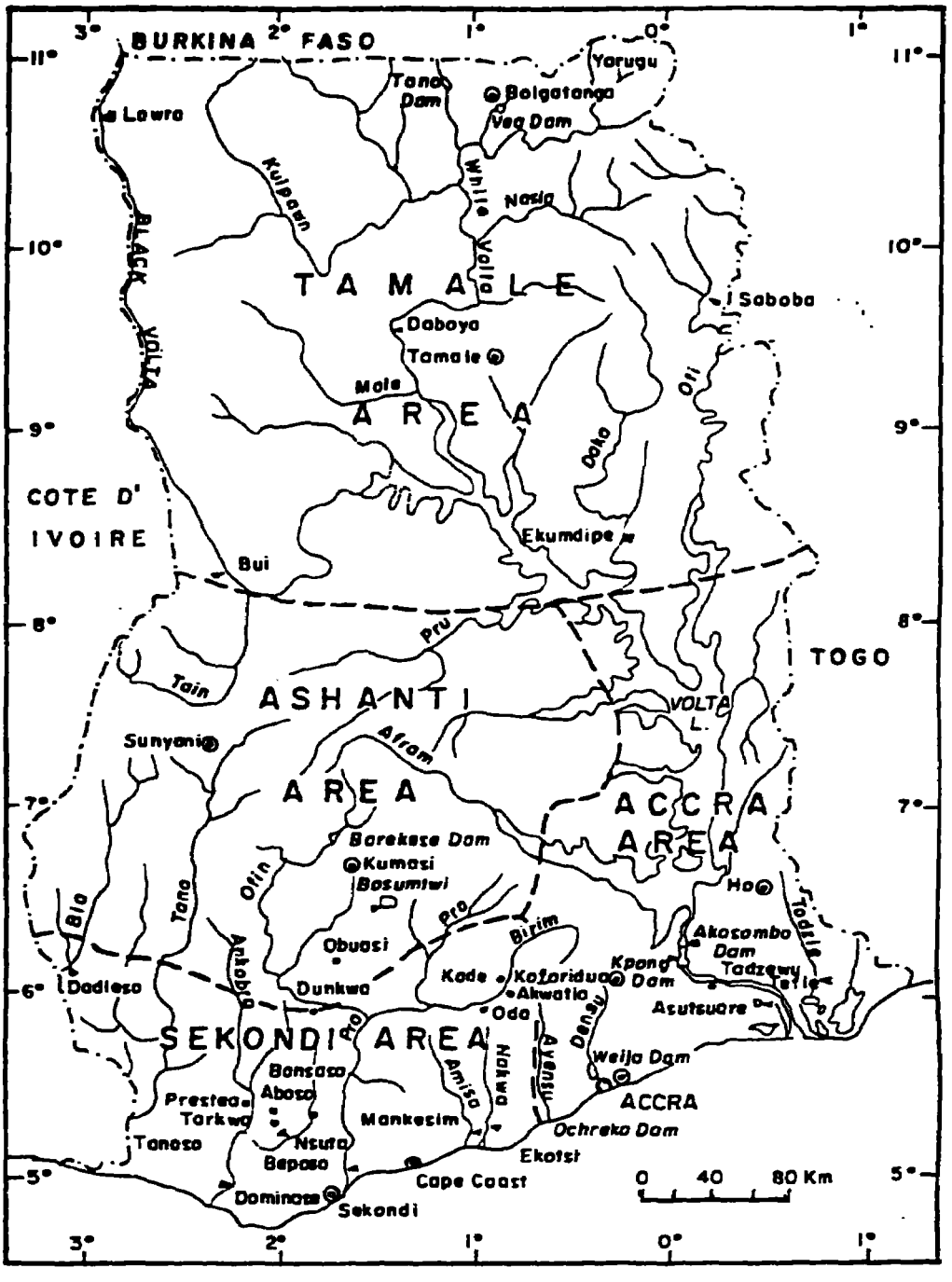


Fig.4 GHANA: PROJECT SAMPLING STATIONS



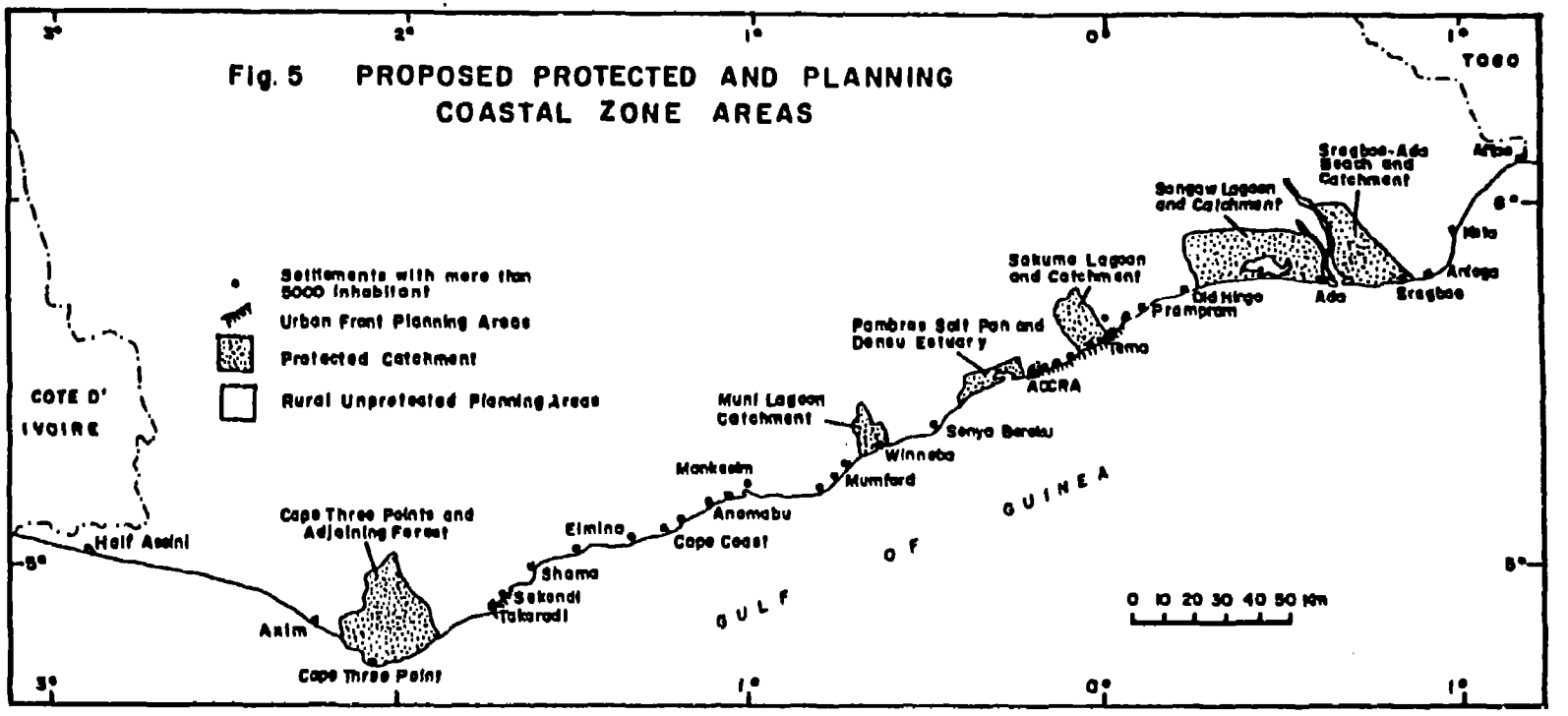


Fig. 5 PROPOSED PROTECTED AND PLANNING COASTAL ZONE AREAS
Settlements with more than 5000 inhabitant
Urban Front Planning Areas
Protected Catchment
Rural Unprotected Planning Areas
COTE D' IVOIRE
TOGO
Half Assini
Cape Three Points and Adjoining Forest
Axim
Cape Three Point
Elmina
Shama
Sekondi Takoradi
Cape Coast
Anomabu
Mankessim
Mumford
Winneba
Senya Beraku
Muni Lagoon Catchment
Pambros Salt Pan and Densu Estuary
Tema
ACCRA
Sakumo Lagoon and Catchment
Prampram
Old Ningo
Songaw Lagoon and Catchment
Ada
Sraebae-Ada Beach and Catchment
Sraebae
Ardega
Keta
GULF OF GUINEA
0 10 20 30 40 50 km

Annex A.1

ACTIVITIES AND THEIR IMPACTS ON RECEIVING MEDIA

	RECEIVING MEDIA				
SECTORAL ACTIVITIES	PEOPLE	ANIMAL	VEGETATION (PLANTS)	WATER (FISH, ETC.)	AIR
AGRICULTURE: CROPS (Agro-chemicals use; farming systems—slash & burn, mechanisation)	- increased human disease - increased un-employment from mechanisation	animal poisoning & death reduced habitat	siltation & flooding from destroyed vegetation & plant cover reduced species diversity	increased water borne diseases from siltation & agro-chemical wash in flooding reduced fish stocks	reduced air quality from CO2 emissions & other gases from burning
GRAZING (free-range or open access & type of ruminant)	reduced arable land reduced crop yields from trespassing ruminants	reduced availability of pasture; increased reliance on grain	destroyed vegetation, especially of rare species from non-selective grazing increased soil and wind erosion	destruction of water sheds & contamination of drinking streams and ponds	increased rates of evaporation of water into air
FORESTRY (logging, fuelwood, land clearing for farming)	reduced fuelwood	reduced habitat & disappearance of endangered species	reduced forests and plant cover increased soil erosion & chances of desertification	destruction of watersheds & drying up of waters reduced moisture carrying capacity of soil	increased evaporation rates vs. lower precipitation rates affecting rainfall patterns
HUNTING (hunting practices by fire/chemicals/ traps; the timing of hunting & the rate & intensity of hunting)	food poisoning	reduced stock & disappearance of endangered species	reduced vegetative cover	chemicals used in fishing pollute water and reduce water species	Environmental Protection Council

Annex A.2

ACTIVITIES AND THEIR IMPACTS ON RECEIVING MEDIA

INDUSTRY MINING: Production & Processing methods(open cast, deep shaft, dredging	ill-health from pollutants loss of arable land	reduced habitat & toxicity from pollutants	destruction of vegetation, soil erosion soil crusting	water contamination from heavy metals, zinc, lead, mercury, manganese and so on diseases of stocks	emissions of sulphur dioxide, nitrogen oxide, carbon dioxides, particulates, arsenic, antimony oxides & so on
MANUFACTURING Production & Consumption. processes	release of toxic compounds reduces human health	destruction of species diversity by pollution	destruction of vegetation by pollution	increase in water-borne disease from chemical discharges (hydroxyl, sodium carbonates, etc)	air pollution from (particulates, sulphur oxides, asbestos, lead, arsenic etc.)
URBANIZATION: household, production and consumption; food preparation and consumption	reduced health from poor sanitation, noise, overcrowding congestion	habitat destruction	reduced vegetative cover for development claims (eg. housing, plants, etc.)	pollution from solid and liquid waste disposal	automobile emissions of carbon monoxide and noise

Annex B.1 Investment Projects to Arrest Environmental Degradation

SECTOR	THEME	PROJECT TITLE	PROJECT OBJECTIVE	ACTIVITIES	IMPLEMENTING AGENCY & PERIOD
Agriculture	Soil Erosion Protection, Soil Replenishment and Conservation	Program for Soil Fertility Regenerating & Maintenance Program (RCH02)	restore and sustain soil fertility through use of inorganic fertilizers, organic manure, crop rotation & agroforestry	- research, extension and formation of fertilizer use advisory committee	Crop Services Dept. (Min. of Agric) 1991 - 2000
		Soil Conservation, Education & Trng. (SIR15)	arrest land degradation, environmental awareness & education (formal & nonformal), & produce multi disciplinary officials, for land management	training needs assessment for land management, development of educational materials, establish demonstration centres & organise seminars & other educational fora and set up land use policy/planning body.	Crop Services Dept. 1991 - 2000
		Soil fertility & Productivity (RCH03)	Improve & sustain soil fertility	-research soil and water conservation, improve crop rotation, and develop fertilizer recommendation	Min. of Agriculture 1991 - 2000
		National Agroforestry Project (DCS 011/88)	Regenerate bush & marginal land fertility for increased agric production	Establish 40 demonstration pilots for alley cropping and establish nurseries to provide seedlings of leucaena shrub and other tree crops suitable for agroforestry	Crop Services Dept. 1988 - 1992
		Drought Resistance/ Tolerance in Cocoa (CHB 005/89)	Develop cocoa types suitable for drier areas and new agronomic methods to protect cocoa from dry season spells.	-Develop suitable hybrid cocoa seeds and irrigation system	Ghana Cocoa Board 1989 - 1992
	Ruminant Feed Development Project	Utilization of straw & other Agricultural waste products for Dry Season Feeding (RAP010/88)	To collect, treat & utilize straw and other similar products for dry season feeding	Feasibility study for technical and economic viability	Animal Health & Production Department (1988- 1990)

Annex B.2 Investment Projects to Arrest Environmental Degradation

		Range Monitoring Program (ESS03)	Monitor rangeland to assess overgrazing, encroachment & impact	Classify vegetation cover, estimate bush and tree canopy, line transects	Animal Health & Production Dept., Min. of Agric (1991 - 2000)
		Range Management Program (RCM04)	Plan and direct range use, assess carrying capacity & maintain ecological balance between flora & fauna, & provide water resources	create grazing reserves, protect overgrazed areas for rehabilitation and monitor range	Animal Health & Prod. Dept. (1991 - 2000)
	Forestry and Wildlife	Forests & woodland monitoring system (ESS04)			Forestry Department
		Improvement of Classified Forests (RCM08)			Forestry Department
		Desertification Control Plan of Action (RCM12)	Mitigate drought effects and promote control of desertification	Establish desertification control machinery, establish data and info. system to monitor desertification, educate and train population about it, and rehabilitate degraded lands	Environmental Protection Council (1991 - 2000)

Annex B.3 Investment Projects To Arrest Environmental Degradation

SECTOR	THEME	PROJECT TITLE	PROJECT OBJECTIVE	ACTIVITIES	IMPLEMENTING AGENCY & PERIOD
AGRICULTURE		Feasibility study of wood saving technology STR 07	promote efficient use of wood devices, identification & testing of stoves (charcoal, firewood, saw dust, etc.) and check level of acceptability	firewood, charcoal, sawdust activity	National Energy Board 1991 - 1995
		Charcoal Production Study (STR 05)	establish current data on charcoal production and develop methodology to assess the impact of charcoal development on the environment	identify charcoal producing areas (visit/surveys), train traditional charcoalers in improved techniques, develop ways to carbonise waste wood and develop vegetation types and fuelwood plantations	National Energy Board 1994 - 2000
		Establishment of Strip Plantation (FOR 008/88)	to establish 25-meter wide strip plantation along selected forest conservation areas to protect Game reserves against bushfires and to protect fauna and flora	to create strip plantations, provide food and shelter for wild animals, make reserve boundaries clearer, and provide logistic support(eg.cutlasses, vehicles, protective clothing)	Game and Wildlife Dept. 1987 - 1992
		Subri Industrial Plant Project (For.012/89)	Maximize production of usable wood bio-mass and produce charcoal from waste wood; and other objectives ....planting cassava, plantain and vegetables for sale and production of sawn timber & cutting of firewood sleepers and poles	convert 4,000 hectares of natural forest to fuelwood and afforest area with gmelina seedlings	Subri Industrial Plantation Ltd. 1988 - 1993
		Wildlife Monitoring System (ESS 05)			

Annex B.4 Investment Projects To Arrest Environmental Degradation

	Wildlife Management Project (For.007/90)	to continue implementation of Department's developmental activities in 7 wildlife conservation areas and to provide for survey, acquisition & resettling programs in reserves	rehabilitation of Departmental buildings in the 7 areas; construct protective camps in reserves and accommodate field staff; acquire logistics support.	Game and Wildlife Dept. 1990 - 1992
	Improved Management of Parks & Reserves (RCN 07)	to supplement the activities of the FRMP and involve local people in reserves conservations and institute scientific measures to maximize wildlife resource production	provide office, camping & field equipment, including vehicles; hiring of consultants and training program for staff, institute conservation education program	Game and Wildlife Dept. 1991 - 2000

Annex B.5 Investment Projects to Arrest Environmental Degradation

SECTOR	THEME	PROJECT TITLE	PROJECT OBJECTIVE	ACTIVITIES	IMPLEMENTING AGENCY & PERIOD
URBANIZATION	URBAN INFRASTRUCTURE	Accra District Rehabilitation Project (DUR 001/89)	Strengthen technically towards development and maintenance of roads in Accra, Kumasi, Sekondi-Takoradi and Tema	Rehabilitation of selected routes in Accra; commissioning of traffic studies and implementation of decongestion of heavily trafficked routes; maintenance programme for drainage structures and road; engagement of local consulting firms for technical assistance	Dept. of Urban Roads (1985 - 1993)
		Urban II and other District Projects (DUR 002/89)	To manage the road and drainage components of the above named cities	Implementation of proposals for Accra traffic study including preparation of detailed designs; rehabilitation of about 260km of road pavement in Accra-Tema (provision of asphalt overlay); Updating of Nadeco Report on Accra drainage; Rehabilitation of about 20km of roads in Sekond-Takoradi; Rehabilitation of parts of Subin drainage system and improvement in pedestrian vehicular conflict areas at Kadjetia, Kumasi; Equiping various district units of the Dept. of Urban Roads.	Dept. of Urban Roads (1990)
		Reduction of Energy Consumption in Urban Transportation (STR 08)	Methodology to assess fuel consumption, identify opportunity for energy conservation and define infrastructural and institutional mechainise to address issue.	Preliminary data review and analysis pilot and national survey; determination of reduction in energy after proposed conservation measures	National Energy Board (1991 - 2000)
	URBAN PLANNING	Improvement in the Solid Waste & Nightsoil disposal systems in Accra MSE 05	Improve the management of waste	Improve collection, treatment and disposal of wastes, improve institutions of waste management, mobilize and co-ordinate NGOs and communities in waste management; construct KVIP's to phase out pan latrines	Waste Management Dept. (AMA) (1991 - 1996)

Annex B.6 Investment Projects to Arrest Environmental Degradation

	National Physical Development Plan KBE 02	To address social, physical and environmental problems connected with major investment projects	Data collection, studies, surveys, analysis of socio-economic & political development, geographic conditions, population, industrial development, forestry, fisheries, settlement patterns, transportation study, utilities, tourism, landuse	Town & Country Planning
URBAN INFRASTRUCTURE	Improvement of Infrastructure in secondary cities KBE 08	Provide ideal and efficient working conditions for fitters and artisans so as to improve road quality and provide open spaces	Survey of sites; preparation and demarcation of layout plans, payment of compensation, construction of roads provision of utilities, shops, toilets and demonstration centres	Town & Country Planning Dept.
URBAN PLANNING	Structure Plan for regional capitals and special areas KBE 03	Programme to improve planning, development and management of each regional capital	Data collection, analysis, review and production of reports	Town & Country Planning Dept. 12 months
	District Structure Plans KBE 01	Development and use of land & other resources, environmental protection, provision of public services; control of hazard areas management, protection, restoration and reclamation	Data collection, analysis, review and production of reports	Town & Country Planning Dept.
	Preparation of 1/25,000 scale maps ESS 01	Preparation of 1:25,000 scale maps	Pre-marking; aerial photographic coverage of terrain; ground control surveys; examination of records; photogrammetric compilations; (arto-graphic fair drawing; field chicking printing; procurement of plotters and instruments; office accommodation for officials and equipment	1991 - 2000

Annex B.7 Investment Projects to Arrest Environmental Degradation

	Appropriate technology for waste disposal and treatment STR 12	Set up a unit to plan, initiate and coordinate programmes and activities on agric/industrial waste management;update directory of manufacturing industries; survey of industries on type of raw materials, products, wastes & pollution management; develop methods of agro/ind.waste cycling rense, treatment and disposal	Set up unit laboratory; industrial surveys; impact assessment of industrial activities; evaluate and test waste/risk and hazard assessment; recover, recycle, and reuse waste; treat transport and dispose waste; set environmental standards; provide waste management and research consultancy/extension and training to industries	Industrial Research Institute 1991 - 2000
	Street and Market foods protection policy and study STR 10	Protect all food (raw & prepared) sold to the public from contamination and infection	Those activities proposed from the action study	Ministry of Health 1991 - 2000

Annex B.8 Investment Projects to Arrest Environmental Degr.

SECTOR	THEME	PROJECT TITLE	PROJECT OBJECTIVE	ACTIVITIES	IMPLEMENTING AGENCY & PERIOD
INDUSTRY		Air Quality Monitoring System (EE909)			Environmental Protection Council
		Incentive System for greater energy efficient industry (PDE 07)	Monitoring energy conservation in industry; implementing energy efficiency measures; updating information on industrial energy efficiency and conservation.	Establishing a monitoring scheme to update information on industrial energy consumption; Establishing incentive systems towards implementation of energy efficiency measures; establishing of monitoring and targeting procedures	National Energy Board
		Strengthening of factory inspectorate (PDD02)	Assist gov't to strengthen Factory Inspectorate Dept. through: -trng. of factory inspectors -provision of operational facilities; -establishment of occupational hygiene laboratory	Promotion of occupational safety and health; Factory inspection; Investigation of reportable occupational accidents	Dept. of Factory Inspectorate (1991 - 2000)
		Industrial Chemicals Control System (PDC 04)			Environmental Protection Council
		Environmental aspects of mining activities (PDC 01)			Environmental Protection Council
		GIS-based environmental monitoring system (EE902)			Environmental Protection Council

Annex B.9 Investment Projects to Arrest Environmental Degradation

		Environmental Awareness Programme (Public Awareness to protect natural resources) (EES 13)	To create an enlightened public opinion on environment; To create individual and collective role in protection and improvement of environment protection of forests & trees protection of soil against erosion	Establish national task force to define programme and secretariat; Mass information; - create specialized mobile units, use audio-visual materials; train management staff, field personnel	Environmental Protection Council
		Environmental Impact Assessment (ESS 12)	Prepare guidelines for the EIA Statement preparation; propose appropriate legislation for institution of EIA, Identify activities affecting the quality of environment	Collect, collate, analyse, synthesize data on EIA; Review existing laws on environment; Establish environmental standards for EIA preparation; Identify activities requiring EIA and description of mechanisms	(1991 - 1993)
		Strengthening Local Training Institutions (ESS 15)			Environmental Protection Council
		Air Pollution Control Programme (POC 06)			Environmental Protection Council

SECTOR	THEME	PROJECT TITLE	PROJECT OBJECTIVE	ACTIVITIES	IMPLEMENTING AGENCY & PERIOD
WATER RESOURCES	Water Quality Monitoring Control & Management	Water Quality Monitoring System ESS08 (N.A.) PIP-89 need 90 - 92			
		Monitoring of Marine Pollution ESS 11	Gather Data on sources, nature and levels of pollutants in marine environment for proper management	Identify and measure major sources and levels of pollution & contaminants, basic oceanographic parameters; survey of beach fauna and flora, studies on microbial degradation	Institute of Aquatic Biology (1991 - 2000)
		River basin water master plan STR02	Develop a master plan for the efficient allocation and use of river basins & water resources	Resource and socio-economic inventory, study of spatial and temporal water resources, current and future demand and its environmental impact from present and future activities development of river basin water master plan	Water Resources Research Institute (1991 - 2000)
		Environmental Impacts of Water-Based Activities STR 13	Identify effects and publicise to policy makers research findings on effects of water-based projects	Survey & collection of data, digging of observation wells, provision of sanitary facilities, health facilities, tree planting resettlement of communities, establish Oil Spill Contingency strenthen institutions for monitoring and evaluation	EPC (1991 - 2000)
	Coastal Zone Management	Impact of offshore Oil development on the Coastal Zone STR 04	To assess the effects of offshore oil development activities	Identify the impact of offshore oil development on marine, etc. collect, collate, and analyse baseline oceanographic data; draw sensitivity map	Institute of Aquatic Biology (1991 - 2000)

Annex B.11 Investment Projects to Arrest Environmental Degradation

		Impact of inland drainage and land based pollution source on coastal zone STR 03	Develop scientific basis for provision of Appropirate abatement and control measure for remedying of pollution effects.	Identify natural and man-made drainage systems; identify sources of pollutants and assess effects; studies on biological impacts	Institute of Aquatic Biology (1991 - 2000)
		Coastal Protection Works	To mitigate the effects of coastal erosion on the coastline; to provide breakwater shelters for the small scale fishermen	To provide coastal protection strcutures for the critical areas under erosion on the coastline; provide landing beaches and breakwater shelters for fishermen	Agric and Engineering Services Corporation (1991 - 1994)