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**Edward S. Ayensu Associates Limited**  
SCIENCE, TECHNOLOGY AND ECONOMIC CONSULTANTS

# **GHANA: BIODIVERSITY AND TROPICAL FORESTRY ASSESSMENT**

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# EXECUTIVE SUMMARY

The objective of this report is to present a concise review and evaluation of what is currently known of the entire range of Ghana's biodiversity and tropical forest resources and the state of their management. In the discussion of the management of these resources, an evaluation is made of current practices for their exploitation and conservation in so far as they promote or detract from sustainability. Measures required for deriving enhanced socio-economic benefits from Ghana's biodiversity and tropical forests which take into full account the critical problems and constraints and the needs of conservation and sustainability of these biological resources are highlighted. These issues have led to the provision of recommendations which are intended to assist USAID prepare a strategic plan for assistance to Ghana covering the period 1997 to 2001.

## **Methodology**

The team made a desk audit of available information on Ghana's biodiversity and tropical forestry. The large body of information on biodiversity which is contained in various documents available in institutions, including World Conservation and Monitoring Centre, (WCMC) Cambridge, UK, World Resources Institute and the Smithsonian Institution were consulted.

Following this desk audit, field work was undertaken during which various individuals and organizations were consulted. This involved eliciting information on policies of various sector Ministries which are concerned directly or indirectly with biological diversity and tropical forest resources of Ghana. These included the Ministries responsible for Environment, Science and Technology, Food and Agriculture, Lands and Forestry, Mines and Energy. Discussions were also held with scientists and officials of the technical Departments of various Ministries, the Universities, and the Council for Scientific and Industrial Research who have been involved in studies and research on various aspects of Ghana's biodiversity and forest resources. In addition, officials of WCMC, the Global Environment Facility and others in the private sector were interviewed.

In the writing of this report a series of coordinating working sessions of the team were convened by the Team Leader.

## **Part 'A': INTRODUCTION**

### **Review of Biodiversity**

An introductory review is provided of the status of biodiversity in Ghana which embodies in summary form the main topics treated in this report and which further provides taxonomic records (together with relevant analyses) of the main biological groups, namely, the microbes, the flora and the fauna.

## **Part 'B': THE PHYSICAL, BIOLOGICAL AND SOCIO-ECONOMIC ENVIRONMENT**

Part B provides a detailed treatment of Ghana's physical, biological and socio-economic environments. The geographical features described include an account of the relief and geology, soils, drainage and water bodies and a preliminary sketch of Ghana's phytogeography which is treated in detail in subsequent sections. In the socio-economic background to this report, the estimated population of Ghana (1994) is 16,525,000 with a high growth rate of 3% per annum. This is a major factor in the increased pressure on the biological resources of the country.

The performance of the economy (with average growth rates of 5%) has been largely the outcome of the Economic Recovery programme (ERP) which was launched in 1983 with the support of the World Bank and the IMF. The ERP included a stabilization phase (1983-1986) and a structural adjustment and development phase. Government has developed a long-term vision of Ghana as a middle-income country by the year 2020.

Agriculture, the mainstay of Ghana's economy, accounted for 43% of GDP in 1991 while the forestry sector (timber) accounted for 5% of GDP and 12% of total export earnings. It is estimated that the available timber would meet domestic and export requirements until the year 2030 but the current overharvesting of high-value and secondary species could bring this forward by as much as 20 years. Unless a revitalized replanting programme is organized on a scale commensurate with the rate of current exploitation, Ghana would become an importer of timber thereafter.

### **Major Ecosystem Types and Floral/Faunal Assemblages**

The floral and faunal assemblages and ecosystem types are treated in Part B of this report comprise. These are: the Tropical Forest Ecosystem; the Mangrove Ecosystem; the Savanna Ecosystem; Rivers, Lakes and Reservoirs; Coastal Wetlands and Lagoons and the Marine Ecosystem.

**The Tropical Forest Ecosystem** which is of particular interest in this study is found in the southern half of Ghana. The closed or high forest is made up of different types of forest ranging from the wet-evergreen (WE) to the dry semi-deciduous type (DSD). The WE is found in the south-western part of the country and constitutes an area of high conservation priority because of the high species diversity and endemism. An account is given of the various forest subtypes and their floral and faunal characteristics.

**The mangrove forest ecosystem**, occupies a very narrow non-continuous coastal area of Ghana and has a flora whose distinguishing characteristic is tolerance to sea water.

**The Savanna Ecosystem** comprising the Guinea Savanna and Sudan Savanna, is described and an account is given of its floral and faunal characteristics.

**Rivers, Lakes and Reservoirs** are treated so as to include brief accounts of their fish diversity. The main river basin comprises the White Volta, the Black Volta, the main or Lower Volta, the Oti, the Pra, the Tano, the Ankobra, the Bia, Todzie Aka, and the coastal basins between the Pra and the Upper Volta and the Lower Volta. The Volta Lake is one of the largest man-made lakes in the world while Lake Bosumtwi, a crater lake, is the only natural lake in Ghana. Other reservoirs mentioned include the Kpong Headpond, the Weija reservoir on the River Densu and the Barekese Reservoir in Ashanti in the forest zone.

**The Coastal Wetlands** include lagoons, lagoonal depressions, swamps and marshes together with the intervening interfluves within the coastal catchment. Along the Ghana coast of 530 kilometers, some 90 Wetland sites comprising lagoons, estuaries, and salt pan complexes have been regularly monitored by a survey team of Save the Sea Shore Birds Project (SSBPG) since 1986. The delta of the Volta River extends for 82 km along the coast, and its associated wetlands extend upstream for 75 km.

**The Marine Environment and Ecosystem** embraces an area equivalent to 85% of the total land area of the country. Three major habitat types based on depth are recognizable with distinctive biodiversity identities and unique species composition:

- . intertidal rocky, sandy and muddy habitats (< 2m), including estuaries, lagoons and mangrove areas;
- . subtidal shallow habitats (< 200m) over the continental shelf;
- . deep-water habitats comprising the continental slope (200 -2000m) and the abyssal (>2000m).

The most diverse habitat is the continental shelf which measures 27,300 km<sup>2</sup> in area. Whereas much is known of the diversity of the organisms that are normally exploited for food (fishes, shelled invertebrates, reptiles and mammals), little information exists on the diversity of the bottom invertebrate macrofauna living with or on the sediments of the ocean floor of the shelf. However, recent studies suggest that the numbers of species in total, will form a significant part of the national biodiversity heritage.

**Aquatic and Marine Resources** Use concentrates on capture fisheries. The inland fisheries (mostly the Volta Lake) provide about 20% of the annual catch while the total marine catch is estimated at 230,000 tonnes. The oceanographic regime is characterized by a seasonal major upwelling, a minor upwelling and a thermocline. The main pelagic fishery is the *Sardinella aurita* fishery which is seasonal. Over the past decade the supply of marine fish has been adversely affected by economic constraints and the high fishing pressure exerted by fleets on commercially important fish.

**Land Use**, considered as an aspect of the physical and biological environment, determines prevailing conditions in the vegetation formations of Ghana. The main categories of land use in Ghana with important impact on biodiversity and forest

resources are agriculture, logging, gathering, urban development, mining, tourism, transportation and infrastructure, and energy (hydro-electric impoundments and fuelwood). The effects of land use on these resources result principally from the technologies employed. Deforestation is the result of various forms of land use. In arid and semi-arid zones deforestation and devegetation may lead to desertification.

### **Critical habitats and plant and animal species of conservation concern**

Ghana has some fairly small but important critical sites. There are currently 16 legally constituted wildlife conservation areas comprising six National Parks, one Strict Nature Reserve, six Resource Reserves, three Wildlife Sanctuaries, and two Ramsar sites with three more proposed. A complete list of wildlife conservation areas, their sizes, year of establishment and vegetation type are provided. In all 6.18% of Ghana's total land area is designated for wildlife conservation. The reserve network in general tends to be fragmented consisting of many small reserves. Furthermore, encroachments pose a threat to their long-term viability. In the south-west of Ghana, there are a large number of reserves some of which are contiguous providing a larger overall area; e.g. the Akose, Bia, Tano, Subin, Krakosua Hills etc together have an area of approximately 1,700,000 ha. A descriptive account, including their floral and faunal diversity, is provided for the following wildlife conservation areas:

Bia National Park (78sq km), Nini-Suhien National Park (104sq km) Bia Production Reserve (3074sq km), Mole National Park (4840.4sq km), Kakum National Park, (207sq km), Ankasa Resource Reserve (343sq km), Shai Hill Game Resource Reserve (54sq km), Bomfobri Wildlife Sanctuary (53.1sq km) and Owabi Wildlife Sanctuary (13.1sq km).

The relative abundance of faunal groups in the different wildlife protected areas is provided. Ghanaian Wild Animals of Conservation concern fall within the following categories: threatened species, endemic species, species that are the subject of international conventions, species of social and economic value, flagship species, keystone species and landraces.

Resource inventories conducted by the Forestry Department of Ghana in 1988 over time give a critical picture of some forest flora used as timber (10 species), chewsticks and chew sponges (6 species), sweeteners (6 species), medicinal plants (16 species), fuelwood and charcoal (2 species), pestles and mortars (10 species), wood carvings (5 species) and canoes (2 species).

### **PART 'C' RESOURCE MANAGEMENT AND ADMINISTRATIVE ENVIRONMENT**

Under this heading are treated, firstly, the policy environment. The policies of the following Ministries are summarily described: Ministry of Environment, Science and Technology, Ministry of Lands and Forestry, Ministry of Food and Agriculture, Ministry of Mines and Energy. Then follows an account of Forest Management, Wildlife Management and the Management of Biodiversity.

## **Forest Management**

An account is given of the Reserve System and the factors which conditioned its development, and the Unreserved System (the off-reserve areas). There are about 200 high forest reserves covering an area of 1.8 million ha. Inventory results indicate that within forest reserves, there is a high forest area of 1.24 million hectares and an effective plantation area of 15,000 hectares. A further 30,000 ha was planted but is now poorly stocked. The current management system for high forest areas is a modified selection system which makes use of a minimum girth limit on exploitation, and a 40-year felling cycle.

Several tree species are used in plantations including indigenous species and exotic tree species. Teak is the dominant plantation species. Increased tree planting and proper management of established plantations are vital if the annual allowable cut of 1.1 million m<sup>3</sup> is to be sustained.

Within the forest reserves, the Forestry Department is in the process of implementing a set of protection proposals based on an extensive plant biodiversity survey. There is a need for a programme of research to support the forest protection system.

## **Wildlife Management**

In 1993, a joint National Forestry and Wildlife Policy was formulated with the aim of developing the nation's forest and wildlife resources. The Ghana Wildlife Policy (which was formulated in 1974) was also revised in 1994 and seeks to elicit local community participation. Wildlife protected areas may be grouped into forest reserves, indigenous protected areas and Wildlife Conservation areas. Conservation outside protected areas include Ex-situ Conservation measures (two Zoos in Kumasi and Accra respectively).

Threats to wildlife resources include habitat destruction, over-exploitation, encroachment of protected areas, ineffective legislation and lack of manpower and adequate resources.

A new protected area system plan has recently been compiled under the wildlife component of the Ghana Forest Resources Management Project.

## **Management of Biodiversity**

A National Resource Conservation Strategy was subsumed under the National Environmental Action Plan. A Draft National Strategic Plan is in the process of being prepared on the basis of a Ghana country study on Biodiversity.

## **Institutional arrangements**

Institutional arrangements for the management of biodiversity and tropical forest resources involve various Government Departments and Institutions including the Ghana Wildlife Department, the Department of Forestry and the Environmental Protection Agency. Financial resources available to these Departments have been generally inadequate, while understaffing impairs their efficiency. The Research Institutions are mainly the Council for Scientific and Industrial Research and the Universities, the Centre for Research into Plant Medicine and the Ghana Atomic Energy Commission.

Non-governmental organizations concerned with wildlife conservation include the Ghana Wildlife Society, the Ghana Association for the Conservation of Nature, Friends of the Zoo, and the Green Forum.

## **National, collaborative and International programmes concerning Biodiversity and Tropical Forestry**

Existing programmes include (among others):

- **National Environmental Action Plan (NEAP)** which subsumed a National Conservation Strategy. The NEAP has involved all relevant sectors in the preparation of a **Ghana Environmental Resources Management Project (GERMP)** which is supported by the Global Environmental Facility (GEF), and IDA.
- **Tropical Forestry Action Plan** is an international programme which provides a global framework for stimulating and expanding substantially the level of economic activity in the forestry sector.
- **Forestry Resources Management Project (FRMP)** encompasses sector Policy Reforms, Forest Management, Rural Forestry, Strengthening of sector Institutions, Education and Training and Research.
- **International Tropical Timber Agreement (ITTA)** is a commodity agreement covering (i) Market intelligence and Economic information (ii) Reforestation and forest management (iii) Value added processing within tropical countries and (iv) Research and development, originally signed in 1983. It was renegotiated in 1994.
- A programme initiated under **UNESCO's Man and the Biosphere** programme on the Savanna Ecosystem in Ghana has had as its sequel the **Cooperative Integrated Project on Savanna systems in Ghana (CIPSEG)**.
- Under the United Nations University's (UNU) programme on **Population, Land Management and Environmental Change (PLEC)**, a project is being carried out on biodiversity and agriculture.

- Under the **UNCED Convention on Biodiversity** several projects have been launched including the Ghana National Biodiversity study.

### **Policy and legislation**

Policy measures and legislation in various sectors which affect biodiversity and tropical forest resources of Ghana are discussed under the headings Forestry, Wildlife, Aquatic and Marine Environments and Land Use.

### **PART 'D': CONCLUSIONS, DATA NEEDS, RESEARCH GAPS AND PROPOSED ACTIONS**

The central problem around which many others hinge is deforestation which has been proceeding without interruption since the beginning of this century and which is currently threatening the reserve system. The underlying factor in deforestation is the high rate of population growth and the resulting pressure on land resources, including the need to undertake projects for the economic development of the country.

The effects of deforestation include habitat and species destruction, degradation of land, soil erosion, siltation of lakes and reservoirs, destruction of wetlands, instability in hydrological regimes, climate change and desertification. Desertification is seen as a real long-term threat having regard to the ecological setting and climatological history of Africa characterized by vast desert expanses and prolonged cyclical droughts. It has been estimated that about 35% of the total land area of Ghana is subject to desertification.

Threats to wildlife, apart from those resulting from deforestation, include over-harvesting by using prohibited methods of hunting, the flouting of hunting regulations, the bushmeat trade, ineffective legislation and lack of resources to enforce regulations.

Although Ghana has a network of protected areas they tend to be small and fragmented except in the south-west. Extra vigilance is accordingly called for in maintaining their integrity. The evidence suggests that with the current uncontrolled poaching and encroachment, exploitation levels may well be above biologically sustainable levels.

Major threats to aquatic and marine environments include over-exploitation of mangrove vegetation, over-fishing in both inland and offshore sectors, the use of fishing nets with smaller sized mesh, the use of illegal fishing methods such as explosives and pesticides and the discharge of toxic effluents from the mining and manufacturing industries.

In attempting to deal with the threats to Ghana's tropical forests and biodiversity, the following should be emphasised:

- The training of a critical mass of scientists (versed in relevant advanced instrumentation and techniques) to undertake necessary research, surveys and data collection on which remedial action can be based.
- Establishment of data bases into which all relevant information can be fed.
- Training of adequate numbers of field workers and technicians who can undertake conservation duties and monitoring operations.
- Strengthening of staffs of the enforcement and policing agencies and the provision of adequate resources and field equipment needed for effectiveness in the performance of their tasks.
- Institutional strengthening with particular reference to policy-making and regulatory as well as implementing and enforcement agencies.
- Encouragement of the private sector and non-governmental organizations to enable them play their full role.
- Promotion of a high degree of community awareness with a view to achieving as much community participation as possible in biological conservation.

The following summary of Data needs, Research Gaps and Actions needed is based on the above.

### **Biodiversity**

- 1) There is the need to fill in the gaps in our knowledge of the country's biodiversity to make it possible to develop an effective strategic action plan for the conservation and sustainable use of the country's biological resources.
- 2) Capacity building in bioprospecting involving collaboration with external private sector institutions should be promoted to enable greater use to be made of the country's biodiversity and to enhance programmes for the conservation of biodiversity.
- 3) Capacity building for research and development institutions in biodiversity utilization and conservation should be given high priority. Biotechnology should be accorded the necessary attention.
- 4) There should be regular monitoring of sites of conservation concern in order to arrest further deterioration.

- 5) Modern techniques for the conservation of genetic resources, both plant and animal, should receive necessary attention.

### **Forestry**

- 1) There is the need to establish a national herbarium with a special fund or subvention. It should give employment to a suitable number of specialist taxonomists to be assisted by various technical staff.
- 2) There is the need to extend the protected area system with protection given to larger forest units. Upland forests and mangroves should be given proper protection.
- 3) Adequate financial resources must be provided for forest and wildlife authorities; more staff should be trained and they should be given adequate field equipment and vehicles as well as radio communication facilities.
- 4) Commercial interests must be encouraged to take a long-term view and be compelled to manage timber extraction on a sustained yield basis.
- 5) The plantation industry must expand so that it contributes more to meet the needs of the nation's wood requirements in the future.
- 6) A national action plan for reforestation should be prepared and donor-support as well as private sector and community participation enlisted for its implementation.

### **Wildlife management**

- 1) A natural history museum which would include a zoological reference collection needs to be established.
- 2) Surveys should be continued and expanded to provide data on wildlife population sizes with particular reference to species of conservation concern in forests and the exploitation of non-timber products.
- 2) Wildlife laws should be reviewed with the aim of incorporating current biodiversity conservation concerns.
- 3) Community participation in biodiversity conservation activities should be encouraged, including the management of sacred groves.
- 4) Ghana's universities and research institutions should be encouraged to include biodiversity issues on their list of priorities.

- 5) Aid funded projects in forestry, wildlife and environment should include training and local research capacity building.
- 6) In order to conserve the genetic resources of wild animals, there is an urgent need to adopt a strategy or action plan involving activities such as collection and inventory, evaluation, etc, as well as techniques such as DNA typing, embryo transfers and improved artificial rearing in zoological gardens.

### **Land Use**

- 1) Priority research should go into the spatial stabilization of agricultural land use. Through the development and adoption of suitable technologies that improve production per unit area of land in Ghana.
- 2) Agroforestry has considerable potential in ameliorating ecological land-use problems (especially in rural areas) by incorporating forest, agricultural and pastoral components in a holistic system thereby increasing the human-ecological carrying capacity of land. Its practice has to be developed and widely adopted.

### **Aquatic and Marine Resources: Capture Fisheries**

Data needs include:

- 1) Stock assessment of the territorial waters of Ghana.
- 2) Detailed predictive model for the Gulf of Guinea upwelling
- 3) Stock assessment of the Volta Lake and Lake Bosomtwe.
- 4) Inventory and mapping of small water bodies.
- 5) National survey of aquaculture facilities.

### **PART 'E': POLICY OPTIONS AND PROPOSED ACTIONS FOR USAID'S CONSIDERATION**

1. The situation in Ghana with regard to biodiversity and tropical forest resources point to possible future hazards as well as opportunities for judicious utilization and conservation provided certain constraints are removed.
2. The various options available to USAID for constructive intervention are discussed under two headings:
  - a) bringing its influence to bear on the Ghana Government on policy issues and actions which have important implications for the livelihood and security of Ghanaians.

- b) Providing donor support or technical assistance with regard to projects which would enhance conservation and effective and sustainable utilization of biological resources through their trigger action or multiplier effects and contribution to awareness creation.

The private sector can be enticed to play a major role in the conservation and sustainable utilization of Ghana's biological resources. The following projects are proposed and justification provided for each of them:

- Project 1:** Capacity building in bioprospecting involving collaboration with external bodies.
- Project 2:** Preparation of a National Plan of Action for Reforestation.
- Project 3:** Strengthening marine fisheries research in support of the rational management of marine fish resources.
- Project 4:** Support for aquaculture development in Ghana.
- Project 5:** Strengthening and upgrading of the Plant Genetic Resources Centre to enable it fulfil its role as a national gene bank.
- Project 6:** Commercial utilization of woodwaste in Ghana.
- Project 7:** Study of the biological diversity of selected sacred groves and support for their management by local communities.

# **PART 'A'**

## **INTRODUCTION**

The objective of this report is to present a concise review and evaluation of what is currently known of the entire range of Ghana's biodiversity and tropical forests resources and the state of their management. In the discussion of the management of these resources, an evaluation is made of current practices for their exploitation and conservation in so far as they promote or detract from sustainability. Measures required for deriving enhanced socio-economic benefits from Ghana's biodiversity and tropical forests which take into full account the critical problems and constraints and the needs of conservation and sustainability of these biological resources are highlighted. These issues have led to the provision of recommendations which are intended to assist USAID prepare a strategic plan for assistance to Ghana covering the period 1997 to 2001.

### **Methodology**

The team made a desk audit of available information on Ghana's biodiversity and tropical forestry. The large body of information on biodiversity which is contained in various documents available in institutions, including World Conservation and Monitoring Centre (WCMC), Cambridge, UK, World Resources Institute and the Smithsonian Institution were consulted.

Following this desk audit, field work was undertaken during which various individuals and organizations were consulted (see page 214). This involved eliciting information on policies of various sector Ministries which are concerned directly or indirectly with biological diversity and tropical forest resources of Ghana. These included the Ministries responsible for Environment, Science and Technology, Food and Agriculture, Lands and Forestry, Mines and Energy. Discussions were also held with scientists and officials of the technical Departments of various Ministries, the Universities, and the Council for Scientific and Industrial Research who have been involved in studies and research on various aspects of Ghana's biodiversity and forest resources. In addition officials of WCMC, the Global Environment Facility and others in the private sector were interviewed.

In the writing of this report a series of coordinating working sessions of the team were convened by the Team leader.

## **The role of USAID in Biodiversity and Tropical Forestry**

The 1986 amendments to the U.S. Foreign Assistance Act Sections 118 and 119, covering tropical forestry and biodiversity, require USAID to address these topics in the preparation of country strategic plans. An earlier report (Dorm-Azobu *et al*, 1991) concentrated on the closed forests and their biological diversity to the exclusion of the species diversity of other ecosystems. The present study, while retaining a special interest in tropical forests (including wildlife) and their management, aims at covering the species diversity of the entire range of ecosystem assemblages: tropical forests; mangroves; savannas; rivers, lakes and reservoirs; coastal lagoons and wetlands; and the marine ecosystem. In addition, this study attempts to summarize the taxonomic record, as far as it is known, for microbes, the flora and the fauna of Ghana. In the outcome, tropical forests are placed within a much broader ecological and biodiversity context than the previous report.

Currently, USAID assistance for protecting the environment in Ghana is focused on three areas, namely, the monitoring and mitigation of environmental impacts of non-traditional export promotion and feeder roads activities; the establishment and protection of the Kakum National Park and adjacent nature reserve, and assistance for agro-forestry through non-governmental organisations, mainly the Adventist Development and Relief Agency.

It is hoped that this study will assist USAID to develop a strategic plan, the implementation of which will contribute to the effective management of Ghana's biological diversity and forest resources as well as ensure that enhanced benefits accrue from their judicious exploitation on a sustainable basis.

### **REVIEW OF BIODIVERSITY**

The following is a summary account of the status of biodiversity in Ghana covering the various topics highlighted hereunder and embodying taxonomic records (and their analyses) of the main biological groups namely the microbes, the flora and the fauna.

#### **Geographical and Ecological Background to Ghana Biodiversity**

Ghana, a country approximately 240,000 km<sup>2</sup> in area, is richly endowed with biological resources whose diversity is the result of varied geographical (geological formations, topography, drainage), climatic (rainfall, temperature) and ecological (vegetational formations, faunistic variability) features. Until humankind became a major ecological factor through his activities involving the utilisation of the resources of the land, the waters and the atmosphere, the regenerability of the various life-sustaining systems and processes was taken for granted.

Biogeographically, Ghana is represented by two major biomes, namely, the Tropical Rain Forest (with all its sub-types) and the Savanna. The Tropical Rain Forest or TRF is, characterised by high amounts of rainfall throughout the year or low precipitation

over a period of a few months of the year and a well-defined dry season. Dominant floral species of the TRF include *Cynometra ananta*, *Tarrietia utilis*, *Tieghemella heckelii*, *Triplochiton scleroxylon* and *Milicia excelsa*.

Over two-thirds of the country is covered by savanna vegetation. The most common floristic species of the two major savanna types (Guinea and Sudan savannas) include *Lophita lanceolata*, *Azelia africana*, *P. clappertoniana*, *B. parkii*, *Daniellia oliveri*, *A. digitata*, *Ceiba pentandra*, *Anogeissus leiocarpus*, *Acacia* spp, and species of the genera *Andropogon*, *Hyparrhenia pennisetum*, *Brachiara* and *Aristida*. Other minor savanna vegetation types exist outside the Guinea and Sudan savannas. The Coastal savanna, believed to have carried a more luxuriant vegetation many centuries ago, is today a vast area of dense scrub with or without grasses, few interspersed tree species including *C. pentandra*, *A. digitata*, *Azadirachta indica* as well as fan palms and wild oil palms.

The entire coast of Ghana has lagoons and estuaries which support mangrove vegetation. Characteristic species include *Avicennia nitida*, *Rhizophora racemosa* and *Laguncularia* spp. Other plant species associated with the lagoons include *Sesuvium portulacastrum*, *Sporobolus virginicus*, *Paspalum viginatum*, *Acrostichum aureum* and *Phoenix reclinata*.

Along the sandy beaches of the Ghanaian coast, stretching from Cape Three Points to Denu, there is a characteristic strand vegetation comprising major woody species such as *Cocos nucifera*, *Casuarina equisetifolius* and *Sophora occidentalis*. The herbaceous species include *Canavalia rosea*, *Ipomoea pes-caprae*, *Riemirea maritima* and *Cyperus maritimus*.

The biogeographical composition of the country comprises the following elements:

- i. species which are found throughout the entire Guinea- Congolian tropical forest,
- ii. species which are limited to the Upper Guinea block of forest,
- iii. species which are found in the Guinea- Congolian forest/savanna transitional zone,
- iv. species which are found in the Sudan savanna.

Animals are generally restricted in their distribution to either forest or savanna zones although some may have geographical ranges which overlap the two.

Apart from the primary ecological divisions mentioned above, Ghana has some ecological sub-systems (wetlands, lakes, dams, high hill tops) which are significant not only in terms of diversity in flora and fauna but also because of the distinctive physical processes and land use. Most coastal wetlands are known to harbour some bird life mostly water fowl species including waders, terns, herons and egrets. Non-coastal

lagoons found in topographical depressions or valley bottoms may be inhabited with *Raffia spp.* raffia palms.

The two most important lakes in the country are the Volta lake (a man-made reservoir of 8,489 km<sup>2</sup>) formed by the Akosombo dam and the Bosomtwe lake. The creation of the Akosombo and the smaller Kpong dams resulted in the inundation of large hectares of land and the loss of undetermined biological resources.

Parts of the country with elevation beyond the 600 m contours are found along the southern (Kwahu Plateau) and northern (Gambaga Escarpment) margins of the Volta Basin.

### **Land Use and Biodiversity**

The high pressure on land and the ever-increasing demand on its resources for economic development and socio-cultural well-being of the population have rendered all these systems vulnerable to change which in most cases are irreversible. Human kind remains the main factor in ecological change with its attendant alterations in faunistic and floristic composition and genetic variability. In Ghana, major categories of land use include agriculture, forestry, gathering/hunting, urban development, mining, tourism, transportation and road infrastructure, energy, grazing and fishing. The severity of any of these land use categories on the biological diversity depends largely on the extent of macro/micro-habitat modifications through removals, displacements and introduction of species.

For many decades, the backbone of the Ghanaian economy has been agricultural production which covered considerable amount of land and involved the largest number of people. Agricultural land use types include cultivated annual crops (cereals, root crops, the pulses and nuts and vegetables), bush fallow and associated gathering, cultivated tree crops (cocoa, coffee, oil palm and rubber with the addition of bananas and cashew of late) and unimproved pastures. Grazing in Ghana is practised by taking animals out to grazing grounds (natural grasslands) in the morning. The management of the vegetation is by a system of burning to allow for fresh growth of green herbage and also to clear unpalatable stubble. However, continued burning results in the degradation of vegetation, exposure of soils and their subsequent erosion (Ayensu, 1993).

Commercial logging of timber from Ghana's forests for export is believed to have begun in the late 1880s when redwood species such as *Khaya*, *Entandrophragma*, *Milicia* and *Lophira alata* were in high demand in Great Britain and elsewhere. Until recently regulated felling was done only in the gazetted forest reserves but outside these areas timber extraction was unregulated. Currently only about 60-70 tree species are logged and exported. Logging operations are monitored with respect to minimum girth limits, logging cycle and annual allowable cuts. Since 1979, a ban has been placed on the export of some species in log form. Fuelwood gathering and charcoal production are activities which many decades ago posed little or no serious threat to the environment,

but currently gainful commercial activities are exerting damaging impact on land including the biodiversity. Fuelwood and charcoal constitute about 93% of domestic energy sources in the rural areas. Besides these hydroelectric dams for the production of industrial and domestic energy impact severely on natural resources in general and, more specifically, the biodiversity.

Gathering of wild plants (e.g. chewsticks, pestles, fibre plants, fruits, nuts, vegetables, wines and beverages etc.) and wild animals (e.g. birds, large mammals, rodents, fish, reptiles, insects, etc.) which a few decades ago was strictly a subsistence land use activity, is currently a highly commercialised enterprise.

Current statistics put the number of towns and villages in Ghana at over 47,800. No valid figures exist for the proportion of the total land area occupied by these settlements. It is, however, evident that with the ever-increasing urban sprawls as a result of rising population and urban migration more land is being converted into settlements and associated land use.

Mining and quarrying are important commercial activities in Ghana. The methods of mining and quarrying effect considerable disturbance on surface soils and landscapes in mining areas and result in the destruction of vegetation and the pollution of water bodies and the air.

Transportation and road infrastructure (e.g. high voltage electricity pylons, dams, bridges, canals, roads etc.) are necessary for economic development but they impact on habitats through the clearing of vegetation, filling of marshes and the quarrying of embankment and other materials.

Tourism in Ghana, including ecotourism, is assuming importance given the rich endowment in natural and cultural resources. This potential is developing fast and may grow to exert a significant impact on the environment in general and specifically on biological diversity.

Land use technologies employed in any one particular land use form may effect changes in the diversity of biological resources. Both traditional (e.g. bush-fallow/slash-and-burn, land rotation systems, animal traction in agriculture; use of fire in game hunting; etc.) and modern (e.g. irrigation; mechanisation; use of chemical fertilizers, herbicides and pesticides; adoption of exotic plants and animal cultivars; monocropping; Agroforestry, etc.) technologies are implicated in this.

The National Environmental Action Plan identified the non-existence of a coordinated and comprehensive land use/management policy as the most critical problem in the Land Management sector (EPC, 1993). To date, Ghana has no effective national land use policy and existing sectoral policies do not sufficiently address the utilisation and conservation of resources in a holistic and integrated way. This deficiency prevents the enhancement of the national biodiversity from being sustainable.

Existing data and information on the nation's resources are sparse, inconsistent and sometimes obsolete. It is, therefore, imperative to develop environmental information systems using modern technologies such as Geographic Information System, Global Positioning Systems and Satellite Imageries to monitor changes in resource utilisation and preservation.

### **Microbiological Status in Ghana**

The diversity of habitats in the country guarantees the variability of microscopic organisms inhabiting them. The Cyano-bacteria (blue-greens) associated with soils, semi-aquatic habitats, tidepools, lagoons and estuaries, artificial harbours, concrete structures, salt pans in Ghana are distributed among three orders, namely, Chamaesiphonales (1 genus, 2 species), Chroococcales (5 genera, 7 species) and Nostocales (11 genera, 26 species). Those blue-greens that associate mutualistically with other organisms mainly of the plant world are capable of fixing atmospheric nitrogen.

True bacteria which may occur as members of mixed communities including algae, fungi, protozoa and other organisms can be found in almost any natural habitats: in soil, in water, in food products, in and on surfaces of plants, and on and within the human body and bodies of animals. In many of the habitats certain bacteria cause decay of organic matter, convert atmospheric nitrogen and other proteinaceous products into forms easily absorbed by plants and animals or participate in the ammonification of complex nitrogenous substances such as urine. While this group of microbes may be seen to enhance the environment by providing favourable conditions for plant and animal growth, the pathogenic group of bacteria attack plant and animal species including humans causing cell destruction and eventual death in certain cases.

To date about 1072 fungal species from 324 genera have been identified in Ghana. The vast majority belong to the Higher Fungi made up of the sub-divisions Ascomycotina (419), Basidiomycotina (316) and Deuteromycotina (297). Within the fungi one may differentiate between the saprophytes and the parasitic ones; the former living on dead organic matter. The second group which contain the obligate and facultative parasites produces obvious and clearly recognisable systems in and on their host or facilitate the efficient decomposition of organic matter. Plant parasitic fungi are found in the orders Chytridiales, Erysiphales (powdery and sooty mildews), Peronosporales (downy mildew), Uredinales (rusts) and Ustilaginales (smuts).

Two categories of viruses are of much concern in Ghana - those associated with humans and animals (Echovirus, HIV, Foot and Mouth Disease viruses, Polio virus and Coxsackievirus) and, secondly, those associated with plants, for instance, the Cocoa Swollen Shoot virus with more than 70 strains.

A deadly disease that is wiping out a large number of coconut palm trees in the country, the Cape St. Paul, is caused by a micro plasma-like organism (MLO).

Micro-organisms are of enormous economic potential and their utilisation for socio-economic development will depend on the understanding of the taxonomy of each group/class of microbes and on the availability of knowledge and information on the physiology of identified species and strains. Similarly important is the development of a system of keeping records of cases of microbial infections among humans and animals.

It is recommended that Microbial Culture Collection Centres be set up within already existing national institutions to fulfil the following obligations:

- i. systematic collection and identification of specimens,
- ii. serving as identification centres for all institutions and organisations,
- iii. maintaining specimen cultures,
- iv. preparation of microbial distribution maps.

### **The Flora of Ghana**

According to the International Union for the Conservation of Nature (IUCN) (1990), the list of Ghanaian plant species in collections rose from below 600 in 1914 to the present level of above 3600. Most of these are held in records either in print (flora, monographs, revisions, inventories); or in dried herbarium materials; or in planted living materials (in botanical gardens, plantations, arboreta) or in preserved living materials (in gene banks). Other sources include the legally and traditionally protected areas.

The three main classes of vascular plants found in Ghana are:-

- (i) Pteridophyta;
- (ii) Gymnospermae; and
- (iii) Angiosperms.

On record there is only one indigenous species of Gymnosperm in Ghana - *Encephalartos barteri* in the family Cycadaceae. There are 833 monocotyledonous and 2269 dicotyledonous species recorded in the class of angiosperms of which the majority are indigenous and a few are naturalised species.

The forest areas of Ghana have been documented to have more plant species endemism and diversity than the savanna areas. Within the forest areas, plant species endemism and diversity decreases from the Wet Evergreen (WE) through Moist Evergreen (ME), Upland Evergreen (UE), Moist Semi-Deciduous (MSD), Dry Semi-Deciduous (DSD), Southern Marginal (SM) to the South-East Outliers (SO). (Hall & Swaine, 1981). Some 19 plant species, mostly in the forest vegetation, are considered endemic in Ghana.

The rich plant diversity in Ghana is harvested for a number of purposes including food (wild fruits, roots and tubers, legumes, vegetables, beverages); fodder (leaves of small trees, shrubs, fruits, grasses); cash crops (perennial plants such as cocoa, coffee, cotton, oil palm, etc.); edible oils; essential oils, condiments and spices; sweeteners; herbal medicine for the sick; timber for building, construction and shelter; fuelwood for cooking, heating and lighting; and cane and rattan for basketry.

It has been recognised that there is a need for more taxonomic studies in all the vegetation zones of the country. Taxonomic differentiation of plant materials, a subject of immense importance, is hardly appreciated and hence the lack of interest in taxonomy among students of Botany in the country. From experience, prospects of employment for trained taxonomists are virtually non-existent. Also the few herbaria and arboreta only function as depositories of floral material with little or no research on the flora being housed.

### **The State of Plant Domestication in Ghana**

It is widely believed that early settlers - the Akans and Guans - in the area now occupied by Ghana might have been driven south during the 11th century from the savanna areas presently occupied by modern-day Sudan, Mali and Chad where they had followed a nomadic pastoral life. The move was apparently in search of pastures for their livestock, to an impenetrable forest. The forest was no ideal place for livestock, and settlers were compelled to take to the cultivation of food crops for their subsistence. It is also probable that these people might have encountered root and tuber crops like yams since according to Harris (1969) and Sauer (1952) marked wet and dry seasons in tropical areas tended to favour the evolution of root and tuber crops with large food reserves in their underground organs.

Domestication of plants might have evolved alongside the Engelbrecht (1916) hypothesis of "rubbish heap", suggesting that such plants may have been first gathered from the wild, from which seeds and other propagules were discarded in rubbish heaps near human settlements. Those plants found palatable were then gathered and eventually brought into cultivation. Early forms of cultivated plants may have been the *Dioscorea spp.* (yams) and *Oryza spp.* (rice). The origin of yams, their geographic distribution and economic importance have been described by Ayensu (1972) and Coursey and Ayensu (1972).

Such were the minimal needs of early settlers that they lived harmoniously with the environment. But with the introduction of modern farming practices, within the context of increased demand for food, clothing and shelter by the ever-growing population in the 20th century, large plantations of cocoa, coffee, kola, oil palm as well as the mono cropping of such annuals as maize, rice, cotton and tobacco were established. The net result is the replacement of diversity with a small number of cultivated plants that require constant human intervention for restoring soil fertility and controlling pests and diseases. It is estimated that 13 million hectares of the natural vegetation has been

transformed into farm lands and certainly with these are gone dozens of plant, animal and microbial species.

Some native landraces of a number of domesticated species appear threatened with extinction themselves as the rapid spread of improved varieties of food and cash crops either from research or introduced into the country causes the disappearance of these landraces. Most threatened crops include landraces of cereals (maize), legumes (cowpea) and tomatoes. Bushfires and drought are adding more woes to the already difficult problems of the conservationist: year after year they devastate large hectares of land destroying seeds and other propagules, soil micro-organisms and less mobile animal species. Noxious weeds and some tree crops, inadvertently or intentionally introduced into Ghana, pose serious threat to habitats that contain indigenous plants. *Chromolaena odorata*, *Leucaena leucocephala* and many others exhibit aggressive habits in this respect.

### **The Fauna of Ghana**

Populations of all species of wild animals have declined drastically as a result of heavy over-exploitation and severe habitat destruction. At least seven reptiles, eight species of birds and 20 mammalian species are threatened.

Species records for the country include 221 amphibians and reptiles, 721 birds and 225 mammals. Endemicity has been recorded among the frogs *Hyperolius baumanni*, *H. fusciventris* and *H. sylvaticus*; and the lizard *Agama sylvanus*. Threatened reptiles include four species of marine turtles which are listed in the IUCN Red Data Book. The Nile crocodile is listed as vulnerable (IUCN, 1994) while the status of the African Slender snouted Crocodile is also said to be vulnerable. In addition to the eight (8) threatened bird species (which include four restricted range species endemic to the Upper Guinea forest block), other bird species of conservation concern include fourteen (14) near-threatened species, i.e., species at risk and requiring monitoring and keystone/indicator bird species such as parrots and hornbills (because of their role in forest regeneration) and birds of prey. Twenty mammalian species are considered threatened and these include the following:-

- i) the African elephant, *Loxondonta africana* - vulnerable;
- ii) the leopard *Panthera pardus* - vulnerable;
- iii) West African manatee *Trichechus senegalensis* - vulnerable;
- iv) Ogilby's Duiker *Cephalophus ogilbyi* - vulnerable;
- v) Red fronted Gazelle *Gazella rufifrons* - vulnerable;
- vi) Diana Monkey *Cercopithecus diana roloway* - vulnerable;
- vii) Western Red Colobus *Procolobus badius waldroni* - vulnerable;
- viii) Olive Colobus *Procolobus verus* - vulnerable;
- ix) Chimpanzee *Pan troglodytes virus* - vulnerable.

Ghana's entomological profile is apparently extensive; they include those insects of economic importance in terms of their role in agriculture and public health. Many other insects are also important for their aesthetic value, food value to humans or livestock, or serve as useful indices of the health of our environment.

Larsen (1994) recorded 860 species of butterflies in Ghana and of these forest species dominated, accounting for 83% as compared to 13% savanna species. Larsen identified 23 endemic butterfly species which he classified into three ecological groups (i.e. the dry forests of the Volta Region, the Atewa Range and the moist and wet evergreen forests of Western Ghana).

Wildlife in the form of game meat constitute the main source of animal protein for rural communities. An overwhelming percentage (90%) of people interviewed in a survey preferred game meat (locally called bush meat) to domesticated animals. Currently, over-harvesting has reduced wildlife stocks and consequently the availability of bushmeat on the market. In addition, the contribution of game meat to protein intake has gone down as a result of scarcity and high prices demanded for this type of meat.

Wild animal exports, have contributed towards the reduction in populations. Department of Wildlife records show that between 1988 and 1993 a total of 327,803 live specimens (averaging 54,634 per year) were exported with reptiles (royal python, Bosc's monitor lizard, tortoises and Agama lizards) and the grey parrot (*Psittacus erithacus*) being the major animals.

A large number of wild animals, like plant species, have cultural and religious associations. In Ghana, three main categories of wild animals of religious and cultural significance are differentiated: totem, taboos and sacrificial and/or ceremonial species.

In Ghana, wild animals and their products such as the meat, skin, hair, tail, bones, teeth, fat, glands and even faecal pellets form the base of medicines for the treatment of a wide variety of ailments.

### **Wildlife Conservation**

Wildlife protected areas in Ghana may be grouped into forest reserves, indigenous protected areas (known as sacred groves) and wildlife conservation areas. Currently, there are over 280 forest reserves covering an area of 23,729 square kilometres, about 10% of the total land area. There are no clear wildlife management practices included in the management plans of forest reserves, though entry for game hunting requires permission from the forest administration ( in the case of forest reserves).

There are currently 16 legally constituted wildlife conservation areas under the administration of the Ghana Wildlife Department. About 13,048.6 square kilometres, equivalent to 5.46% of Ghana's total land area, has been designated as wildlife conservation areas. In addition, 1725 square kilometres of coastal sites have been proposed as Ramsar sites, giving a total of 6.18% of Ghana's land area.

The forest protected areas of Nini Suhien/Ankasa, Kakum/Assin Attandanso and Bia form the eastern end of the Upper-Guinea forest block which is known to be a centre of high endermism and high species density. Over 200 mammalian species have been recorded in these areas, including species of conservation interest such as the Elephant, the Bongo, the Leopard, several species of duikers and ten species of primates including the threatened Diana Monkey, Red Colobus Monkey and the Chimpanzee. Six avifauna species which are considered threatened occur in these areas.

The five proposed Ramsar sites are noted for their migratory waterbird species comprising terns, herons, egrets, ducks and waders. Eleven species of waders occur in internationally important populations. (Ntiamao-Baidu, 1991).

Although there are laws and regulations prohibiting certain hunting methods and techniques and establishing periods for the closed season, these are flouted due to lack of adequate enforcement, and motivation on the part of wildlife officers to exercise their policing authority.

Two zoological gardens exist in Ghana. They were established with the aim of:

- educating the general public about wild animals and to create interest in wildlife;
- increasing the aesthetic appreciation of wild animals;
- using the zoos as research laboratory for the study and breeding of endangered species;
- using them to raise funds to support conservation initiatives.

Major threats to wildlife resources in the country include:

- habitat destruction through deforestation, desertification, bush fires, agriculture and mining operations;
- over-harvesting by using prohibited methods of hunting;
- encroachment on protected areas for more agricultural land, gathering and collection of non-timber forest products;
- ineffective legislation and policy framework;
- lack of manpower and adequate resources;
- lack of information which militate against effective monitoring and evaluation of conservation efforts; and
- non-involvement of communities in the management (utilisation and conservation) of wild animals.

### **Forest Management**

Forest management in Ghana dates back to the early 1900s with the passing of the Timber Protection Ordinance in 1907, a Forest Ordinance, in 1910 and the setting up of a Forestry Department. The Forest Ordinance of 1910 empowered the colonial Government to declare certain lands subject to Forest Reservation. In 1984, the first national forest policy was adopted, but with all its good intentions it remained silent on conservation in the off-reserve areas. The principle of sustained yield could not be applied to these areas in view of the diverse ownership, tenural variations and the unrestrained land use existing.

Apart from these two categories - the reserved and unreserved areas - there existed small patches of original forest vegetation set aside by communities, traditional authorities or religious authorities for cultural and religious purposes. Until recently no exploitation was allowed in these areas.

Plantation management is a rather young practice in Ghana and achievements have been uneven. To date, only 70,000 hectares have been planted mostly with teak, of which about 15,000 hectares can be described as successful.

The current management system for high forest areas is a Modified Selection System which is based on the use of a minimum girth limit, a 40 - year felling cycle combined with yield control applied to each compartment (128 ha) using data obtained from 100% stock and other harvesting guidelines.

Hawthorne and Abu-Juam (1993) proposed the setting up of categories of protection to ensure that the genetic diversity of the forest and its environmental protection functions are not further eroded. These categories can be summarised as follows:

- Special Biological Protection Areas for conserving biodiversity hotspots;

- Hill sanctuaries - all contiguous areas of slopes greater than 15 degrees;
- Swamp protection areas - all large areas of inundated land;
- Provenance protection areas;
- Fire protection areas; and
- Convalescence areas - degraded areas kept for a period for rehabilitation.

A number of programmes and activities are under way to better manage the natural resource base of the country to avoid loss of biological diversity among other things. Salient among these are:

- FORIG/ITTU Odum Project;
- National Conservation Strategy (NCS);
- National Environmental Action Plan (NEAP);
- Ghana Environmental Resources Management Project (GERMP);
- Forest Resources Management Project (FRMP);
- Tropical Forest Action Program (TFAP);
- International Tropical Timber Agreement (ITTA); and
- United Nations Commission on Environment and Development (UNCED), with the implementation of the Forest Principles and the Conventions on Biological Diversity and Climate Change.

### **Aquatic and Marine Resources**

In 1977, Ghana claimed a 370 km (200 nautical mile) limit as her territorial waters. The continental shelf off its coast is narrow, ranging between 24 and 35 km from Half Assini to Cape Three Points and 24 and 80 km off Takoradi. In Ghana, three major habitat types based on depth are recognizable with distinctive biodiversity identities and unique species composition. These are: (i) intertidal rock, sandy and muddy habitats (<2m), including estuaries, lagoons and mangrove areas; (ii) subtidal shallow habitats (<200m) over the continental shelf; and (iii) deep-water habitats comprising the continental slope (200 - 2000m) and the abyssal (>2000m). Whereas much is known of the diversity of the organisms that are normally exploited for food, little information exists on the diversity of the bottom invertebrate macrofauna living with or on the sediments of the ocean floor. Recent studies indicate extremely high biodiversity on the benthos of the shallow waters of the continental shelf. Total polychaete species described from shallow depths of 15 - 65m is about 199 with several yet to be identified to their putative species. Depending on the scale of map used, the coastline of Ghana is estimated to range from 520 to 550 km.

It is believed that there are over 90 coastal lagoons in Ghana most of which are small with a water area of less than 100 ha. The total lagoon waters area calculated from maps is 36,596 ha, which represents 0.15% of the total land area of Ghana. Lagoons provide suitable habitats for a wide range of fauna and therefore are centres of biological diversity.

Lake Bosomtwi, the only natural lake in Ghana, is approximately 50 square kilometres in area. The level of the lake fluctuates and has risen in recent years. Information on its biological resources is restricted to fishes. The major man-made lake, the Volta Lake, was formed in 1964 by damming the Volta river at Akosombo. It covers an area of 8480 square kilometres and has a volume of 165 cubic kilometres. At the time of creation, large tracts of forested land were inundated and it is possible that certain species endemic to the area might have been lost. It is, however, known that the creation of the dam has resulted in the near extinction of the bivalve *Egeria radiata* (adode) and displacement of the shrimp (*Macrobrachium sp.*) into waters far downstream of the dam.

Ghana is well drained by rivers. The numerous rivers are centres of biological diversity.

Aquatic and marine resources are used principally in Ghana for:

- capture fisheries which is practised either in the inland water bodies, marine environment and coastal lagoons;
- traditional fish ranching, culture based fishery and aquaculture;
- transport;
- consumptive use for domestic and municipal supply, industrial water supply, irrigation, livestock, power generation, waste disposal, salt production and recreation;
- traditional/cultural aspects. Several water bodies are believed to be the abode of gods.

Major threats to aquatic and marine resources use include:

- over exploitation of mangrove vegetation;
- over fishing in both inland and off-shore sectors. The use of fishing nets with smaller sized mesh and the use of illegal fishing gear and methods (e.g. explosives, pesticides);
- salt production which may pose possible threat to some coastal wetlands by disturbing the hydrology and salinity;
- sand winning which leads to changes in beach profiles and disturbs or destroys the fauna of the beach;
- eutrophication (excessive build - up of nutrients);

- chemical pollution with pesticides, heavy metals, industrial chemicals and hydrocarbons; and
- drought and sea level rise as a result of climate change.

### **Aquatic Biology/Fisheries**

Aquatic biological/fisheries resources may be broadly considered under Freshwater Resources and Marine Resources. The former deals with inland water bodies, viz, streams, rivers, lakes and reservoirs. The later deals with the estuaries, lagoons and the sea. 122 freshwater fish species belonging to 58 genera and 24 families have been recorded in 12 major rivers and streams (Pra, Oti, White Volta, Black Volta, Asukawkaw, Pra, Offin, Birim, Densu, Ankobra, Tano, Bia). Out of this figure, 69 species belonging to 332 genera and 16 families are food fish of commercial value. Before the Kpone headpond in the Lower Volta was constructed in 1981, 50 fish species had been recorded from the area. However, since the impoundment only 39 species belonging to 30 genera and 16 families have been encountered. Ecological conditions created below the Kpong and Akosombo dams have resulted in permanent fresh water, silt-free waters and the growth of submerged aquatic weeds, conditions which are unfavourable for estuarine or brackish water fishes.

Eighteen fish species belonging to 15 genera and 10 families have been recorded from the Barekese reservoir in Kumasi. Records show that the Bosomtwi Lake contains 11 fish species belonging to nine genera and five families, including the endemic *Tilapia discolor* (Whyte 1975)..

Aquatic (freshwater) molluscs recorded in Ghana include species belonging to the following families:

- Neritidae;
- Thiaridae (Melaniidae);
- Pilidae (Ampullariidae);
- Potamididae;
- Mutelidae;
- Etheriidae; and
- Donacidae.

Other freshwater gastropods found in water bodies, both natural and artificial (i.e. impoundments and irrigation systems) have become, in most cases, serious public health problems since they transmit Trematodes, Schistosoma, Fasciola and Paragonimus.

Marine and fresh water reptiles found in the country include those from the families:

- Chelonidae (Turtles);
- Crocodylidae ( Crocodiles); and
- Colubridae, Elapidae (Snakes).

Mammals found in marine and fresh water bodies include manatee, marine porpoises or dolphins, common dolphins and sperm whale.

Ofori - Adu (1988) listed 392 marine species comprising 347 fish species belonging to 82 families. Most of these are taken either as food or used in animal feed preparations.

Estuaries and lagoons in the country harbour a rich diversity of species, fishes, crustacea (shrimps, prawns, lobsters, crabs) and molluscs (gastropods, clams, oysters).

The diversity of aquatic ecosystems, populations as well as species have been seriously affected through development activities including:

- damming, impoundment, restriction of flow of rivers and streams;
- mining and dredging including sand winning and
- valley bottom agriculture. As many flood plains are converted into rice farms many flood plain aquatic fauna are lost.

### **Genetic Resources**

Little has been done to identify genetic resources in the country for socio-economic development and conservation purposes. There is a wealth of traditional knowledge and practices of the indigenous people who deal with the sources of genetic resources. These are of immense importance in the identification, utilisation and conservation of genetic resources.

Micro-organism resources abound in the country and there is potential for their use as raw materials in biotechnology, desirable microbes for fermentation activities in our indigenous food processing technologies and as bioagents (biocides) for combating insects and other pests. There are also nuisance ones which are destructive and cause harm to humans and animals.

Domesticated animals form a valuable genetic resource base that has to be maintained as well as used in stock improvement. Domesticated animals in Ghana include cattle, sheep, goats, pigs, poultry, horses, donkeys, dogs and cats. Ruminant livestock appear to have the greatest impact on the environment giving the present grazing system. Indiscriminate crossbreeding of the indigenous livestock and poultry with exotic commercial stock is the main threat to the gene pool of the domesticated animal.

The genetic resources of wild animal populations in Ghana have not been studied and major data gaps exist in DNA characterisation, genetic differentiation and genetic variation of all groups. At present, conservation of wild animal genetic resources is based on species protection and habitat protection in the wildlife reserves and to a more limited extent in the forest reserves and zoological gardens. Traditional sacred groves also offer an avenue for habitat protection and species conservation.

Management of wild animal genetic resources is insufficient as a result of failing capabilities and capacities in the country for collection and inventory, evaluation, conservation, documentation and data management, training, research as well as organisation and the development of infrastructure.

The Plant Breeding Division of the Cocoa Research Institute of Ghana has for decades undertaken steps to ensure successful breeding of cocoa, coffee, cola and sheanut by systematically collecting and conserving germplasm of these crops.

### **Environmental Planning, Management and Legislation regarding Biodiversity in Ghana**

An array of policies and legislation in many different sectors affect biodiversity in various ways, ranging from indirectly creating incentives to exploit natural resources in unsustainable ways to directly requiring improved management of biological resources.

Since the 1880s, when commercial logging began in Ghana, various governments, both colonial and post-colonial, have through enactment of laws and policies, sought to conserve, protect and manage forest and wildlife resources. The Forest Ordinance (Cap. 157) approved the constitution of forest reserves in Ghana. Below is a list of some of the policies and regulations under which the country's natural resources have been utilised and conserved:

- Concessions Act, 1962 (Act 124);
- Forest Protection Decree 1974;
- National Forestry Policy Statement adopted in 1948;
- Protected Timber Lands Act, 1959;
- Trees and Timber Ordinance, 1994;
- Trees and Timber (Control of cutting) Regulations, 1950;
- Trees and Timber (Control of Measurement) Regulations, 1961;
- Trees and Timber (Control of Export of Logs) Regulations, 1961;
- Wild Animals Preservation Act, 1961 (Act 43);
- Wildlife Conservation Regulations, 1971 (LI 685);
- Wildlife Reserves Regulations 1971 (LI 710); and
- Wildlife Conservation Policy, 1974.

The 1994 Forest and Wildlife Policy which has replaced the 1984 National Forestry Policy Statement and the 1974 Wildlife Conservation Policy emphasises sound utilisation of forest and wildlife resources for socio-economic development with regard to conservation objectives. Existing laws and regulations provide varying degrees of

protection to named wild animal and tree species thus, enabling endangered species to be legally protected, regulate hunting, capture and destruction of these resources, and control the export of the same.

Policies and legislation also exist in the following areas:

- water and land management;
- human settlements; and
- mining, manufacturing, use and disposal of hazardous chemicals.

All these policies and legislation are deficient in a way since they are neither integrative nor holistic. There is the imperative need to draw an umbrella Environmental Protection legislation which will consider issues contained in the sectoral policies and legislation.

Ghana needs to adopt and implement a national framework towards biodiversity conservation to ensure the achievement of resource sustainability. Existing sectoral strategies, mostly disjointed, must be put together in a comprehensive format - a National Resource Conservation Strategy Document - which should form an integral part of an overall national development plan. Such strategies should be formulated and implemented with full and broad participation by all levels of civil society.

Further, a framework within which land use and production systems are compatible needs to be created. Relevant issues for consideration should include:

- insecurity of resource ownership and tenural rights;
- promotion of local production modes and resource utilisation and conservation approaches;
- integration of full costs of resource depletion and environmental degradation in social and cultural terms into national income accounts.

The paucity of information in Ghana, particularly on land use planning, is recognised as a serious draw-back. There is an increasing need for this country to establish a national-level system of strategic natural resource and land use planning that incorporates biodiversity issues. Planning should reflect the objective of conserving representative ecosystems from each of the biomes. Planning for biodiversity conservation needs to consider:

- involving all stakeholders;
- adopting the bottom-up and participatory approach;
- policy and institutional reforms and changes; and
- mechanisms for monitoring implementation.

Natural resources inventories and other baseline data are scanty in Ghana making it extremely difficult to monitor change in levels and patterns of biological resources, ecology, human conditions and other factors. Monitoring remains an essential tool in resource conservation initiatives.

It has been recognised in Ghana that creating awareness and understanding of biodiversity conservation issues and taking due cognisance of traditional knowledge and appreciation for biological resources constitute the foundation for a successful implementation of strategies for conservation. To this end, the Ghana Environmental Education Strategy document (prepared by EPA) which covers both the formal and non-formal sectors has been launched by the Environmental Protection Agency as part of the programme for the implementation of the NEAP.

Also, it has been recognised that training and development of local expertise is important for sustainable management of Ghana's natural and environmental resources. A major component of a policy for the management of the country's biological diversity should be the establishment of country centres of expertise. Ecosystems and their ecological dynamics are less studied. There is urgent need to research into ecological systems and processes. Local ecological skills and initiatives are important for research into ecological formations and systems, and research efforts must be a partnership between 'formal' science on the one hand and 'community' ecological knowledge on the other. A major component of the nation's research programme should be research into living resource planning, management and conservation.

### **Economic Analysis of Ghana Biodiversity**

Biodiversity value could be economic (measurable) and intrinsic (not measurable). Direct measurable use of biodiversity include the benefits such as food, medicines and industrial products. Indirect measurable use value is the ecologists' concept of ecological function, for example, soil conservation, watershed protection, etc.

In estimating the direct economic value of Ghana's biodiversity, considerations are made from the supply side or demand side of the resource. The export or world market prices of the products or services are used to compute economic values from the supply side. In some cases, GDP values attributable to the products are used. Biodiversity assets can be estimated by using the willingness-to-pay concept or the incremental cost approach (i.e., the cost of rebuilding or refurbishing the lost resources).

The value of biodiversity cannot be easily measured, due to data non-availability and also due to gaps in knowledge about linkage between environment and the economy. Resource accounting in Ghana is in its infancy due also to lack of local expertise in this field.

# PART 'B'

## COUNTRY-SPECIFIC PHYSICAL, AND BIOLOGICAL ENVIRONMENT

### I. PHYSICAL GEOGRAPHICAL FEATURES

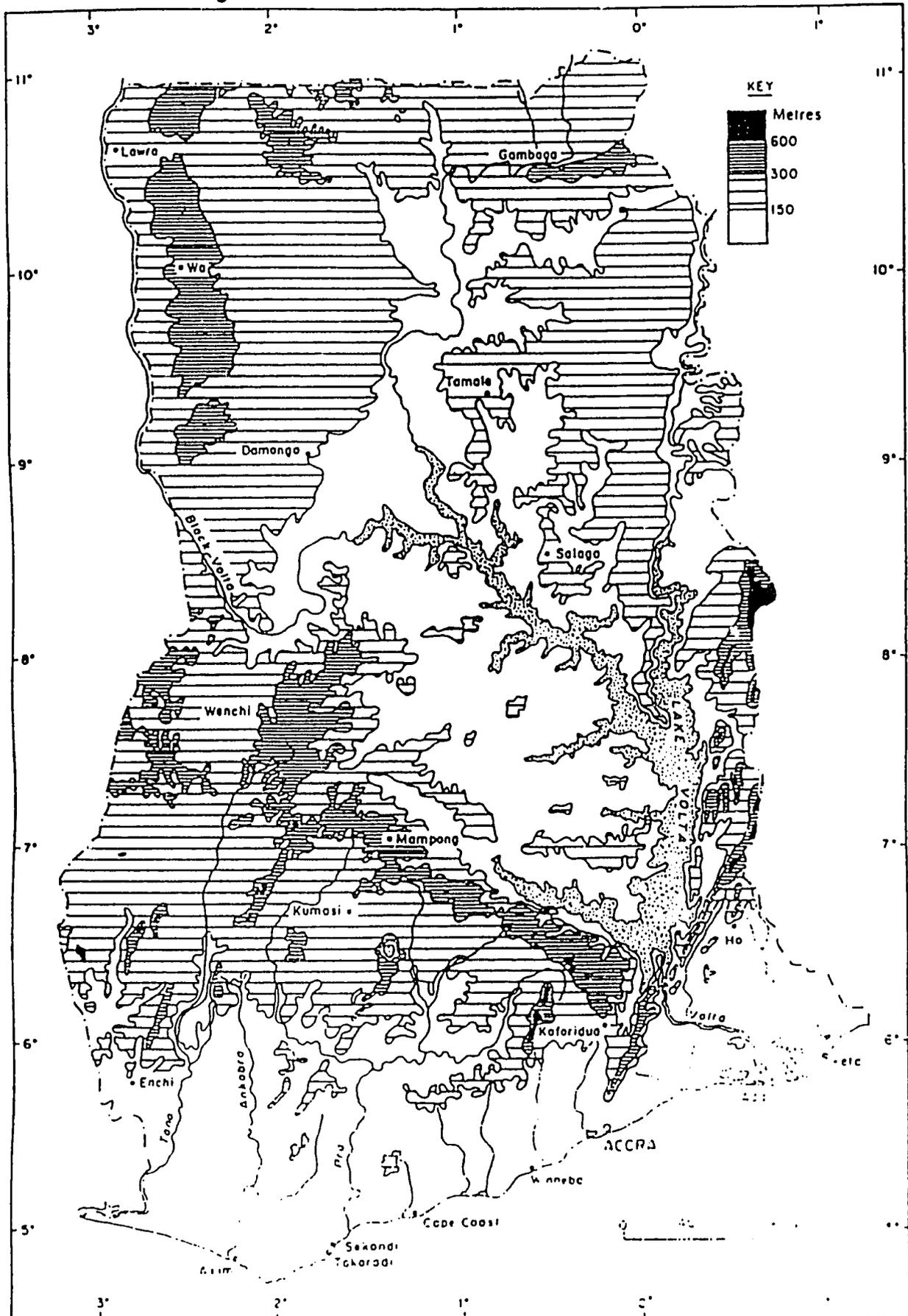
Ghana lies along the Gulf of Guinea in West Africa and covers an area of some 240,000km<sup>2</sup>. It lies within longitudes 3°5'W and 1°10'E and latitudes 4°35'N and 11°N. It has a southern coastal shore-line of 550km. The Exclusive Economic Zone (EEZ) adds an extra 110,000km<sup>2</sup> of the sea to the territorial area of Ghana. The country is bordered on the east by Togo, on the west by Cote d'Ivoire and on the north by Burkina Faso.

#### **Relief and Geology**

The relief and geological features of Ghana (figs. 1 and 2) exhibit many of the characteristics of sub-Saharan Africa with its ancient rocks and extensive plateau surfaces marked by prolonged sub-aerial erosion (Boateng, 1993). About half of the country's land surface consists of Pre-cambrian metamorphic and igneous rocks while the greater part of the remainder consists of a platform of Palaeozoic sediments resting on the older rocks. A vast area in the north-central part of the country which constitutes the Voltaian basin is occupied by these Palaeozoic sediments consisting of beds of clay and sandstone (fig 3). The raised edges of the Voltaian basin along its north and south give rise to high plateaux, averaging between 300 and 600 m in height. The imposing Gambaga scarp (or Gambaga plateau) borders the northern edge while the more extensive Kwahu plateau borders the southern fringe. The Volta basin is further surrounded on all sides, except along its eastern border by, a highly dissected peneplain averaging between 150 and 300 m above sea level but with some notable distinct ranges within it which attain heights of up to 600 m. A narrow zone of highly folded Precambrian rocks, composed largely of quartzites, sandstones and phyllites extends along the eastern edge of the Voltaian basin with a north-east and south west orientation. It constitutes the Akwapim-Togo ranges which vary in height between 300 and 900 m and extend northward across Togo and Dahomey as the Togo-Atakora range, one of the most distinctive mountain features in West Africa.

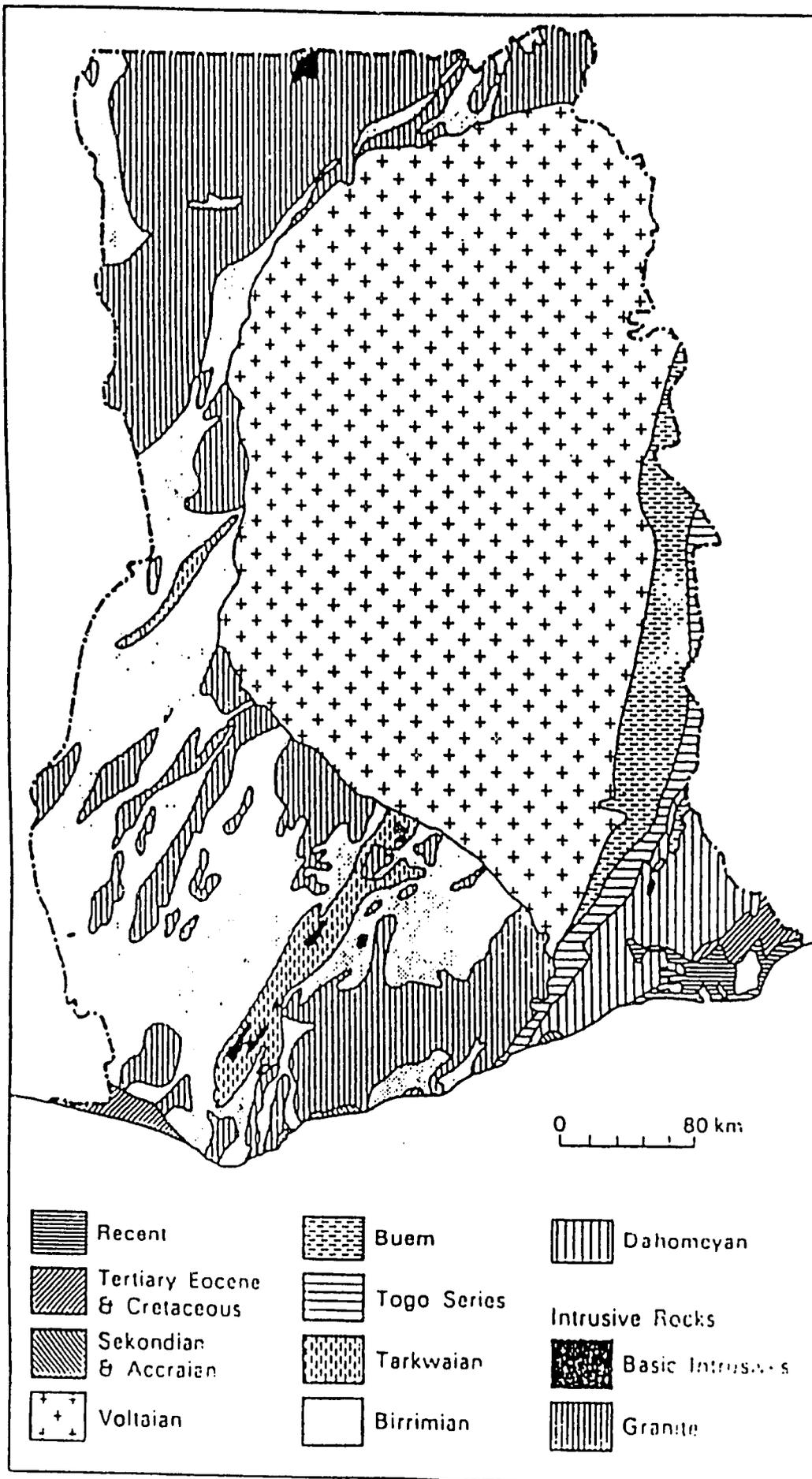
Below the Akwapim-Togo ranges in the south-east corner of the country are the generally flat or mildly undulating Accra-Ho-Keta plains. The plains are underlain by Dahomeyan rocks - the oldest in the Precambrian series - and contain extensive areas of gneiss from which the heavy but fertile Akuse clays are derived by prolonged weathering.

Fig. 1 GHANA: RELIEF



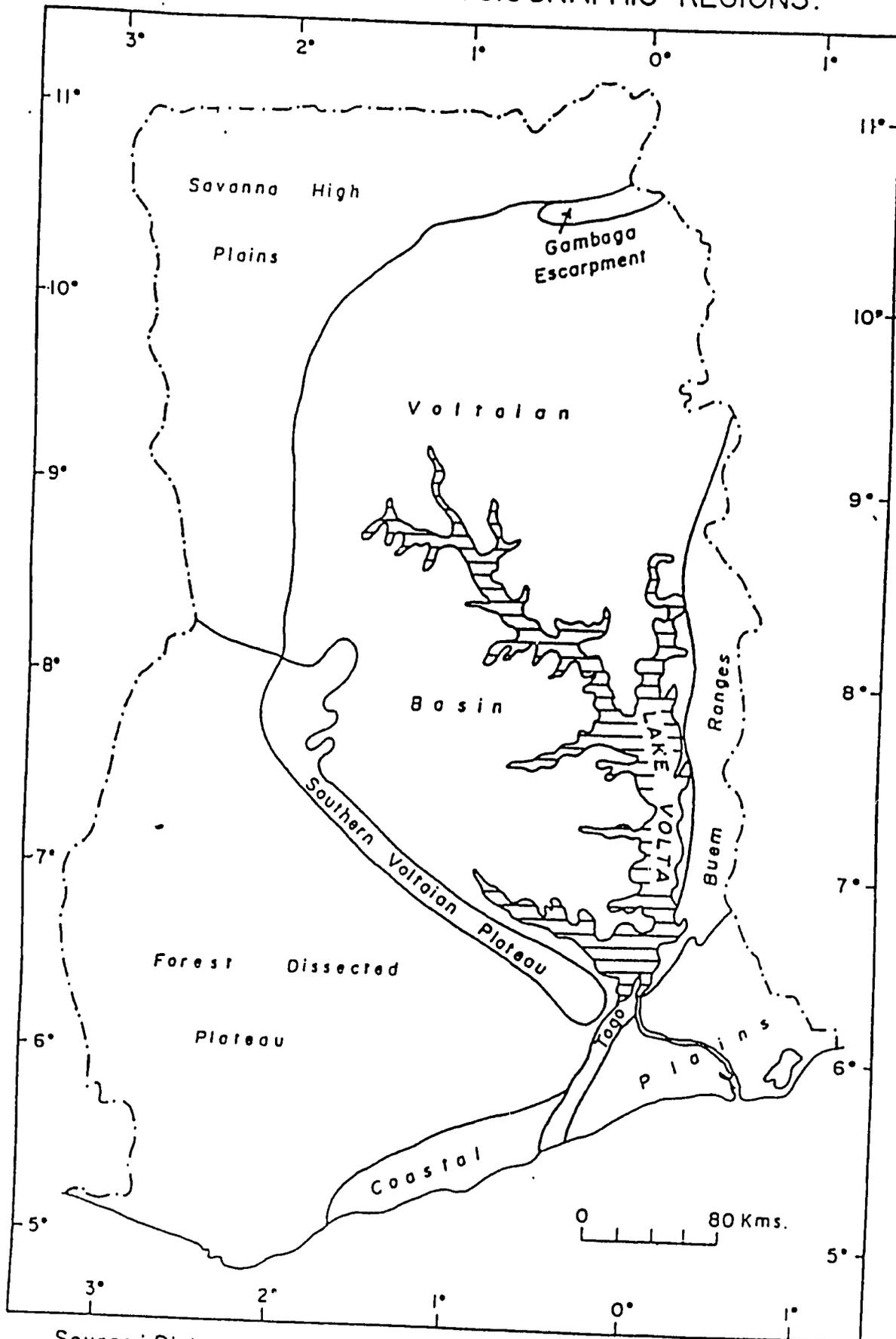
Source: Dickson and Bennet (1988)

Fig. 2 GHANA : GEOLOGY.



Source: Dickson and Benneh (1988)

Fig. 3 GHANA : PHYSIOGRAPHIC REGIONS.



Source: Dickson and Benneh (1988).

Within the broad delta of the Volta river in the eastern part of the Accra Plains and also along the Axim coast in the extreme south-west corner of the country are to be found the only extensive stretches of younger rocks of Tertiary to Recent age. In the intervening littoral zone between Axim and Tema scattered patches of Devonian sediments have combined with the rocks of the Precambrian peneplain to produce the sandy bays and rocky reefs which are characteristic of Ghana's attractive coastline.

The considerable mineral wealth of Ghana which includes gold, diamonds, bauxite and manganese is derived from the older Pre-Cambrian rocks. There are indications that petroleum in commercial quantities may be available in the younger sediments as evidenced by the actual exploitation for a short period of offshore deposits at Saltpond.

### **Drainage and Water Bodies**

The Volta river and its tributaries occupy a dominant position in the drainage system of the country. The Volta complex comprising the Black, Red and White Voltas (and their tributaries, the Kulpawn-Sisile, Nasia, Daka and Oti which, together, drain the northern savannah areas) and the Afram which drains the mid-country transitional areas finally empties into the sea at Ada. The southern rivers are - from east to west - the Densu, Ayensu, Nakwa, Amisa, Kakum and the Birim-Offin-Pra complex which drain the predominantly deciduous forest areas and empty separately into the sea. The Ankobra and Tano which drain the rain forest area in the south-west of Ghana also enter the sea separately (fig 4).

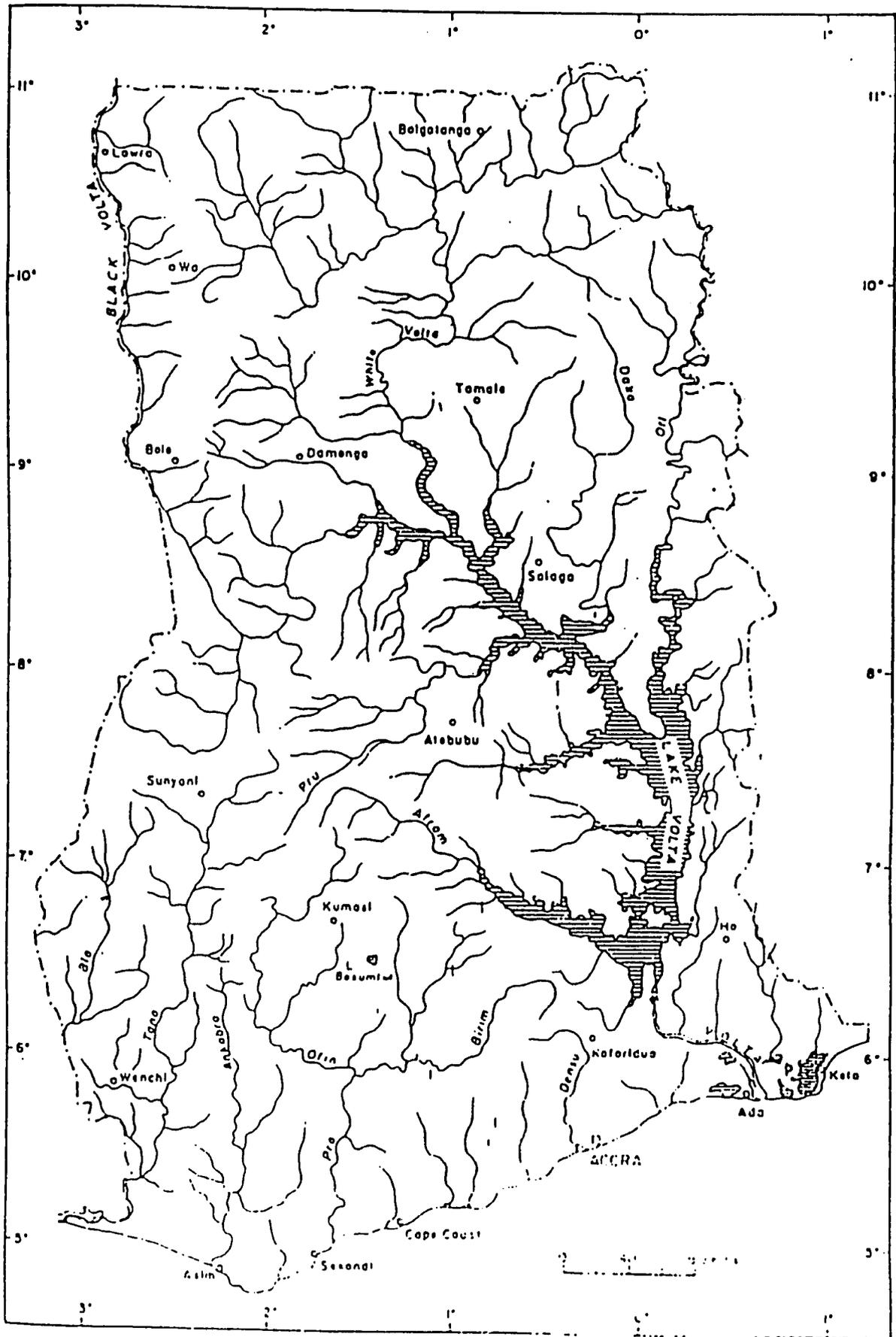
The Volta system further includes the Volta Lake, a vast man-made Lake, one of the largest of such lakes in the world, (with a surface area of 8,480 km<sup>2</sup>, 4% of the surface area of Ghana) which was created by the damming of the Volta river at Akosombo for hydroelectric power generation. A second impoundment, the Kpong headpond, has been created by a dam constructed 8 km downstream from Akosombo.

The only natural lake in Ghana is the Bosomtwe (surface area approximately 50 km<sup>2</sup>) believed to be a crater lake. Located about 32 km south-east of Kumasi, it is circular in shape and receives inlet streams but has no outlet streams. The number of lagoons on the coast of Ghana is generally given as 50 but the more recent 1:50,000 scale maps from the Ghana Survey Department indicate that there are at least 90 coastal lagoons in Ghana. Their surface areas range in size from the 0.010 km<sup>2</sup> Apantse lagoon near Apam to the 250 km<sup>2</sup> Keta lagoon complex. (Gordon, 1995).

There are two types of lagoons: the open lagoons which have a permanent or semi-permanent connection to the sea and the closed lagoons which are cut off from sea for most of the year.

It should be noted that each area of water is surrounded by a flood zone and that the size of the entire wetland is dependent very much on the climatic conditions that prevail. The total lagoon water area calculated from maps is 36596 ha which represents 0.15% of the

Fig. 4 GHANA: DRAINAGE



Source Dickson and Benneh (1988)

total land area of Ghana. The importance of these lagoons to biodiversity, however, far outweighs their small contribution to the total area figure. This is because of the habitats such as sea grass beds and mud flats, that they provide for a wide variety of fauna.

Aquifers underlie most of the country and the occurrence of groundwater is controlled principally by local geology and factors such as topography and climate. Groundwater occurs in two main formations in Ghana, the sedimentary formation covering 43% of the land area mainly in the Volta basin and the central parts of the country. It was estimated in 1990 that there are about 10,000 boreholes and hand-dug wells in use in Ghana.

## **Climate**

Like other parts of the West African coast, Ghana's climate is mainly the result of the interplay between two principal airstreams: the hot, dry, continental air mass or harmattan from the north-east and the moist, relatively cool air mass or monsoon from the south-west across the Atlantic. The Inter-Tropical Convergence Zone, along which these two air masses meet, oscillates north and south in conformity with the movements of the sun and largely determines the incidence of rainfall.

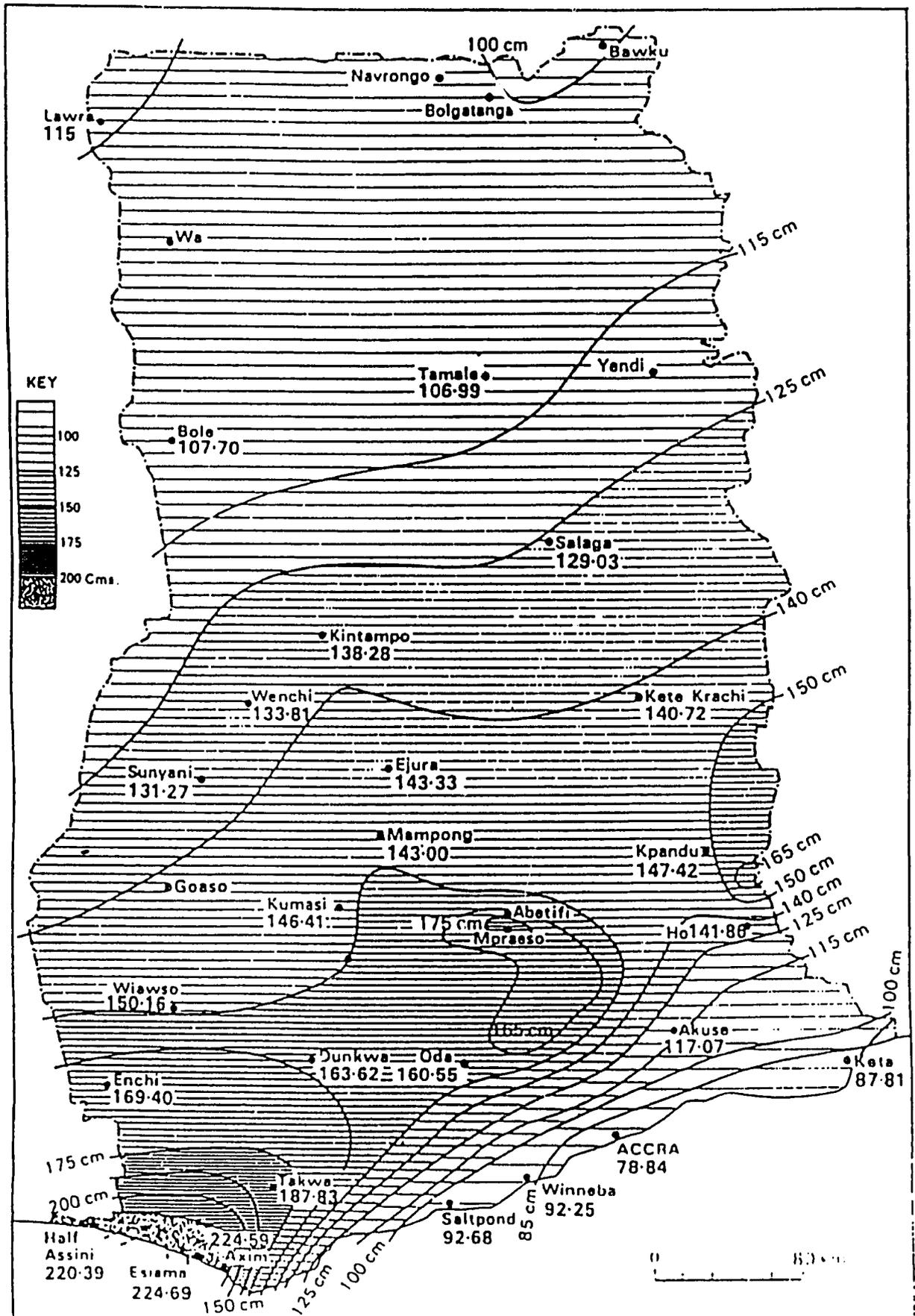
In the southern part of the country with high rainfall of between 1,270 and 2,100mm there are two rainy seasons, April-July and September-November. The northern part has a single season which falls between April and September with rainfall figures ranging between 1,100 and 1,270 mm and thereafter experiences a long dry season dominated by the harmattan (fig 5).

Mean temperatures lie between 26°C and 29°C. Although temperatures are uniformly moderate, there are important variations in different parts of the country as a result of altitudinal variations in landscape and distance from the sea. In the coastal areas due to the modifying influence of the sea, the annual difference between the maximum and minimum monthly temperatures is about 5°-6°C. Much farther inland the difference is between 7°-14°C. Diurnal temperature ranges are more significant than the monthly ranges. In the forested zones of the south the mean diurnal range is moderate but in the northern savannas the difference may be as much as 14°-20°C (fig 6).

## **Vegetation**

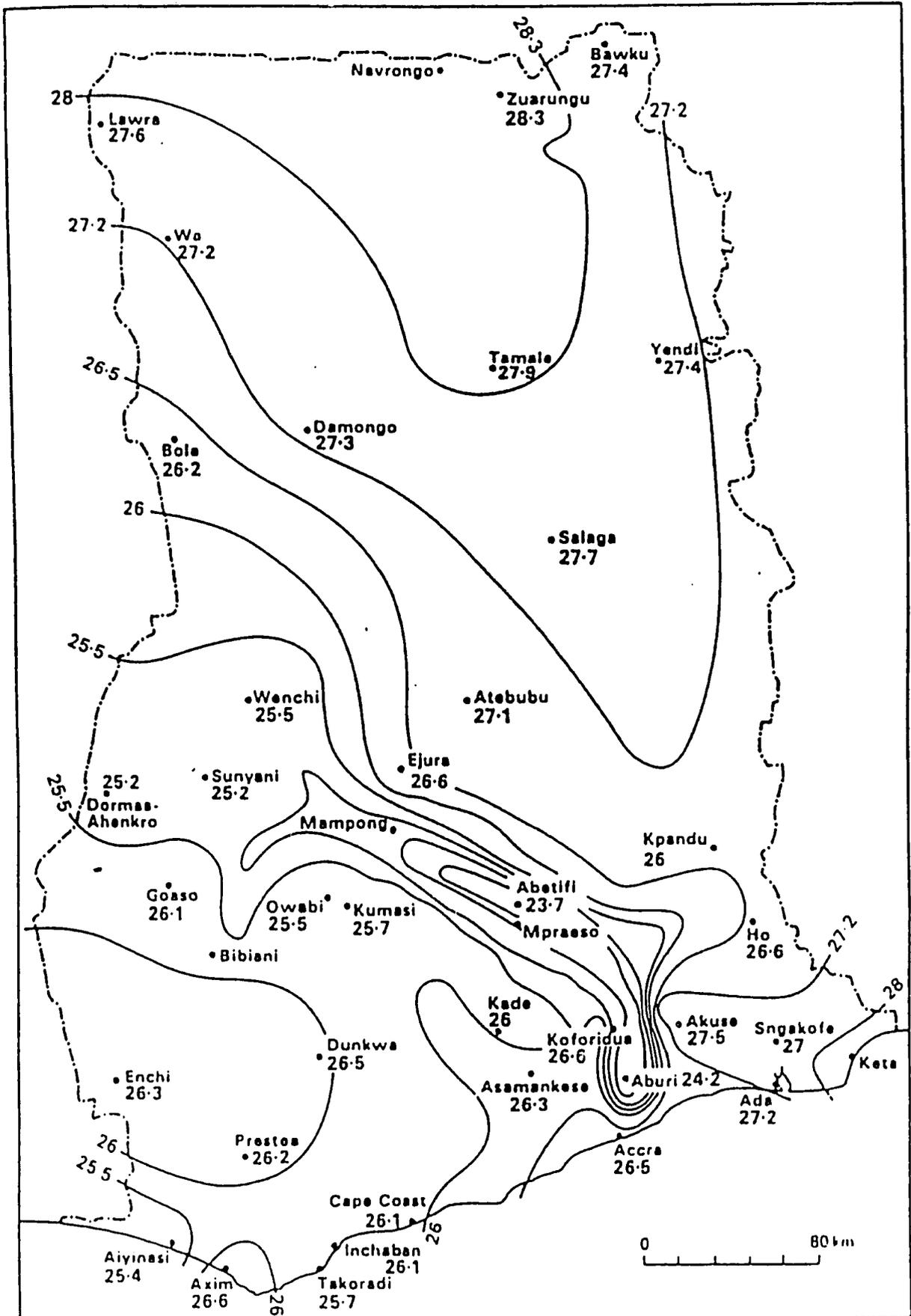
Broadly speaking, two major biomes may be distinguished in Ghana, namely, the tropical rain forest and savanna. The southern half of the country supports the closed forest while the northern half supports savanna vegetation. In more specific terms the area of heavy annual rainfall broken by two relatively short dry seasons which occur in the south-west portions of the country and along the Akwapim-Togo ranges is covered in the wetter portions with evergreen forest, while the area of lower rainfall which occurs in a single peak in the northern two-thirds of the country and the area around Accra are covered with savanna and scrub. The major vegetation types are by no means uniform and are interspersed with variants.

Fig. 5 GHANA : MEAN ANNUAL RAINFALL.



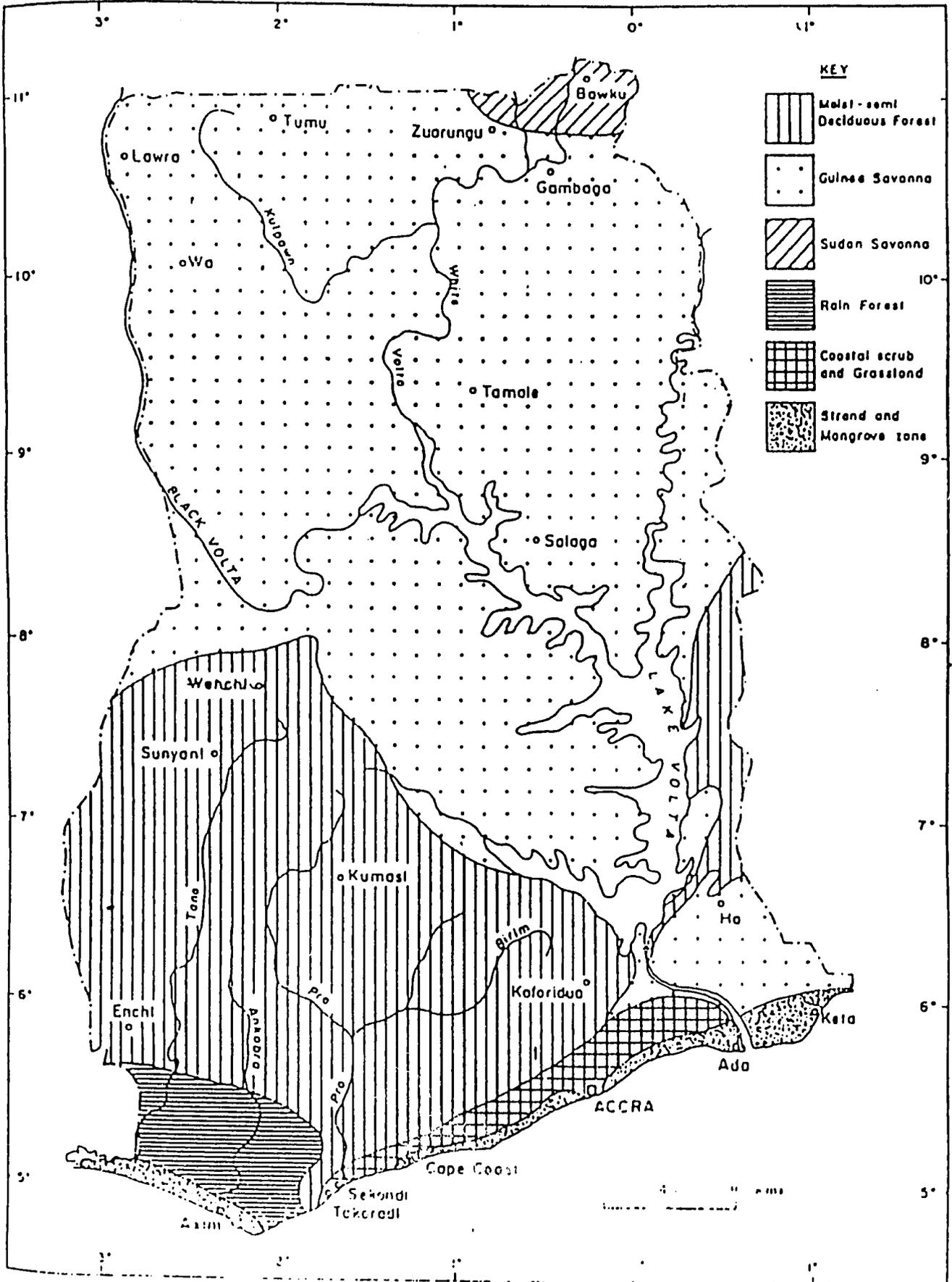
Source: Dickson and Bennet (1988)

Fig. 6 GHANA : MEAN ANNUAL TEMPERATURE



Source: Dickson and Benneh (1988)

Fig. 7 GHANA - VEGETATION.



Source: Dickson and Benneh (1988)

For example, there are areas of swamp forest where the ground is waterlogged in the forest zone while in some areas forests fringe the edges of rivers in the savanna zone. For further details about Ghana's vegetation and phytogeography, see pages 60-63 and 67-69.

## Soils

The soils of Ghana (fig 8) which support the main biomes and ecosystems in Ghana may be grouped as follows:

- (i) In the evergreen rainforest in the extreme south-west corner of Ghana where rainfalls above 1750 mm are recorded are to be found the oxysols (Oxisols: USDA; Ferric Plinthic Acrisols: FAO). They are strongly leached soils with predominant kaolinitic clays and of varying humus content. Oxysols are susceptible to water erosion on exposure and to rapid nutrient depletion.
- (ii) In forest and savanna environments with rainfalls between 900 and 1650 mm are developed the ochrosols: (Utisols, USDA; Rodic Ferralsol: FAO). The savanna ochrosols occur in the northern and coastal savannas in the middle range of the rainfall limits and under a single maximum rainfall in the northern savannas. The profile of ochrosols may contain iron pan or gravel at depths which are shallower in the savanna areas. The organic matter content is low especially in the savanna soils. Although droughty in the surface horizons and susceptible to water erosion, the ochrosols are extremely important agriculturally and are widely cultivated in both forest and savanna areas.
- (iii) In the northern and coastal savanna areas under rainfall of between 1000 and 1270 mm occur the Tropical Black Earths (Vertisols: USDA; Pellic Vertisols, FAO). These soils are dark grey and cracking clays which occur at low topographic sites. They cannot be effectively cultivated with traditional implements as they are extremely heavy-textured. Their nutrient status is generally good even though they may be deficient in nitrogen and phosphorus.
- (iv) In the Accra-Ho-Keta plains, under rainfalls between 600 and 900 mm, are to be found the tropical Grey Earths (Alfisols: USDA; Gleyic Solonetz: FAO). They are little-used soils with a profile characterized by the occurrence of a hard compact sandy clay pan a few millimetres below the surface. The status of organic matter of nitrogen and phosphorus in these soils is low. Furthermore, they are waterlogged in the rainy season and droughty in the dry season. Susceptible to water erosion and having a high sodium content in the lower horizons, they present problems in agricultural use.
- (v) In upland locations occur the groundwater laterites, the poorest soils in humid tropical Africa (Inceptisols: USDA; Plinthic Ferralsol: FAO). The profile of these soils consists of up to 61 centimetres of sandy or silty loam on iron pan or undulating mottled clay. Where the surface is disturbed, they exhibit exposed

concretionary surface horizons. Being droughty they are mostly unfarmed over the granites where they may be degraded through erosion.

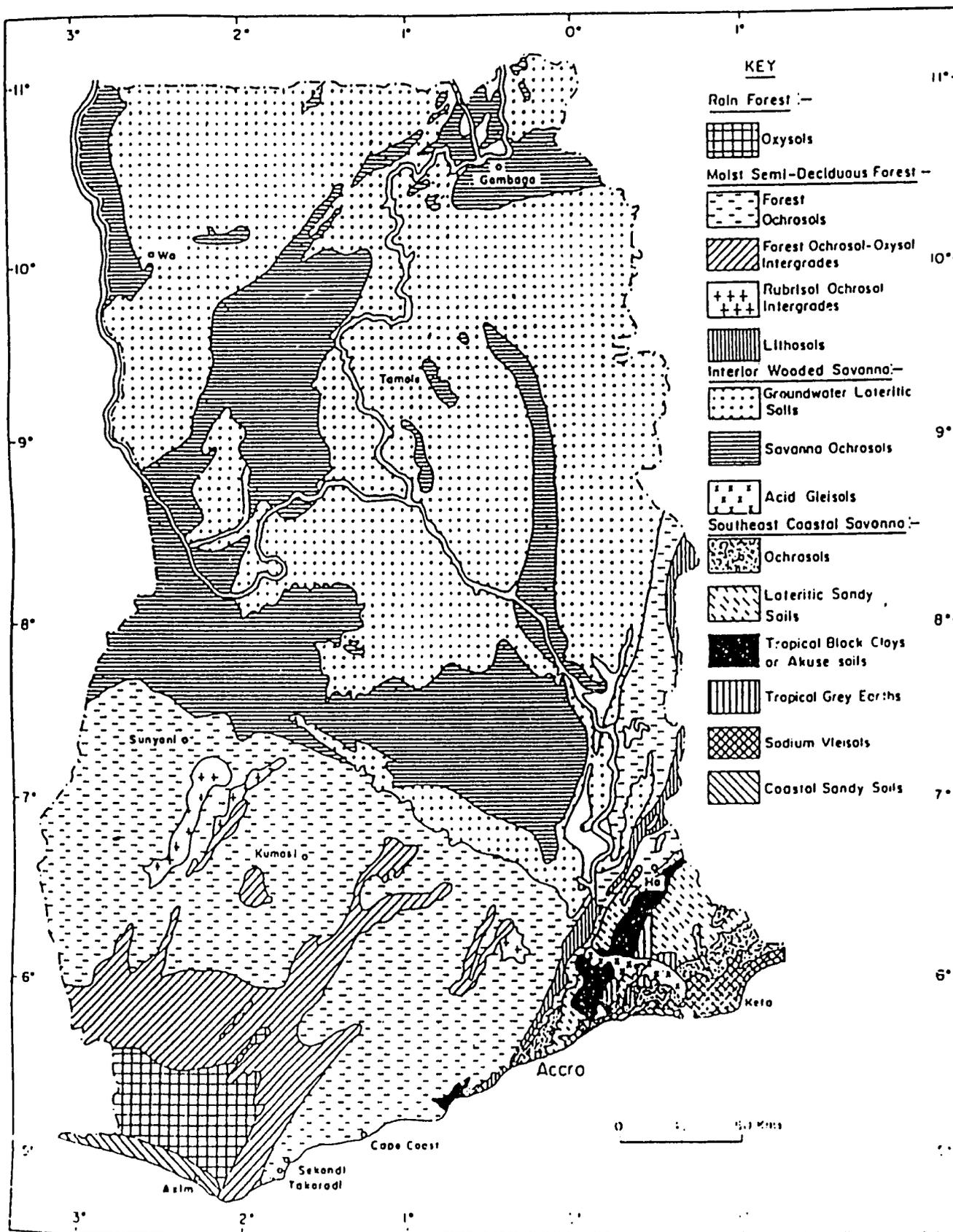
(vi) Other major soils of Ghana are integrades of the above soils and their lower topographic associates:

- \* In various alluvial and terrace material are to be found the acid gleisols (Gleysols: USDA; Dystric gleysols: FAO).
- \* On steep slopes occur lithosols (Entisols: USDA, FAO).
- \* On coastal sands and estuarine fills are to be found regosols (Entisols: USDA; Rhegosols: FAO).
- \* In marginal lagoonal environments occur sodiun vleisols (Inceptisols, USDA; Gleyic solenchacks: FAO).

### **Land Use**

It has to borne in mind that the land is no longer under continuous vegetation cover whether one is thinking of the evergreen forest or the savanna. Over the centuries, man has been utilizing the land in a variety of ways including farming, hunting, logging, mining and construction of roads and houses. Indeed the original closed forest vegetation of some 82,259 sq km<sup>2</sup> has now been reduced to 17,184 km<sup>2</sup> while in the savanna area prolonged cultivation and bushburning have caused serious degradation not only of the vegetation but also (in some areas) of soils.

Fig. 8 GHANA SOILS.



Source: Dickson and Bennet (1988)

## **II. SOCIO-ECONOMIC ENVIRONMENT**

### **Population**

The census of 1984 recorded a Ghana population of 12,296,081 giving an approximate density of 35.8 inhabitants per sq km. The annual population growth between 1980-1991 was 3.4%, and the mid-year population in 1991 was estimated by the UN at 15,509,000, giving a density of 65.0 per sq km. The highest population densities are to be found in cocoa-farming areas and in urban centres in the southern part of the country. The serious economic and environmental problems created by the high population growth rate have caused the Government to launch a campaign on family planning and population control.

The total population of Ghana in 1994 is estimated at 16,525,000, with a growth rate of 3.0% per annum (Vision 2020). This gives a population density of 69 per sq.km.

### **The Economy**

#### **Agriculture**

Agriculture is the mainstay of Ghana's economy and accounted for 43% GDP in 1991 apart from employing 49.3% of the working population. Cocoa is the most important export crop and exists largely as a smallholder crop. It occupies more than one-half of the country's cultivated land. Other cash crop exports include coffee, pineapple, bananas, palm kernels, copra, limes, cola nuts and shea nuts. Rubber, cotton, oil palm and kenaf are grown for processing by local manufacturing industries. In recent years, however, productivity has fallen because of poor planning and rising prices of imported inputs. Food crop farming concerns maize, millet, sorghum, rice, cassava yams and plantains.

Cocoa production declined during the 1970s as a result of factors which included the lowering of cocoa prices, lack of incentives for farmers, and low producer prices. By the 1980s the decline had not been arrested and was in fact exacerbated by the severe drought of 1982, which gave rise to widespread bush fires, and smuggling to neighbouring countries. Disease also took a heavy toll, especially, on ageing cocoa plants. Despite efforts by the government, assisted by international funding agencies, to revitalize cocoa production its production has remained below 300,000 tonnes per annum and in fact fell to 243,000 tonnes in 1991/92. A target of 350,000 tonnes set by the Government has not been achieved despite the fact that 320,000 ha of cocoa farming land were designated as special zones for rehabilitation and spraying to prevent black pod disease.

The droughts of 1982 made it necessary to import staple foods and to have recourse for assistance under international food aid programmes. But even when favourable conditions returned, combined with new price incentives and increased crop yields,

250,000 tonnes of food aid was needed to make up for food deficit in 1984. By 1988, however, staple food production had increased to 6.8m tonnes. Crop surpluses were recorded in 1989. Maize production increased to 932,000 tonnes in 1991 compared with 574,000 tonnes in 1985 with paddy rice attaining a production of 151,000 tonnes.

Cattle production is restricted to the Northern region and the Accra Plains. Meat production is insufficient and a local annual demand of 200,000 tonnes is the average imported.

Domestic fisheries (marine and the Volta Lake) account for about one-half of an annual demand of 600,000 tonnes. Catches in 1988 and 1991 were 362,000 and 391,000 tonnes respectively.

In 1991 the government implemented a Medium-Term Agricultural Development Programme (1991-2000) which aimed at achieving complete self-sufficiency in food production by the year 2000.

### **Mining**

Gold is Ghana's principal mineral export and replaced cocoa as Ghana's principal export commodity in 1992. Annual exports of gold were \$92m in 1985 and \$300 million in 1991. Ashanti Goldfields Company accounts for 75% of Ghana's official production. Following exploration and development by private investors, several medium-scale producers commenced gold extraction operations in 1991/92. Gold mining investment in 1987-91 totalled \$600m and a further investment of \$500 million is predicted. Other minerals include industrial diamonds (Akwatia), (Awaso) and manganese (Nsuta).

### **Timber**

Ghana's timber export was substantial in the 1960s, but it declined with the establishment of a Timber Marketing Board with powers to fix minimum contract prices. Export earnings from timber were \$88m in 1989 but increased to \$135m in 1990. The Timber Export Development Board which replaced the Timber Marketing Board revitalized the industry, and timber exports were projected to reach 700,000 cu m per annum. In 1990, the forestry sector accounted for 5% of GDP and 12% of Ghana's total export earnings. The necessary replanting of 11,000 ha per year in the 1970s had declined to 4,000 ha per year by the late 1980s. It is estimated that the available timber would meet domestic and export requirements until the year 2030. Unless a revitalized replanting programme is organized on a scale commensurate with the rate of current removals, Ghana would become an importer of timber thereafter.

### **Manufacturing**

Manufacturing output stagnated in the 1970s and declined sharply in the early 1980s. The sector's contribution to Ghana's total GDP declined from 22% in 1973 to under 5% in 1983. Since 1981 the contribution of the industrial sector to total GDP has fluctuated, but remained at unacceptably low levels.

The Volta Aluminum Company (VALCO) operates one of the largest capital-intensive industries owned by the multinational KAISER Aluminium, and Chemical Corporation (90%) and Reynolds Metals. (10%). The company produces aluminium ingots from imported alumina.

The response of the private sector to the improved macro-economic environment has not been satisfactory. Under-performing industries are being closed down. New policies since 1990 are designed to promote private investment in manufacturing. In 1993, a new investment bill was accepted by Parliament which, among other things, reduces the minimum capital requirements for new foreign investment and reserves very few activities exclusively for Ghanaians. The new policies further include reductions in tax-rates and an extension of the capital allowances provided under the new Investment code to all manufacturing enterprises.

Privatization of the manufacturing sector was accelerated in 1993 and a Divestiture Implementation Committee has undertaken to sell the government's shares in a number of state owned enterprises including the Tema refinery, the Tema Food Complex, Ghana Industrial Holding Corporation, Borsatires and the Cocoa Processing factories in Tema and Takoradi.

## **Energy**

The major source of energy in Ghana is from biomass in the form of wood fuel and charcoal which accounts for some 71% of the total energy consumed. Forest resources therefore are an important component of the economic infrastructure. (Ayensu, 1983)

Petroleum products form about 19% of the total energy used in the country. These are mainly used for transportation and to a much smaller extent for cooking and lighting (kerosene and liquid petroleum gas). The mineral fuels are refined from imported crude oil. Substantial deposits of natural gas have been found from oil exploration activities though these are yet to be exploited. The prospects of finding commercially viable deposits of oil are said to be good.

In 1986 the Akosombo plant, with an installed generating capacity of 912 MW and, subsequently, the 160-MW Kpong plant which was installed provided all Ghana's electricity needs and allowed electricity to be exported to Togo and Benin. Drought and reduction of Volta Lake levels compelled the Volta River Authority to restrict output in 1983 and 1994. Plans to construct a 450-MW hydro-electricity plant at Bui on the Black Volta have been delayed and a thermal plant with a capacity of 400MW is expected to be built in 1997 in the Western region to supplement existing supplies.

Current electricity generated provides about 10% of total energy consumed.

## **Foreign Trade**

Ghana is essentially an exporter of primary products, mainly gold, cocoa and timber, and an importer of capital goods, foodstuffs and mineral fuels. The propensity to import is high, both among consumers and producers. Since the mid-1970s, the Ghanaian economy has become increasingly reliant upon external finance. Bilateral aid and loans from trading partners fluctuated with political changes. In recent years these sources of funds have been replaced by increasing financial support from the World Bank and the IMF culminating in 1993 in the pledge of US\$2,100 million in Paris to support the Government's economic policies.

The repayment of the short maturity credits from the IMF, which has been contracted since 1983, has increased the pressure on the capital account of the balance of payments. Furthermore, Ghana's external debt has increased enormously to exceed \$4,100 billion in 1992 of which \$1,347m was medium-term and \$2,797m long term debt.

## **Economy Recovery Programme**

The Economic Recovery Programme was launched in 1983 with the support of the World Bank and the IMF, initially, as a stabilization phase of the recovery of the economy which had suffered near-collapse. A second programme, ERP2 (1987-90), was designed as the structural adjustment and development stage of the recovery. Despite an impressive performance, with Ghana registering average growth rates of about 5%, the country suffered a period of uncertainty in the early 1990s arising from difficulties in fiscal management and reduced earnings which caused Government expenditure to exceed agreed levels. A new commitment was, however, made by donors at a meeting held in Paris in June 1993 to help Ghana meet her balance of payments difficulties.

Under the new Civilian Administration a new phase of accelerated growth modelled on the pattern of growth of a number of East Asian countries has been launched with the creation of a vigorous private sector and a liberal investment environment as indispensable ingredients. The country is, however, a long way from alleviating poverty or significantly raising standards of living for most Ghanaians.

## **Vision 2020**

To address the current economic problems, the Government has developed a long-term vision for Ghana to become a middle-income country by the year 2020. The National Development Policy Framework articulates the long term, 25-year (1996-2020) perspective for Ghana's socio-economic development and, therefore, represents GHANA-VISION 2020.

The first step in Vision 2020 is a five year medium term Coordinated Programme of Economic and Social Development Policies for 1996-2000. It aims at consolidating the gains secured so far through the various economic policies over the past decade and to

lay strong foundations for accelerated growth and development in the subsequent two decades.

The coordinated programme is meant to be human centred, comprehensive and based on the coordinated endeavours of government agencies, national, sectoral, regional and district as well as the private sector including the NGO's.

The basic objectives of the medium term programme are based on five development themes, namely:-

- human development
- economic growth
- rural development
- urban development
- an enabling environment

The success of the Vision 2020 objectives will depend to a large extent on the integration of science and technology in the various development programmes to ensure the maintenance of the integrity of the environment. The programme thus promotes the levels of sustainable development as suggested at the Earth Summit of 1992.

### **III. MAJOR ECOSYSTEM TYPES AND FLORAL/FAUNAL ASSEMBLAGES**

#### **1. INTRODUCTION: Biogeographic Zones of Ghana, their floral and faunal characteristics and their relation to adjoining zones in the West Africa sub-region.**

Ghana extends over three main biogeographic regions, the Guinea Congolian in the South-west, the Sudanian in the north and the Guinea-Congolian/Sudanian transition zone in the middle and in the South-east (Fig. 9).

The forests in the south-western part of the country constitute the eastern end of the Upper-Guinea forest block which is an area of high conservation priority because of the high species diversity and endemism.

The over 3,600 species of plants recorded in Ghana form part of the five endemic elements which invariably relate to the major regional centres of endemism of White (1965, 1983, See Fig 9).

These endemic elements are:-

- i) Guineo-Congolian wides, referring to species occurring in all three sub-centres of the Guineo-congolian region (i.e. the Upper Guinea, Lower Guinea and Congolian);
- ii) Guinea wides referring to species in the Upper and Lower Guinea and sub-centres only;
- iii) Upper Guinea endemics referring to species restricted to the Upper Guinea sub-centre only;
- iv) Satellites referring to species restricted to Ghana and not found within the Upper Guinea sub-centre; and
- v) Chorological transgressors referring to species distributed widely outside the Guineo-congolian region.

Categories i-iii make up the West African endemics. Some 19 species, mostly in the forest vegetation, are considered to satisfy category iv. These species are either neo-endemic or paleo-endemic (Hall and Swaine, 1981) and this relates to whether the closely related species are extant or not found in West Africa.

An estimate of over 66% of the species in Ghana appear to belong to the category (v) of the endemic elements. These are the species that are not restricted to the West Africa sub-region alone, but go beyond the rest of the African continent.

A considerable proportion of the species relate to the Sudanian regional centre of endemism and its transitional zone with the Guineo-Congolian, all of which extend to central and eastern Africa.

The fauna of Ghana, like the flora, is composed of the following elements:-

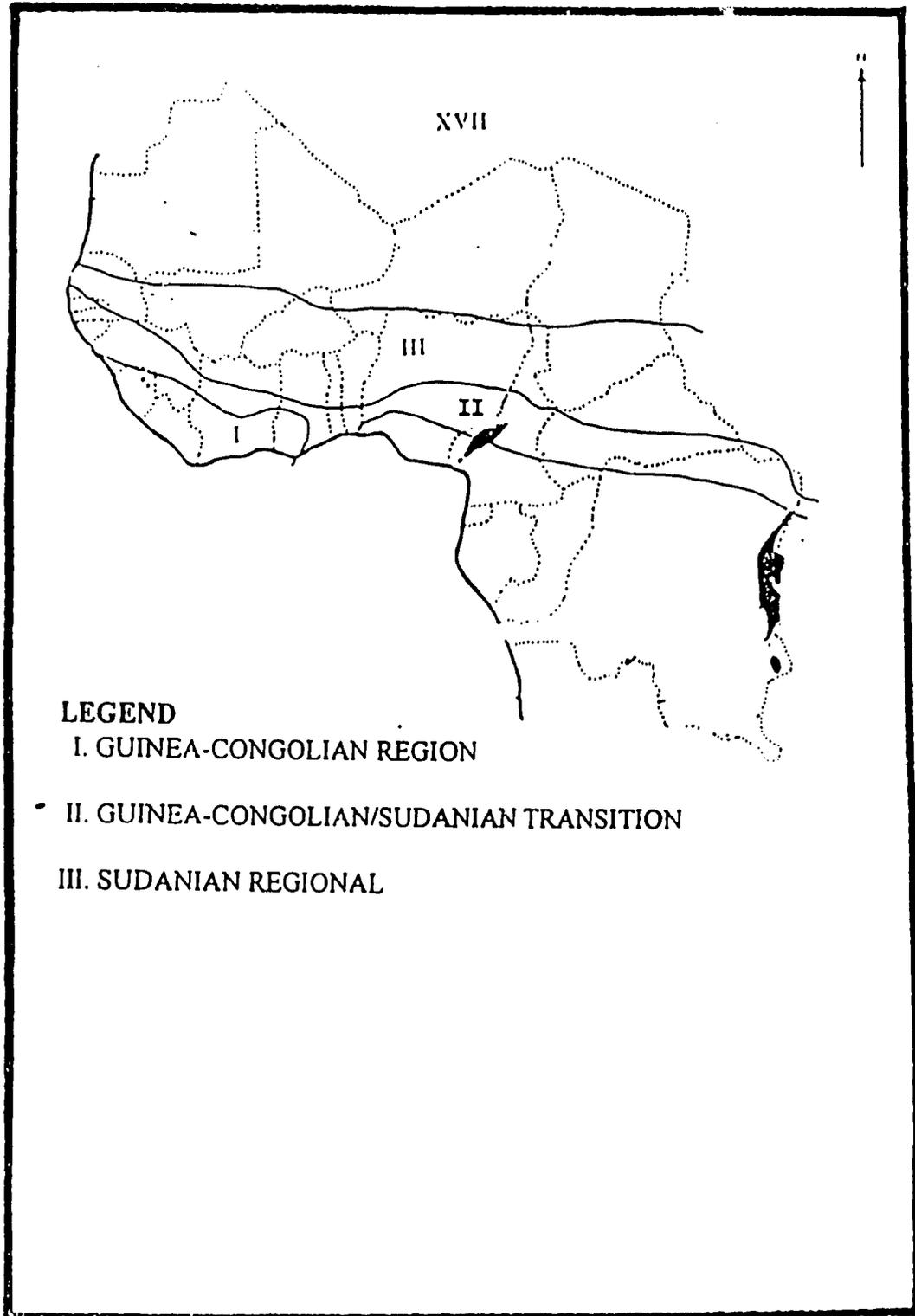
- i) Species which are found throughout the entire Guinea-Congolian tropical forest.
- ii) Species which are limited to the upper Guinea block of forest from the Congo forest.
- iii) Species which are found in the Guinea-Congolian Forest/Savanna Transitional zone.
- iv) Species which are found in the Sudan savanna. A belt of dry coastal savanna, the Dahomey Gap, separates the Upper Guinea block of forest from the Congo forest.

Animals are generally restricted in their distribution to either the forest or savanna, but a few have geographical ranges which overlap the two. Some forest species enter the savanna along gallery forests while some savanna species enter the forest when it is opened up by farms, roads and other human activities (Booth, 1959; Grubb 1978). Species with specialized habitat requirements such as the forest elephant and many of the primates have become threatened.

While the broad biomes of forest, coastal savanna, guinea savanna and sudan savanna are the major ecological zones for biodiversity considerations, the relative isolation of the Guinea block explains the great affinities between Ghanaian fauna and those countries within that block, namely, Cote d'Ivoire, Liberia, Guinea and Senegal. There is general agreement that within western Africa, west of the Dahomey Gap, the Sierra Leone/Liberian area and the Ivory Coast/western Ghana border areas which have the highest precipitation and the richest faunal diversity, represent forest refugia from past dry periods.

The zoogeographical affinities between Ghanaian fauna and those of the countries in the West African Forest Zone, namely Cote d'Ivoire, Liberia, Guinea, Sierra Leone and the Senegal are illustrated by the number of species in Ghana which are endemic to the entire region.

FIG. 9 MAP OF WEST AFRICA SHOWING THE EXTENT OF BIOGEOGRAPHIC ZONES IN GHANA



## **2. THE TROPICAL FOREST ECOSYSTEM AND ITS SUBTYPES**

The tropical forests of West Africa occupy an area approximately 320 km<sup>2</sup>, the southern limit of which is defined by the Atlantic coastline, the northern limit by available rain. The southern half of Ghana lies within the belt. For a complete description of the Rainforests of West Africa with detailed description of the ecology, threats and conservation, see Claude Martin (1991).

### **THE PRIMEVAL RAIN FOREST**

The primeval rain forests probably contained many thousands of different species including the 680 tree species recorded in Ghana. These primeval tropical forests were characteristically stratified, that is, the crowns of the trees formed layers at different heights above the ground (Richards, 1952). Typically, the upper stratum or first storey consists of trees 35-50 m in height often with wide crowns. Trees of this storey are known as emergents because of their tendency to rise above the middle stratum or second storey without forming a continuous canopy. The second storey, 18-35 m in height with generally wider and deeper crowns, formed a continuous canopy laterally thereby blocking incoming radiation and giving the forest a rather gloomy outlook. The trees of the lower stratum or third storey, which include saplings of species of both the first and second storeys, were typically very dense and 5-18 m tall. Their crowns varied in shape, but the conical shape was more prevalent. Below this storey were a shrub and a ground layer which were not very well developed. For a vivid and pictorial appreciation of the structure of the rain forest, see Ayensu (1980).

Undoubtedly, the original rain forests experienced minor modifications through human disturbances from the time when man was just a food-gatherer to the time of sedentary existence. With the development of small isolated settlements came the associated activities of tree-felling, subsistence farming, and rudimentary bush track communications. In some areas native gold digging took place. It had been estimated that it took only 30-40 years for the forest to return to its original state after such disturbances. It is, however, widely believed now that primary forests in their primeval state no longer exist in Ghana; most of the forests in the country now are really secondary forests at different stages of succession. In sparsely populated areas, however, these forests develop to a stage close to the climatic climax, but in densely populated areas, where pressure on the land is great, the secondary vegetation is very different from the climax with more species of forbes.

### **The closed or high forest ecosystem**

The closed forest, sometimes referred to as the high forest, is made up of different types of forest ranging from the wet evergreen, which experiences high amounts of rainfall throughout the year, to the dry semi-deciduous type which experiences low amounts of rainfall distributed only at certain times of the year and a well-defined dry season.

The wet evergreen (WE) forest type may be found in the south-western corner of the country. It receives a mean annual rainfall of over 2000 mm and looks green and luxuriant all year round. Rainfall generally decreases from this forest type towards the north. Typical species include *Cynometra ananta*, *Tarietia utilis*, and *Tieghemella heckelii*. In terms of precipitation, the upland evergreen (UE) forest is similar to the WE but the two differ markedly in their floristic composition and structure. The UE forests are found on hills and mountains and are, therefore, referred to as monotone forests. The moist evergreen (ME) forest located around Tarkwa, Dunkwa and Enchi receives between 1950-2000 mm a year but does not differ in structure from the WE forest although there may be some slight differences in the floristic composition.

The moist semi-deciduous (MSD) forest type averages 1,500 mm rainfall a year and there is also a more clearly defined dry season. This forest type may be conveniently divided into a north-western (NW) sub-type and a south-eastern (SE) sub-type. The former sub-type is located around the Goaso and Dormaa Ahenkro areas and the latter covers areas like Obuasi, Kumasi and Oda. Together, these two sub-types contain most of the country's valuable timber species including the redwoods, the mahoganies and the cedars. The ubiquitous *Triplochiton scleroxylon* is most commonly found in the MSD (NW) sub-type. The species composition in the MSD forest as a whole differs from the evergreen sub-types. In the former, many of the species in the upper and middle strata exhibit the deciduous habit during the dry season when the influence of the harmattan is pronounced.

A dry semi-deciduous (DSD) forest type bordering the Guinea savanna may receive between 1,000-1,500 mm rainfall a year and has a pronounced dry season with its associated high temperatures. Different types of nomenclature, including derived savanna and interior wooded savanna (Dickson and Benneh 1988), have been used for this forest type, which occupies the areas around Ejura, Techiman, and Wenchi, also known as the Transition zone. The DSD forest sub-type, which is sometimes described as 'forest containing clearings of savanna' or 'savanna with clumps of forest trees' may also be conveniently divided into an inner zone (IZ) sub-type and a fire zone (FZ) sub-type. One of the most important timber species, *Milicia excelsa*, reaches its maximum abundance in the DSD (IZ) sub-type although at present this species is endangered. The DSD (FZ) sub-type is characterised by the occurrence of periodic fires, especially during the dry season. This forest sub-type supports species like *Adansonia digitata*, *Parkia clappertoniana*, *Butyrospermum parkii* and *Acacia spp.*

The south-east outliers (SO) represent the driest of forest types (rainfall of 750-1000 mm per annum) and are the least extensive occupying an area of approximately 20 sq km in small scattered patches. South-east outliers are found on the Accra Plains, one notable example being at Shai Game Production Reserve. This forest type is characterised by a low floral diversity and trees with low canopies. Typical species include *Milletia thonningii*, *Talbotiella gentii*, and *Drypetes parvifolia*. Within this forest type there are several rare tree species and few commercial timber species.

## Floristic diversity of Ghana's forests

Of the 3,600 species of plants recorded for Ghana, over 2,100 species have been identified in Ghana's forest zone, and new species are continually coming to light. These are from some 125 plant families of which the Rubiaceae holds the greatest number of species (218 spp.). The second largest species count is 124 Orchid species, most of which are epiphytes. The ferns account for 126 species.

There are 818 tree species in Ghana, and among the woody plants, the figs have the largest number of species (33), many of which are epiphytic. There are no genera of tall trees with many species (*Entandrophragma*, for example, has only 4 spp.) but some genera have moderate numbers of understorey trees (e.g. *Diospyros* (17 spp) and *Drypetes* (13 spp)). There are 604 species of woody climbers, but conspicuously few palms.

The greatest species numbers have been recorded in primary forest (i.e. unfarmed), with 1,360 species. In the mosaic of farmland habitats 343 secondary species have been recorded, with a further 203 species in ruderal vegetation and 167 species in swamps.

In the wettest forests, about 150 species of trees (>10cm dbh) have been recorded on 2 ha areas, and if all plants (from herbs and grasses to climbers and emergent trees) are counted in small plots, 400 plant species have been recorded/ha. The high species richness is to be expected in tropical rain forest, although even the richest in Ghana are somewhat lower than recorded in dipterocarp forests of South-east Asia.

The Ghanaian forests are at the eastern edge of the Upper Guinean sub-centre of the Guineo-Congolean phytogeographical region. Almost all species in Ghana have been recorded in Cote D'ivoire but fewer in rain forests of Nigeria, separated from the Ghanaian forests by the arid Dahomey Gap. The flora therefore has strong affinities with the forests in Cote d'Ivoire, Liberia and Sierra Leone. However, there are still 19 full species endemic to Ghana and at least two further subspecific taxa. Nine of these are trees, 2 are large lianas, 3 shrubs and 5 herbs.

Wet evergreen forests have the highest species richness (200 spp. in 0.0625 ha) and most endemic plants, including four trees (*Hymenostegia gracilipes*, *Cola umbratilis*, *Alsodeiopsis chippii* and *Monocyclanthus vignei*), all of which are of conservation concern. The neighbouring moist evergreen forests also have a rich flora (170sp/0.0625 ha), including one endemic. The moist semi-deciduous forest have still fewer species (100sp/0.0625 ha), but hold two endemic species including the tree *Uvariopsis globiflora* (Annonaceae).

In drier forests (1500 mm rainfall per year), species diversity drops markedly. The dry semi-deciduous forests (40-100 spp/0.0625 ha), on the northern edge of the forest zone can be sub-divided into those that experience fires and those that do not. In the two

dry coastal forest types, southern marginal and southern outlier, species richness is even lower, with 90 per cent of the vegetation attributed to a single species in some of the southern outlier forest plots. Despite this paucity of species, these two forests have five endemic species, including 3 trees (*Talbotiella gentii*, *Dalbergia setifera* and *Turraea ghanensis* and the southern outlier forests are unique to Ghana.

Over 150 Ghanaian non-endemic species of plants are of some conservation concern. Virtually all of these have a restricted West African distribution and are poorly known as regards their conservation circumstances in the wild.

Forest species thought to be endemic in Ghana are listed in Table 1.

**Table 1: Forest Species thought to be endemic in Ghana**

Name	Family	Forest Type	Life Form	Neo-or Palaeo-endemic
<i>Alsodeiopsis chippii</i> Hutch	Icanaceae	WE	Pygmy tree	neo
<i>Bonamia vignei</i> Hoyle	Convolvulaceae	MS	Large climber	palaeo
<i>Bowringia discolor</i> J. B. Hall	Papilionaceae	WE	"	"
<i>Cola umbracilis</i> Brenan & Keay	Sterculiaceae	WE	Small tree	neo
<i>Commiphora dalzielii</i> Hutch	Burseraceae	SO	Shrub	palaeo
<i>Dalbergia setifera</i> Hutch & Dalz	Papilionaceae	SM	Small tree	neo
<i>Diaphananthe suborbicularis</i> Summerh	Orchidaceae	DS	Epiphytic herb	"
<i>Dissotis entii</i> J. B. Hall	Melastomataceae	MS	Ground herb	"
<i>Grewia megalocarpa</i> Juss.	Tiliaceae	SM-SO	Shrub	palaeo
<i>Hymenostegia gracilipes</i> Hutch & Dalz	Caesalpiniaceae	WE	Medium tree	neo
<i>Ledermanniella bowlingii</i> (J.B.Hall) C. Cusset	Podostemaceae	DS	Aquatic herb	palaeo
<i>Monocyclanthus vignei</i> Keay	Annonaceae	WE	Pygmy tree	"

<i>Nephtytis swainei</i> _Bogner	Araceae	ME-WE	Ground	
<i>Oleandra ejurana</i> C.D. Adams	Davalliaceae	DS	Epiphytic fern	"
<i>Psychotria ankasensis</i> _J. B. Hall	Rubiaceae	WE	Ground herb	"
<i>Talbotiella gentii</i> Hutch & Greenway	Caesalpiniaceae	SO-SM	Medium tree	"
<i>Turraea ghanensis</i> _J. B. Hall	Meliaceae	SM	Pygmy tree	"
<i>Uvariopsis globiflora</i> _Keay	Annonaceae	MS	Small tree	neo
<i>Virectaria tenella</i> _J.B. Hall	Rubiaceae	DS	Ground herb	palaeo

Neo-endemic - spp. closely related to some WA spp. speciated within fairly recent times

Palaeo - endemic - spp. lacking extant close relatives or nearest relatives are absent from West Africa

WE = Wet Evergreen

MS = Moist Semi-deciduous

SO = South-East outlier

SM = Southern Marginal

DS = Dry semi-deciduous

Source: Hall and Swaine 1981

Based on available data, the forest areas have higher numbers of endemism and diversity in descending order, viz: Wet Evergreen (WE), Moist evergreen (ME), Upland Evergreen (UE), Most Semi-Deciduous (MSD), Dry Semi-Deciduous (DSD), Southern Marginal (SM) and South-East outliers (SO). Thus there is higher (SM) species endemism and diversity in the western part of the country.

### Faunistic Diversity of Ghana's Forests

Larsen (1994) recorded 860 species of butterflies in Ghana. Forest species predominate accounting for 83% of the total number of species. The wet evergreen and the moist evergreen forests of Ghana are the most important repository of butterfly diversity in Ghana and by implication the diversity of other insects.

Species of Amphibians which are found solely in the rain forest environment belong to the families Arthroleptidae (2 species); Bufonidae (1); Hyperolidae (11); Ranidae (12); Rhacophoridae (13); and Caeciliidae (1).

Among the reptiles the distribution by Order/Suborder is as follows:- Testudinata (2); Lacertilia (14); Ophidia (32). The Crocodylians are found exclusively in rainforests.

Some 200 species of birds out of a total of 721 listed for the country, have been recorded within the forest zone, with 80 species being restricted to primary forest (WRI, 1990). This includes six species of hornbills, the African grey parrot *Psittacus erithacus* and the endangered white-breasted guineafowl *Agelastes meleagrides*, which was seen in Boin-Tano Forest Reserve in 1989.

The mammal fauna of the closed forest zone is biotically diverse and includes over 200 species, many of which are rare or endangered. Ungulate species include Maxwell's duiker *Cephalophus maxwelli*, bushbuck *Tragelaphus scriptus*, buffalo *Syncerus caffer*, bongo *Tragelaphus euryceros* and the rare Ogilby's duiker *Cephalophus ogilbyi* (Ankudey and Ofori-Frimpong, 1990). Carnivores are represented by species such as leopard *Panthera pardus* and golden cat *Felis aurata* which are rare, African civet *Viverra civetta* and several species of mongoose. Of the 16 primates recorded in the country, many, including the red colobus monkey *Colobus badius waldroni*, diana monkey *Cercopithecus diana*, white-collared mangabey *Cerocebus atys*, bushbaby *Galago senegalensis*, Bosman's potto *Perodicticus potto* and chimpanzee *Pan troglodytes* are found in the the forest zone. Eight primates occur in Bia and Nini-Suhien national parks. Other species of this zone include forest elephant *L. a. cyclotis* and the increasingly rare pygmy hippopotamus *Choeropsis liberiensis*.

The closed forest zone also supports 74 species of bats, 37 rodents, three species of flying squirrel.

### 3. THE SAVANNA ECOSYSTEM AND ITS SUBTYPES

By far the greater part of the country is covered by savanna vegetation (Table 2). Two of the three major types of savanna are represented in Ghana - The Guinea and Sudan savannas.

#### The Guinea Savanna

The Guinea savanna, which occupies an area of about 148,542 sq.km, consists of mostly broad-leaved trees some of which are also found in the DSD (FZ) forest sub-type. Most species lose their leaves during the prolonged dry season and fire is an important ecological factor within this vegetation type to the extent that some of the commonest tree species, such as *Lophira lanceolata*, *Azelia africana* and *P. clappertoniana*, have developed thick barks which make them fire-resistant. The grasses found in this savanna type are tall (1-3m high), tussocky, and fire-resistant. They include species of the genera *Andropogon*, *Hyparrhenia* and *Pennisetum*, among others.

The Guinea savanna is by no means uniform or homogeneous. Many local variations exist and this has resulted in a variety of nomenclature. Parkland savanna is used to describe a situation where the trees are in clumps and orchard savanna describes the condition where the trees are more or less evenly spaced. Lawson (1966) also makes reference to two sub-divisions of the Guinea savanna: the northern and southern types. This distinction is essentially based on the floristic composition. For instance, in the northern sub-type, *P. clappertoniana* and *B. parkii* are quite common since they are protected by the local people because of their food and economic values respectively. Also, this sub-type is characterized by *Isobertinia doka* while the southern savanna sub-type is characterized by *Lophira lanceolata* and *Daniellia oliveri* (Lawson, 1966).

#### The Sudan Savanna

The Sudan savanna lies to the north of the Guinea savanna and covers a greater part of Burkina Faso and Mali. In Ghana, this zone is limited to the Navrongo-Bolgatanga-Bawku corridor, an area of about 1,955 sq.km (Table 2). The natural vegetation is characterized by short grasses, such as species of *Brachiaria*, *Aristida* and *Pennisetum* interspersed with low-density woodland of drought - and fire-resistant species including *P. clappertoniana*, *B. parkii*, *Adansonia digitata*, *Ceiba pentandra*, *Anogeissus leiocarpus* and *Acacia spp.* This vegetation type is also not homogeneous.

**Table 2: Area of Land Covered by the Vegetation Types of Ghana**

Vegetation Type	* Association	Area (sq.km)	%
Rain forest	<i>Cynometra-Lophira-Triplochiton</i>	7,524	3.15
Transition Zone	<i>Lophira-Triplochiton</i>	8,405	3.52
	<i>Celtis-Triplochiton</i>	39,316	16.48
	<i>Antiaris-Milicia</i>	27,014	11.32
Guinea Savanna	-	148,542	62.27
Sudan Savanna	-	1,955	0.82
Coastal Savanna	-	4,507	1.89
Strand and Mangrove	-	1,277	0.55

Source: Annual Report Of The Forestry Department, Ghana. Ministry of Lands and Natural Resources, 1987. \* Based on the classification of Taylor (1952)

In addition to the two major biomes, other minor vegetation types are found in the southern part of the country. There is the coastal savanna, usually referred to as the Accra-Winneba Plains in the south-eastern part of the country, the strand or coastline vegetation along the seashore, and the mangrove vegetation of the lagoons and estuaries distributed all along the coasts of Ghana, from Cape Three Points in the south-western part of the country to Denu in the south-eastern corner of the country. The latter two vegetation types are not represented on the map.

### Coastal Savanna

Early reports indicate that the Accra-Winneba Plains, an area which lies within the dry equatorial climatic region, used to carry a more luxuriant vegetation - probably a drier and more open variety of the dry semi-deciduous forest. The original vegetation, however, has been greatly modified by man in the last few centuries. Today, it consists of a dense scrub without or with few grasses west of Winneba, and mainly grass with isolated patches of scrub and occasional trees east of Winneba. Tree species commonly found within the area include *Ceiba pentandra*, *A. digitata* and *Azadirachta indica*. In the wetter parts, particularly east of the Volta, fan palms and wild oil palms are also found in large numbers.

In view of the nature of the coastal savanna vegetation, it has been called various names by different authors including coastal scrub and grassland (Taylor 1952), coastal

thickets and grassland (Lawson 1966), and southern marginal (SM) forest by Hall and Swaine (1981), who believed that the vegetation is part of the southern marginal dry semi-deciduous forest zone, pockets of which are still found within the area, especially on hills. The various names clearly reflect the different interpretations given to the origin of the vegetation.

The coastal savanna is far from being homogeneous, although it may generally be described as consisting of clumps of woody shrubs, scattered trees and grassland forming a mosaic of vegetation types. The following vegetation types have been identified as part of the mosaic; (1) scrub forest, a dense tangle of woody shrubs and stunted trees 4-6m high; (2) thicket clumps, mainly found on old termitaria; (3) rocky hill forest, basically two-storeyed with woody and thorny climbers; (4) derived savanna, found at Akosombo and the Shai Hills where the Guinea savanna reaches its southernmost limits; and (5) cultivated land, which basically consists of stretches of grassland maintained by human activities, such as burning, grazing and farming.

#### **Faunistic Diversity of the savanna regions of Ghana**

A general idea of the savanna fauna may be gained from Table 3 which provides a list of typical animals recorded in the forest and savanna protected areas in Ghana, together with an indication of their status.

**Table 3: Status of typical animals recorded in forest and savanna protected areas in Ghana**

(Source: Adapted from Wilson, 1994. KEY: C: Common, seen or heard often, P: Present in area recently recorded but status unknown; R: Rare, very seldom seen and population in low numbers; EX: Extinct, no longer occurs in the area but did occur there in the past; UN: Unknown, may occur in the area but not recorded so far; S: Satisfactory).

Species	Status in Forest Protected Areas					Status in Savanna Protected Areas		
	ANKASA	KAKUM	BIA	MOLE	BUI	DIGYA	GBELE	KOGYAE
<b>CARNIVORA</b>								
Lion <i>Panthera leo</i>				R	EX	EX	R	EX
Serval <i>Felis serval</i>				R	R	EX	EX	EX
Leopard <i>Panthera pardus</i>	R	R	R	R	R	EX	R	EX
Hyena <i>Crocuta crocuta</i>				R	EX	EX	R/EX	EX
Golden Cat <i>Felis aurata</i>	R	R	R					
African Civet <i>Viverra civetta</i>	R	R	R					
Civet <i>Civettictis civetta</i>				R	R	UN	UN	R
Side Striped Jackal <i>Canis adustus</i>				R	EX	EX	UN	EX
Water Mongoose <i>Atilax paludinosus</i>	R	P	P	C	C	UN	UN	C
Cusimanse <i>Mungos crossarchus</i>	C	C	C					
Egyptian Mongoose <i>Herpestes ichneumon</i>				R	R	UN	UN	UN
Slender Mongoose <i>Galerella sanguinea</i>				C	C	UN	UN	C
White tailed Mongoose <i>Ichneumia albicauda</i>				R	R	UN	UN	UN
Gambian Mongoose <i>Mungos gambianus</i>				C	C	UN	UN	C
Honey Badger <i>Mellivora capensis</i>	R	R	R	R	R	UN	UN	R
Pardine genet <i>Genetta pardina</i>	?	C	C					
Palm civet <i>Nandinia binotata</i>	C	C	C					
<b>PRIMATES</b>								
Potto <i>Perodicticus potto</i>	P	P	P					
Demindoff's Galago <i>Galago demidovii</i>	C	C	C					
Senegal Bushbaby <i>Galago senegalensis</i>				C	C	UN	C	C
Red Colobus <i>Procolobus badius waldroni</i>	R	R	R					
Black and white Colobus <i>Colobus vellrosus</i>	R	R	R					

Species	Status in Forest Protected Areas			Status in Savanna Protected areas				
	ANKASA	KAKUM	BIA	MOLE	BUI	DIGYA	GBELE	KOGYAE
Olive Colobus <i>Procolobus versus</i>	R	R	R					
Campbell's mona Monkey <i>Cercopithecus campbelli</i>	C	C	C					
Diana Monkey <i>Cercopithecus diana roloway</i>	R	R	R					
Spot-nosed Monkey <i>Cercopithecus p. petaurista</i>	C	C	C					
White-Crowned Managabey <i>Cercocebus lunulatus</i>	P	P	P					
Chimpanzee <i>Pan troglodytes</i>	P	P	P					
Anubis Baboon <i>Papio anubis</i>				C	C	R	C	C
Green Monkey <i>Cercopithecus aethiops</i>				C	C	R	C	C
Patas Monkey <i>Erythrocebus patas</i>				C	C	R	C	C
<b>PHOLIDOTA</b>								
Tree pangolin <i>Manis tricuspis</i>	C	C	C					
Long-tail Pangolin <i>Manis tetradactyla</i>	R	R	R					
Giant Pangolin <i>Manis gigantea</i>	P	P	P					
<b>RODENTIA</b>								
Giant Forest Squirrel <i>Protoxerus stangeri</i>	C	C	C					
Ebie Squirrel <i>Epixerus ebii</i>	P	P	P					
Red-footed Squirrel <i>Funisciurus pyrropus</i>	C	C	C					
Small green Squirrel <i>Paraxerus poensis</i>	C	P	C					
Red-legged sun Squirrel <i>Heliosciurus rufobrachium</i>	P	P	P					
Beecroft's Flying Squirrel <i>Anomalurus derbianus</i>	P	P	P					
Pel's Flying Squirrel <i>Anomalurus pelii</i>	C	C	C					
Pygmy Flying Squirrel <i>Idiurus macrotis</i>	P		P					
Emin's giant Rat <i>Cricetomys emini</i>	C	C	P					
Brush-tailed Procupine <i>Atherurus africanus</i>	C	C	C					
<b>HYRACOIDEA</b>								
Tree Hyrax <i>Dendrohyrax arboreus</i>	C	C	C					

Species	Status in Forest Protected Areas					Status in Savanna Protected areas			
	ANKASA	KAKUM	BIA	MOLE	BUI	DIGYA	GBELE	KOGYAE	
<b>PROBOSCIDEA</b>									
Elephant <i>Loxodonta africana cyclotis</i>	C	C	C						
Elephant <i>Loxodonta africana africana</i>				C	EX	UN			
<b>TUBULIDENTATA</b>									
Antbear <i>Orycetopus afer</i>				C	C	UN	UN	UN	
<b>ARTIODACTYLA</b>									
Red River Hog <i>Potamochoerus porcus</i>	C	C	C						
Giant Forest Hog <i>Hylochoerus meinertzhageni</i>	R	R	R						
Warthog <i>Phacochoerus aethiopicus</i>				C	R	C	C	UN	
Hippopotamus <i>Hippopotamus amphibius</i>				R	R	EX	EX	EX	
Buffalo <i>Syncerus caffer</i>				C	R	UN	R	LY	
Red-flanked duiker <i>Cephalophus rufilatus</i>				C	C	C	C	C	
Bushbuck <i>Tragelaphus scriptus</i>				C	C	UN	C	C	
Bongo <i>Tragelaphus euryceros</i>									
Bay Duiker <i>Cephalophus dorsalis</i>	S	S	S						
Black Duiker <i>Cephalophus niger</i>	S	S	S						
Yellow backed Duiker <i>Cephalophus sylvicultor</i>	R	R	R						
Maxwell Duiker <i>Cephalophus maxwelli</i>	C	C	C						
Common duiker <i>Sylvicapra grimmia</i>				C	C	C	C	C	
Reedbuck <i>Redunca redunca</i>				R/EX	R/EX	R/EX	R/EX	R/EX	
Waterbuck <i>Kobus ellipsiprymnus</i>				C		R	C	R	
Kob <i>Kobus kob</i>				C		R	C	R	
Roan Antelope <i>Hippotragus equinus</i>				C		EX	C	EX	
Oribi <i>Ourebia ourebi</i>				C	C	UN	C	R	
Royal Antelope <i>Neotragus pygmaeus</i>	S	S	S						

#### 4. MANGROVE ECOSYSTEM

The mangroves of Ghana occupy a very narrow, non-continuous coastal area , occurring along the lagoons which extend from the eastern to the western parts of the country. The Ghanaian mangrove ecosystem, like other forest formations of the country, possess a rich genetic diversity including tolerance to sea water intrusion.

Floristically, the mangrove comprises approximately 4 species of 3 genera belonging to 3 families (Lawson 1986; Sackey, Laing and Adomako 1993; Taylor 1960). The occurrence of a fifth species (*Rhizophora mangle*) is not certain (Commission of the European Communities 1987). Table 4 shows the mangrove and associated flora of Ghana.

The local mangrove fauna is highly diverse. The macrofauna is represented mainly by Mollusca, Crustacea, Fishes, Reptilia and birds. Bird species recorded in the mangrove forests include shore birds or waders, herons, ducks and gulls. Table 5 shows the mangrove fauna commonly encountered. This list is, however, incomplete as the mangrove fauna of the country has been little studied. Thus, the data on it are scanty.

Traditionally, mangrove resources, especially wood, fish, oysters and crabs have been intensively exploited by the people living near the mangrove areas. With the exception of a few, all mangrove stands in the country are of secondary or tertiary development due to the heavy exploitation of mangrove by local communities near the mangroves. About 70% of the country's mangrove forest has already been lost through deforestation (IIED 1992). This has had serious consequences on the diversity of the mangrove fauna. For instance, the distribution of the mangrove oyster, *Ostrea tulipa*, is now limited to only a few places due to the destruction of their natural habitat, the stilt roots of *Rhizophora*.

Conversion of mangrove land into other land uses, notably agriculture, housing, roads and salt ponds, has also accelerated the destruction of mangroves in the country. For instance, about half of the area potentially occupied by mangroves near the mouth of the Densu River near Accra has been converted into salt ponds (Lawson 1986, Singh 1987).

The mangrove areas in Ghana have received practically no attention in terms of rational utilization. The mangrove forests are privately owned, and the right of use of the resources are more or less open, which is an incentive for uncontrolled exploitation. Opportunity to protect pristine mangrove areas in the country is limited as most of the mangrove communities have been touched or disturbed.

Interest in the mangrove environment in the country is recent. Detailed management recommendation for the entire coastal zone have, however, been drafted in the "Coastal Zone Indicative Management Plan" by Agyepong *et al* (1990) prepared for the Environmental Protection Council. Many of these recommendations have been incorporated in the policy document *Ghana National Environmental Action Plan* prepared by the EPC. In addition, Ramsar site development is planned for five coastal wetlands. The management strategy advocated for these wetlands also seeks to address issues pertaining to the management of the mangroves present in the areas. A proper management strategy will require a better understanding of the knowledge, practices and perceptions of the mangrove resource users. In many of the mangrove areas, many of the people living near them and collecting mangrove products are those described as "living below the poverty threshold". For these people, the basic thing is survival and they have to do everything just to survive. Most of these people do not have alternative sources of income other than the direct monetary gain derived from the mangroves. The activities of the salt producers who convert mangrove into salt ponds are, on the other hand, driven by profit motives. For these people, the mangrove is a wasteland which should be converted into profitable ventures.

Table 4: Mangrove and associated flora in Ghana

\* indicates mangrove species

*Acrostichum aureum*  
*Avicennia africana* \*  
*Conocarpus erectus*  
*Cyperus* spp  
*Hibiscus tiliaceus*  
*Ipomoea pes-caprae*  
*Laguncularia racemosa* \*  
*Paspalum vaginatum*  
*Phoenix reclinata*  
*Rhizophora harrisonii* \*  
*Rhizophora racemosa* \*  
*Sesuvium portulacastrum*  
*Tapinanthus* sp  
*Thespesia populnea*

**Table 5: Some common faunal components of Ghanaian mangroves**

**Invertebrates**

Molluscs	-	<i>Crassostrea gazat</i>	oysters
	-	<i>Littorina spp</i>	periwinkles
Crustacea	-	<i>Uca tangeri</i>	fiddler crabs
	-	<i>Cordsima sp</i>	crabs
	-	<i>Penous spp</i>	shrimps
<b>Vetebrates</b>			
Fish	-	<i>Tilapia spp</i>	tilapia
	-	<i>Periophthalmus</i>	mudskipper
Herpetofauna (Reptiles)	-	<i>Varanus spp</i>	monitor lizards
	-		snakes
	-	<i>Himantopus himantopus</i>	black-winged stilt
	-		
Birds	-	<i>Actitis hypoleucos</i>	common sandpiper
	-	<i>Egretta garzetta</i>	little egret
	-	<i>Bubulcus ibis</i>	cattle egret
	-	<i>Egretta gularis</i>	reef heron
	-	<i>Butorides striatus</i>	green-backed heron

## 5. RIVERS, LAKES AND RESERVOIRS

### RIVERS AND STREAMS

Ghana is well drained by rivers. Figure 10 presents a map of the drainage basins of Ghana. The main river basins are the White Volta, the Black Volta, the Main or Lower Volta, the Oti, the Pra, the Tano, the Ankobra, the Bia, Todzie-Aka and the coastal basins between the Pra and the Lower Volta. Ahenkorah *et al.* (1994), have recently reviewed some aspects of water resources in Ghana based on the work of Opoku-Ankomah (1986). The drainage areas and runoff of the main river basins are presented in Table 6 below. The length of the major rivers and their flow ranges are given in Table 7.

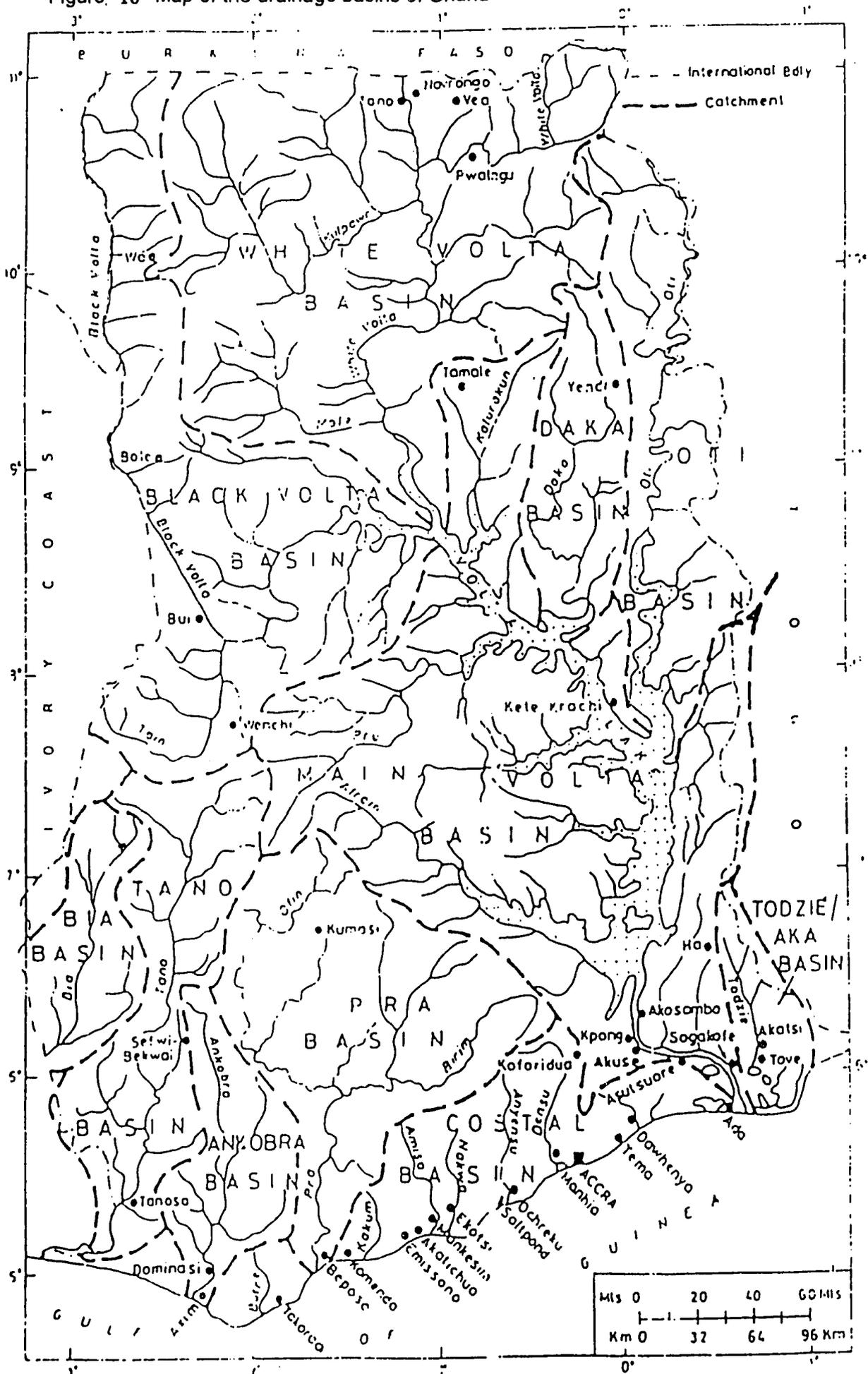
The run-off from the various basins generally follow rainfall trends. In the southern part of the country with two rainy seasons, run-off flows are high in June - July and in October. In northern Ghana which has one rainy season, high run-off flows are found in the months of August - October. Low run-off flows are found at other times of the year. A majority of the smaller order streams are temporary and ephemeral flowing only in the rainy season.

**Table 6. Drainage areas and run-off yields of the main river basins of Ghana.**

River Basin	Drainage Area km <sup>2</sup> x 10 <sup>3</sup>	Run-off x 10 <sup>6</sup> m <sup>3</sup> day <sup>-1</sup>		Monthly min
		Annual Mean	Monthly max	
White Volta	45.8	10.28	104.98	0.09
Black Volta	35.1	4.92	53.83	0.17
Oti	16.2	9.59	73.44	0.17
Main/Lower Volta	68.6	12.10	249.70	0.17
Pra	23.2	20.74	94.18	1.38
Ankobra	8.5	10.45	40.61	1.30
Tano	14.9	6.39	45.27	0.17
Bia	6.5	3.63	40.95	0.17
Coastal Basins	15.6	5.36	61.17	0.43
Todzie/Aka	3.6	1.38	155.52	0.09
Total	238			

Source Opoku-Ankomah, 1986

Figure 10 Map of the drainage basins of Ghana



**Table 7: Length of major rivers and their flow ranges**

Drainage Basin	Major River System Name	Length (km)	Flow Range m <sup>3</sup> S <sup>-1</sup> x10 <sup>3</sup>
1.	Volta Basin		
1a.	Black Volta	650	0.01-1.10
1b.	White Volta		0.1-1.41
1c.	Oti	900	0.01-1.27
1d.	Volta		0.141
2.	Bia	200	0.13
3.	Tano	625	0.03-0.92
4.	Ankobra		0.05
5.	Pra	445	0.05
6.	Ochi-Amissa		0.001-0.06
7.	Ochi-Nakwa		
8.	Ayensu		
9.	Densu	116	
10.	Subri-Amansuri		
11.	Butre		0.06
12.	Kakum-Saruwi		
13.	Todzie		
14.	Aka/Keta		
15.	Coastal Streams	variable	

(Source Opoku-Ankomah, 1986)

### **Fish Diversity**

The fish species recorded in the following 12 major rivers and streams: Pru, Oti, White Volta, Black Volta, Asukawkaw, Pra, Offin, Birim, Densu, Ankobra, Tano and Bia, cover 124 species belonging to 62 genera and 24 families. These are fishes with recorded locality in the rivers noted. In addition, there are fishes generally recorded as occurring in rivers in Ghana.

Of the fishes reported, 69 species belonging to 32 genera and 16 families are food fish of commercial value. 46 species belonging to 22 genera and 12 families are economically important as aquaria fish.

## LAKES AND RESERVOIRS

### The Volta Lake

The Volta Lake, formed in 1964 by damming the Volta river at Akosombo, is the only man-made water body which can be considered to be a large lake (Gordon, 1992a).

The Volta Lake has a dendritic shape with a number of important arms and branches (Fig. 11). The overall length of this vast water body is 410 km with a maximum width of 25 km. It lies between latitude 6° and 9° north and 1° west and 0° 15' east. The extreme length of the lake means that it bridges two climatic zones, the northern part of the lake having a single rainfall peak while the southern part has a bimodal rainfall pattern. The maximum depth of the lake is found just behind the dam (79 metres) and the mean depth is 19 metres. The maximum operating height is 84.1 metres above mean sea level, and at that level the lake covers an area of 8480 km<sup>2</sup> and has a volume of 165 km<sup>3</sup>. The change in water level caused by dam operation and inflows follows a unimodal annual cycle with lake levels peaking in October - December and minima in June - August. The annual drawdown is of the order of 4 metres, which in turn creates a drawdown area of 85,000 ha. The mean annual discharge from the dam is 1150m<sup>3</sup>s<sup>-1</sup>.

### Fish species in the Akosombo Gorge area of the Volta Lake

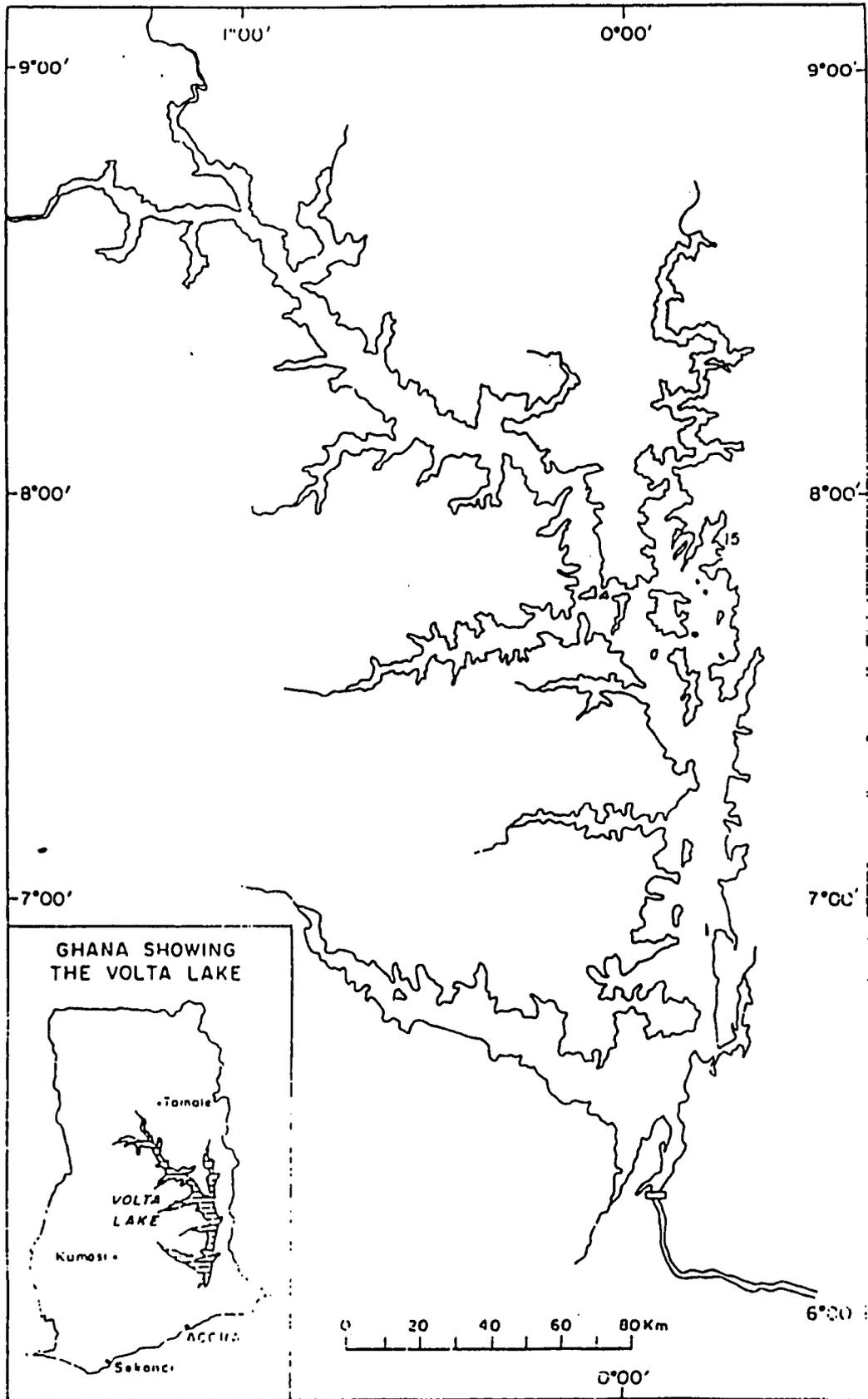
The gorge area of the Volta Lake is the deepest part of the lake, it being closest to the dam site. 38 fish species belonging to 28 genera and 13 families have been recorded from the area. These include some of the most valued food fishes and commercial species in the Volta system, eg. *Lates niloticus*, and the tilapias. It is only species such as *Malapterurus electricus* and *Tetraodon lineatus* which are not popularly valued but are otherwise used.

### Fish species in the Kpong Headpond in the Lower Volta

The headpond was created when the Kpong dam was constructed in the Volta river in 1981 about 15 km below the Akosombo dam.

Before the pond was created 50 fish species had been recorded from the area by Vanderpuye (1985). However, since the impoundment only 39 species belonging to 30 genera and 16 families one of which (Mugilidae) is a marine element have been encountered. The species which no longer exist in the headpond are mainly estuarine species which apparently have no more access to the upper reaches of the Volta river because of the barrier created by the dam. They include *Caecula cephalopeltis* (Family: Ophichthyidae), *Doryichthys aculeatus* (Family: Syngnathidae), *Eleotris senegalensis* (Family: Eleotridae) and *Gerres malanopterus* (Family: Gerridae).

Figure. 11 Map of the Volta lake



With the exception of the protopterid and polypterid species the fishes in the headpond are all of commercial importance.

It is to be noted that no facility was created to allow fishes to move upstream beyond the dams (Kpong and Akosombo). Moreover, ecological conditions created below the two dams have resulted in permanent freshwater, silt-free waters and the growth of submerged aquatic weeds (Odei, 1987), conditions which are unfavourable for estuarine or brackish water fishes.

### **Lake Bosumtwi**

There is only one natural lake in Ghana, Lake Bosumtwi, also known as the 'sacred lake of the Ashantis'. Believed to be of caldera origin, it is located about 32 km south-east of Kumasi. The lake is circular in shape and has a diameter of 7.5 km (Lelak, 1968) and a depth of about 75 metres. The lake area is approximately 50 km<sup>2</sup>. The lake level is maintained by direct rainfall input (1520 mm annual mean) and by a number of low order. The level of the lake fluctuates and has risen in recent years. The village of Abonu has been resited at least three times due to rise in water level (Owusu-Nimoh, 1977). It has a number of inlet streams but no outlet stream.

### **Fish species in Lake Bosumtwi**

Eleven (11) fish species belonging to nine genera and five families have been recorded from this lake.

The fish species listed are all of commercial importance except the *Cyprinodontids annuals*, which, however, are known to be larvivorous and therefore play an important role in the destruction of aquatic larvae of insects of public health importance. eg. mosquitoes.

### **Fish species of the Weija Reservoir on the River Densu**

The Weija reservoir is located in the lower Densu basin. It is mainly for water supply to Accra and for irrigation. It is also heavily exploited for fish.

17 species of fish belonging to 11 genera and 7 families have been recorded from this reservoir. Virtually all these fish species are of commercial importance. Because of its proximity to Accra (14km), fish from the reservoir finds ready market.

### **Fish species in the Barekese Reservoir (Ashanti)**

The Barekese reservoir was created for water supply. It is situated in a forest zone.

Altogether, 18 fish species belonging to 15 genera and 10 families have been recorded from this reservoir. With the exception of the Cyprinodontid, the fish species recorded in this reservoir are generally of commercial importance. There is some conflict between the management of the reservoir and villagers who enter the reservoir to fish. This is mainly with regard to possible contamination and pollution of the water arising from the use of unorthodox means of fishing e.g. use of chemicals.

## **6. COASTAL LAGOONS AND WETLANDS**

The coastal wetlands are part of the coastal zone which is ecologically distinct because of the transitional nature between land environments and the open seas. The distinctiveness is in terms of flora, fauna, physical processes and land use. The coastal wetlands include lagoons, lagoonal depressions, swamps and marshes together with the intervening interfluves within the coastal catchments. Along the Ghana coast of 550 kilometres, 80 wetland sites comprising lagoons, estuaries, salt pan complexes and stretches of sandy beaches have been regularly monitored by the survey team of the Save the Sea Shore Birds Project (SSBPG) since 1986, (Ntiamoah-Baidu and Gordon 1991). Most of these sites harbour some bird life but only 10 of them are considered as important bird sites. Waterfowl species of significance in the coastal wetlands include waders, terns, herons and egrets. Eleven of the 42 species of waders recorded on the Ghana coast occur in internationally important populations.

There are also non-coastal wetlands in various areas of the country. These are topographic depressions or valley bottoms. These sites in the forest may be dominated by raffia palms. In drier areas not disturbed by cultivation, typical trees are *Xylopi* spp. These wetlands sites are becoming increasingly threatened as sites for the cultivation of rice.

The dominant macrophytes in the wetlands are *Fuirena umbellata* and *Rhynchospora wallichiana* in the fringing sedge zones, *Nymphaea lotus* and *N. maculata* in a zone of rooted, floating leaf plants, and in deeper water *Nymphoides indica* and *Cytosperma senegalense* with some *Raphia hookeri* and *R. vinifera* in water up to 3m deep, with *Vossia cuspidata*, *Chrysichthys vellifer*, *Hemichromis fasciatus* and *Tilapia aurea* between the stem bases, are the common fish.

The coastal wetlands include the following:-

- a) The Western Border
- b) The Amansuri Wetlands
- c) Ankwao River
- d) Cape Three Points to Takoradi
- e) Krobu River - Cape Coast District
- f) Amisa River & Lagoon
- g) Nakwa River & Lagoon
- h) Sumina & Apabaka Lagoons
- i) The Winneba Wetlands
- j) Wetlands of the Accra District
- k) The Volta Delta

The wetlands are described from west to east along the coast. Most of the systems are small and only brief details are provided, since most conform to the pattern of typical open or closed lagoons at river mouths. A detailed account of the water chemistry and physical characteristics of 15 major lagoons on the Ghana Coast have been undertaken. Gordon (1987) has reviewed work on the Ghana lagoons to that date.

### **The Western Border**

In the extreme west, Unvaiye Lagoon (5007'N/2055'W) of 200 ha area, and which is entirely situated in Ghana, opens into Ehy Lagoon in Cote d'Ivoire, itself part of the By Lagoon complex. Close to it, and opening to the sea at 2047'W, is the small Domini Lagoon, which with its peripheral zones of inundation covers some 400 ha. A few kilometres inland, the Ghana/Cote d'Ivoire border is delineated by the channel of the Tano River, which discharged into Ehy Lagoon, but above the lagoon permanent forest swamps cover 7500 ha in Ghana.

### **The Amansuri Wetlands**

In moving east along the coast, a block of 8000 ha of semi-permanent swamp land surrounds Amansuri lagoon which lies 2.5 km inland behind a sandy-rocky coast which obstructs drainage seawards at 2° 34'W. The lake measures 2.5 km x 1 km and is rectangular, with an open water surface of 2600ha, while the surrounding wetland measures 24 km across and 11 km deep. Amansuri Lake receives water from several small streams, notably the Adnimumio, Evini, Bosoke, Eivla and Myejini, which have a combined catchment of close to 1010 km<sup>2</sup>, mostly below the 50 m contour. The system is very flat, but is backed to landward by low hills about 10 km from the coast (Gordon, 1986).

The lake has a mean depth of 2.8 m with a maximum depth of 5 m. The swamp lands are inundated to a depth of 1 m during the rainy season, but tend to dry

completely by the end of the dry season. The lake level falls by 1-2 m in the dry season and the inflows cease so that the residual lake water becomes stagnant. The system drains via the Amansuri River to Amansuri Lagoon on the coast farther east at 2°23'W. The constricted mouth of this lagoon is mostly open, and the swamps and zone of temporary inundation which enclose the lagoon, extend inland for 12.5 km, attaining a maximum width of 8 km and an area approaching 9000 ha. Secchi depths in the lake reach 1.1 m, and pH varies from 7.0 in the peripheral sedge zone to 5.9 in the open water. The concentrations of the principal ions are sodium 17 mg/l; potassium 2 mg/l; calcium 1.6 mg/l; sulphate 22 mg/l and chloride 20 mg/l (Gordon, 1986).

The dominant macrophytes in the peripheral vegetation of the lake are *Fuirena umbellata* and *Rhynchospora wallichiana* in the fringing sedge zone, *Nymphaea lotus* and *N. maculata* in a zone of rooted, floating leaved plants, and in deeper water *Nymphoides indica* and *Cyrtosperma senegalense* with some *Raphia hookeri* and *R. vinifera* in water up to 3 m deep, with *Vossia cuspidata* between the stem bases. *Chrysichthys vellifer*, *Hemichromis fasciatus* and *Tilapia aurea* are the commonest fish. There are several villages in the area, with a total population approaching 5000. The lake is fished quite intensively from a fishing village built out into the lake on piles; coconuts are grown on the periphery of the swamps. *Raphia* palms are tapped for their sap, and hunting occurs in the swamps.

### **Ankwao River Floodplain**

A 9000 ha floodplain which includes patches of permanent swamp land extends 15 km upstream from the mouth of the Ankwao River (2°15'W), reaching widths of up to 6 km.

### **Cape Three Points to Takoradi**

To the east of Cape Three Points, semi-permanent swamps occupy some 1200 ha on the Suni River (2°00'W) along the boundary of the Cape Three Points Forest Reserve. In continuing east, a zone of inundation occupying 950 ha occurs on an ephemeral stream which reaches the sea at longitude 1°54'W, and again there are small tidal floodplains on the little inlets at Mpatano (1°52'W) and Apowa (1°50'W). Immediately behind the mouth of the Hwini River (1°47'W) there is floodplain of 850 ha, and another small wetland exists immediately east of Takoradi (1°45'W).

### **Krobu River - Cape Coast District**

A floodplain with some patches of permanent swamp, the lower parts of which experience some tidal influence, covers a total of 6000 ha behind the Krobu River mouth (1°37'W). It extends 7.5 km along the coast and 7.5 km inland. Farther east there are 8 isolated pockets which are subject to inundation during the rains. These include small areas of permanent swamp and total 4000 ha in extent. They are situated inland of Komenda (1°30'W), and a further 6 patches are situated inland of the town of Cape Coast (1°15'W). *Raphia spp.* occur in all these swamps. The small lagoon at Apa (1° 10'W) has an open water area of a few hundred hectares.

### **Amisa River and Lagoon**

There is a substantial lagoon at the mouth of the Amisa River (1°00'W). The lagoon is 3 km long and 1 km wide, while the peripheral floodplain covers 7500 ha and extends inland for 15 km, with widths of up to 8 km. The lagoon mouth is perennial.

### **Nakwa River and Lagoon**

Here (0°55'W) the lagoon has a maximum width of 1.7 km and is 5 km long, oriented E-W parallel with the coast, while a swampy floodplain extends up the Nakwa River for 30 km. There are patches of semi-permanent swamp a few kilometres distance from the river in depressions. The total of this system probably amounts to a little over 7200 ha, including the open water surface of the lagoon. *Raphia spp.* occur in this system.

### **Sumina and Apabaka Lagoons**

Still farther east are the little Sumina Lagoon (1°048'W) and Apabaka Lagoon (1°0044'W), which with its peripheral tidal inundation zone occupies 1000 ha.

### **The Winneba Wetlands**

Areas of tidal and seasonal inundation occur around Muni Lagoon to the west of Winneba (0°037'W), while a floodplain and a lower tidal inundation zone occur on the Ayensu River which discharges to Ouiba Lagoon to the east of the town. The combined wetland extends along the coast behind the coastal dunes, for 12.5 km, and reaches 4 km inland. Other patches, totalling 2000 ha, subject to seasonal inundation, occur inland on the Pon Pon, Ngana and Okruda Rivers, centred on a longitude of 0°026'W.

## **Wetlands of the Accra District**

West of Accra some seasonally inundated grasslands are found upstream on the Densu River and its tributaries extending 27.5 km inland from the sea, at a point 0020'W, totalling some 6700 ha in extent. Tidal influence extends at least 10 km upstream and the lower pocket is partly tidal. Other areas of seasonally inundated grassland occur to the east of the city, amounting to another 3000 ha, situated between 20-38 km inland, at longitude 0005'W. Between the Accra Wetlands and the Volta Delta there are 5 small lagoons, each with small peripheral inundation zones. Sakumona Lagoon (0020'W) is the most westerly and Jange (0010'E) the most easterly.

## **The Volta Delta**

Towards the eastern border with Togo, the delta of the Volta River extends for 82 km along the coast and associated wetlands extend upstream for 75 km. The wetlands fall into two blocks. The westward block comprises 25 500 ha, which includes Songaw Lagoon (0030'E), some 16 km long from east to west and 7 km wide. The whole western block is 10 km deep along the river and tapers down to 4 km at the western end, over a distance of 36 km. The eastern block is much larger and includes Keta (0050'E) and Avu Lagoons, and numerous small lakes and lakelets. It covers a total of 167000 ha. Keta Lagoon has an open water surface of 27 000 ha and measures 27 km in length and 15 km in maximum width. Avu Lagoon is 11 km long with a maximum width of 5 km. The mouth of the Volta is 750 m wide, but immediately inside the mouth the river contains several islands and the channel expands to a width of 5 km. The total area of 182 000 ha, save for that of the lagoons, is flooded seasonally, but permanent swampland exists in a number of localities throughout the delta. These are concentrated on the east bank of the main channel and on the margins of some of the islands.

Songaw Lagoon has a mean depth of 1.75 m and a maximum depth of 4 m, while the corresponding figures for Keta Lagoon are 80 cm and 2 m. The mean pH values for these lagoons are 7.2 and 8.1 respectively, and mean salinity is 2.3 and 18.7‰. Mean Secchi depths are 85 cm and 35 cm. Water temperatures average 29.5°C in Songaw and 31.2°C in Keta Lagoon. Sodium and chloride are the principal ions in Songaw Lagoon, each having concentrations close of 35 meq/l, while potassium, calcium, magnesium and other anions are very low, all about 1 meq/l. In Keta Lagoon, sodium and chloride both reach mean annual concentrations close to 280 meq/l, while the figures for potassium, calcium and magnesium are 9, 19 and 12 meq/l respectively, and those for bicarbonate and sulphate are 2 and 22 meq/l respectively. Songaw Lagoon is very rich in nitrates.

The construction of the dams on the Volta at Akosombo and Kpong has affected the ecology of Avu and Keta Lagoons, leading to lower water levels and increased salinities as seasonal floods in the delta have virtually ceased. The

only discharges nowadays are those associated with the generation of electricity. Songaw Lagoon has, however, been less affected. Some rice is grown on the coastal floodplains, and the estuaries and lagoons are fished intensively. Over 57 000 people were engaged in the fishing industry in 1960, and recent reports suggest that this figure has not altered significantly, due to the well developed fishery on Lake Volta. However, canoes have largely given way to motor boats as fishing vessels and catches have increased. Sea fishing is now carried out almost exclusively by motor boats and large trawlers, but lagoon and lake fishing still involves traditional canoes. The mean national annual catch was close to 40,000 tonnes from inland waters and 184,000 tonnes from coastal waters in 1984 (FAO statistics). The bulk of the inland fish catch comes from Lake Volta. Prior to the construction of the dam at Akosombo, Keta Lagoon was the most principal source of non-marine fish and, although diminished in importance, it still supplies a substantial proportion of the inland catch. Clams are farmed in the lower Volta below the Kpong Dam. Rice is grown on some of the coastal floodplains and the acreage converted to rice paddy is increasing.

#### **FISH FAUNA OF COASTAL LAGOONS**

Fishes in these ecosystems, as expected, may be in freshwaters, brackish waters and even in the sea. Those reported have been recorded in the localities (ie. water bodies) indicated. They represent a rich diversity of species, fishes, crustacea (shrimps, prawns, lobsters, crabs) and molluscs (gastropods, clams and oysters). Most of these species are of high commercial value.

## 7. THE MARINE ENVIRONMENT AND ECOSYSTEM

### TERRITORIAL WATERS AND THE COASTLINE

#### Territorial Waters

In 1977 Ghana claimed a 370 km (200 nautical mile) limit as her territorial waters [Territorial Waters and Continental Shelf Act 1973 as amended by the Territorial Waters and Continental Shelf Amendment Decree 1977] (Fig. 12). The most southern point is off Cape Three Points. The territorial water sectors and sedimentological subdivisions with estimated areas are given in Tables 8 and 9.

Table 8. Territorial Waters of Ghana

Territorial waters	Area (km <sup>2</sup> )	%
Continental Shelf (down to 200m)	23,700	10.8
Gulf of Guinea	194,820	89.2
<b>TOTAL</b>	<b>218,520</b>	<b>100</b>

(adapted from Bernacsek, 1986)

The total area represents the equivalent of eighty-five percent of the total land area of the country. Most of this area has not been properly mapped and the information available comes from fishing trawls and the occasional visit of a foreign oceanographic vessel (Bernacsek, 1986).

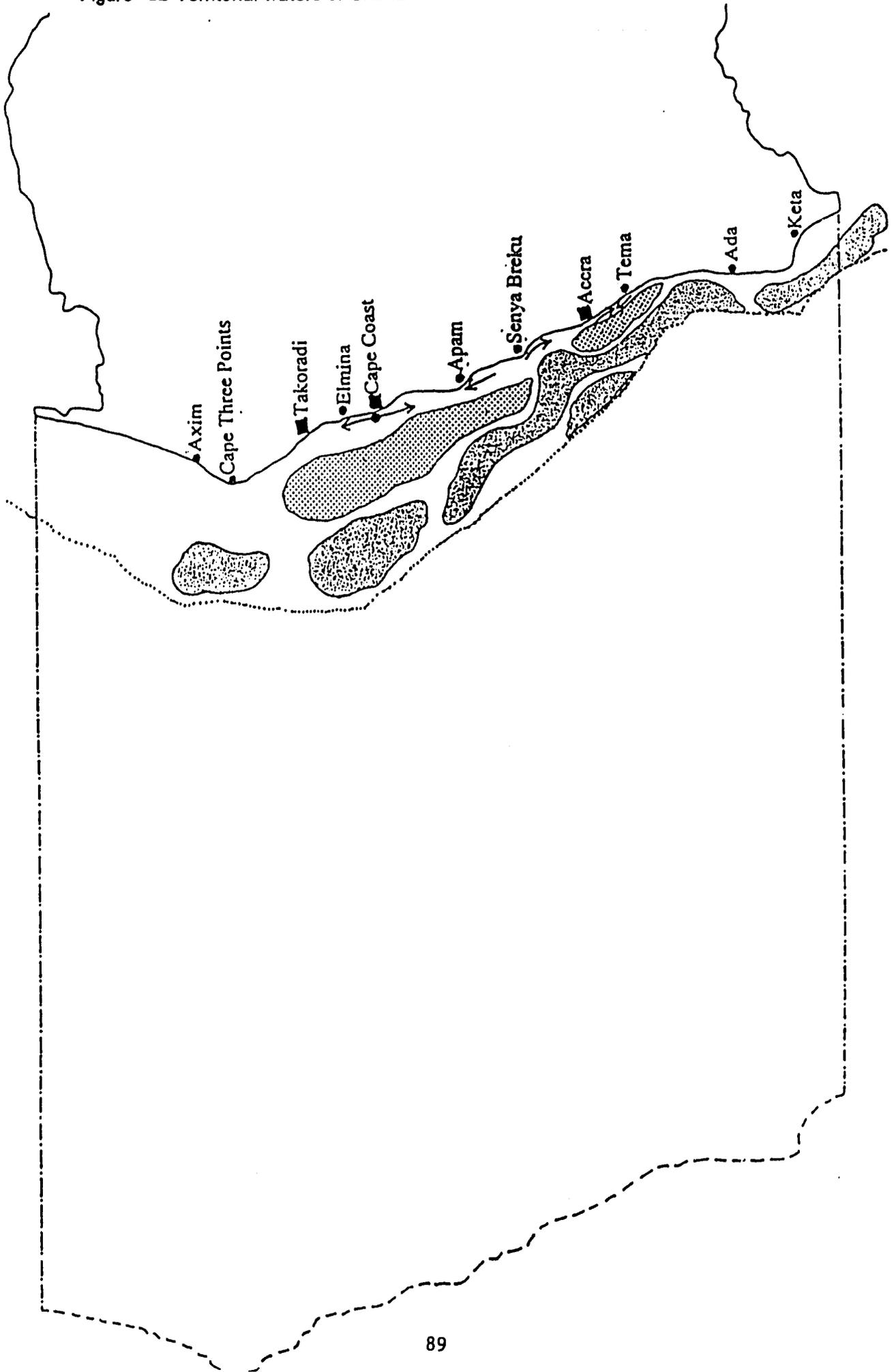
Table 9: Sedimentological sub-divisions of the continental shelf of Ghana

Zone		Area km <sup>2</sup>	% of total marine area	% protected by National Parks
Inshore 10 - 50 m	Soft	8,700	3.9	0
	Hard and Sandy	2,700	1.2	0
	Rocky	300	0.1	0
Offshore 50 - 200 m	Soft	6,500	2.9	0
	Hard	2,500	1.1	0

(adapted from Bernacsek, 1986)

The continental shelf off the coast of Ghana is narrow. From Half Assini the continental shelf is about 24 - 35 km wide up to Cape Three Points. Off Takoradi the shelf widens to about 80 km and then narrows again to just 24 km.

Figure 12 Territorial waters of Ghana



## The Coastline

Ghana is situated on the western Gulf of Guinea and has a coastline of 536 km. It should be noted that the length of coastline is dependent very much on the scale of map from which it is measured. Estimates of the coastline range from 520 to 550 km.

The coastline consists of the following regional sectors (Table 10).

Table 10: Coastline length of Ghana (source Bernacsek, 1986)

Region	Coastline length (km)
Western	193
Central	148
Greater Accra	120
Volta	75
Total	536

Ly (1980) describes the following characteristic features of the Ghanaian coast:

1. West of Cape Three Points: the coast is marked by a flat and wide beach, backed by coastal lagoons. Wave height is generally low.
2. Between Cape Three Points and Tema: the aspect is of an embayed coast of rock headlands and sandbars or spits enclosing coastal lagoons. The surf zone is a medium to high energy environment with wave heights often exceeding 1 metre. The southwesterly prevailing winds cause oblique wave approach to the shoreline which generates an eastward littoral sediment transport.
3. East of Tema: the shoreline is sandy and is characterized by the eroding Volta delta. Wave and sediment dynamics are similar to those between Cape Three Points and Tema.

## The Marine Flora and Fauna

Marine ecosystems contain about 20% of the world's animal species despite their vast volume and area (71% of the earth's surface). This is mainly because they lack the small scale structure complexity seen in terrestrial ecosystems. At the higher taxonomic level, however, marine ecosystems are actually more diverse than either terrestrial or freshwater biota, with more phyla and endemic phyla. There are 28 phyla living in marine habitats, compared with 14 and 11 phyla in freshwater and terrestrial habitats respectively. Marine animals also generally have higher genetic variation than terrestrial species. A major reason

why marine ecosystems have not received more attention is the lack of information as a result of paucity of marine scientists in Ghana.

In Ghana, three major habitat types based on depth are recognisable with distinctive biodiversity identities and unique species composition. These are:

1. intertidal rocky, sandy and muddy habitats (<2 m), including estuaries, lagoons and mangrove areas.
2. subtidal shallow habitats (<200 m) over the continental shelf.
3. deep-water habitats comprising the continental slope (200-2000 m) and the abyssal (>2000 m).

The most diverse, however, is the continental shelf which measures 27,300 km<sup>2</sup> in area. The productivity and diversity of the deep benthos is, however, very low because of insufficient light for photosynthesis. These communities are thus dependent on organic detritus that drifts down from above or is carried in by currents by more productive areas of the sea or land.

Whereas much is known of the diversity of the organisms that are normally exploited for food, (mammals, reptiles, fishes and larger shelled invertebrates), little information exists on the diversity of the bottom invertebrate macrofauna living with or on the sediments of the ocean floor.

Recent studies by the University of Ghana (Armah, pers. comm), indicate high biodiversity of the benthos of the shallow waters of the continental shelf. Between the depths of 15-65 m, Van Veen bottom grabs of 0.1 m<sup>2</sup> biting area yield an average of 20 polychaete families. Total polychaete species described from this shallow depth is about 100 with several yet to be identified to their putative species and could be new to science as they do not match any of the taxonomic keys available. As a matter of fact, about 60% of the soft-bottom benthic macrofauna encountered are new records for Ghana.

Extrapolating the abundance, diversity and biomass to cover the entire continental shelf suggests that, as the area involved is so large, the numbers of species in total, will form a significant part of the national biodiversity heritage.

A significant aspect of the soft-bottom fauna is their crucial role in the intricate trophic relationship between habitats, which results in increase of the overall number of species within coastal habitats. There is, therefore, the need to initiate studies into their diversity, abundance and biomass because of their significance for sustenance of the entire coastal biodiversity.

Another group of benthic marine organisms on which there is absolutely no information in Ghana are the meio- and microfauna (organisms that will pass

through a 0.5 mm mesh). The meiofauna are usually dominated by oligochaetes and crustaceans and the microfauna with such organisms as ciliates, amoebas, and foraminiferans.

In addition, there are over 90 coastal lagoons, several estuaries, rocky shores and mangrove habitats where the bottom in fauna diversity value and level are yet to be fully appreciated (Gordon, 1995).

Finally, are the marine algal communities and their diversity. Evidence available indicates the emergence of new species not recorded in Ghana. The pattern of invasion appears to follow the general eastward coastal current direction, with the new colonizers spreading from the west to the east of our coastal waters.

### **Marine Fish Fauna**

The fishes recorded cover only species which are known to have been captured in identifiable localities in the coastal waters within the boundaries delineated by the Volta Region in the east and the Western Region to the west.

Within these specified limited areas of the coastal waters, 393 fish species belonging to and 82 families are reported (Ofori-Adu, 1988). The fishes listed in this report are all of commercial importance. Those not taken as food are used in feed preparations.

#### **IV. AQUATIC AND MARINE RESOURCE USE: CAPTURE FISHERIES**

In the foregoing account of rivers, lakes and reservoirs and of the marine ecosystem fish resources have been considered in respect of their biological diversity without reference to capture fisheries.

Fish constitute more than 60% of the animal protein diet in Ghana (in some coastal communities up to 90%) and provides employment to a significant proportion of the work force. It has such secondary benefits as the role it creates for women as artisanal processors and traders.

The annual national fish requirement is put at about 400,000 tonnes. The inland fisheries provide about 20% of the annual catch and most of this is from the Volta Lake. The catch from the Volta Lake is in the region of 40,000 tonnes each year while the catch from the Kpong Headpond has been estimated at between 300 to 600 tonnes per year. (Futa, 1983).

The annual catch in rivers has is yet to be comprehensively assessed but Dunn (1989) has suggested a potential catch of between 240 - 800 tonnes per year.

Fish farming in fish ponds outside the natural habitats of rivers and lakes has been given a boost since 1980. Aquaculture contribution to the national fish budget is not yet significant although its potential is recognized. Total fish production from this sector was estimated at 400 tonnes per annum in 1990 but had risen to 1,500 tonnes in 1994. (IAB, 1995).

The Institute of Aquatic Biology (IAB) which has an Aquaculture Research and Development Station at Akosombo has provided considerable stimulus to local fish farmers. It is currently helping some fish farmers to hand-sort their own tilapias into two sexes in order to use all-male Tilapia for their fish-culture which can improve yields by about 50%. During 1994 the Institute produced 91,000 all-male Tilapia of which 56,000 were distributed to farmers. Currently it is helping selected rice farmers in the northern region to integrate fish culture with rice cultivation. The area of rice plots integrated with fish farming with the help of the Institute increased from 1130m<sup>2</sup> in 1993 to 5227m<sup>2</sup> in 1994. (IAB, 1994)

The bulk of fishing activity is in the marine environment. The total marine catch of Ghana has been estimated at around 230,000 metric tons. The marine fishing industry in Ghana has three main sectors: artisanal (61.5%), semi-industrial (7.4%) and industrial (distant water), (7.6%) and tuna (5.3%).

The oceanographic regime is characterized by a seasonal major upwelling, a minor upwelling and a thermocline. The major upwelling occurs when sea surface temperatures fall below 25°C. Dissolved oxygen values are low while salinity values are high during the major upwelling and vice versa during the thermocline period. High biological production (plankton and fish) occurs during the major upwelling (Laing, 1994).

There is one major fishing season which takes place during the major upwelling from July to September. Both demersal and pelagic fisheries take place in the coastal waters of Ghana. The main pelagic fishery is the *Sardinella aurita* fishery which is seasonal. The main stock of the *Sardinella* stays in deep waters during the thermocline period. At the onset of the major upwelling the *Sardinella* migrates inshore and spreads along the coast to both Togo and Cote d'Ivoire. It spawns in Ghanaian coastal waters during this migration. The stock returns to the deep waters at the end of the major upwelling. The maximum sustainable yield of *S. aurita* is put between 42,000 and 49,000 metric tones. While the stock level of *Sardinella* has dwindled considerably during the last decade, the stock level of the trigger-fish appears adequate for extensive exploration. The present level of exploitation of anchovy fish appears sufficient but there is room for expansion in the tuna fishery (Laing, 1994).

Over the past decade, the supply of marine fish to the Ghanaian population has been hit by economic constraints that have limited the supply of inputs for fishing purposes and the high fishing pressure exerted by fleets on important fish stocks. Another problem of equal importance is the non-implementation of the management measures aimed at the rational exploitation of limited fish stocks. For example three sets of regulations have been made which set standards for sizes of minimum mesh to be used in the pelagic and demersal fisheries in order to avoid catching juvenile fishes and forbid the use of explosives and poisonous materials in fishing, but their enforcement has been very weak.

Threats to aquatic and marine resource use in general include overexploitation, salt production, sand-winning, eutrophication and pollution, among others.

## **V. LAND USE AND ITS RELEVANCE TO BIODIVERSITY AND TROPICAL FORESTS**

### **General Land Use**

#### **Factors of Land Use**

Wills (1962) has indicated that land use in Ghana is the result of the interaction of a number of factors related to the country's physical and human geography. In Ghana, climate, particularly rainfall, has influenced regional concentration of certain crops. For example, tree crops like cocoa, coffee, oil palm, citrus etc. and food crops like plantain and cassava are found in the south of the country (Fig 13). The land use zones are related to vegetation formations which are closely related to climatic conditions.

Until recently, steep slopes were generally uncultivated in Ghana due to difficult accessibility. High ranges in the forest zone were also less cultivated. They were set aside as forest reserves. However, at present, as a result of population pressures, hills and steep slopes near large settlements are being cultivated.

There is no evidence of soil as a major influence on land use. Pests and disease have had some influence on land use. For instance, onchocerciasis-infested areas have been avoided for settlements and farmlands. The capsid and swollen short disease reduced the area under cocoa cultivation in the Eastern Region in the past.

Socio-economic factors like urbanization have led to the increase in the area under cultivation of certain crops, particularly food crops. Urban growth has overrun extensive peri-urban land where agriculture often dominated land use. Wet valley bottoms are being cultivated in both forest and savanna zones, particularly for rice. The gathering of non-timber forest produce and hunting, have increased in terms of the volume and variety of produce. The same can be said with regard to communication facilities. Farms are located along roads, railways and other routes to ensure transportation of produce.

The major categories of land use in Ghana include agriculture, forestry, gathering, urban development, mining, tourism, transportation and infrastructure, energy, grazing and fishing. These categories of land use have varying degrees of effect on biodiversity depending on the extent of macro/micro-habitat modification and the possibilities of species introductions.

## **Agriculture**

Agriculture is a major category of land use in Ghana in terms of land area, the number of people involved, and contribution to the economy. In a study conducted in 1970 (FAO 1976) crop intensity for the country was noted to be 31% and projected to 36% in 1990. Crop intensity is the ratio of cropped area to available land expressed as a percentage.

Agricultural land use types include cultivated annual crops, bush fallow and associated gathering, cultivated tree crops and unimproved pasture.

The major annual crops of Ghana can be classified into cereals, root crops, the pulses and nuts and vegetables. The distribution of these crops is largely determined by the amount and seasonal distribution of rainfall. The important cereals are maize and rice. Maize is grown throughout the country by about 63 per cent of food farmers in Ghana. Rice is a cash crop of importance especially in the valley bottoms in the Northern, Upper East and Upper West Regions. The majority (that is about 75 per cent) of rice-growing farmers in the country are in the Northern, Upper East, Upper West, Central and Volta Regions.

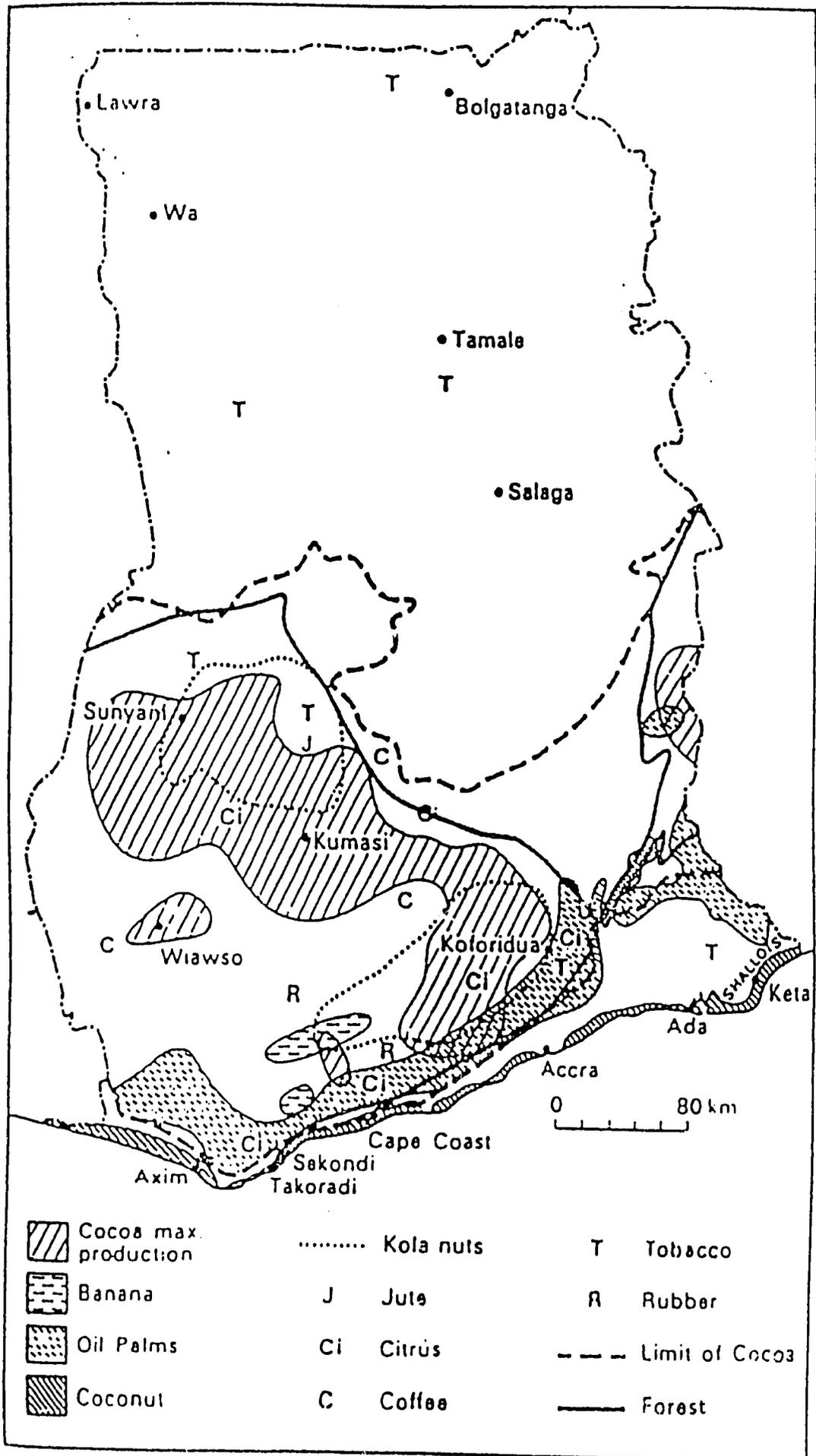
The most widespread root crop in Ghana is cassava. About 73 per cent of food farmers cultivate the crop in the country. In most districts of Central, Eastern, Ashanti and Volta Regions over 80 per cent of farmers cultivate the crop. It is, however, not important in the Upper West and East Regions because climatic conditions are not so suitable for the crop.

Yam is a major tuber crop cultivated both as a subsistence and cash crop. It is mostly grown as a pure stand and concentrated in Brong Ahafo and the Northern Regions. Cocoyam is the third major root crop. It is grown as a subsidiary to other crops grown on the same field. 30 per cent of the total area is located in the Ashanti Region.

Pulses and nuts are grown largely in the Upper East, Upper West and Northern Regions. Over a quarter of the total area under groundnuts is concentrated in the Upper East Region while 37 per cent is in the Northern Region. 75 percent of holders growing groundnuts live in the Northern, Upper East and Upper West Regions. The three regions also account for most of the cultivation of beans.

Cocoa is the most important tree crop in Ghana. It is the main export crop, accounting currently for more than 40 per cent of the foreign exchange earnings of the country. The crop is cultivated everywhere in the forest region. Other important tree crops cultivated in the forest zones include coffee, oil palm, rubber and bananas. Oil palm is cultivated not only by smallscale farmers but also by large scale farmers in plantations owned by individuals as well as by private and state enterprises.

Fig. 13 Distribution of commercial crops



Source: Dickson and Banneh (1986)

## **Forestry**

Logging in Ghana began in 1888 and the value of timber extracted and exported increased rapidly after 1945. Species logged were restricted to *Khaya* (African Mahogany), *Entandrophragma*, *Triplochiton scleroxylon*, *Milicia* and *Lophira alata* (Kaku). There are some 320 timber species out of which only about 80 grow to sizes and quantities considered suitable for commercial exploitation. Currently between 60-70 species are logged and exported. Logging is on the basis of timber concessions granted. Concessions are granted in both reserved and unreserved forests. Logging operations are monitored with respect to minimum girths and the logging cycle. Logging was done under a selection system with a felling cycle of 15 years (reduced from 25 years in 1971, and now increased to 40 years). Since 1979, a ban has been placed on log exports of some species (Odum, Sapele, Candollei, Utile, Makore, Edinam, Lova, Mansonia, Afrosia, Mahogany, Black Hyedua, Avodire, Nyankom). Now emphasis is placed on processing before export and utilisation of less known species. Timber products include logs, veneer, plywood, blackboard etc.

## **Gathering**

This type of land use is prevalent in rural areas and involves the removal of wild plant and animal produce usually for use or gain. Plants collected include chew sticks, chew sponges and teeth cleaners, plants for basketry, fibre plants, construction poles, fruits, vegetables, sweeteners, wine and beverages, medicinal and poisonous plants, latex, gums and resins. Animals captured or hunted for game, sports, for domestic use or trophies include a large variety of birds, large mammals, rodents, fish, reptiles, insects and fungi.

It is estimated that some 30-40 years ago, this land use activity was a subsistence one. However, it has become increasingly commercial with urbanisation and it is feared it may lead to the endangering of some species. For instance, large numbers of Ghanaians, about 90%, use chewsticks collected from the forests.

A large number of plant and animal species have been extensively and intensively gathered to the point of becoming scarce which is indicated by scarcity in the rural areas and by price trends in urban markets. (See p124) for Commercially endangered plants and Table 13 for Threatened species of Wild Animals in Ghana).

## **Settlement and Associated Land Use**

Ghana has over 47,800 towns and villages (Boateng et al, 1994). Settlements with populations of over 5000 are regarded as towns. Those with less than 5,000 are rural settlements where the primary occupations are crop farming, lumbering, animal rearing and fishing.

Most Ghanaians, (about 70%) live in rural settlements. Rural settlements are dispersed or nucleated. There has been a tremendous growth in the number and sizes of towns in Ghana since 1945. The number of towns grew from 39 in 1948 to 135 in 1970 and 189 in 1984. The town population also grew from 12.8% of the country's population to 28% in 1970 and 32% in 1984. No valid measurement exists regarding the actual area of land occupied by towns (Benneh, Agyepong 1990). It is, however, evident that the area occupied by towns in Ghana is increasing rapidly through the development of urban sprawls especially in the regional capitals. Urban development has overrun surrounding agricultural lands, filled in and drained wetlands and polluted streams and water bodies.

It must be mentioned also that a number of rural settlements in Ghana have migrant communities who engage in farming. As they have no special commitment to the lands on which they farm they tend to engage in practices which degrade the land leading to loss of biodiversity. They then move to new areas to continue their environmentally unfriendly activities.

### **Mining and Quarrying**

Mining and quarrying are important commercial activities in Ghana. Nearly all minerals in Ghana are mined in the closed forest (Fig. 14). The most important minerals include gold, diamonds, manganese and bauxite. Gold mining has taken place in the country over many centuries. Diamond, bauxite and manganese have been mined in the present century. The methods of mining are underground, open cast or quarrying and dredging for gold, dredging for diamond and open-cast for bauxite and manganese. Land used for mining include the quarry, dredging or shaft site, the associated surface installation and the locations for the tipping of overburden or tailings. There is considerable disturbance of surface soils in mining areas, the destruction of vegetation and the pollution of water and air which have increased over the years.

Quarrying provides the bulk of construction materials such as sand, gravel, stones and clay. The quarrying of sand, gravel or laterite often leads to complete destruction of soils and landscapes. These problems have resulted from the absence of planning control to ensure adequate measures to protect quarried land.

### **Tourism**

Tourism is essentially a recreational activity directed towards areas where objects or features of an interesting character or capable of giving aesthetic pleasure and satisfaction, or offering unusual opportunities for sport and relaxation are to be found. Ghana has considerable tourism potential especially as far as endowments associated with natural and cultural environments are concerned. This potential has not been fully tapped due to the absence of an organised infrastructure for this land use in the past. However, there has been a

policy shift to correct the situation in addition to the development of infrastructure. Tourism is, therefore, becoming important and may prove an important source of revenue if the potential is utilised. At the moment there is no evidence to suggest that there is a serious impact of tourism on land use.

However, the potential impact of tourism on the environment in general and specifically biodiversity should not be ignored. It is important that at the early stages of developing tourism infrastructure, environmental safeguards are put in place.

### **Transportation and Infrastructure**

Transportation is a function of land use. Its demand is derived from the major components and functions of the land. It is associated with settlement development. The principal modes of transportation in Ghana are roads, railways, aviation, shipping and inland water ways. In 1979 (MLNR, 1979) the total area of existing area of road surfaces, rails and airports was estimated to be 2063.65 km<sup>2</sup>, 0.818% of Ghana's land area, of which roads made up 1,955.82 km<sup>2</sup> and a length of 44,581 km, railways made up 77.2 km<sup>2</sup>, 0.032% of land area of Ghana and a total length of 1287.2 km; airports occupied 129.05 km<sup>2</sup> or 0.05% of land area of Ghana. In 1994 the total length of trunk roads in Ghana was 14,724 km covering an area of 107,485.2 km<sup>2</sup>. The total length of feeder roads in the country at the moment is about 22,000km.

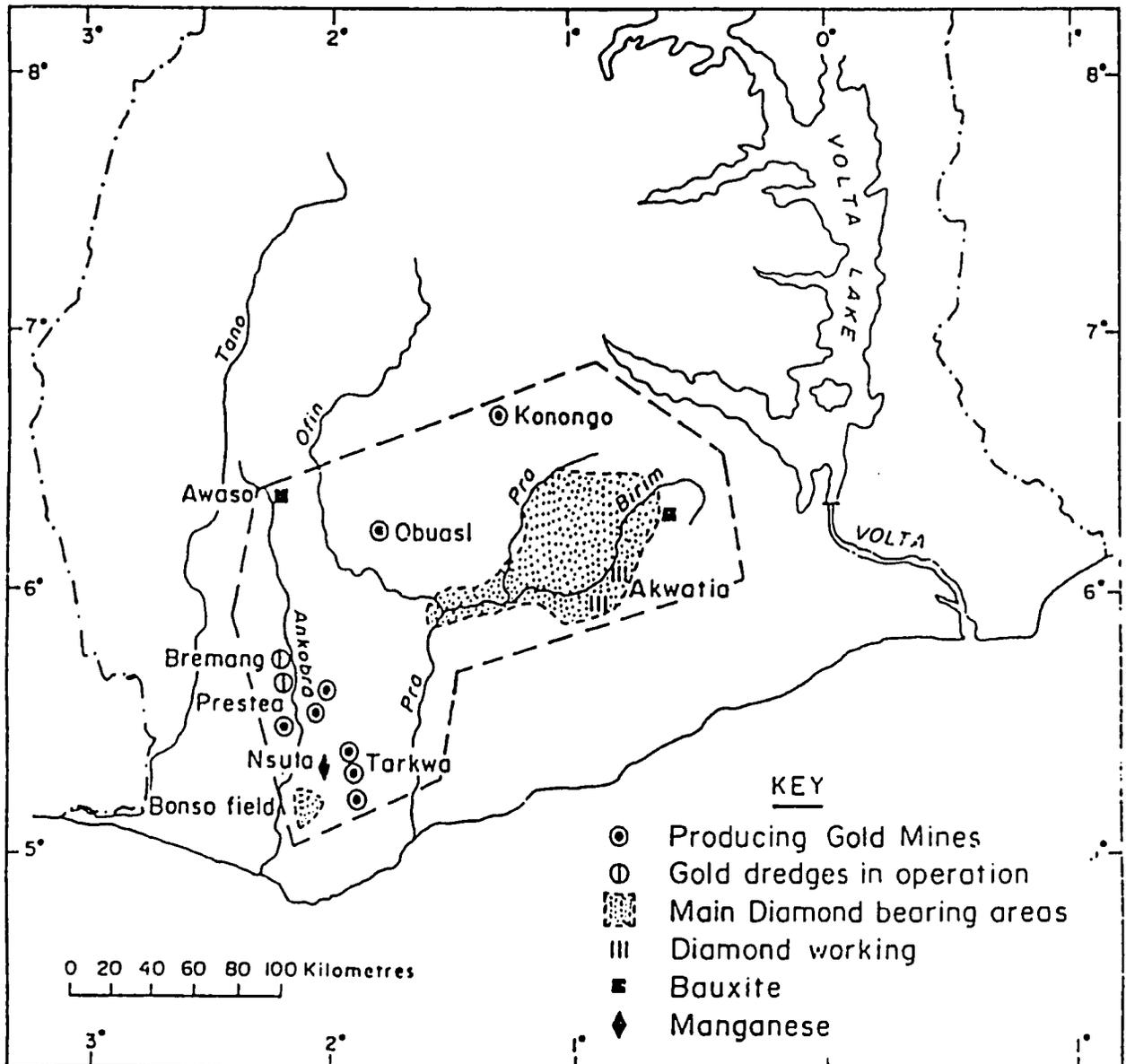
These are necessary for economic development but they involve impacts on habitats through the clearing of vegetation, filling of marshes and the quarrying of embankment and other materials.

### **Energy**

Fuelwood and charcoal constitute by far the greatest proportion of energy sources for the people of Ghana. Wereko-Brobby and Nkum (1989) estimate that fuelwood and agricultural residues constitute about 93% of domestic energy sources in the rural areas. 16% of the urban households use it and about 80% of the domestic energy consumed by the urban-poor is in the form of fuelwood. It is also the most popular fuel used in government institutions such as schools, hospitals and prisons. The volume of wood cut in 1986, 1987 and 1988 were 8.6, 16.3 and 9.2 million metric tons respectively. This comprised a large variety of tree and shrub species.

Fuel gathering affects biodiversity in several ways and contributes to deforestation with chain reactions of increased wind flow, greater desiccation, greater fire risk, soil erosion and loss of habitats and species. The stacks of split wood along the major roads suggest that both the closed forest and savanna are important sources of fuelwood not only for subsistence use but also for commerce.

Fig. 14 Area of Mine Concentration in Ghana



Source: Dickson and Bennet (1983)

More than 30 species in the closed forests are used for fuelwood. Energy derived from hydroelectric dams also creates significant impacts on biodiversity of areas inundated by dam water. Large scale hydroelectricity generation is by far the major electric power in Ghana. The Akosombo dam was built on the Volta River in the 1960s and provides 912 MW power. The system was expanded in the construction of the Kpong project with 140 MW capacity. There are plans to provide further capacity from the Birim, Black Volta, The Pra, Tano and the Volta. Potential new sites have been surveyed on these rivers. As dams fill vegetation is submerged and wildlife trapped and destroyed.

### **Grazing**

Animal rearing takes place in all the ecological zones of Ghana. Cattle, sheep, goats and chicken are reared on subsistence or commercial basis. The northern and coastal savannas are the main grazing lands in Ghana (Ayensu, 1983). The majority of cattle herds in Ghana are, however, concentrated in the north where there are ample grazing grounds. The natural grasslands which constitute the rangelands are community utilised. In the northern savanna region, more than 80 per cent of the inhabitants are farmers who grow food crops and rear ruminant livestock. Areas with high population densities are intensively farmed and grazed. Traditional cattle rearing in Ghana is based on an extensive system of production and is entirely dependent on the natural grass vegetation. The utilization of grazing resources is controlled by traditional practices which under existing conditions are well suited to the socio-economic needs of the people. The animals are taken to graze in the morning and herded back later in the day, to be milked and kraaled. The management of the vegetation is by a system of burning which allows the following:

- i) The fresh growth of green herbage; and
- ii) Clearing of unpalatable harsh stubble.

These practices provide a uniform utilization of the natural grassland resources and reduce the incidence of bush and woody species. Continual burning, however, results in the degradation of vegetation, exposure of soils and their subsequent erosion. Degradation of vegetation takes the form of the elimination of fire tender and often more palatable species, both grasses and woody species (Rose Innes, 1963).

## **LAND USE TECHNOLOGIES, DEFORESTATION AND DESERTIFICATION**

### **Traditional Technologies**

The effect on biodiversity of the various uses of land discussed in the earlier sections results principally from the technologies employed. This is clearly illustrated with respect to agriculture.

The predominant methods of cultivation in Ghana are the traditional bush-fallow methods, land rotation, in which fire is a major tool for land clearing and a means of incorporating mineral nutrients in the soil in the form of ash residues. The standard tools are the hoe, the machet and the axe. Soil fertility is maintained through periods of natural regrowth fallows. About 5-10 years of fallow are required for every 2-3 years of cropping. As a system, bush fallow agriculture usually involves the extensive use of land for intercropped staple foods, vegetables, fruits, fodder, fuel and construction materials over the wide area of the community land space. The productivity of the system is low per unit area and labour supporting only low population densities. The critical population density may be as low as 20 persons per square kilometer depending upon soil conditions.

In the savanna areas, particularly in the Upper Regions, the practice is to crop around house compounds year after year with the same crop. Draught animals are often used. The technology in this type of agriculture has remained almost as traditional as in the shifting cultivation. In terms of soil exhaustion and erosion, many of these compound farm areas are worse off than those under shifting cultivation. The use of household wastes and cattle dung as manure, however, maintains the fertility of small gardens immediately adjoining the houses.

Often biodiversity has been reduced to the minimum with seldom any wildlife available except a few reptiles and birds while the soil surface remains without cover for half the year during the dry season.

### **Deforestation**

In Ghana the average population density is about 69 persons/km<sup>2</sup>. Many rural areas in the northern savannas may be carrying more people than the system can sustainably support (Cody and Classen, 1981). With the rapid increase in population during the present century, the bush fallow system has not been able to cope. Where land is available extension has taken place into virgin lands, for example, in the Northern and Western Regions. In other situations, the fallow period has been shortened to 1 or 2 years and marginal lands on hillslopes have been cultivated as in parts of the Eastern Region. The inevitable effect has been the destruction of habitat areas and biodiversity through clearing and bush burning. During the 1982/3 dry seasons, 1005 bush fires were recorded throughout Ghana (Ampadu-Agyei, 1988). The inability of the bush fallow system to adapt to increasing population, and increasing monetisation of the economy

have led to land use changes that have had far reaching consequences for biodiversity and the environment generally.

There is a general trend towards the elimination of the climax forest and savanna cover and consequently the associated life support systems. It is estimated that the 500,000 ha of the high forest outside the reserved system is being lost at the rate of 20,000 - 25,000 ha per annum (Owusu et al. 1989). This is enough to eliminate the unreserved high forest cover in about 20 years. The lack of clear government land use policy has contributed to these changes.

### **Desertification**

In arid and semi-arid areas, one of the extreme consequences of deforestation and the consequent misuse or overuse of the land is desertification. It is estimated that about 35% of the total land area of Ghana (i.e. an area of about 83,489 km<sup>2</sup>) is subject to desertification, with the Upper East Region and the eastern parts of the Northern Region (an area of 78,718 km<sup>2</sup> or 33% of the total land area of the country) facing the most hazard. Deforestation is perhaps the major contributory cause and manifestation of desertification.

The Ghana Environmental Action (Laing, 1994) sets out the scenario for intensified desertification in Ghana as follows:-

- Low carrying capacity of savanna woodland areas with relatively low (100 - 1150 mm) and erratic rainfall;
- Farming practices relying mainly on natural bush fallow for restoration of soil fertility;
- High and increasing human and domesticated population densities exerting pressure on the vegetation and soil resources;
- Excessively shortened fallows due to increasing populations and consequent demand for land;
- Uncontrolled man-made fires occurring at the peak of the dry season resulting in destruction of organic matter and the natural bank of seeds and seedlings, reduction in perennial plants, retrogression in the value of the ecosystem and reduced nutrient cycling;
- Commercialization of fuelwood encouraging villagers to cut trees affected by fires instead of leaving them to recover, a tendency to harvest living trees and generally increased devegetation.

## **Introduced Technologies**

Introduced technologies include those used in agriculture, mining and construction. These have the potential of increasing production but they also impact on the environment and affect biodiversity.

In agriculture, introduced technologies include mechanization for land preparation, harvesting and transportation, the use of chemical fertilizers, pesticides and the adoption of exotic plant and animal cultivars.

Mechanization involves the use of wheeled tractors and harvesters. In the 1960s and 1970s, these became common in all parts of the country, particularly in the savanna areas where it facilitated the clearing of vegetation over extensive areas, sometimes simply to be abandoned to the sun, rain and erosion. This, for example, was the case with the State Farms during 1957 - 1965. The unavailability of hard currency for the importation of machinery and equipment has led to a considerable reduction in the use of farm machinery in recent years.

A large variety of chemicals are used in agriculture and related activities. The effect of these may not be limited to the target organisms such as pests and weeds. The residual effects are often harmful to both macro- and micro soil and aquatic organisms.

Heavy machinery has been used to remove vegetation and soils over increasingly large areas for surface mining, road construction, logging and settlement development. Inadequate planning and lack of rehabilitation has often resulted in the destruction of extensive areas of habitat.

Large scale irrigation schemes in the northern and coastal savannas have inundated extensive valley areas and have prevented the flooding of flood plains thus changing ecosystems and modifying others.

Forestry technologies of inventory improvement planting, logging and monitoring are basically modern and introduced.

Forests have been reserved since 1927. The reserves are high forest and savanna areas set aside by ordinance and managed for the sustained production of timber, non-timber forest produce, game and wildlife or for the protection of watersheds and steep slopes. About 11% of the land area of Ghana is so reserved. Management has not always been successful but the reserves, covering extensive areas and containing diverse habitats, constitute important sources of biodiversity in Ghana. The introduction of the reserved forests is associated with introduced forestry technologies geared towards commercial exploitation of forest resources. To ensure continuous exploitation, plantations were introduced which were characterised by the growing of fast growing exotic tree species. The biodiversity status of the plantations is low since they are mono-cropped. Agroforestry systems have also been introduced to

integrate agriculture and forestry to arrest the process of land degradation. They have the potential to improve agricultural biodiversity.

### **Sacred Groves**

The most important traditional practice with respect to biodiversity is the institution of sacred groves as a land use category. These are land or water areas of varying sizes set aside by communities for religious and cultural practices. The utilization of the resources of these areas is restricted and controlled through taboo and totemic systems (Dorm-Adzobu *et al*, 1991, Ntiamoah-Baidu, 1995). There are over 3000 such groves in Ghana. Because of restricted use, sacred groves often exhibit higher but varying levels of secondary climax biodiversity than the surrounding areas. For example, in three sacred groves around Tamale in the northern savannas, it has been observed that grove species composition is several times that of the surrounding cultivated lands (CIPSEG 1993).

### **Land Tenure and Biodiversity**

Though land ownership and tenure vary in different parts of Ghana, the basic principle is that most land is communally owned and vested in a chieftaincy head or a family head for, and on behalf of, the owning group. "Strangers" may use land under various arrangements including produce sharing and renting. Several factors are known to affect the proper use of land and the assurance of the maintenance of biodiversity under these ownership and tenure arrangements. For example, the common problems of limited commitment to land improvement and conservation associated with common ownership certainly militate against the preservation of biodiversity. Valuable timber trees generally do not belong to the land user in direct contact with the land. The custodian of the land, the chief, or the "tendamba" in the north, may share in the non-timber forest produce such as game and fruits. The reduced economic benefits to the land user reflects in reduced interest in the investment of labour and financial resources in conservation. While the system is equitable and makes land available, the need for conservation may not be adequately addressed.

### **Land Use Policy**

Effective national land use policy would certainly enhance biodiversity through the controlled uptake of land for urban development, the development of conservational standards, the control of mining and logging and effective tenure arrangements and pricing of land and the products of land. Ghana, however, can hardly be said to have had an effective land use policy over the years.

Forest reservation under ordinance begun in 1927, which stipulated a forest estate of 20% of the land area of Ghana was sufficiently forward looking. The

over 200 forest and wildlife reserves, constituting some 11% of the country are the most important sources of biodiversity in the country at present.

The Town and Country Planning Ordinance of 1945 has not been very successful in dealing with uncontrolled extension of urban areas into agricultural and other lands. Rural land use has seldom been affected by planning. The soil erosion and land planning ordinance of 1953 (amended 1957) still remains on the statute books. Implementation in the northern savanna was halted after independence. The ordinance empowered the Governor to declare areas as planning areas where there was the danger of the land being degraded or where it was considered that measures were required to maintain the productive potential of the land. Land use conservational planning was undertaken by committees on which the local people served (Lynn 1942).

In 1979, the Ministry of Lands and Natural Resources appointed a committee to assemble information for national land use planning. The Committee recommended among other things, the establishment of a land use planning and co-ordinating body. None of the committee's recommendations were implemented. Other areas of land use where policy instruments were provided include the Concessions Ordinance (1939) and the native jurisdiction (Forest Land Use) 1883.

The Ministry of Lands and Forestry established a Committee in 1994 to formulate a Land Use Policy for the country. The draft report of the committee is currently being studied by the Ministry for further action.

It is hoped that the outcome of the committee's work will lead to a national policy which will address the various uses to which land is put in the country. The issue of land tenure and land ownership should also be dealt with by this policy document.

The Environmental Action Plan (EAP) adopted by government in 1991, and the current implementing projects (the Ghana Environmental Resources Management Project - GERMP) including the Land Management and the Coastal Wetlands projects envisage sustainable land use. The current land use mapping component envisages a land use map of Ghana at the scale of 1:250,000 using satellite images. Together, with the soil suitability, topographic, meteorological and land ownership maps at the same scale, the current land use map will provide database sets for environmental information system development and the effective use of land.

## RESEARCH

Land use as a subject for research has often been subsumed under research focussed on crop production enhancement. This has been the approach in Ghana for most part of this century.

In 1954, a suggestion by C. F. Charter, then head of the Soil and Land Use Survey, to integrate estate (large scale) and peasant agriculture included the need for research on the estates and the dissemination of results to the peasant farmers. The proposal envisaged comprehensive land use planning involving field consolidation and settlement rationalisation. The beginning of the system of agricultural research stations of the Ministry of Agriculture may be traced to this proposal. The CSIR has inherited part of this system and is responsible for the various institutes that have research mandates regarding the productive use of land: Soil Research, Arable Crops, Tree crops and Savanna agriculture.

These institutes undertake "on-station" trials in various ecological zones in the country and test their results on farmers' farms so as to demonstrate to farmers what can be achieved by improved technologies. Of particular significance is the work of the Soil Research Institute and of breeders who have developed high-yielding, disease-resistant varieties of various crops. The development of cropping systems which ensure soil fertility, complements the work of the Soil Research Institute which undertakes soil surveys of areas earmarked for agricultural production and makes recommendations on needed soil amendments.

Under the Ghana Grains Development Project, the Crops Research Institute (CRI) and the Savanna Agricultural Research Institute (SARI) have produced new varieties of cereals (maize, sorghum and rice) and legumes (cowpea and groundnuts) which have been released to farmers. The new maize releases within the last five years include Obatanpa (with high protein content), Okomasa and Abeleehi, all of which are streak resistant. These improved varieties can outyield local varieties by as much as five times, depending on inputs. The incorporation of disease resistance in the varieties means the avoidance of expensive chemicals whose widespread use poses health hazards. It has been estimated that countrywide an average of 54% of maize-growing farmers are adopting the improved varieties of maize.

The Institutes have further evolved cropping systems which have not only led to increased production but have promoted the sustained fertility of land. For example, SARI which is supported by GTZ and where research is based on the farming systems approach, has developed cropping systems involving the incorporation of legumes without an over-reliance on external nitrogen inputs.

Under the Root and Tuber Crops Improvement Programme, three cassava varieties (Afisiafi, Glemo Duade and Abasafita) with three times the yield of local cultivars have been released to farmers in 1993. The minisette technique for

producing yam planting material has been extended to various farming communities with success. (CSIR, 1992, 1993)

Biotechnology could contribute to the solution of several problems in the breeding programmes of these institutes which were formerly considered unduly difficult. A strong case has been made for the use of biotechnology in cassava research (Komen, 1990).

It should be noted in connection with the relevance of biotechnology to the work of Ghanaian breeders that germplasm collections are currently maintained in the field which exposes them to various hazards including bush fires. Biotechnology procedures make possible the *in vitro* maintenance of germplasm under conditions which slow down growth.

#### **Research Undertaken into Impact of Land Use on Biodiversity**

In the past biodiversity had been taken for granted and had been enjoyed without considering the effects of land use. Research had not been directed to the effects of land use on it. Thus enhanced production through the study of crop ecology and plant breeding have not been emphasised. The Plant Genetic Resources Centre of the CSIR has, however, concerned itself with the preservation of plant genetic diversity.

## **VI. CRITICAL HABITATS AND PLANT AND ANIMAL SPECIES OF CONSERVATION CONCERN**

### **CRITICAL SITES**

1. Ghana has some fairly small but important sites in the lowland tropical forests in the southwest of the country. The Bia Resource Reserve and the adjacent Bia Game Production Area still include some unexploited forest, although heavy logging is taking its toll and the populations of primates and other species are being depleted partly by hunting and partly by loss of food trees. The Kakum National and Assin Atandaso Forest Reserves in the forest zone in the southern moist semi-deciduous forest zone, were recently re-gazetted to form the Kakum National Park and the Assin Atandaso Resource Reserve. In the extreme southwest of the country, the Nini-Suhien National Park and the contiguous Ankasa Resource Reserve are of high priority, and there are proposals to gazette them as a single national park. Other Forest Reserves containing significant populations of large mammals are Boin River, Boin-Tano, Draw River, Ebi Shelterbelt and Cape Three Points.
2. Ghana has three important savanna woodland national parks, namely, Bui, Digya and Mole, all of which have important populations of large mammals. The management of all these needs strengthening, particularly Mole National Park as poaching is prevalent and there is little effective control. The Kogyae Strict Nature Reserve is of importance for its antelope populations, but has been heavily degraded by the activities of yam farmers. Over 50% of this reserve has been destroyed.
3. -The Kalakpa Resource Reserve in the southeast of the country contains some important forests and an interesting array of bird species.  
  
The forests on the southern escarpment of the Volta Basin, and in several areas to the south and southwest, are important as locations of breeding colonies of the remarkable white-necked picathartes but are currently unprotected.
5. In the western part of the high forest zone, the Brong Ahafo region may be important, especially for the long-term survival of the forest elephant. More information is needed about the status and conservation needs of this and other species in the region.
6. Some extensive coastal mangroves and lagoons occur in the southeast, and protection of this habitat needs to be improved. The effect of decreased sediment outflow and increased erosion on the coast,

particularly in the Keta lagoon since the construction of the Akosombo Dam and creation of the Volta, is not known.

7. There are five proposed Ramsar sites along the Ghana coast in addition to the one established inland Ramsar site, the Owabi Nature Reserve surrounding the Owabi reservoir which supplies water to Kumasi.

### **National Parks, Nature and Resource Reserves, Wildlife Sanctuaries and Ramsar sites**

There are currently 16 legally constituted wildlife conservation areas under the administration of the Wildlife Department, comprising six National Parks, one Strict Nature Reserve, six Resource Reserves and three Wildlife Sanctuaries. In addition, there are two proposed wildlife conservation areas and five proposed Ramsar sites. The complete list of wildlife conservation areas, their sizes, year of establishment and vegetation type are given in Table 11 while Figures 15 and 16 give the location of the different sites within Ghana. The established and proposed terrestrial sites cover an area of 13,048.6 km<sup>2</sup>, equivalent to 5.46% of Ghana's total land area. The proposed Ramsar sites account for a further 1725 km<sup>2</sup>. Thus, 6.18% of Ghana's total land area is designated for wildlife conservation.

**Table 11: Wildlife Conservation Areas in Ghana**

<i>Name of Protected</i>	<i>Vegetation Formation Group</i>	<i>Area (km<sup>2</sup>)</i>	<i>Year/LI</i>
<b>National Parks</b>			
Mole	Tall-grass savanna	4921	1971/LI 710
Digya	Tall-grass savanna	3126	1971/LI 710
Bui	Tall-grass savanna	3074	1971/LI 710
Bia	Moist semi-deciduous/Moist evergreen	78	1977/LI 1105
Nini-Suhien	Wet evergreen	160.2	1976/LI 1085
Kakum	Moist evergreen	207	
<b>Resource Reserves</b>			
Shai Hills	Short-grass savanna/South-east outlier	54	1971/LI 710
Kalapa	Short-grass savanna	324	1975/LI 1022
Ankasa	Wet evergreen	343	1976/LI 1085
Gbele	Savanna woodland	324	1975/LI 1022
Bia Resource Reserve	Moist evergreen/Moist semi-deciduous/	228	1977/LI 1105
Assin-Attandanso	Moist evergreen	140	
<b>Strict Nature Reserve</b>			
Kogyae	Tall-grass savanna	324	1971/LI 710
<b>Wildlife Sanctuary</b>			
Bomfobiri	Dry-semi deciduous/Tall-grass savanna	73	1975/LI 1022
Owabi*	Moist semi-deciduous	52	1971/LI 710
Buabeng-Fiema	Tall-grass savanna	4.4	1974 ACT 359
<b>Proposed Sites</b>			
Kyabobo National Park	Dry-semi deciduous	359.8	
Agumatsa W. Sanctuary	Dry-semi deciduous	3.1	
TOTAL		13,768.50	
% Ghana's land area		5.74	

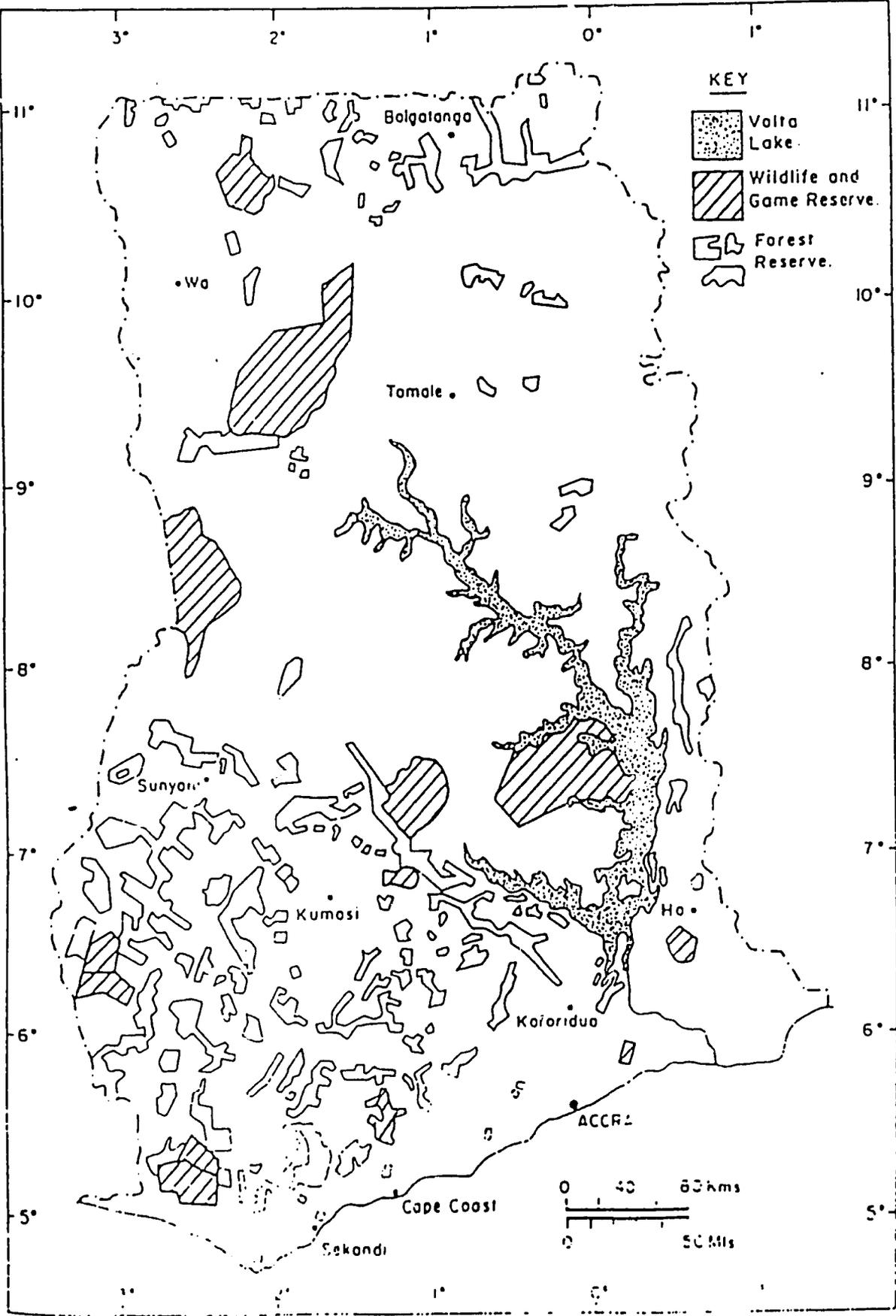
<b>Proposed Ramsar Sites</b>	<b>Management area km<sup>2</sup></b>	<b>Lagoon area km<sup>2</sup></b>	<b>Core zone</b>
Keta	1200	300	25
Songur	330	115	5.0
Densu Delta	70	20	3.5
Muni Pomadze	90	3	1.5
Sakumo	35	3	1.0
Total Wetland Sites	1725	441	

\* Also a Ramsar Site



Fig. 16

Forest, Wildlife and Game Reserves



All the established wildlife conservation areas currently in Ghana were acquired compulsorily by the Government (with or without payment of compensation) and, therefore, belong to the state. While the acquisition of traditional protected area categories would probably follow this system, it is considered inappropriate to adopt the same strategy in the case of the proposed Ramsar sites. Ownership of the Ramsar sites will remain with the local communities and the management strategy advocated is based on the wise-use concept with local community participation.

The following account gives a description of some of the key wildlife conservation areas:

### **Bia National Park (78 km<sup>2</sup>)**

Bia has one of the best studied forest flora and fauna in Ghana and straddles the moist evergreen and moist semi-deciduous forest regions. With parts of Nini-Suhien National Park, it represented the only primary forest in the country but it has been exploited in recent past and has very broken canopy. It is contiguous with the Bia Resource Reserve.

It has a high density of timber trees, and 629 vascular plants have been identified within the park. A full range of plant forms abounds from 70 m tall emergents to myriad epiphytic ferns and orchids.

The fauna is equally diverse. Rare large mammals include forest elephant - one of the two known large herds occur here, giant forest hog and bongo, rare carnivores such as the leopard and golden cat. Forest primates which were once common, including the chimpanzee, olive colobus and Diana monkey are now rare. Forest duikers include the large yellow-backed duiker and bay duiker. The rodent and bat fauna exceed 30 species.

White-breasted guineafowl have been sighted, along with the rare Ghanaian form of the black-collared lovebird, Chapin's spine-tailed swift and Sharpe's apalis. In all over 160 bird species have been recorded at Bia.

The park, originally established in 1974, and covering 30,600 ha was reduced to 23,000 ha in 1979 and further reduced in 1980 to its present size. This was the result of the high pressure from the timber industry and illustrates the general threat to the protected areas for timber, hunting and agriculture.

The shrinking of the park has resulted in forest elephants coming into conflict with surrounding farms more often. It also means that hunters have easier access to the inner parts of the park. Together with the Bia Resource Reserve, this area has been designated as a Biosphere Reserve with the National Park forming the core area.

Surveys are carried out by the Ghana Wildlife Department (GWD) and strict control of hunting has been endeavoured with the assistance of the police. However, the Wildlife Department has very limited resources with which to carry out its duties.

### **Nini-Suhien National Park (160.2 km<sup>2</sup>)**

This park is in the wet evergreen zone where tree species richness is greatest, and in which there are endemic species, including the endemic genus *Monocyclanthus*, and *Cola umbratilis*. There is a rich array of different plant life-forms to match the species richness and endemism.

There have been few faunal surveys, but it is apparent that there is a rich forest fauna, including many species of primates - possibly at higher densities than in Bia National Park, three species of duiker, forest elephants as well as the cats, bongo and bushbuck. The avifauna is equally diverse, with preliminary surveys indicating that white-breasted guineafowls occur, along with two other guineafowl species.

Like the Bia National Park, Nini-Suhien is a relatively small area. It was selectively logged once, and still has a full timber stand. However, the park is heavily poached and the Wildlife Department require more resources and motivation to carry out effective patrols.

### **Bia National Resource Reserve (228 km<sup>2</sup>)**

This National Resource Reserve was established in 1971 and covers an area of 228 km<sup>2</sup>. The Black Volta River practically bisects the park. The vegetation is generally of the Guinea savanna woodland with gallery forest along the rivers. The fauna in the park include the olive baboon *Papio anubis*, patas monkey *Erythrocebus patas*, hippopotamus *Hippopotamus amphibius*, buffalo *Syncerus caffer*, red-flanked duiker *Cephalophus rufilatus* and the hartebeest *Alcelaphus buselaphus*. The area also has a rich and varied birdlife.

The major disturbances in the reserve are human settlements which are still within the park boundaries.

### **Mole National Park (4921 km<sup>2</sup>)**

This was first established as a game reserve in 1961 and became a national park in 1971.

Guinea woodland savanna predominates in the park with gallery forest along rivers. The communities recognised in the areas include middle slope *Burkea africana-Hyparrhenia spp*, upper slope, *Detarium microcarpum-Loudetia simplex*, top slope *Isoberlinia doka - Loudetia scaetiae* and scarp *Strychnos spinosa-*

*Ischaemum\_hirsutum*. The scarps also support a denser woodland community of *Dispyros mespiliformis-Monodora tenuifolia*.

The fauna in the park include the Guinea baboon, olive baboon, vervet and patas monkey, the side-strapped jackal, spotted hyena, lion, leopard, elephant and a variety of ungulates such as bushbuck, buffalo, waterbuck and roan antelope. The reptiles include the Nile crocodile, the slender-snouted crocodile and the Nile and Bosc's monitor. Several terrapins and river turtles are also in the area. Birdlife is very rich.

Scientific research taking place in the area relate to the studies of animal populations, habitats and ornithology.

Poaching and illegal hunting are a major concern in the area.

### **Kakum National Park (207 km<sup>2</sup>)**

Kakum National Park, which received substantial financial support from USAID and Conservation International, provides the first opportunity for a protected area to demonstrate the concrete benefits provided by conservation. The park has the potential to set a standard for all future design and development of such areas, and this should help in redefining the image of protected areas, and of conservation itself, through Ghana. (See Bailey's (1995) study for the assessment of the park).

The mission of Kakum is. to preserve biodiversity habitats, natural systems and functions. The goal is to develop the park as a tourist attraction.

The fauna within the park include: forest elephants, bongo, yellow-backed duiker, Diana monkeys (now rare) as well as a rich diversity of butterflies, birds, reptiles and amphibian species.

The flora are made up of a transition zone of forest types from the rain forest. Moist Evergreen Forest - seasonally dry semi-deciduous forests and several species of herbaceous and woody plants.

The headwaters of the major rivers in the region are in Kakum and these provide water to the nearby villages as well as the urban centres of Cape Coast and Elmina.

Though the development of Kakum is being undertaken within the local community, there is still some amount of poaching and illegal hunting. The extent of this is not, however, as serious as in the other national parks.

Future development of Kakum will aim at restoring the natural habitats to an ecologically viable, diverse community of native plants and animals. This will include:-

- re-establishing indigenous plants that attract birds, insects and other animals.
- creation of a series of ponds along the stream corridor to enhance the beauty and biological diversity of the area, introduce native species such as dwarf crocodile and other reptiles and amphibians, and improve waterfront and wading bird habitat;
- enhancing wildlife habitats such as bird and bat houses, dead dross for cavity resting species, and brush piles for small animal retreats.

### **Ankasa Resource Reserve (343 km<sup>2</sup>)**

This reserve is adjacent to the Nini-Suhien National Park and has a similar fauna and flora. The area has been less well surveyed than the Bia region, so details of what occurs are urgently needed.

Controlled hunting and logging are allowed in the reserve. It is clear, however, that the area has already suffered much poaching of duikers and primates for the bushmeat trade.

### **Shai Hills Game Resource Reserve (48.6 km<sup>2</sup>)**

This is the only area of southern outlier forest that is protected in the coastal zone. It contains three species of endemic trees. The fauna is not the same as in the wetter forests, but closer in composition to savanna communities (e.g. with baboons and green monkeys). Species records are available in mimeographed materials and reports within the Wildlife Department.

There are no commercial timber species within the reserve but a potential problem is the illegal collection of fuelwood, which is in high demand by populations on the coastal plain.

The area is fenced and there are plans to introduce species for ranching and also to allow indigenous mammals (kob and baboon) numbers to increase and then cull populations to supply bushmeat to Accra.

### **Bomfobiri Wildlife Sanctuary (53.1 km<sup>2</sup>)**

This is a small patch in the dry semi-deciduous forests, between the forest and savanna zones that experience fire. The vegetation is secondary with some cultivation. The fauna of the Sanctuary is intermediate between savanna and forest.

### **Owabi Wildlife Sanctuary (13.1 km<sup>2</sup>)**

This small area lies within the north-western sub-division of the moist semi-deciduous forests. It could have a fauna similar to the northern part of the Bia National Park, if hunting had not been uncontrolled. The vegetation consists of secondary forest including cultivated areas.

### **Ramsar Sites**

In contrast to the terrestrial protected areas, the avi-fauna of the wetland sites are well studied (Ntiamo-Baidu, 1988; 1991; Ntiamo-Baidu & Gordon, 1991). The relative importance of bird populations both nationally and globally has been well documented. The proposed Keta and Songor Ramsar sites, the two most important coastal wetland sites in the country, support total populations of over 100,000 water-birds comprising terns, herons, egrets, ducks and waders, of which eight species of waders (Spotted redshank, Greenshank, Curlew sandpiper, Little stint, Black-tailed godwit, Avocet, Black-winged stilt) occur in internationally important populations. Three other smaller sites, Sakumo, Densu delta, and Muni-Pomadze also support water-bird populations of over 20,000 as well as internationally important populations of six, four and one species of waders respectively.

### **Limitations of Ghana's Protected Areas**

Despite the fact that Ghana possesses an extensive network of protected areas, much of what is protected is not high priority habitat: most protected areas lie in already degraded habitat types such as savanna/woodland. None of the country's coastal mangroves are also reserved. It is, therefore, important that Ghana upgrades the protection, management and status of some of the forest reserves important for protecting flora, fauna and water catchment.

The reserve network also tends to be fragmented consisting of many small reserves, few of which are larger than 500,000 ha. This implies that at the highest density estimates, elephant population, for instance, will be probably too small to survive within the confines of the reserve areas. This is more so when human populations close to reserve boundaries are dense and conflict over crop raiding ensues. Human encroachments are also greater with respect to the small reserves.

In South West of Ghana, however, there are a large number of reserves some of which are contiguous providing a larger overall area. For instance, the complex of Akuse, Bia Tano, Subin, Krokosua Hills, etc, together have an area of approximately 1,700,000 ha with a possible elephant population of 200-500. Other forest reserves, game production reserves and national parks close by would be linked by extensions of the "shelter belt" system and developing new connections between the numerous small reserves, to allow elephants to travel more freely between protected areas.

Another major problem in Ghana's reserve areas is their extensive exploitation by people, especially local communities. The limited resources of the Ghana Wildlife Department makes it impossible to effectively restrain public access to wildlife and forest reserves, as well as hunting and gathering of non-timber forest products. Though statistics are not available, it is believed that the exploitation levels are well above biologically sustainable levels, and could lead to the local extinction of some wildlife species.

Particularly worrying was the gradual erosion of the Bia National Park to its present size, and the reports that there is continuing pressure to log within it.

Two forest habitats have not been protected. The Upland evergreen forests have some very rare plant species and are especially important for watershed protection, because they are often on steep hills that modern machinery can now log.

### **Animals in Terrestrial Wildlife Protected Areas**

Species records of faunal groups in different wildlife protected areas are given in Table 12. Mammalian species lists are available for all the sites. Information on avi-fauna is lacking for Bui National Park and Gbele Resource Reserve while reptiles and amphibians have not been well studied for any of the sites.

Table 3 provides a comparison of the typical mammalian species found in the forest and savannah wildlife protected areas and gives the status (relative abundance) of the species. Mole National Park, the largest and most developed of the savanna protected areas, supports 46 species of large mammals including good populations of many species of special interest such as the Elephant, the Buffalo, Buffon's Kob, Western hartebeest, Roan antelope, Oribi and the Red-flanked duiker as well as carnivores such as the Leopard, Lion and Hyaena. Rare species such as the Black and White Colobus monkey and the Yellow-backed duiker also occur in the riverine forest of Mole (Wilson, 1993).

**Table 12: Species records of faunal groups in different Wildlife Protected Areas**

	Mammals	Birds	Reptiles*	Amphibians*	Invertebrates
<b>NATIONAL PARK</b>					
Mole	46	167	3	-	-
Digya	40	67	17	2*	-
Bui	36	-	-	-	-
Bia NP/RR	45	160	13	-	43**
Nini-Suhien NP/Ankasa RR	48	100	5	-	225**
Kakum NP/Assin Atandanso RR	69	255	8	2*	402**
<b>RESOURCE RESERVE</b>					
Shai Hills	19	84	10	-	-
Kalapa	48	43	-	-	-
Gbele	28	-	-	-	-
<b>STRICT NATURE RESERVE</b>					
Kogyae	49	33	7	2*	-
<b>WILDLIFE SANCTUARY</b>					
Bomfobri	32	31	9	-	-
Owabi	15	161	-	-	-
Buabeng-Fiema	8	-	-	-	-

\*Incomplete list

\*\*Butterfly

The forest protected areas Nini Suhien/Ankasa, Kakum/Assin Atandanso and Bia form the eastern end of the Upper-Guinea forest block which is known to be a centre of high endemism and high species diversity. Over 200 mammalian species have been recorded in these areas including species of conservation interest.

#### **GHANAIAN WILD ANIMAL SPECIES OF CONSERVATION CONCERN**

Wild animal species considered to be of conservation concern fall within the following categories:

- \* Threatened species
- \* Endemic species
- \* Species that are listed on the Ghana Wildlife Legislation and/or are subject of international conventions
- \* Species of social and economic value (for both subsistence use by local communities and commercial exploitation at national and international levels)

- \* Flagship species, ie species that can be used as focus for projects to generate wider biodiversity conservation action
- \* Indicator or keystone species
- \* Landraces, varieties and wild ancestors of domesticated species.

These categories are often indistinct since a species may qualify under more than one category, eg, the African elephant, *Loxodonta africana*, is a threatened species and is also considered as a keystone species. Such species require special conservation efforts. Table 13 lists the threatened species of wild animals occurring in Ghana while accounts of the status and distribution of all the wild animal species considered to be of conservation concern are provided in the following section.

Table 13: Threatened species of wild animals occurring in Ghana.

	Scientific Name	Common name (status*)
<b>REPTILES</b>		
<b>CROCODYLIA</b>		
Crocodylidae	<i>Crocodylus cataphractus</i>	Slender snouted Crocodile (I)
	<i>Crocodylus niloticus</i>	Nile Crocodile (V)
	<i>Osteolaemus tetraspis</i>	West African Dwarf Crocodile (I)
<b>TESTUDINATA</b>		
	<i>Lepidochelys olivacea</i>	Olive Ridley Turtle (E)
	<i>Caretta caretta</i>	Loggerhead Turtle (V)
	<i>Chelonia mydas</i>	Green Turtle (E)
	<i>Eretmochelys imbricata</i>	Hawksbill Turtle (E)
	<i>Dermochelys coriacea</i>	Leatherback Turtle (E)
<b>BIRDS</b>		
<b>GALLIFORMES</b>		
Phasianidae	<i>Agelastes meleagrides</i>	White-breasted Guineafowl (E)
<b>STRIGIFORMES</b>		
Strigidae	<i>Scotopelia ussheri</i>	Rufous Fishing Owl (R)
<b>PASSERIFORMES</b>		
Campephagidae	<i>Campephaga lobata</i>	Western Wattled Cuckoo Shrike (V)
Pycnonotidae	<i>Criniger olivaceus</i>	Yellow-throated Olive Greebbul (V)
Muscicapidae	<i>Picathartes gymnocephalus</i>	White-necked Picathartes (V)
Laniidea	<i>Malaconotus gladiator</i>	Green-breasted Bush-shrike (R)
<b>MAMMALS</b>		
<b>PRIMATES</b>		
Cercopithecidae	<i>Cercopithecus diana roloway</i>	Diana Monkey (E)
	<i>Colobus badius waldroni</i>	Red Colobus (E)
	<i>Cercocebus torquatus</i>	White-collared Mangabey (V)
Pongidae	<i>Pan troglodytes</i>	Chimpanzee (V)
<b>ARTIODACTYLA</b>		
Suidae	<i>Hylochoerus meinertzhageni</i>	Giant Forest Hog (K)
Bovidae	<i>Tragelaphus euryceros</i>	Bongo (K)
	<i>Cephalophus dorsalis</i>	Bay Duiker (K)
	<i>Cephalophus ogilbyi</i>	Ogilby's Duiker (V)
	<i>Cephalophus sylvicultor</i>	Yellow-backed Duiker (K)
	<i>Cephalophus spadix</i>	Abbot's Duiker (K)
	<i>Neotragus pygmaeus</i>	Royal Antelope (K)
	<i>Damaliscus korrigum</i>	Topi (K)
	<i>Gazella ruffifrons</i>	Red-fronted Gazelle (K)
Tragulidae	<i>Hyemoschus aquaticus</i>	Water Chevrotain (K)
Hippopotamidae	<i>Choeropsis liberiensis</i>	Pigmy Hippopotarnus (V)
<b>CARNIVORA</b>		
Viverridae	<i>Genetta johnstoni</i>	Johnston's Genet (K)
	<i>Poiana richardsoni</i>	African Linsang (K)
Felidae	<i>Panthera pardus</i>	Leopard (V)
<b>SERINIA</b>		
Trichechidae	<i>Trichechus senegalensis</i>	West-African Manatee (V)
<b>PROBOSCIDEA</b>		
Elephantidae	<i>Loxodonta africana</i>	African Elephant (V)

Key: E- endangered; I- indeterminate; V- vulnerable; K- insufficiently known.

## VII. COMMERCIALY ENDANGERED PLANTS

Certain imprudent activities of man pose a threat also to the plant world including those used as timber, (Ayensu & Bentum, 1974), chew sticks and chew sponges, sweeteners, preservatives, rattan and canes, medicinal plants, firewood, pestles and mortar, canoes and wood carvings. For those plant species whose forms of utilization have not yet been established, and on which little or no studies have been conducted with regard to their biology (especially ecology), their fate is anybody's guess. It is uncertain as to whether they are threatened, endangered, extinct or protected and preserved. It is also unclear as to whether there is adequate appreciation for such lesser known plant species (possibly some in a state of total disappearance). However, these species may unexpectedly become useful, or even important.

Ghana's forests are subjected to severe and vicious resource harvesting with a consequential erosion of biological diversity. Resource inventories conducted by the Forestry Department of Ghana in 1988 over time give a critical picture of the following selected forest flora grouped according to their economic uses:

- (a) **Timber:** *Guarea cedrata*, *Milicia excelsa* (*Chlorophora excelsa*), *Nauclea diderrichii*, *Lovoa trichilioides*, *Pericopsis elata*, *Khaya anthoteca*, *Khaya ivorensis*, *Entandrophragma angolense*, *E. cylindricum*, *Tieghemella heckelii*.
- (b) **Chew sticks and chew sponges:** *Garcinia kola*, *G. atzelii*, *G. epunctata*, *Teclea verdoomiana*, *Acacia pentagona*, *A. kamerunensis*.
- (c) **Sweeteners:** *Thaumatococcus daniellii*, *Dioscoreophyllum cumminsii*, *Synsepalum dulcificum*.
- (d) **Rattan/Cane Craft:** *Calamus deerratus*, *Raphia hookeri*, *Ancistrophyllum* (*Laccosperma*) *secondiflorum*, *A. opacum*, *Eremospatha* spp.
- (e) **Medicinal:** *Voacanga africana*, *Zanthoxylum zanthoxyloides*, *Rauvolfia vomitoria*, *Piper guineensis*, *Carapa procera*, *Cassia occidentalis*, *Strophanthus hispidus*, *Bridelia ferraginea*, *Brucea guinensis*, *Spigelia anthelmia*, *Triclisia gillettii*, *Aframomum melegueta*, *Griffonia simplicifolia*, *Heliotropium indicum*, *Physostigma venenosum*, *Corynanthe pachyceras*.
- (f) **Fuelwood and Charcoal:** *Psydrax subcordata* (*Canthium subcordatum*), *Uapaca Heudelotii*.
- (g) **Pestles and mortars:** *Celtis mildbraedii*, *C. zenkeri*, *C. wightii*, *Terminalia ivorensis*, *Morus mesozygia*, *Milicia excelsa*, *Khaya* spp., *Nesogordonia papaverifera*, *Azelia africana*, *Nauclea diderrichii*.

(h) **Wood Carvings:** *Diospyros mespiliformis*, *Discoglypemma caloneura*,  
*Swartzia madagascariensis*, *Ricinodendron heudelotii*, *Nauclea*  
*vanderguchtii*.

(i) **Canoes:** *Triplochiton scleroxylon*, *Heritiera utilis*.

## **PART 'C'**

### **RESOURCE MANAGEMENT AND ADMINISTRATIVE ENVIRONMENT**

#### **POLICY ENVIRONMENT**

The following account focuses on the Government Ministries whose policies and programmes directly or indirectly concern biodiversity and tropical forestry.

#### **Ministry of Environment, Science and Technology (MEST)**

MEST was formed in 1994 through the merger of the former Ministries of Environment, and Science and Technology. The creation of MEST was a response to the national development need to integrate environmental, scientific and technological considerations in the country's sectoral, structured and socio-economic planning process at all levels.

The role of MEST is to provide the necessary policy framework within which the integrity of the country's environment can be maintained.

The Ministry's overall policy framework is defined by the National Environmental Action Plan which was adopted by the Government of Ghana in 1991. The ultimate aim of this policy "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 developments and natural resource conservation" (EAP, 1991).

The policy specifically seeks, inter alia, 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;
  - integrate environmental consideration in sectoral structural and socio-economic planning at the national, regional, district and grassroot levels;
- and

- seek common solutions to environmental problems in the West African Region and the world".

In this vein, MEST plays a catalytic role in ensuring that all sectors of the economy address environmental concerns in their development programmes. At the international level, MEST represents the country at fora at which environmental issues are discussed to articulate Ghana's point of view and ensures that the necessary follow up actions are taken. For instance, MEST has seen to the ratification of the two major Conventions which were signed at the Rio Earth Summit in June 1992. These are:

- the Convention on Biological Diversity;
- the Framework Convention on Climate Change

The Ministry has also initiated action towards the ratification of the Convention on Desertification.

In line with its obligations under the Convention on Biological Diversity, the Ministry, with financial support from the Global Environment Facility, is undertaking a Biodiversity Country study. This should provide the baseline information on the status of biodiversity in the country. At the same time, a study is being undertaken to develop a Strategy and Action Plan for the conservation and sustainable use of the country's biodiversity.

As part of the process, the Ministry has recently organised a Workshop at which all identifiable stakeholders came together to discuss the draft country study and also to identify the major issues to be addressed by the Strategy and Action Plan.

The Strategy and Action Plan would ensure that the impact of development on all aspects of the country's biodiversity (including forestry) are assessed and appropriate measures taken to minimize, if not eliminate, the impacts.

In addition to the above Conventions, the Ministry seeks to ensure that other conventions on environment for which other sector ministries have prior responsibility are ratified and duly implemented in the country.

## **Ministry of Lands and Forestry**

The Ministry of Lands and Forestry is responsible for formulating policies with respect to land and forestry issues.

The issue of land management has been a major problem in the management of the country's land based resources as well as human settlements. In 1978, a Land Use Planning Committee was set up to:-

- 1) collect land resource information in a form suitable for planning;
- 2) elaborate land resource use policy aimed at:
  - a) resolving conflicts in land 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 of the Committee brought out useful information on:-

- 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.

Government did not react to the Committee's findings.

In 1994, the Ministry set up another Committee to consider the issue of land use.

The Committee on Land Policy is charged with the responsibility of reviewing all current policies relating to Land Use. It is to address issues such as the following:-

- Ghana's Land resource base (area, geology, topography, climate, biodiversity, soils);
- Land ownership tenure;
- Institutional arrangements for land administration;
- Various land uses (agriculture, forestry, wildlife, mining and quarrying, energy, human settlements, tourism, etc);
- Conservation measures

The Committee was then to propose appropriate policies on:-

- land ownership and tenure;
- institution and land administration;
- land use;
- conservation;
- inventory.

The Committee has completed its work and submitted its report to the Ministry for appropriate action.

The Forest sector is an area where policies have generally not been very consistent with sustainable development and thus the Rio Forest Principles Declaration. There have also been problems with respect to implementation of these policies.

Essentially, policies of the Ministry have dealt with:-

- logging
- conservation arrangements
- afforestation activities

The Ministry has currently formulated a Forest and Wildlife Policy to ensure the conservation and sustainable use of the country's forests and wildlife which has been detailed in this report.

### **Ministry of Food and Agriculture (MOFA)**

The Ministry of Food and Agriculture is responsible for policy formulation relating to the production of food (crops, livestock and fisheries) for consumption in the country. With the realisation that agriculture is the major contributing factor to environmental degradation in the country, the Ministry is putting in place appropriate measures to address the relationship between agriculture and the environment. In evolving its programmes to ensure sustainable agricultural production systems, the Ministry has the following goals, among others:-

- a) food security to ensure appropriate and sustainable balance between self-sufficiency and self-reliance;
- b) employment and income generation to eradicate poverty; and
- c) natural resource conservation and environmental protection.

The 10-year Medium Term Agricultural Development Programme (MTAPD) provides the general framework governing the Ministry's sustainable agriculture programme. Some of the strategies being implemented under the MTAPD are:-

- i) intensification of agricultural production. For crop production, this implies raising the productivity per unit area to generate higher outputs with minimum increase in area under cultivation;
- ii) land and water management, to reduce degradation and pollution;
- iii) promotion of integrated pest management, as against the use of agrochemicals;
- iv) promotion of agroforestry to reverse the destruction of various flora and fauna from current agricultural practices and also provide fodder for livestock, fuelwood for both rural and urban use as well as for construction.

The Ministry has initiated a number of projects for the implementation of the MTAPD.

### **Ministry of Mines and Energy**

The Ministry has responsibility for the formulation of policies relating to the mining and energy sectors. In all these areas, the Ministry aims at the sustainability of its activities.

Mining is regulated by the Minerals and Mining Law of 1986 (PNDCL153). This law has provisions to protect the environment. Section 72 of PNDCL153 provides that:-

“the holder of a mineral right shall in the exercise of his right under the licence or lease have due regard to the effect of the mineral operations on the environment and shall take steps as may be necessary to prevent pollution of the environment as a result of such mineral operation.”

With the requirement that all investments should be assessed with respect to their impacts on the environment (Act 490 of 1994), the Ministry has the

framework to ensure that all mining operations (including small scale mining) are conducted in a manner which will maintain the integrity of the environment. As with other sectors of the economy, the Environmental Protection Agency has responsibility under Act 490 for the approval of Environmental Impact Assessments. Unfortunately, as has been observed with respect to other sectors, implementation of the laws are beset by a number of problems leading to the destruction of the environment, but more especially the country's biodiversity and forestry, are being adversely affected.

The country relies on forest resources for some 80% of her energy needs. Various efforts have been made by the Ministry to promote alternative sources of energy. These include:-

- use of more efficient cooking stoves;
- use of liquified petroleum gas;
- use of renewable energy sources, such as solar energy; and
- promotion of woodlot cultivation in various communities.

Unfortunately, all these programmes have had associated with them diverse problems which have meant that deforestation is taking place at a higher pace than the corresponding programmes for afforestation.

With other energy sources such as hydropower and thermal the Ministry is ensuring that appropriate safeguards are made for the protection of the environment, especially the biodiversity in the areas where they are installed.

## **I. FOREST MANAGEMENT**

### **MANAGEMENT SYSTEM**

The origins of forest conservation which Colonial governments attempted to apply in West Africa took the form of the conservation strategies worked out in India, Burma, Mauritius and South Africa. Essential to this development was the involvement of a cadre of professional botanists nurtured in the medical schools of Scottish Universities and the botanic gardens of Paris and Edinburgh. They put pressure on the Colonial office and Colonial Governors to pursue forest protection policies and to develop official biological expertise.

A book written by Alfred Moloney, later Governor of Lagos Colony, and published in 1887 called 'Sketch of the Forestry of West Africa' catalysed the thinking at the time and was prophetic in asserting that deforestation would lead to rapid climate change, degradation and famine.

Early attempts to press forward with these conservation ideas were routed through the Public Lands Ordinance of 1876 and later in 1894 through the Crown Lands Bill. A combination of protests from indigenous landowners, chiefs, educated African capitalists and local lawyers soon put the Colonial administration on the defensive. The protests grew and spread and were to postpone enactment of adequate forest legislation for almost another thirty years. This period also saw the birth and nurturing of Gold Coast nationalism.

The pre-First World War period saw the passing of a Timber Protection Ordinance, (1907) a Forest Ordinance, (1910) the setting up of a Forestry Department and the presentation and passing of yet another Forest Bill in 1911. All these enactments continued to be opposed by the Aborigines Rights Protection Society and their allies.

The war actually made it difficult for the Department to operate and it was not until the rapid clearance of forests for cocoa cultivation presented incontrovertible evidence of irreversible deforestation that the Department began to make some headway in reservation.

The process of forest reservation was influenced by the Government's desire to control land to tap its resources, yet it clearly did not want to disturb the heritage of the indigenous people, recognising the militancy the issue had engendered. The strategy then shifted from control of land to controlling the means of production.

The 1907 Timber Protection Ordinance sought to protect immature trees of certain species from felling. By 1910, the Forest Ordinance empowered the Government to declare certain lands subject to Forest Reservation, but as implementation was prohibited by local opposition, such reservation as was done was placed under Native Administration Bye Laws.

This measure was taken in compliance with the principle of local land ownership but when it was obvious that the forests were not being protected, the 1927 Ordinance was reviewed in 1935 to ensure a more meaningful and rapid attainment of objectives.

The 1935 Forest Ordinance speeded up the reservation of forests but did not ensure management in its bye-laws. The bye-laws were later replaced with Rules which obliged local authorities to manage the reserves in accordance with the advice of the Forestry Department.

In the period up to the 2nd World War, forest exploitation took place in land outside forest reserves. Forest Management up till then could be described as conservation, protecting water supplies, preventing erosion, ensuring the maintenance of climatic conditions to favour agricultural production and the provision of other indirect benefits.

The pursuit of sustained timber production led to a number of inventories, over time, as a low percentage count of whole reserves and then repeated permanent sample plot measurements to refine estimates of times of passage for the various species. Such information, followed by 10% stock mapping of compartments and yield selection, have formed the basis of the sustained yield management. The quest for optimal ways of sustained production goes on and in recent years the scope is being widened to cover more than timber. The pilot studies are yet too rudimentary to report on.

## **THE RESERVE SYSTEM**

A number of factors conditioned the development of the Reserve System:

- Most of the land, with very small exception, is owned by the people and not by Government.
- The interests of the people require that the use of land should be directed towards monitoring it as a profitable asset and producing from it the maximum return in real value.
- The necessity for the maintenance of perennial streams and rivers to provide an adequate water supply for the people and for the prevention of the extremes of flooding and desiccation.
- The necessity for the maintenance of climatic conditions suitable for agricultural crops.
- The necessity for soil conservation and minimisation of erosion.
- The necessity for regular annual production in perpetuity of timber, wood, and other forest products for local consumption and consequently for the maintenance under forest cover of an area sufficient to meet the present demands and such future needs as may reasonably be foreseen; and
- The desirability of maintaining a steady surplus of timber over and above local requirements to enable the establishment of forest industries.

## THE UNRESERVED SYSTEM

In view of the diverse ownership and tenurial practices and the unrestrained land use in areas outside forest reserves, otherwise known as unreserved or off-reserve areas, the policy and principle of sustained yield have not been applied. These areas which are supposed to be converted to other forms of land use, encompass all those forest lands that do not form part of the permanent forest estate. Continuous interference for subsistence farming, some plantation agriculture, mining and other developments affect these areas most.

There is a late interest of some communities in some off-reserve areas as forest.

## TRADITIONAL GROVES

These are small patches of forest or original vegetation set aside by communities, traditional authorities or religious authorities for cultural and religious purposes. They serve as a replica and reminder of the original forest vegetation. Usually customary and other religious rites are performed there. No exploitation is allowed whatsoever. Having been protected from fire unlike the areas around, they are distinctive and distinguished and very interesting biologically.

## PLANTATIONS

There is a long history of tree planting in Ghana, dating back to 1900 when wood lots were planted in the northern savanna zone. The 'taungya' system of planting trees with agricultural crops was initiated in 1928 and was succeeded by larger scale mechanical planting by 1948. Careful planting continued through until 1961, when there was a lapse, followed by a major effort in 1966. About 40,000 ha were planted between 1968-1977, but planting fell in the late 1970's to 1,000-2,000 ha per annum.

Current estimates for the land under forestry plantations are difficult to make because many of the areas planted did not develop into successful plantations. However, in 1980 about 26,250 ha were covered by industrial plantations and 49,020 ha by non-industrial plantations. A different estimate gives plantations covering 52,000 ha for sawn timber supplies and 24,000 ha as woodlots in the savanna zone.

Several tree species are used in the plantations. Indigenous species include *Terminalia ivorensis*, *Tarrietia utilis*, *Triplochiton schleroxylon*, *Mansonia altissima*, *Khaya ivorensis* and *Anogeissus leicocapus*. Exotic tree species include *Tectona*, *Cedrela*, *Gmelina*, *Eucalypius* and *Pinus*.

Presently the industrial plantations are not managed in a systematic fashion, although there is some thinning of poles, so this potentially large source of wood for both export and domestic use is being under-used. Increased tree planting,

and management of established plantations is vital if the annual cut of 1.1 million cubic metres is to be sustained.

The establishment of industrial plantations needs to be done outside forest reserves as much as possible, since there is continual pressure to erode the natural forest base. For example, the planting of *Gmelina* in the Subri River FR, a large area in the second richest forest type for timber trees, is counter-productive for sustained management of indigenous high-grade commercial timber, since *Gmelina* can be planted anywhere. Few large areas of manageable forest remain.

It is clear that, in addition to industrial plantations, fuelwood and poles must be planted by farmers, to meet domestic needs in rural areas.

## **FOREST ANALYSIS**

The permanent forest estate in the high forest zone of Ghana was gazetted for the dual purpose of providing for environmental stability and to provide the basis for a sustainable timber industry. There are about 200 high forest reserves covering an area of 1.8 million hectares (20% of the high forest zone). Management regimes include protection, selective logging and plantations.

In order to provide an overview of the forest status a national inventory was started in 1986 and has recently been completed. This inventory enumerated all tree species greater than 5 cm diameter at breast height (dbh) in 3101, one hectare sample plots. A separate inventory of plantation areas was carried out from 1991 to 1994.

Inventory results indicate that within Forest Reserves, there is a high forest area of 1.24 million hectares and an effective plantation area of 15,000 hectares. A further 30,000 hectares was planted but is now poorly stocked.

The current management system for high forest areas is a Modified Selection System. This makes use of a minimum girth limit on exploitation, a 40-year felling cycle combined with yield control applied to each compartment (128 ha) using data obtained from 100% stock survey. Pre-exploitation stock survey is central to this system and is a complete mapping and measurement of all trees greater than 50 cm dbh of the 62 commonly exploited species. An interim yield formula is being used with the intent of removing only the growth of the forest over the 40-year cycle. During stock survey the condition of the forest is also assessed and the intensity of harvesting is reduced if the forest is in poor health. Since regulation is through the use of a minimum diameter limit and it is desirable to retain seed trees, a minimum of two trees greater than the felling limit are retained in each compartment. Care is taken when choosing the trees to be felled to ensure that gap size and canopy disturbance are minimised through the operation of tree selection rules. Guidelines for logging operations

cover details such as road width, riparian buffer zones and slopes. Additional protection is given to species which are facing commercial extinction. These species are not given out as part of the normal yield but require a special permit for any exploitation.

Most plantation areas were established in the early 1970s and are currently receiving a final thinning. A rotation length of 30 to 35 years is expected for teak, which comprises some 90 per cent of the plantation area. New planting is being carried out on a small scale in non-forest areas (mostly fire induced grassland).

Outside the permanent forest estate, trees are cut both by concessionaires and by independent chainsaw operators. In these areas only the girth limits restrict exploitation. Monitoring of operations is constrained by lack of resources. In response to a greatly increased level of exploitation in these off-reserve areas, the Ministry of Lands and Forestry is taking action to bring a higher level of control and monitoring of exploitation of the off-reserve resource.

## **TIMBER CONCESSION POLICY**

Eastin (1992) in his assessment of the Ghanaian forestry sector discusses the problems of concession policy. In the early 1960s, timber concessions were awarded on a 30 to 50-year basis with very few restrictions being applied. Since 1975 timber concessions have generally been awarded on a 15-year basis. Ghanaian citizenship is a requirement for being awarded a timber concession. No single administrative agency maintained overall supervision of the concession system. As a result, records on timber concessions are maintained by several departments, complicating their administration. Other problems encountered were:

- 34% of timber concessions were inactive.
- 31% of concessionaires had not renewed their property marks.
- Third party felling agreements were commonplace.
- Over 5,000 km<sup>2</sup> of concessions were observed to have farming activities over more than 50% of their area.
- The average felling cycle had decreased from 35 to 15 years.
- 68% of concessions were too small to be managed in a sustainable manner.
- Only 14% of timber mills possessed adequate concession holdings.

- Many concessions had been awarded to people who did not possess harvesting equipment and, presumably, little harvesting experience.

As a result these problems and the outcome of the recent forest inventory, the government has suspended the award of new timber concessions pending the promulgation of a new concession policy.

## **FOREST PROTECTION**

There are three protected reserves in the high forest zone under the jurisdiction of the Ghana Wildlife Department: Bia National Park (Biosphere Reserve) - Bia Resource Reserve, Nini Suhien National Park-Ankasa Resource Reserve and the Kakum National Park - Assin Attandanso Resource Reserve. Theoretically, the National Parks are given the highest level of protection with controlled exploitation of the Resource Reserves. In fact Nini Suhien and Bia National Parks have not been logged while the other reserves have been heavily logged.

Within the Forest Reserves, the Forestry Department is in the process of implementing a comprehensive set of protection proposals (Hawthorne & Abu Juam, 1993) based on an extensive plant biodiversity survey. The proposals are intended to ensure that the genetic diversity of the forest and its environmental protection functions are not further eroded. In brief, they cover both large grained protection for contiguous blocks of forest and fine grained protection to be used at the metre scale as part of logging operations. The latter have been largely incorporated into the management system and harvesting rules described above.

There are five permanent categories of large grained protection and a temporary one to allow for forest rehabilitation. Within these areas logging will not be allowed and other disturbances will be minimised. The categories of protection are;

- Special Biological Protection Areas (SBPA) for conserving biodiversity hotspots;
- Hill sanctuaries - all contiguous areas of slope greater than 15 degrees;
- Swamp protection areas - all large areas of inundated land;
- Provenance protection areas - areas with healthy populations of heavily exploited species (exact criterion yet to be decided);

- Fire protection areas - blocks surrounding fire vulnerable reserves (forest-savanna transition zone);
- Convalescence areas - degraded areas kept for a period for rehabilitation.

Of these categories it is the hill sanctuaries along with provenance protection that is likely to contribute most to the protection of the prime timber species. (Many of the SBPA's are also hills and the fire protection areas are already somewhat degraded. The other categories are small in area although the Swamp protection is important for particular species.) In all, hill sanctuaries will amount to about 15% of the total forest area. When these proposals are implemented there should be sufficient forest under high levels of protection to ensure that further genetic erosion of exploited species is minimised. There are however recent reports of several of these sanctuaries being already logged. This threat needs to be contained.

## **RESEARCH INTO FORESTRY AND UTILIZATION OF FOREST PRODUCTS**

The Forestry Research Institute of Ghana (FORIG) is the national institute which undertakes research into forestry and the utilization of forest resources. It has research Divisions in Forest Management, Plantation Production, Tree Improvement and Seed Technology, Biology and Wood Preservation, Engineering and Mechanical Processing, Chemistry and Chemical Technology and Economics, Policy and Marketing. As at 31st December 1994 its staff strength comprised 49 research workers and 65 technical staff with supporting administrative and junior staff. (FORIG, 1995)

Under the IDA/ODA/DANIDA/GOG Forest Resources Management Project, the Institute is being rehabilitated to provide guidance for the management of the natural forest resource, forestry for rural development, agroforestry and utilization of forest plantations.

Recent or current (on-going) projects of FORIG include the following:

- Effect of soil type and light intensity on the growth of selected indigenous timber tree species.
- Seed and seedling ecology.
- Impact of logging at different intensities on forest structure and environment.
- Integration of timber tree species with food crops.

- Seed collection and pre-treatment of seeds for breaking dormancy.
- Wood anatomical properties of lesser-used species and their effect on wood working.
- Natural durability and resistance to pests of lesser-used timber species.
- Development of genetic resistance in Odum (*Milicia excelsa*) to the insect pest *Phytolyma lata*.
- Drying characteristics of lesser-known timber species.
- Sawdust/clay composite production.
- Upgrading of ligno-cellulosic waste with white rot fungi for ruminant animal feed.

The ODA-funded "Seed and Seedling Ecology" Project at FORIG was intended to provide information on the responses of Ghanaian timber species to canopy disturbance. The results indicate that large gaps created by logging may result in poor regeneration because of high irradiance. The results further suggest that instead of grouping species into the traditional ecological guilds viz. pioneers, non-light-demanders, non-pioneer shade bearers (Hawthorne, 1993), they should be ranked along a continuous ecological gradient. (FORIG, 1995)

The ITTO-funded Odum (*Milicia excelsa*) project is aimed at the plantation production of this species - perhaps the most valued timber species which is currently endangered because of overharvesting. Odum has very poor natural regeneration, and previous attempts to propagate it in plantations had been frustrated by the damaging gall-forming insect *Phytolyma lata*. The Institute has developed *Phytolyma*-resistant Odum material which should make possible its plantation production. In this connection, rooted cuttings from mature plants (20 years) have been obtained using a novel technique.

ITTO is also funding the project on "Industrial Utilization and Improved Marketing of some Ghanaian Lesser-Used Species from Sustainable Managed Forests" which has three components namely Product Development Studies, Ecology Studies and Marketing Studies.

The Institute is collaborating with the Hebrew University of Jerusalem in a project (supported by USAID) on the Upgrading of ligno-cellulosic wood waste (saw dust and other wood substrates) into ruminant animal feed using mainly tropical, white-rot basidiomycetes in a solid state fermentation process. Having regard to the amount of wood waste produced by sawmilling factories, this project is of

considerable importance. Also relevant to sawdust utilization is a project on sawdust-clay composite production. (FORIG, 1994)

The Institute has a Pulp and Paper Unit which, although currently manned by highly qualified staff, is not undertaking any laboratory work in this area because of lack of equipment. Its achievements some years back included the production of pulp and paper from tropical hardwoods. The product was to have been pilot-plant produced at Daboasi in South-Western Ghana but because of lack of funds pilot plant installation did not materialize. Assistance to the Unit would be very worthwhile.

## **THE TROPICAL HARDWOOD INDUSTRY**

The Ghanaian timber industry is one of the most important sectors in the Ghanaian economy. It ranked third in foreign exchange earnings behind cocoa and mineral exports. Foreign exchange earnings from timber exports in 1990 totalled almost US\$135 million, accounting for approximately 13% of Ghana's total foreign exchange earnings.

In 1990 the timber industry consisted of 169 logging operations, 118 sawmilling operations and nine (9) veneer string operations. It is estimated that there are over 250 furniture manufacturers operating in Ghana but the majority are very small firms which produce exclusively for the domestic market (Eastin, 1992).

The majority of sawmills in Ghana are equipped with outdated and inefficient processing machines. The lack of modern processing equipment limits the ability of the timber industry, particularly furniture manufacturers, to manufacture high value-added products that possess the quality to be competitive in the international market place. Furthermore, timber producers often employ agents to export their products to Europe, thereby separating producers from end-users. The resulting restriction of access to market information is a handicap for Ghanaian producers who are unable to develop a sound understanding of current market conditions on to identify new markets for their products. (Eastin, 1992).

These constraints have to be overcome if the Ghana timber industry is to make its rightful impact on the Ghanaian economy.

## **II. WILDLIFE MANAGEMENT**

### **Ghana Wildlife Policy**

The first Wildlife Policy for Ghana was adopted in 1974. The 1974 policy recognised the value of wildlife resources to Ghanainas and the need to conserve the resources for both the present generation and posterity. It recognised the role of protected areas in wildlife conservation and advocated the establishment of wildlife conservation areas containing representative assemblages of Ghana's fauna and flora in all the major ecological zones in the country. The policy further recognised the need for surveys and inventories of the country's wildlife resources and the importance of ecological research as a basis for management actions. It emphasised the role of zoos in education and research on threatened wild animal species and as a means of raising funds to support conservation projects.

The major shortcoming of the 1974 policy was that it perpetuated a strict preservationist approach (a strategy which was perhaps necessary if any wildlife was to be saved in the country), a strategy of externally enforced exclusion of local communities was adopted and no attempt was made to involve the local people in protected area management. With improved education and a better appreciation of conservation issues and the need for wildlife protection, it has become possible to advocate the involvement of local communities in the management of their wildlife resources.

In 1993, a joint National Forestry and Wildlife Policy was formulated. This policy aims at developing the nation's forest and wildlife resources to maintain environmental quality and sustainable flow of economic, scientific and educational benefits to all Ghanaians. Following from this, the Ghana Wildlife Policy was revised in 1994. As an improvement on the 1974 Wildlife Policy the 1994 revised Policy seeks to elicit local community participation by:

- encouraging and seeking to enhance community initiatives and involvement in conservation;
- advocating equitable access to wildlife resources as an incentive for conservation;
- recognising the role of traditional institutions and traditional knowledge in biodiversity conservation; and
- recognising the scientific and cultural significance of indigenous protected area systems such as sacred groves.

The main goals of the 1994 Ghana Wildlife Policy may be summarised as follows:

- Establish and maintain in perpetuity a system of wildlife protected areas to ensure that representative samples of all the major biotic zones of the country are protected;
- Develop appropriate institutional arrangements and legal framework and provide adequate resources for the effective management of the protected areas and Ghana wildlife resources;
- Provide adequate policy framework to ensure that biodiversity issues are properly addressed in development issues and ensure that national accounting systems give recognition to wildlife values;
- Promote public awareness of conservation issues and encourage community participation in wildlife conservation;
- Seek collaboration with and coordination of conservation actions by institutions involved in conservation and participate in international conservation treaties which promote conservation and wise use of wildlife resources.

## **WILDLIFE PROTECTED AREAS**

Protected areas in Ghana may be grouped into three main types: Forest Reserves, indigenous protected areas commonly known as Sacred Groves and Wildlife Conservation areas.

### **FOREST RESERVES**

Records from the Forestry Department indicate that there are currently over 280 forest reserves covering a total area of 23,729 km<sup>2</sup> under the Department's administration. It is estimated that 75% of the reserves comprise production reserves which are exploited for timber, while the remaining 25% are protection reserves perhaps too inaccessible to be worked for timber (Hall and Swaine, 1981). No clear wildlife management practices are included within the management plans of the forest reserves, but a measure of wild animal protection is afforded, since hunters require permission to enter and hunt within reserves.

### **SACRED GROVES**

Sacred groves are relatively undisturbed remnant forest patches protected by rural communities in Ghana and other West African countries for cultural and religious purposes. Traditionally, such forests are considered sacred because of some historical event, or because they support populations of a sacred or tabooed wild animal species, or because they are believed to be the abode of ancestral spirits or gods. They are accorded strict protection; in many cases all forms of use are prohibited and they are visited only occasionally for cultural

ceremonies and religious rites. The responsibility for protection is vested in the entire community.

In Ghana, sacred groves are referred to by various vernacular names like Abosompow/Asoneyeso (shrine); Mpanyinpow (ancestral forest); Nsamanpow (burial grounds). The basis for declaring a patch of forest as sacred varies and several categories of groves exist (Dickson, 1969; EPC, 1976 Dwomoh, 1990; Ntiamoa-Baidu, 1993; Ntiamoa-Baidu, 1995, Ntiamoa-Baidu *et al.* 1992).eg.:

- Small shrines (less than one ha.), comprising an object (a tree, stone, rock, etc) considered to be a god or the abode of a god, and its immediate surroundings (eg. Malshegu sacred grove near Tamale in northern Ghana (Dorm-Adzobu *et al* 1991; Ntiamoa-Baidu *et al.*, 1992).
- Patches of forest in which the royals of a particular village are buried may be protected because of respect for the dead and the belief that the ancestral spirits lived in that forest.
- Rivers and streams which provide the main source of drinking water for a village community and the surrounding forest lands protected on the basis of the belief that the spirit of the river resided in the forest.
- Forest patches or forests supporting wild animal species considered to be sacred, totem or tabooed.
- Tracts of forest associated with specific historical event-linked with the culture of a community. (These tend to be sizable tracts of forests and often become associated with gods and religious beliefs e.g. Nkodurom Sacred grove near Kumasi and the Asantemanso grove near Esumegya).

The total number of sacred groves in Ghana and the land area covered by the groves is unknown. A questionnaire survey by the Ghana Forestry Commission returned a minimal figure of 1,904 of which 79.1% were in the southern parts of the country. The biological composition of many of the groves has also not been studied. There is, however, some evidence of the botanical value of sacred groves and their importance in preserving scattered patches of primary forests. According to Hall and Swaine (1981), the only surviving specimens of the Inner Zone subtype of the Dry Semi-Deciduous and the Southern Marginal type were in sacred groves. In many areas sacred groves constitute the only remnant forest amidst severely degraded forest lands and farmlands. The very small sizes of the groves limit their individual value in terms of biodiversity conservation. However, together, they form a matrix of biotic islands with a high potential for the conservation of remnant communities of flora and fauna. There is, therefore, an urgent need for an inventory of the groves and an assessment of their biological value with the aim of integrating such traditional conservation systems into the country's protected area system.

## **WILDLIFE CONSERVATION AREAS**

### **Categories of Wildlife Conservation Areas in Ghana**

Identifiable categories of wildlife conservation areas in Ghana under the administration of the Wildlife Department are: National Park, Strict Nature Reserve, Wildlife Sanctuary, Resource Reserve (formerly known as Game Production Reserve) and Ramsar sites. In addition one conservation area complex, the Bia National Park and Resource Reserve, has been designated as a Biosphere Reserve. The extent and character of Wildlife Conservation areas are discussed under **Critical Habitats and Plant and Animal Species of Conservation Concern**. (See page 110).

## **CONSERVATION OUTSIDE PROTECTED AREAS**

### **MEASURES PROTECTING WILDLIFE OUTSIDE CONSERVATION AREAS**

The greater part of the conservation efforts in the country focus on protected areas. Attempts at conservation of wild animals outside protected areas involve hunting laws and institution of the closed season. Group hunting, night hunting as well as use of artificial light and certain types of traps e.g. gin-traps are prohibited. Both hunters and traders are required to obtain game licences. Hunting of all wild animals apart from the grasscutter is prohibited between 1st August and 1st December every year.

The scientific basis of the period for the closed season is not clear. Although this is purported to allow animals to breed and replenish game stocks, a number of wild animal species are known to breed outside the closed season, and hunting is known to be heaviest during the dry season (December -March) when grass height is low and hunting methods using burning are most effective.

These regulations are, however, ineffective due to lack of adequate enforcement and ignorance. Wildlife officers are too few and most people, particularly in the rural areas, are not aware of wildlife laws.

### **EX-SITU CONSERVATION MEASURES**

According to the 1974 Ghana Wildlife Policy, zoos were established in Ghana for four reasons:

- **Education:** to educate the general public about wild animals and create interest in wildlife.
- **Aesthetic:** to increase the aesthetic appreciation of wild animals.

- Research: to use the zoo as a laboratory for the study and breeding of endangered species.
- Fund raising: to use the zoo for raising funds to support conservation initiatives.

The extent to which these objectives have been met is difficult to evaluate because of the incompleteness of data on animals kept in the zoo to date and statistics on total number of visitors to the zoos since their establishment. The current species of animals in both the Kumasi and Accra Zoos is presented in Table 14.

### **INDIGENOUS CONSERVATION STRATEGIES**

Traditional strategies for biodiversity conservation exist in most African communities, particularly among rural communities. These strategies are often enshrined in religious/cultural beliefs and superstitions, and are enforced by taboos. The taboos have no legal backing, but in the past, the beliefs were strong enough to make people respect the associated rules. Three categories of strategies which advertently or inadvertently conserve biodiversity can be identified in Ghanaian rural communities (Ntiamoa-Baidu, 1992a; 1995):

These are:

- strategies which protect particular ecosystems/habitats (e.g. sacred groves, royal burial grounds, sacred rivers)
- strategies which protect particular animal/plant species (e.g. totem and tabooed species)
- strategies which regulate exploitation of natural resources (e.g. closed seasons).

Unfortunately, most of these traditions are no longer respected and their value as tools for biodiversity conservation is being eroded rapidly. A classical example of an unwritten traditional law which effectively regulated the exploitation of a wildlife resource was the closed season for the forest snails *Achatina achatina*, which was strictly enforced in most Ashanti villages. At the beginning of the snail season when the snails were laying their eggs, a gong-gong would be beaten forbidding snail collection to allow hatching and growth of young snails. This was strictly adhered to until the season was opened by the beating of another gong-gong. Unfortunately, snails have been wiped out in many areas where they were formerly abundant as a result of the break-down of the traditional controls and the resultant over-exploitation, coupled with extensive snail habitat destruction. The breakdown of the traditional beliefs has been attributed to the influence of western-type education and religion, immigration of people with different cultures who may not have any respect for the traditions of a particular area (Ntiamoa-Baidu, 1990; 1991a; b) and the lack of modern legislation to reinforce the traditional rules and regulations.

**Table 14: List of animals in Ghanaian zoos**

Species	Kumasi Zoo	Accra Zoo
Forest genet	+	+
Two spotted palm civet	+	-
Africa civet	+	+
Lion	+	+
Hunting dog	-	+
Leopard	-	+
Spotted Hyaena	-	+
Black-backed Jackal	-	+
Side-striped Jackal	-	+
Bushbuck	+	-
Maxwell duiker	+	-
Black duiker	+	-
Bay duiker	+	-
Red-flanked duiker	+	-
Royal antelope	+	-
Eland	-	+
Donkey	-	+
Grasscutter	+	-
Brush-tailed porcupine	+	+
Crested porcupine	+	+
Side Stripped Squirrel	-	+
Mongoose	-	+
Rat	-	+
White mice	-	+
Baboon	-	+
Patas monkey	+	-
Mona monkey	+	-
Green monkey	+	+
Spot-nosed monkey	+	+
Chimpanzee	+	+
White-colored mangabey	+	+
Macaque	-	+
Red Patas monkey	-	+
Bosman's potto	-	+
Terrapin	+	+

cont.---

Species	Kumasi Zoo	Accra Zoo
Soft shelled turtle	+	+
Gaboon terrapins	+	-
Dwarf crocodile	+	-
Long-snouted crocodile	+	+
Broad-fronted Crocodile	-	+
African python	+	+
Bosc monitor lizard	+	+
Nile monitor lizard	+	+
Rhinoceros viper	+	-
Black cobra	+	-
Royal python	+	-
Giant tortoise	+	+
Hinged tortoise	+	-
Tortoise	-	+
African Beauty Snake	-	+
Spitting Cobra	-	+
Eagle owl	+	-
Orange crowned parrot	+	+
Red eyed dove	+	-
Tambourine dove	+	-
Village weaver	+	-
Scarlet macaw	+	+
Brown cheeked hornbill	+	-
Kestrel	+	-
Black kite	+	+
Violet plantain eater	+	-
Green turaco	+	-
Green fruit pigeon	+	+
Palmut Vulture	-	+
Fish Eagle	-	+
Barn Owl	-	+
African Grey Parrot	+	+
Senegal Parrot	-	+
Duck	-	+
White-faced duck	-	+
Touracous	-	+
Pea fowl	-	+
Laughing Dove	-	+
King Reed hen	-	+
Egyptain Goose	-	+

+ = Present

- = Absent

# **EFFECTIVENESS OF CURRENT WILDLIFE CONSERVATION STRATEGIES**

## **REPRESENTATIVENESS OF THE WILDLIFE CONSERVATION AREAS**

A draft protected area system plan has recently been compiled under the wildlife component of the Ghana Forest Resources Management Project (Grainger, 1994). The document examines the current situation of protected area conservation in the country and analyses the adequacy of the current system for biodiversity conservation and makes suggestions for improvement.

### **Biogeographic criteria**

Four main biogeographic regions are represented in Ghana: the Guineo-Congolian, the Sudanian, Guineo-Congolian/Sudanian transitional, and the Volta,

The Guineo-Congolian regional Centre of Endemism is represented by four wildlife protected areas in Ghana. Three of these are significantly large areas comprising two contiguous reserves, Nini Suhien NP/Ankasa RR; Bia NP/Bia RR and Kakum NP/Assin Atandanso RR while the fourth, Owabi Wildlife Sanctuary, is very small. All the three large areas have global importance in terms of the threatened faunal groups they support, and have each been recognised as regionally important for the conservation of the antelope species characteristic of this biogeographic region (East, 1990)

The Sudanian regional Centre of Endemism is represented by two significantly large wildlife protected areas, Mole NP and Gbele RR. The fauna of Gbele has not been well studied but Mole is known to be of outstanding importance for the conservation of antelopes in the biogeographic sub-region.

The Guineo-Congolian/Sudanian transitional region is adequately represented by six wildlife protected areas (Digya NP, Bui NP, Shai Hills RR, Kalakpa RR, Kogyae Strict Nature Reserve and Bomfobiri Wildlife Sanctuary) three of which are of significant size.

The Volta Region has only recently been distinguished by the analyses of the results of a study of butterflies in the country (Larsen, 1994). The proposed Kyabobo NP, when gazetted, would fill the present gap in the representation of the Volta region.

Thus, it can be concluded that a representative sample of each of the major biogeographic zones found in the country is protected within the current system of wildlife protected areas.

## **Vegetation formation groups**

Ten vegetation formation groups have been identified in Ghana comprising eight forest types and two grass savanna (Fig 18 ). The extent of coverage of the wildlife protected areas in relation to the ten vegetation formation groups found in the country is presented in Table 15.

Three of the formation groups are well represented, the wet evergreen forest, mangrove forest and the tall grass savanna. The wet evergreen is represented by the Ankasa RR and Nini Suhien NP. Ankasa RR is reported to have the highest "genetic heat index" (a conservation score based on a measure of rare species found in the reserve) of all the reserves studied in the forest zone (Hawthorne and Juam-Musah,1993). The greater part of the mangrove stands found along the coasts of Ghana fall within the proposed Ramsar sites, although a large extent of the mangrove forest is degraded through heavy exploitation for fuel-wood. The tall-grass savanna is very well represented by six wildlife protected areas including the three largest national parks, Mole, Bui and Digya. This formation group, however, is one that there is still room for extension of the protected area system in the region of the Gambaga escarpment (Grainger, 1994).

The short grass savanna, Moist and Dry semi-deciduous forest types, the South outlier forest type are under-represented and even in areas where these forest types are protected, they are either degraded or restricted to small portions of the protected area. These forest types are, however, well represented by reserves under the jurisdiction of the Forestry Department. There is, therefore, an obvious need to examine the possibility of introducing wildlife protective strategies into the existing forest reserves.

Two vegetation formation groups, the Upland evergreen forest, and the South marginal forest, are un-represented in the wildlife protected area system. These forest types are, however, small and localized and it may not be possible to create new protected areas. The obvious approach will be to increase protective efforts in forest reserves presenting these formations.

Sacred groves also provide excellent opportunities for protecting these under-represented and un-represented vegetation formations. For example, Hall and Swaine (1981), found that the only surviving specimens of the Inner Zone subtype of the Dry Semi-Deciduous and the Southern Marginal type were in sacred groves. This underscores the need to assess the biological importance of the groves and to promote the conservation of those with high biodiversity value.

## **THREATS TO WILDLIFE RESOURCES**

### **Habitat destruction**

Habitat destruction is caused by a number of factors including deforestation, desertification, bushfires and mining operations. Most of the original forest in Ghana has been destroyed. The intact forest left in the country is currently estimated to be between 15,800km<sup>2</sup> and 17,200 km<sup>2</sup>, representing only 10.9 to 11.8% of the original forest cover (WCMC, 1992). The bulk of the remaining intact forest is in protected areas with less than 1% outside (Hawthorne, 1990). Figures on rate of deforestation are only estimates and it currently stands at 22,000 ha/annum.

The main causes of deforestation and forest degradation in Ghana are clearance for agricultural ventures, bushfires, timber operations and cutting for fuelwood. Deforestation resulting from increased demand for agricultural land for subsistence farming is directly linked with rapid human population growth. Loss of forests through bushfires is another major cause for concern in the country. It is estimated that in 1982/83, 50% of Ghana's vegetation cover and 35 % of standing crop of cereals were destroyed (IIED, 1992). Desertification is the outcome of farming practices and fuelwood collection, particularly charcoal burning, and is most serious in the savanna areas.

The loss of forests and forest degradation resulting from timber extraction lead to loss of habitats and niches for many wild animal species and a decrease in species diversity. Species particularly affected by loss of forest habitat include primates. However, some forest species can withstand changes in forest structure e.g. degradation from primary to secondary forest, and some opportunistic species such as maxwell duiker and the royal antelope can thrive in degraded forests and fallow lands.

### **Over-exploitation**

In Ghana, all species of wild animals are acceptable as food resource. As a result, wild animal populations within and outside reserves are under constant threat from heavy hunting pressure, most of which is illegal. Hunting goes on all the year round despite the law on the closed season which prohibits hunting of all species of animals apart from the grasscutter during the period 1st August to 1st December. Prohibited methods of hunting such as night hunting, group hunting and use of certain traps are all practised, even in protected areas. The species of animals marketed as bushmeat range from common species such as antelopes and rodents to wholly protected species such as primates and pangolins. In coastal villages, all species of marine turtles, notably Leatherback, Green and Olive Ridley, though protected, are killed at sea or during egg-laying on the beaches, and their eggs are dug-up. Hunting has greatly reduced the populations of many species of animals and is a major threat to rare species,

most of which have been hunted to extinction in localities where they were originally abundant e.g. the Water Chevrotain which was said to be a delicacy, is now extinct from forest areas in the Western region as a result of hunting of the species in the past (Ntiama-Baidu, 1992)

#### **Encroachment on Protected areas**

Protected areas in the forest zone are under increasing pressure from the demand for more fertile agricultural lands and forest products. Illegal farming is a major problem that forestry and wildlife field officers have constantly to contend with. It is estimated that 50% of the only Strict Nature Reserve in the country, Kogyae, has been devastated by commercial yam farming, while 40 % of Digya National Park has been lost as a result of the activities of settler farmers.

Illegal hunting and collection of forest products, like chew sticks, poles, rope, cane and snails are also sources of regular conflicts between local people and wildlife/forestry officers. Of the 26 cases of "poaching" documented in the Nini Suhien NP/Ankasa RR between 1988-1990, 12 involved cutting of chew sticks, *Garcinia* spp, nine were hunting for bushmeat, two involved live animal collection and three involved cutting of cane. Poaching in wildlife protected areas is not only a threat to the animals but also to the life of wildlife officers. At least two officials of the Wildlife Department have lost their lives and a number wounded in the recent past as a result of the activities of poachers. This situation greatly threatens staff morale.

#### **Ineffective Legislation and lack of manpower and adequate resources.**

Legislation on wildlife in the country is characterised by frequent changes, so much so that currently the laws are incoherent and few people understand them. What laws exist are not readily available to even the law enforcement agencies. The case of the Bia National Park being down-graded in the 1970s by the then government to allow timber logging shows how ineffective the legislation can be.

The lack of public awareness and knowledge of wildlife issues and laws is another factor mitigating against wildlife conservation in the country. Communities living around conservation areas have little knowledge of the aims, objectives and conservation activities going on in the reserves. Under such a situation, it is difficult to expect any support or participation from these communities.

The Wildlife Department is very poorly staffed with approximately 30 % of the established positions vacant. Until recently, when the Department obtained resources from the World Bank under the Ghana Forest Resources Management Project and also from the Global Environment Facility under the Coastal Wetlands Management Project, even vehicles for field operations were unavailable and often poachers had better arms and ammunition than the protection staff.

### **Lack of coordination of conservation efforts.**

There is very little coordination between the activities of Government departments involved in biodiversity conservation. A typical example is the situation between the Departments of Forestry and Wildlife, where Forestry controls the greater proportion of intact forests in the country (and probably the greater concentration of the country's biological resources), but no attempts have been made to incorporate wild animal conservation in the management of the forest reserves.

## **III. MANAGEMENT OF BIODIVERSITY**

At various stages of her development, Ghana has made strident efforts at living at peace with the environment through wise resource use planning, creation of effective institutional arrangements, legislation and regulations. It has achieved considerable success in infrastructural and human development but, in most cases, at the expense of the environment which is severely stressed and strained in its ability to repair itself.

The need for a stronger sense of environmental responsibility demands we take a good look at our development processes and take urgent approaches (i.e. adopt and implement imperatives) towards sustainable development. A national framework towards biodiversity conservation should ensure the achievement of sustainability.

### ***Objective 1:* Formulation of National Resource Conservation Strategies.**

Ghana has prepared a comprehensive National Environmental Action Plan which contains environmental policy objectives including:

- maintaining life-support systems and ecological processes essential for the functioning of the biosphere;
- ensuring prudent and sustainable management of natural resources and environment;
- ensuring adequate protection for humans, life-support systems and ecosystem inhabitants from activities and practices that adversely impact on these;
- integration of environmental considerations in sectoral structural and socio-economic planning at all administrative levels.

The Policy document in its entirety is aimed at:

- (a) sustainable natural resource utilisation;
- (b) promoting land use planning and accommodation of land use options;
- (c) protection of ecosystems;
- (d) promoting institutional capacity strengthening and human capacity development;
- (e) promoting and supporting research programmes, and
- (f) establishing effective legislative and institutional framework for monitoring, co-ordinating and enforcement of environmental considerations.

Other vital documents designed to address natural resource utilisation and conservation which are in the making include:

- (i) Tropical Forestry Action Plan
- (ii) Forest and Wildlife Policy
- (iii) National Land Policy
- (iv) UNEP Project on Biodiversity Country Study for Ghana

It may serve a more useful purpose to put all strategies on natural resource utilisation and conservation in a comprehensive format, such as a National Conservation Strategy which integrates biodiversity concerns. Such a strategy should form an integral part of an overall national development plan whose formulation and implementation processes are pursued with full and broad participation by all levels of society. Environmental planning and the allocation of resources demand that evaluations are conducted to assess the characteristics of ecosystems and match them to the most appropriate uses. In fulfilment of matching characteristics to uses and therefore funding the resource use pattern with the least trade-offs, it becomes a strategic imperative to mandate formal and qualified institutions and groups.

**Objective 2:** Creation of a framework within which land-use and production systems are compatible.

Settled agriculture, fishing and pastoralism are making systematic changes in the environment especially in the forest and savannah ecosystems as well as in fresh water ecosystems. Industrialisation possesses the potential to transform human societies and the modes of production and subsequently relations with the environment. Moreover, it is capable of prompting rapid population growth

and more rapid migration, increased resource utilisation and waste production. However, industrialisation need not enhance rate of resource degradation and extinction. Sound considerations in the form of strategies and actions need to be formulated and implemented to match industrialization with conservation concerns. These may include the following:

- integration of biodiversity conservation policy into a comprehensive land use policy. Indeed, this approach has been adopted by the Ministry of Lands and Forestry in preparing a National Land Policy;
- fine tuning of sectoral policies to accommodate conservation concerns. A major determining factor in sustainable resource utilisation is the insecurity of resource ownership and tenure. Like many other constraints, policies in other sectors that are at variance with the objectives of biological diversity conservation need to be reviewed and revised to ensure and promote the preservation of biodiversity;
- promotion of local production modes that have little impact on biodiversity. There is an untapped fund of traditional knowledge which provides useful ways of preserving biodiversity;
- integration of full costs of resource depletion and environmental degradation in social and cultural terms into national income accounts.
- direct use of modern production technologies in ways desirable for sustainable resource utilisation and conservation of biological diversity. Activities and industrialisation technologies (such as use of agrochemicals, drainage of wetlands, irrigation, damming of rivers etc.) which pose danger to resource conservation should be restricted.

### **Objective 3: Resource Management and Protection**

Large tracts of land in both ecological zones in Ghana have been put aside as protected areas where entry is restricted and, in some cases, prohibited. The mode of acquisition of these lands and the alienation of the local custodians from entry (i.e. prohibition of traditional resource use) into protected areas have created a serious handicap towards land and biodiversity conservation. Moreover, there is high resentment of the creation of reserves (hot spots of biological diversity) because the benefits derived from the reservations have rarely been shared fairly and equitably; local populations have seen deprivation and unfair distribution of benefits. The idea of creating areas of protection for fauna, flora and micro-organisms maintains its validity. There is need to reassess

the effectiveness of these systems by adopting and implementing certain actions including the following:

- review procedures for the creation of protected areas by adopting criteria for honing, for instance, the degree of threat of ecosystem loss and the location of the elements of the system that appear most threatened.
- adopt clear classification of protected areas to eliminate doubts as to functions for which they have been constituted. Define levels and rates of entry.
- ensure regular resource auditing and monitoring of utilisation and conservation operations in protected areas.
- adopt comprehensive management plans that conflict less with major objectives of conservation and that which are amenable to accommodate other use forms.
- ensure fair and equitable distribution of benefits accruing from resource utilisation and conservation.

## **IV. INSTITUTIONAL ARRANGEMENTS**

### **GOVERNMENT DEPARTMENTS**

#### **GHANA WILDLIFE DEPARTMENT**

The Ghana Wildlife Department (formerly Department of Game and Wildlife) has the responsibility of managing the country's wildlife, both outside and within conservation areas. The Department was established in 1965 and comes under the Ministry of Lands and Forestry. The Department is headed by a Chief Wildlife Officer and has three Divisions, (Administration, Management and Research), each headed by a Deputy Chief Wildlife Officer. The Management Division handles three sections: General Wildlife Conservation Services, Zoological Gardens and Conservation areas (comprising National Parks, Resource Reserves, Wildlife Sanctuaries and Strict Nature Reserves)

#### **Staffing Position of the Wildlife**

As an example of the staffing situation of the establishments responsible for managing the environment, the Ghana Wildlife Department situation is as follows; the Department has an approved staff establishment of 61 Professional

and 76 Technical staff, plus an additional 385 sub-technical staff and a variable number of unestablished posts comprising grades such as artisans, drivers and watchmen as well as administrative support staff (Table 9). 64% of the approved professional staff positions remain vacant while less than 50% of the technical positions are filled. The poor staffing situation of the department is partly due to the lack of graduates with the appropriate training (until recently, there were no institutions within Ghana that offered training in wildlife management and all professional staff had to be trained outside), unattractive service conditions and the difficult field conditions under which staff have to operate.

Financial resources available to the Department have generally been inadequate to meet its needs.

**Table 15: Ghana Wildlife Department Staff Strength (as at October 1994)**

<b>Grade</b>	<b>Establishment</b>	<b>At Post</b>	<b>Vacancies</b>
<b>Professional staff</b>			
Chief Wildlife Officer	1	1	-
Deputy Chief Wildlife Officer	3	1	2
Principal Game Warden	8	3	5
Snr. Wildlife Conservation Education Officer	1	-	1
Snr. Game Warden	24	3	21
Asst. GW/Game Warden	36	14	22
<b>Technical staff</b>			
Snr. Game Protection Officer	10	6	4
Game Protection Office	24	6	18
Game Ranger/Snr. Game Ranger	42	22	20
Sub Technical staff	385	309	76
	Total	534	365
	% Vacant	68.3	

## **FORESTRY DEPARTMENT**

The Forestry department has the traditional responsibility of protecting and managing the forest resources of today and the creation of those of tomorrow. However, these functions have been augmented by new ones, including:-

- collection of royalties from off-reserves;
- planting and management of trees off-reserves to protect water-courses, catchment areas, dug-outs and in particular the Volta Lake;
- the planting and management of trees off-reserves to protect soils and improve their fertility, to provide shade and amenity, to provide food and fodder and to provide energy;
- protection of shrines and groves to maintain biodiversity; and
- rehabilitation of degraded areas off-reserves.

The Department is responsible for over 270 Forest Reserves throughout the country. As with other organisations, the Department has serious problems with respect to resources for undertaking its national responsibilities. These include inadequate staffing, poor mobility and lack of funds.

The Department currently realises that the best way to manage its Forest Reserves is through collaborative arrangements with the communities in the

area. The Department is also considering the establishment of Action Groups at various levels from the community to the national to assist in the prevention, detection and investigation of forest offences. The Action Groups of the community levels will involve both the traditional and political leadership.

Through much community based programmes the Department is hoping to evolve appropriate management systems for the country's forest reserves.

The Department is currently undertaking two projects - The Forest Inventory Project being funded by UK ODA and the Forest Resource Management Project being funded by the World Bank.

In addition, there are specific projects being undertaken for the sustainable management of some of the forest reserves. These include the USAID funded Kakum National Park and the EU funded Bia National Park and Game Production Reserve and the Ankasa Game Production Reserve.

#### **ENVIRONMENTAL PROTECTION AGENCY (EPA)**

In 1973, the government established the Environmental Protection Council as a response to the UN Global Conference on Human Environment held in Stockholm, Sweden in 1972. The Council has both policy-making and advisory functions. Unfortunately, enabling legislation (NRCD 239 of 1974) did not offer to the Council any regulatory authority.

With the establishment of a Ministry responsible for policy issues in the environment in 1993, the role of the council had to change. This led to the enactment of the Environmental Protection Agency Act, Act 490 of 1994 which gave the new EPA the mandate to initiate and implement programmes that would ensure the maintenance of environmental integrity. As a regulatory body, the EPA has the responsibility for initiating environmental legislation and ensuring that these laws are enforced.

The EPA is the main implementing agency of MEST on environmental issues. Presently, the EPA is implementing the NEAP through a ten-year project called the Ghana Environmental Resource Management Project (GERMP). This is being funded by a number of agencies including the World Bank, GEF, UK ODA and DANIDA. GERMP essentially has three components, namely:-

- i) Development of an Environmental Resource Management System;
- ii) Land and Water Resources Management;
- iii) Coastal Wetlands Management.

In addition, EPA is the implementing agency for the following projects in Ghana:-

- i) Man and the Biosphere; and
- ii) CIPSEG

The general mode of operation of the EPA in all its activities is the network approach where all stakeholders are brought together to discuss and formulate appropriate programmes and plans for solving environmental problems.

A major tool available to the EPA under Act 490 is the use of the environmental impact assessment as a tool for ensuring that development is sustainable. In this way, the Agency ensures that issues relating to biodiversity (and forestry) are adequately addressed in development programmes.

As has been rightly pointed out by Gilbert *et al* (1995) various considerations underscore the fact that sound environmental management in Ghana depends on the EPA's continuing development into a technically strong, credible agency capable of articulating environmental needs clearly and forcefully in the face of opposing interests and of exercising operational leadership in implementing environmental policy through inter-agency coordination.

### **COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH - CSIR**

The CSIR was established in 1968 to coordinate the country's scientific and industrial research activities. The institutes under the council focus on the needs of agriculture, industry, forestry, health, housing and transportation. The major institutes whose activities directly relate to biodiversity and forestry are:-

- Forest Research Institute of Ghana;
- Plant Genetic Research Centre;
- Oil Palm Research Institute;
- Crops Research Institute;
- Animal Research Institute;
- Institute of Aquatic Biology;
- Savanna Agriculture Research Institute.

The work of these institutes provides the scientific and technical basis for the policy formulation activities of MEST.

### **CENTRE FOR RESEARCH INTO PLANT MEDICINE**

This Centre is involved in prospecting activities relating to drugs. Based on information from traditional medical practitioners, the Centre undertakes scientific study of specific plants to identify the active ingredients in these plants. The Centre collaborates with various external laboratories in its analytical programmes.

## UNIVERSITIES OF GHANA

There are four Universities in the country which are situated incidentally within the different ecological zones of the country. These are:-

- University of Ghana, Legon
- University of Science & Technology, Kumasi
- University of Cape Coast
- University of Development Studies

The faculties of science and agriculture in these Universities undertake activities that directly or indirectly relate to biodiversity or forestry. For instance, the Botany Department of the University of Ghana houses the Ghana Herbarium, the Biochemistry and Chemistry Departments of the University of Ghana collaborative in research activities relating to the miracle berry *Synsepalum dulcificum*, the morphology, anatomy and chemistry of which have been described in detail by Ayensu (1972). The Institute of Renewable Natural Resources is involved in various activities relating to the conservation and sustainable use of the country's forests and other renewable resources.

The faculties also are centres of training for the various personnel needed by agencies such as EPA, Forestry Department and the Ghana Wildlife Department.

## NON-GOVERNMENTAL ORGANISATIONS

In addition to the government agencies concerned with wildlife conservation, a number of non-governmental organisations in Ghana are active in several aspects of wildlife conservation. Notable among these are the Ghana Wildlife Society (GWS), the Ghana Association for the Conservation of Nature (GACON), The Friends of the Zoo (FONZ) and the Green Forum.

The **Ghana Wildlife Society** is active in ecological research on wildlife and in conservation education. Current research efforts of the Society concentrate on sea- and shore birds and coastal wetland ecosystems, marine turtles and forest and savannah birds. The Society is currently undertaking a survey of the important bird areas of Ghana as part of Birdlife International's African IBA Project. The project involves inventories of bird species in all protected areas and other intact forest types, including traditionally protected areas. The results of the survey should guide governmental decisions on the expansion of the current protected area system in the country and the definition of wild animal protection strategies in existing protected areas. The GWS has a comprehensive conservation education and public awareness programme

covering the entire country and organises the Wildlife Clubs of Ghana, a youth conservation group with a membership of over 10,000.

The **Ghana Association for the Conservation of Nature** is involved in community conservation projects. Their activities are concentrated within the Ashanti Region where they are currently assisting a couple of communities to manage their sacred groves.

The **Friends of the Zoo** are a group of people who are concerned about the welfare of animals kept in Ghanaian zoos and support the zoos financially and technically. The group currently collaborate with the Department of Wildlife in the management of the Accra Zoo.

The **Green Forum** is an association of environmentally concerned journalists which is very active in conservation and environmental education programmes.

## **V. NATIONAL, COLLABORATIVE AND INTERNATIONAL PROGRAMMES FOR CONSERVING BIODIVERSITY AND TROPICAL FORESTRY**

### **NATIONAL ENVIRONMENTAL ACTION PLAN**

Plans towards the preparation of a National Conservation Strategy (NCS) were subsumed by the Environmental Action Plan (EAP) in 1988, coordinated by Environmental Protection Council (EPC) and sponsored by a number donor agencies, World Bank, Overseas Development Agencies (ODA), DANIDA. The EAP provides a new set of concepts for Ghana. There being no previous formal Governmental mechanisms for dealing with environmental issues it is now easy to identify achievements. An environmental policy has been introduced de novo and a new line Ministry, Environment, Science and Technology, created.

The EAP has involved all relevant sectors in the preparation of Ghana Environmental Resources Management Project (GERMP) which is supported by the sponsoring donors, GEF and an IDA loan.

A Forestry Sector Review led by the World Bank, ODA, CIDA and DANIDA in 1986, effectively hybridised the Tropical Forest Action Plan (TFAP) process and led to the formulation of the Forest Resources Management Project (FRMP) currently supported by World Bank, ODA and DANIDA. A new forest policy awaits Parliamentary blessing, and a number of institutional reforms are being considered.

Principal constraints to effective and coordinated delivery of international assistance in the forestry sector are of an institutional nature. With the FRMP frequent changes in project administration has led to a loss of impetus and these difficulties are further compounded by a sense that international donors are not consistent in their requirements and conditionalities.

Despite the absence of a planning framework or rolling plan mechanism, the process has been timely and subsequent donors have identified and developed independent work. Non-governmental organisations are free to develop financing arrangements with external bodies without government restriction.

### **TROPICAL FORESTRY ACTION PLAN**

The Tropical Forestry Action Plan was launched jointly by the World Resources Institute, the UNDP, FAO and the World Bank in 1985.

The five principal aims of the TFAP are:-

1. Forestry in land use. This mainly concerns the integral role of forests and trees for food security and the use of the forests by small farmers and communities.
2. Forest-based industrial development. Action in this area primarily aims at promoting long-term sustainable forest management, a question critically associated with the industrial use of the forests.
3. Fuelwood and energy. The Plan recognises the need for reforestation, for the use of waste wood and for the development of alternative sources of energy.
4. Conservation of tropical forest ecosystems. This section concerns the conservation of plant and animal genetic resources, research, integrated forest management and the setting up of information systems.
5. Institution building. This area is not limited only to forest institutions, but also includes the planning agencies and other institutions responsible for a large proportion of the problems of the forest sector.

Intended to provide a global framework for stimulating and expanding substantially the level of economic activity in the forestry sector and obtain political commitment to tropical forest conservation, the launching agencies have worked at the investment and technical assistance requirements of tropical countries confronted with deforestation, land degradation and rural poverty.

TFAP also calls for the Government to integrate the forestry sector more fully into the national development plan and policies.

## **FOREST RESOURCES MANAGEMENT PROJECT (FRMP)**

Ghana's Forest Resource Management Project (FRMP) arising out of a Forestry Sector Review by ODA, CIDA, FAO, DANIDA and World Bank resulted in a US \$64.6 million World Bank/IDA loan.

The main component of the FRMP are as follows:

1. Sector Policy Reforms
  - Forest Revenue Policy Procedures.
  - Improvement of Staff Incentives.
  - Rationalisation of Timber Trade Policy.
2. Forest Management
  - Natural Forest Inventory.
  - Updating annual allowable cut.
  - Preparation of Working Plans and Harvesting Schedules.
  - Reduction of logging waste.
  - Rehabilitation of existing Plantations.
3. Rural Forestry
  - Extension
  - Collaboration with Ministry of Food and Agriculture on Agroforestry.
4. Strengthening of Sector Institutions
  - Formulation of Policy Planning, Monitoring, Evaluation Department (PMED) in Ministry of Lands and Forestry.
  - Re-organisation of Forestry Department.
  - Civil Works for various institutions.

- |    |                        |   |
|----|------------------------|---|
| 5. | Education and Training | <ul style="list-style-type: none"> <li>- Institute of Renewal Natural Resources (IRNR) and School of Forestry, Sunyani (SFS), to build up their capacities.</li> <li>- SFS to be upgraded.</li> <li>- Staff Development.</li> </ul> |
| 6. | Research               | <ul style="list-style-type: none"> <li>- Staff Development and Adaptive Research at Forestry Research Institute.</li> </ul>   |

## **INTERNATIONAL TROPICAL TIMBER AGREEMENT**

The International Tropical Timber Agreement (ITTA) is a commodity agreement first signed in 1983 by the main producers and consumers of tropical timber and has this year been renegotiated. The International Tropical Timber Council (ITTC) is the highest political authority whilst the International Tropical Timber Organisation (ITTO) is the ITTC's Secretariat.

The ITTO's four principal areas are:

- (1) Market intelligence and economic information.
- (2) Reforestation and forest management.
- (3) Value added processing within tropical countries.
- (4) Research and development.

The ITTC has agreed to ensure that all tropical timber entering international trade will be derived from sustainably managed forests by the year 2000.

ITTO's Action Plan includes criteria and priority areas for programme development for each of its three permanent committees, and guidelines for the sustainable management of tropical forests, which have been adopted as reference standards and codes of best practice. However, the guidelines indicate areas which require attention together with desirable actions, but are not prescriptive at the national level. Critical policy work on social and economic incentives for improved forest management is on-going and methodologies for recording the condition and use of forests are being refined.

## **UNESCO**

### **Man and the Biosphere**

Currently, a number of researches have been initiated to study the impact of land use on biodiversity. In 1982 under the UNESCO Man and the Biosphere (MAB)

programme, a project was initiated by the Environmental Protection Council to study the Impact of Human Activities on the Structure and Productivity of the Savanna Ecosystem in Ghana - Phase: Fallowing and Rotation in the Accra-Winneba Plains.

The main objective of the project was to establish research geared to the effective utilization of savanna rural land in Ghana by:

- i) initiating research and development work on the structure and productivity of the savanna ecosystems in Ghana;
- ii) establishing qualification, fallowing and rotation patterns of the Accra-Winneba Plains and assessing present land use needs; and
- iii) determining the effects of such practices on soil in relation to varying cropping and fallowing periods, soil type, topography and on vegetation structure and composition and production.

Results showed that the Winneba Plains is dominated by shrub and thicket vegetation whilst the Accra Plains is dominated by grass vegetation. From the study it was noted that there was insignificant change in terms of land cover/land use between the date of aerial photos used in 1962 and 1975 and the time of photo-interpretation in 1988.

### **Cooperative Integrated Project on Savanna Ecosystems in Ghana**

In 1992 as a sequel to the previous study, another UNESCO sponsored research - titled Cooperative Integrated Project on Savanna Ecosystems in Ghana (CIPSEG) - was launched. This involves biodiversity studies on the Northern Ghana Guinea Savanna Ecosystems. The general agricultural technology of most farmers is the use of the hoe and cutlass under slash/burn techniques as the most commonly practised methods for land preparation. Burning from farmers' point of view is the cheapest and least laborious method of land clearing.

The goal of CIPSEG is to develop a scientific knowledge base of relict climax vegetations in sacred groves. This is to serve as a basis for evolving holistic and environmentally sound land use management patterns that relate the biological diversity in such sacred groves. From the development point of view, the purpose is to demonstrate the application of science and technology to sustainable development in the Northern Ghana Guinea Savanna based on integrated ecological concepts.

The major research themes which are land use related are:

- i) Improvement of the Northern Ghana Guinea Savanna ecosystem. This involves analysis and application of desertification control mechanisms and anti-erosion measures; agro-silvo-pastoral farming systems, rational use of fuelwood, and improving the physico-chemical properties of arable land.
- ii) Management of wood plants through burning and livestock impact studies in the Northern Ghana Guinea Ecosystems. This involves the assessment of the possible beneficial use of controlled burning and determination of the tolerance of trees and shrubs to livestock browsing.
- iii) Improvement of the Northern Ghana Guinea Savanna land use systems. The objectives of this component are the development of agroforestry and agro-silvo pastoral systems through experimentation and adaptive trials which tie in directly with people's concern and indigenous appeal. It also involves the development of improved fallows with multipurpose trees and herbaceous legumes for both fodder and soil fertility improvement. The land use systems would be improved by the development of hedge row-intercropping systems with fast-growing leguminous multipurpose trees on crop lands and pastures; development of environmental and watershed protection systems and assessment of the factors of evolution of land use patterns. The study is still in progress.

### **United Nations University**

The United Nations University (UNU) under its programme on Population, Land Management and Environmental Change (PLEC) carried a pilot study relating to the pressure on the environment and change in biodiversity and agriculture in Ghana's forest-savanna ecotone as a basis for further work by West African members of PLEC. The PLEC programme addresses the questions of the interrelationships between population dynamics and environmental change. It seeks to examine and disaggregate the processes of adaptation of indigenous resource management systems and land use through a series of field-based research projects in key agro-ecological zones of tropical and sub-tropical environments. The study stresses agro-diversity with the ultimate aim of providing researched options for the better management of land and other environmental resources for small-scale producers.

### **UNITED NATIONS CONFERENCE ON ENVIRONMENT AND DEVELOPMENT AND THE CONVENTION ON BIODIVERSITY**

The conventions on Biological Diversity and Climate Change were signed in June 1992 by over 150 nations at UNCED in Rio de Janeiro. Both have implications for natural and man-made forests. UNCED in addition approved the

"Rio Declaration" consisting of 27 principles related to sustainable development; "Agenda 21" the "Forest Principles" and proposals to initiate negotiations to combat desertification and promote the development of small island states. All of these have direct or indirect consequences for, and linkages with, the forestry sector and its associated planning mechanisms. In August 1994, Ghana ratified the Convention of Biological Diversity.

Ghana participated in the first conference of Parties of the Convention held in the Bahamas and is also participating in the second conference of Parties.

In fulfilment of her obligations under the Convention, Ghana, with funding from the Global Environment Facility, is undertaking a Biodiversity Country Study to obtain baseline information on the status of biodiversity in the country. From the country study, Ghana will evolve a Strategy and Action Plan for the sustainable utilisation of the country's biodiversity. A national workshop was organised in August this year by the Ministry of Environment, Science and Technology to seek the views and commitment of all stakeholders to the work that has been done with respect to the country study as well as the issues that have to be incorporated into the strategy and Action Plan.

#### **OTHER INTERNATIONAL ACTIVITIES**

Ghana is party to a number of international conventions concerned with protected areas, namely the Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention) ratified on 4 July 1975, and the Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention) acceded to on 22 February 1988. Ghana is also signatory to the International Convention in Endangered species of Wild Fauna and flora (3 March 1973). Ghana participates in the Unesco Man and the Biosphere (MAB) Programme, under which one biosphere reserve was approved in 1983. At a regional level, Ghana ratified (1968) the African Convention on the Conservation of Nature and Natural Resources (African Convention), which advocates the establishment of several categories of protected areas.

#### **VI. POLICY AND LEGISLATION**

An array of policies and legislation in many different sectors affect biodiversity in various ways, ranging from indirectly creating incentives to exploit natural resources in unsustainable ways to directly requiring improved management of biological resources.

An overall account of the policies and legislation leading to the rational use and conservation of the biodiversity of Ghana is well documented (EAP Vol. II, 1994).

## FORESTRY

Since the colonial era to date, governments of Ghana have, through enactment of laws and policies, sought to conserve, protect and manage the natural resources of the country which invariably are the active centres of biological diversity. As far back as 1906 the colonial administration passed a law aimed at controlling the felling of commercial timber species. This law did not stress conservation and preservation but the intent was sound.

Forest reserves are constituted under the Forest Ordinance (Cap. 157), following a procedure which requires:

- (i) notification (in the Gazette) of the intention of the Central Government to create the area described in the notice as Forest Reserve and appointing a Reserve Settlement Commissioner (RSC). With this notification the area becomes legally protected from illegal clearing and illegal logging;
- (ii) publicising Government's intention by the RSC within communities in the vicinity of the proposed reserve;
- (iii) the holding of a public enquiry by the RSC (RSC's Court) for the purpose of receiving and considering evidence relating to the existence of rights over the proposed area;
- (iv) judgement by the RSC incorporating his findings and recommending areas to be constituted, the rights to be admitted and the rights to be commuted for cash payment;
- (v) final Order in the Gazette constituting the area as a Forest Reserve and setting out the nature and extent of admitted rights.

Although this legal procedure takes a long time, it has the advantage that rights are properly identified and established and that there is some limited public participation and a lot of awareness creation.

Owing to widespread opposition to the initial attempts at enacting a law for the reservation of forests, the Forest Ordinance initially encouraged the creation of forest reserves by landowners under Bye-Laws. In view of current emphasis on participation of local communities in the management of forest resources, the abolition of this power (S.16 (7) of Act 124/62) was probably a retrograde step (EAP Vol. II, 1994). The involvement of local communities in the management of the reserves is possible however under section 18 of the Ordinance.

Most of the offence-creating sections of the Ordinance (namely sections 22-33) have been repealed and replaced by the Forest Protection Decree,

1974 (NRCD 243). The Ordinance is nevertheless important for more than just constituting forest reserves since by virtue of S.16(8) of the Concessions Act 1962 (Act 124), the Ordinance "shall apply mutatis mutandis to any land outside a forest reserve in respect of which rights relating to timber or trees have been or shall be granted." Actions that within forest reserves could be prosecuted as constituting offences under NRCD 243 as amended by PNDC 142 (e.g. felling, removal, destruction of trees or timber without written authority of the competent forestry authority) have been successfully prosecuted when done in areas subject to timber leases and licenses outside forest reserves.

Besides fully constituted forest reserves, certain timber-carrying lands may be proclaimed Protected Areas under Part II of the Trees and Timber Decree, 1974 (NRCD 273) and given protection almost similar to that given to constituted forest reserves. This provision, which was first introduced in 1959 under the Protected Timber Lands Act (No. 34 of 1959), enables areas with a good stocking of timber trees to be temporarily protected against cultivation which otherwise could not be done within concessions and areas subject to timber leases and licences.

From these regulation-making powers, the Trees and Timber Decree would appear, like the Trees and Timber Ordinance, 1949, which it revoked and replaced, to be aimed at controlling the cutting and removal of trees and timber. Besides the power to create and protect Protected Areas, the Decree provides for the registration of Property Marks and the marking and numbering of stumps and logs as a way of relating a log found anywhere in the country to its stump, the locality from which it was felled, and the person who claims title to the tree and on whose behalf it was felled.

Apart from the Property Mark Regulations which were repealed and re-enacted as part of the new principal legislation, all other Regulations under the 1949 Ordinance then in force were merely saved and continued in existence. Of these, the Trees and Timber (Control of cutting) Regulations, 1950 prescribes minimum girths below which named species of timber trees may not be felled for conversion into timber or bought, sold or exported without specific exemption being granted by the Chief Conservator of Forests. The defects in this law are that only a few species are covered and the legal girth limits it establishes do not correspond to, or are often lower than, the minimum limits the Forestry Department would want to impose for management purposes.

The Trees and Timber (Control of Measurement) Regulations, 1961 prescribe a Log Measurement/Grading Certificate without which no transaction in timber is valid and no log can be transported by rail or exported. The LMC forms the basis for payment of freight and is useful

also for exercising the quality controls (inspection, grading and marking) required for log exports under the Trees and Timber (Control of Export of Logs) Regulations, 1961.

The right to exploit timber (also minerals and "other natural products of the soil"), under the Concessions Ordinance (Cap 136) had been acquired through private negotiation with the land owners followed by enquiry into and validation of the ensuing contract by the Concessions Court. The Concessions Act, 1962 (Act 124) substituted a tenurial system of leases and licences granted by the Head of State acting as trustee for the landowners. In particular, section 16 of the Act vested in the Head of State in trust for the owners, all existing and proposed Forests Reserves, stool and similar lands subject to the Administration of Lands Act 1962 on which timber rights have been or shall be granted, and rights to timber or trees on other lands. From the promulgation of the 1969 Constitution of the Second Republic, a Lands Commission has exercised this power on behalf of the Head of State.

The legal and administrative procedures prescribed under the Timber Leases and Licences Regulations, 1962, which have been reinforced by the requirement to establish regional sub-committees of the Lands Commission, appear to have been designed to ensure that the centralised decision making authority was fed with information from the locality and the Region, and that the Forestry Department would have the opportunity to comment and advise. The procedures have, however, led to justifiable complaint about the time it takes to obtain or renew a lease, which sometimes leads to illegal harvesting and often to large scale farming before approval.

The input of the forestry authorities has been strengthened by the provision under PNDC 42 S.34 (i) (h) that the Forestry Commission advise the Lands Commission on the grant of public lands that affect forests and forestry. The Lands Commission has agreed to seek the Forestry Commission's advice on all applications for timber rights and the involvement of the forestry bodies now ensures that, among other things, ecological factors are taken into account in considering application for timber leases and licences. Possible conflict with farming is also being taken into account through the involvement of inspection teams constituted by the appropriate Deputy Regional Secretaries of Agriculture wherever heavy farming activities are suspected.

**The National Forestry Policy Statement** adopted in 1948 was a useful "manifesto" of broad ends. Taken by itself it could be criticised as being too general. For example, "Creation of permanent forest resources by reservation of suitably situated areas of forest ...., indirect benefits in the form of ... regulation of water supplies ..." could be interpreted (but not

necessarily so) as an objective of reserving the headwaters of the principal river systems.

In the Manuals of Procedure of the Forestry Department, however, the Policy Statement used to be preceded by a section headed "Basis for the Policy" and followed by "Measures to Implement the Policy". The "Measures" properly should be regarded as part of the Policy as they constitute the guiding principles to the programmes of the Forestry Department for implementing the "Statement" and ought to have been kept revised.

The major environmentally-related deficiency in the Forest Policy Statement and Measures is the absence of any perceived permanent role for trees on land use outside the reserved forests. This deficiency has been remedied in practice by the recent acceptance of the need to promote agroforestry, tree planting and various forms of social and community forestry.

A Unit which is expected to grow into a Department of Agroforestry has been set up in the Ministry of Agriculture, and a National Agroforestry Committee to assist in the development of agroforestry policies and programmes has been constituted. Agroforestry is being taught at various levels to both student and practising foresters and agriculturists, and subjects to address the skills and knowledge needed for promoting social/community/rural forestry have been identified for inclusion in the curricula of the Sunyani School of Forestry and the Institute of Renewable Natural Resources of the University of Science and Technology at Kumasi.

Currently (1994) the country's Parliament is considering a Trees and Timber Bill which is aimed at facilitating efficient timber utilization and downstream processing of logs.

## **WILDLIFE**

The Principal legislation governing wildlife conservation in the country is the Wild Animals Preservation Act, 1961 (Act 43). The spirit of this Act is very much like that of its predecessor - the Wild animals Preservation Ordinance - and the 1900 London Convention for the Preservation of Wild Animals, Birds and Fish in Africa from which both originated, namely: the preservation of wild animals considered useful or inoffensive to man; the concept of "nuisance or offensive species" in respect of which measures might, or needed to, be taken to reduce their numbers, and a recommendation for the constitution of game reserves. Completely protected animals under Act 43 (1st Schedule) still emphasised Birds used in the plumage trade, owls, secretary bird, elephants - i.e. animals "useful to trophy hunters, ivory traders and skin dealers" (Lyster, 1985).

Nuisance species (5th Schedule) still included lions, leopards, pythons and crocodiles.

Fortunately, the regulation-making powers (section 11) were wide enough for the radical change that subsequently occurred in attitude (from "preservation" to "conservation"; from the preservation of "wild animals" to the conservation of "wildlife" - i.e. flora and fauna; and from a criterion of useful/offensive to humans to one of degree of threat or endangerment of the species) to be contained within the Act, the only radical amendment required being the complete replacement of the Schedules.

The Wildlife Conservation Regulations 1971 (LI 685) as subsequently amended (LI 1284 of 1983 and LI 1357 of 1988) provided the instrument for translating the new attitudes into legislation and replacing the outmoded Schedules to the Act. The Regulations have proved adequate for example for dealing with the system of permits and certificates required for regulating international trade in endangered wildlife species, under the Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973 (CITES) to which Ghana has acceded.

They provide varying degrees of protection to named wild animal species thus enabling endangered species to be legally protected, regulate the hunting, capture and destruction of wild animals, and control the export of animals (living or dead) or parts of animals (trophies) in commercial quantities.

The Wildlife Reserves Regulations 1971 (LI 710, (subsequently amended several times to add to, delete or alter the boundaries of wildlife reserves) establish Wildlife Reserves by name and boundary description. Since the policy is to establish such reserves "by proclamation," no general legal procedure for their constitution is provided. In practice the establishment of wildlife reserves has involved acquisition by the State with consequent payment of compensation to the land and resource owners.

Four different designations are given to the reserves named in the Regulations, namely, National Parks, Strict Nature Reserves, Wildlife Sanctuaries and Game Protection Reserves, but no definition of these different categories is provided. It has been argued that definitions are not really necessary since all wildlife reserves, whatever their designations, are given the same degree of protection relating to entry (subject to authorisation by the Chief Wildlife Officer), protection of their fauna and flora (hunting, capturing, destruction and collection prohibited except with the written consent of the Chief Wildlife Officer) and protection of their amenities. While this may be correct and indeed an advantage as far as protecting the reserves against the public is concerned, the lack of definition does not provide protection against the actions of the

management authorities or the State where this becomes necessary. For example, should it be just as easy to de-reserve a National Park or Strict Nature Reserve as to de-reserve a Game Production Reserve (merely by publishing an amendment to LI 710 in all cases)? Again while the Wildlife Conservation Policy permits the introduction of non-native animals into Game Production Reserves and areas outside wildlife reserves it envisages that such introduction into strict Nature Reserves and National Parks would not be allowed. The absence of any real legal distinction between these different categories of reserves leaves the observance of this requirement of the Policy entirely to the discretion of the wildlife authorities.

The major deficiency in the Wildlife laws of the country, however, is the continuing emphasis on wild animals and the relative neglect of endangered wild plants. The schedules to Act 43 strictly relate to animals. Game and trophy export permits are required only for animals and their trophies (Reg. 11 of LI 685). The definition of trophy under Act 43 refers to animals and animal parts only. In fact, the relation-making authority under S.11 of Act 43 specifically mentions animals in all instances - even in the two paragraphs (paragraphs (1) and (o) relating to the establishment of reserves. The provision against collecting or destroying any plant within the Wildlife Reserves (Reg. 3 (i) of LI 710) would itself thus seem to rest on the weak legal argument that collection or destruction of any kind would endanger "the protection and preservation of reserves and of the animals therein" (S.11 (o) Act 43). A clearer legal provision that would enable endangered or threatened plants in various situations to be given varying categories of protection including regulation of international trade and export is required.

In order to reduce pressure on wild resources considerably, it would be highly desirable to introduce programmes for domestication and ranching, in which one or other of the larger antelopes, kob or bush-buck, was bred and made available on a large scale.

The policy aims at creating sufficiently large wildlife reserves to safeguard representative samples of the wildlife resources of the country. In practical terms, we need as large reserves as possible, interconnected by as many as possible corridors or stepping stones. As has been mentioned already, there are no marine or estuarine wildlife reserves in the country. Whether it is still possible to create "sufficiently large reserves" of those ecosystems that are not, or are poorly, represented is open to doubt.

Wildlife remains an integral part of the forest and savannah ecosystems. A comprehensive and integrated Forest and Wildlife Policy has been prepared for approval by the Fourth Republican Parliament. In its entirety

it provides guidelines and strategies for the rational utilization and conservation of the living resources by emphasising the harmonious accommodation of other land-use forms with forestry and wildlife; development of efficient forest and wildlife-based industries; promotion of adaptive and applied research into resource management and conservation; active public involvement and education in resource management and conservation; and the enhancement of institutional arrangements.

There are over 282 legally constituted permanent forest reserves spread over an estimated area of 1.7 million ha of which 1.2 million ha and 0.5 million ha have been designated as productive and protective forests respectively. Outside the gazetted permanent reserves about 0.4 million ha of forest (productive as well as protective) are found. As at August 1994, fifteen (15) reserves had been demarcated and declared reservation areas for wildlife. These are found in both the forest and savannah zones and cover an area estimated to be about 1.28 million ha comprising six Game Production Reserves, Six National Wildlife Parks, one Strict Nature Reserve, and three Wildlife Sanctuaries. Besides, six wetland areas are being considered as Ramsar Sites.

#### **AQUATIC AND MARINE ENVIRONMENTS**

The following ordinances have existed in Ghana's statute books for a long time seeking to protect the coastal environment against misuse:

- (i) Beaches Obstruction Ordinance of 29th January, 1987 (Cap 240);
- (ii) Rivers Ordinances of 4th February 1903 (Cap 226).
- (iii) Land Planning and Soil Conservation Ordinance, 1953 (No. 32 of 1953).
- (iv) Improved urban drainage systems with discharge points further into the open ocean.
- (v) Regular studies of river basins and mapping out of sensitive areas which need protection.

With regard to marine pollution existing legislation mainly covers protection of the marine environment from oil pollution. Ghana has ratified the International convention for the Pollution of the Sea by Oil 1954 which has been implemented for Ghana as the Oil in Navigable Waters Act, 1964. This does not take into account the 1962 and 1969 Amendments. Other International Conventions have been ratified but these are yet to be implemented as Ghanaian domestic law. These include the Liability 1969 and Fund 1971 Conventions.

In practice, no legal restrictions exist on discharges into the marine environment of sewage, chemicals and other industrial wastes from land, ships or aircraft.

Ghana is signatory to eight International Conventions relating to coastal protected areas. These are implemented at the national level through the following national legislations:

- Wild Animals Preservation Act (43) (1961);
- Oil in Navigable Waters Act (235) (1964);
- Wildlife Reserves Regulations (1971);
- Forest Protection Decree (1974);
- Wildlife Conservation Policy (1974);
- Fisheries Decree (1979);
- PNDC Law 42 (1982); and
- River, Lakes and Beach Law (under review)

Legislation and Regulations exist for managing marine fisheries. These are:-

- The Fisheries Decree of 1972;
- The Fisheries (Amended) Regulations of 1977; and
- The Fisheries (Amended) Regulations of 1984.

These regulations set standards for sizes of minimum mesh to be used in the pelagic and demersal fisheries in order to avoid catching juvenile fishes, and forbid the use of explosives or poisonous materials in fishing.

There is no statute in Ghana which deals with the impact of inland drainage. However certain statutes exist whose contents are relevant to the control of water pollution. These are:

- The Volta River Development Act 1961;
- The Ghana Water and Sewerage Act 1965.

No legal restrictions specifically exist on discharges into the marine environment of sewage, chemicals and other industrial wastes from land-based sources.

As regards abstraction of fresh water, the following is the current (1991) legal position:

- (i) The Volta River Authority (VRA) in its establishment Act 46 (1961) Section 33 (1)b, has been given power to prohibit, restrict or regulate the abstraction of water from the Volta River or the lake, otherwise than for the purpose only of obtaining water for domestic use in any village, town or house situated within the catchment area of the River Volta.
- (ii) Under Section 2(1) of the Minerals and Mining Law of 1986, "No person shall obtain, direct, impound or convey water from any river, stream or watercourse for mining or other industrial purposes without a licence granted by the Secretary for the purpose".
- (iii) The IDA, under Section 20 (1)a of its establishment Decree SMCD 85 of 1977, has been given power to make regulations and bye-laws, prohibiting, restricting or regulating the use of any reservoir created for any irrigation project taking the national interest into consideration. This power does not appear to have been exercised.
- (iv) For the GWSC, there is no such provision in its establishment Act 310 of 1965 to prohibit, restrict and regulate the use of its raw water resources as in the case of VRA and IDA. Rather under Section 15(2) the Corporation is expected to have preference over other authorities in the use of water resources for public, domestic and industrial purposes.

With regard to the control of water pollution or the discharge of effluents and emission, the need for control has been widely recognised and the power to control has been given to various agencies as follows:-

- (i) The EPC, under Section 2(l)g of NRCD 239 of 1974, is required" ... to ensure the observance of proper safeguards in the planning and execution of all development projects including those already in existence that are likely to interfere with the quality of the environment". Under the power to make Regulations, the EPC, under Section 17, may make recommendations to the Commissioner for Economic Planning who may, by Legislative Instrument, make regulations to give effect to the provision of the Decree establishing the Council.
- (ii) The IDA, under Section 2(f) of its establishment Decree SMCD 85 of 1977, is required to co-operate with other agencies in safeguarding the

health and safety of all people living within or around irrigation project areas.

- (iii) The VRA, under Section 10 (l) (e) of its Act, is to be responsible for "the development of the lakeside area for the health and well-being of the inhabitants, and people living adjacent thereto". Under Section 11(l), the Authority is required to prevent so far as practicable:
  - (a) The harmful penetration of saltwater up the River Volta to a greater degree than was normal at minimum river flow preceding the construction of the dam.
  - (b) The level of the lake from rising to a height greater than 280 ft (85.3 m) above sea level.
  - (c) Such a flow of water past the dam as may cause flooding downstream from the dam above the level which were normal preceding the construction of the dam.

In Section 11(2), the Authority is required to take all reasonable measures to give warning on possible flooding from the lake or from the River Volta downstream the dam.

Under Section 13, it is required to take steps to safeguard the health and safety, among other things, of inhabitants in Akosombo and the lakeside area. It is also required to execute the Mosquitoes Ordinance (Cap 75) in the land and the lakeside area. Under the power to make regulations, it has been given power to make regulation by Legislative Instrument to give effect to the provision of the Act establishing it.

- (iv) The GWSC has been given power, under Section 14, to make regulations, among other things, to prevent the pollution of water. As far as can be ascertained, this provision has not been used.
- (v) Under the Minerals and Mining Law (1986) PNDCL 153, the Secretary is empowered under Section 183(2) to make regulations to provide for:
  - a. the restriction of prospecting operations in or near any river, dam, lake or stream.
  - b. preventing the pollution of waters, springs, streams, rivers and lakes. No such regulation has so far been made.

## **LAND**

There are two sets of existing legislations relating to land management. These are the Land Planning and Soil Conservation (Amendment) Act, 1957 read as one with the Land Planning and Soil conservation Ordinance, 1953 and the Control of Bushfire Law 1983 PNDCL 46.

**The Land Planning and Soil Conservation (Amendment) Act** has not been repealed but is not being implemented. The purpose of the Act is to promote utilization of land in designated areas by land planning and soil conservation through preserving land, reclaiming land and protecting water resources. The Act is implemented through the establishment of committees in designated areas for land planning and soil conservation. Co-ordinating committees are to be established by the Minister for Agriculture to co-ordinate the work and policy of two or more committees. The Committees may promote, for the purpose of the Act, other land use by proper methods of land cultivation and soil conservation.

The Committees have the power to enter upon land and construct and maintain works in a designated planning area - for example to protect sources of water, control of water, prevention and mitigation of erosion, reclamation of land the utilization of swampland. It also has power to transfer any farmer, that is any one utilizing land for agriculture and animal husbandry from one area to any other land within the planning area where land for agriculture or animal husbandry is exhausted or inadequate. The Minister also has power to make regulations for the following purposes.

- (a) Prohibiting, regulating and controlling the breaking up or clearing of land for cultivation or for any other purposes, grazing or watering of livestock and firing, clearing or destruction of vegetation.
- (b) Requiring, regulating and controlling afforestation or re-forestation of land, protection of slopes, banks of streams and rivers and of dams, construction, repair and maintenance of contour banks, ridges, terraces or other anti-erosion barriers, repairing of gullies and maintenance and repair of artificial dams, reservoirs or other water conservation devices.

The Act seems sufficient to regulate the management of land (EAP Vol. II, 1994). Since its enactment, seven areas have been designated as planning areas: Dedoro, Wiaga, Frafra, Seilo-Tuni, Bumbugu, Tamne and Damongo. To ensure the proper management of all lands, the Act should be extended to all areas of the country since areas should not be exhausted before action is taken.

The Act should also require comprehensive land use planning as a prerequisite to particular land use decisions - e.g. any development

affecting land. This Act should provide the guidelines for the Land Use Policy and Planning body proposed in this report.

The Town and Country Planning Ordinance, 1945, Cap 84 (Review 1951) provides that schemes may be made in relation to any land with the general purpose of controlling development, of securing proper sanitary conditions and of protecting and extending amenities while conserving and developing resources. Such schemes must deal with matters mentioned in the schedule to the Ordinance which include town and country planning (including slum clearance), the protection and preservation of amenities (views, prominent features of natural beauty, objects of architectural, archaeological or historical interest) as well as the provision of public utility services such as water supply, sewerage, drainage and refuse disposal. The Town and Country Planning Department has dwelt more on the town aspects of the Ordinance to the neglect of the country aspects.

The Control of Bushfires Law, 1983, prohibits the setting of fires for any purpose except the burning of farm slash, grass, herbage etc. if controlled and confined within boundaries of the farm or as a management tool in forest or game reserves.

An amendment to this law has been proposed with provisions for the establishment of anti-bushfire committees and fire volunteer squads for towns and villages. This would be enough to ensure that the provisions of the law are enforced.

## **VII. CONCLUSIONS, DATA NEEDS, RESEARCH GAPS AND PROPOSED ACTIONS**

In this assessment of tropical forestry and biodiversity in Ghana it is evident that the central problem around which many others hinge is deforestation which has been proceeding without interruption since the beginning of this century. Currently even the reserve system is being seriously threatened.

The underlying factor in deforestation in Ghana is the high rate of population growth and the resulting pressure on land resources including the need to undertake projects for the economic development of the country. Thus the various activities that encourage deforestation include:-

- Demand for new forestland for agriculture as a result of unsustainable agricultural practices (eg. bush-fallow/slash and burn, rotation systems) and expansion of cash crop farming.

- Infrastructural development (such as road construction), human settlement and urbanization.
- The creation of hydro-electric dams.
- Bush fires.
- Excessive browsing on seedlings and ligneous vegetation by grazing animals.
- Mining and quarrying operations.
- Excessive harvesting of fuelwood to meet domestic energy needs.
- Excessive logging operations (encouraged by economic policies that look on forests as a ready source of foreign earnings).
- Lack of human and material resources to enforce regulations.

The effects of deforestation include habitat and species destruction, degradation of land, soil erosion, siltation of lakes and reservoirs, destruction of wetlands, instability in hydrological regimes, climate change and desertification, among other things.

Desertification and climate change are matters which must be taken seriously in Ghana. It must never be forgotten that Africa has huge deserts which were once covered with forests and wildlife; desertification proceeds apace in the Sahel; and sub-Saharan Africa has been prone to prolonged droughts in recent years which decimate domesticated animals and wildlife alike and lead to widespread wildfires which wreak havoc on biological diversity. It is evident that the natural forces that promote desertification are still at work; and the resilience required to withstand them is certainly weakened by man-induced devegetation.

It has been estimated that about 35% of the total land area of Ghana (ie. about 83,489km<sup>2</sup>) is subject to desertification with the Upper East Region and the eastern parts of the Northern region (an area of 78,718 km<sup>2</sup> or 33% of the total land area of the country) facing the most hazard (Laing, 1994 p.159).

The frightening fact is that reforestation has not been taken seriously while deforestation proceeds with seeming remorselessness. Plantation production has not produced significant results and is in virtual disarray.

Threats to wildlife apart from those resulting from deforestation include overharvesting by using prohibited methods of hunting, the flouting of hunting regulations, and the bushmeat trade, among other things. Ineffective legislation and lack of resources to enforce regulations have exacerbated the present trend. Lack of information militates against effective monitoring and evaluation of conservation efforts.

The fact that Ghana possesses an extensive network of protected areas can hardly be cause for complacency. Much of what is protected lies in already degraded habitat types such as savanna woodland. Besides, outside of south-west Ghana, the reserve network tends to be fragmented, consisting of many

small reserves few of which are larger than 500,000 ha. In South-West Ghana, however, there are a large number of reserves some of which are contiguous. However, the level of encroachment and poaching which cannot be controlled because of the limited resources of the Ghana Wildlife Department suggests that exploitation levels may well be above biologically sustainable levels. The gradual erosion of the Bia National Park is a case in point.

Major threats to aquatic and marine resources include:

- Over-exploitation of mangrove vegetation.
- Over-fishing in both inland and off-shore sectors.
- The use of fishing nets with smaller sized mesh and the use of illegal fishing gear and methods (eg. explosives and pesticides).
- Salt production which may pose a threat to some coastal wetlands by disturbing the hydrology and salinity.
- Sand winning which leads to changes in beach profiles and disturbs or destroys the fauna of the beach.
- Eutrophication (excessive build-up of nutrients).

Environmental threats which add to habitat destruction in Ghana are toxic effluents from mining and manufacturing industries.

In attempting to deal with the threats to Ghana's tropical forests and biodiversity several actions are needed which are interrelated.

- There must be a critical mass of scientists who have a clear understanding of the nature of the threats, and have the ability to take an inventory of the country's biological resources as well as undertake surveys and research that would yield data and other information on which remedial action can be based. Thus the training of scientists in the relevant disciplines must be accorded the highest priority.
- There must be the data bases into which all relevant information from research and surveys can be fed.
- Scientists must be trained in the use of modern techniques of research and survey including the use of advanced instrumentation where relevant. The notion that advanced techniques are unsuited to the local situation must be abandoned. For example, the use of satellite imagery (supported with ground truthing surveys) enables accurate information and data to be speedily obtained nationwide which would otherwise take years to assemble. In vitro techniques for conservation of germplasm must be actively promoted since (among other things) field conservation is liable to be frustrated by pests, disease and fire.

- There must be trained field workers and technicians in sufficient numbers adequately equipped with necessary equipment who can undertake conservation duties and regularly monitor the state of the various critical sites, the stock levels of endangered species and any infringements of regulations and promptly bring to the attention of the regulatory and enforcement authorities. They must either be part and parcel of, or be supported by, the actual policing and enforcement officers who must be greatly increased in numbers and adequately equipped to enable them discharge their duties effectively.
- Institution building or strengthening is very basic for any conservation process. The strengthening of policy-making and regulatory institutions as well as of the implementing and enforcement agencies should be closely tied with training. In the absence of effective and well organized and managed institutions imbued with a sense of mission, trained manpower could be frustrated in its work.
- The private sector and non-governmental organizations must be made to play their full role.
- Finally, it needs to be emphasized that no nationwide conservation programmes undertaken or executed by scientists and public officers, whatever their numbers, are likely to achieve the necessary results in the absence of a high level of community awareness which would enable the enlistment of community participation.

In presenting the ensuing Data Needs, Research Gaps and Actions Needed, the above have been some of the underlying considerations.

#### **A) BIODIVERSITY**

- 1) There is the need to fill in the gaps in our knowledge of the country's biodiversity to make it possible to develop an effective strategic action plan for the conservation and sustainable use of the country's biological resources.
- 2) Bioprospecting should be undertaken to enable greater use to be made of the country's biodiversity and to enhance programmes for the conservation of biodiversity.
- 3) Capacity building in research and development institutions in biodiversity utilization and conservation should be given high priority. Biotechnology should be accorded the necessary attention.

- 4) There should be regular monitoring of sites of conservation concern in order to arrest further deterioration.
- 5) Modern techniques for the conservation of genetic resources, both plant and animal, should be accorded high priority.

**B) FORESTRY**

- 1) There is a need to establish a national herbarium with a special fund or subvention. It should be able to give employment to a suitable number of taxonomists to be assisted by various technical staff.

The taxonomists will be given special tasks on the flora of Ghana to accomplish.

- 2) A national Botanic Garden must be established alongside the national herbarium. This should give employment to horticulturists of different persuasions who would liaise with the taxonomists to consider ways of cultivating indigenous plants that are under threat of extinction as a result of over- exploitation or habitat change.
- 3) There is a need to extend the protected area system with protection given to larger forest units, and upland forests and mangroves to be given proper protection. The management of both conservation areas and forest reserves around them needs to be thorough and effective.
- 4) It is vital for commercial interests to be encouraged to take a long-term view and compelled to manage timber extraction on a sustained yield basis.
- 5) A timber management system that can accommodate different rates of extraction and the latest large machinery needs to be found. Past methods of logging may no longer be appropriate models on which to base current policies. Furthermore, much more attention needs to be focussed on the effects of timber extraction and hunting on the poorly managed wildlife resource. Erosion of genetic resources is weakening the base for breeding programmes to meet the needs of the future, especially since the plantation industry may have to contribute considerably more to the nation's wood requirements in the future.
- 6) There is need for further research to support the high forest management systems. Examples are:
  - (i) monitoring of forest condition to ensure that management systems are sustainable.

- (ii) relationship between logging intensity and damage and mortality of the residual stand (as a check on the yield formula).
  - (iii) the relationship between logging on slopes and hill erosion.
  - (iv) the effectiveness of riparian buffer zones on sediment flows after logging.
  - (v) the impact of forest roads and road design (drainage etc) plus harvesting systems on soil erosion and run-off.
- 7) A comprehensive long-term National Action Plan for Reforestation should be prepared and donor support, the private sector participation and local communities enlisted for its implementation.

## **C) WILDLIFE**

### **Natural History Museum**

A natural history museum which would include a zoological reference collection needs to be established.

### **Wild animal populations in protected areas**

Data on wild animal populations are very incomplete. The Wildlife Department has initiated surveys of selected conservation areas under the FRMP. This should be continued and extended to all protected areas including forest reserves. Such data are crucial for monitoring and evaluating conservation efforts.

### **Status of species of conservation concern**

Population size and status of individual species, with particular reference to species of conservation interest (threatened species, indicator species, flagship species, species of economic and cultural significance and species exploited as food resource) both within and outside protected areas should be determined. Such data will provide the baseline for monitoring, evaluation and redefinition of the conservation status of such species. In view of the present low staffing levels of the Wildlife Department, it will be necessary to use NGOs and local consulting groups to undertake the initial baseline data collection and definition of monitoring programmes.

### **Data on wildlife utilisation**

Attempts have been made at various points in time to collect data on bushmeat trade and exploitation of non-timber forest products. There is, however, no systematic, long term nation-wide study of wildlife utilisation in Ghana and available data are either localized or cover limited time periods. Questions which

need to be answered include how dependent Ghanaians are on wild animals and other forest products, sustainability of current exploitation levels etc. The study would not concentrate only on bushmeat, but all other non-timber forest products and industries such as carving which utilize wild animal products. Such information will not only enable incorporation of wildlife considerations in the national economy, but is crucial for formulation of policies regarding biodiversity conservation issues.

### **The closed season**

The concept of the closed season is no doubt a very useful one and should be enforced. However, the appropriateness of the current period for the season is questionable. There is a need therefore to commission a specific study of reproductive patterns of commonly exploited wild animals with the aim of assessing the effectiveness of the present closed season and vary it if found necessary. Such a study can be effectively carried out by an NGO such as the Ghana Wildlife Society, or more cheaply, as post-graduate research projects by relevant universities.

### **Wildlife Laws**

There is an urgent need to examine the current wildlife laws with the aim of amending the concepts to incorporate current biodiversity conservation concerns and bringing all the laws together in one coherent, readily accessible volume.

### **Wildlife protection in forest reserves**

The Forestry Department currently controls the greater proportion of the intact forests in the country. In the past, forest reserves found to contain high populations of wild animals have been converted to wildlife protected areas and removed from forestry and placed under the administration of WD. This situation creates a lot of tension between the two key Departments whose cooperation is crucial for biodiversity conservation in the country. Moreover, such a move does not address the wider problem of conservation of wild animals in the other forest reserves. There is a need to assess the current management strategies adopted in forest reserves with the aim of incorporating mechanisms for the conservation of wild animals within all forest reserves.

### **Community participation in biodiversity conservation**

It is obvious that the survival of the country's biological resources depends on the efforts of the entire Ghanaian population and conservation activities cannot be left to the few staff of Government departments concerned with conservation.

Serious attempts should be made, therefore, to encourage establishment of community biodiversity conservation projects and involve local communities in protected area management.

## **Sacred groves**

In addition to the potential of sacred groves for biodiversity conservation, the concept demonstrates what can be achieved through community concerns and participation in terms of biodiversity conservation. There has been very little attempt beyond the local level to explore and develop the potential of sacred groves for biodiversity conservation, and no attempts have been made so far to integrate traditional knowledge and practices in modern conservation strategies. In a study commissioned by the Environmental Protection Council, Ntiamo-Baidu *et al* (1992) outlined a management strategy for Ghana's sacred groves. This document advocated a three-step strategy for the management of Ghana's sacred groves:

- a nationwide inventory of the groves and the biological resources they contain,
- legislation to reinforce the traditional regulations regarding usage and access, and
- provision of resources to improve local people's capability to manage their groves.

The above points are still very relevant if the full potential of sacred groves in the conservation of the country's biological diversity is to be realized.

## **Training needs**

Expertise within the country to undertake ecological research on wild animals is very limited. Ghanaian ornithologists and vertebrate zoologists with post-graduate training in the country are less than ten, and there is no herpetologist in the country. The need for adequately trained manpower to monitor biological resources and undertake the research studies needed for management decisions cannot be overemphasized. Ghanaian university and research institutions should be encouraged to include biodiversity issues on their list of priorities and aid-funded projects in forestry, wildlife and environment should include training and local research capacity building.

## **Monitoring and evaluation**

Monitoring and evaluation of the status of the country's wildlife resources and conservation efforts should be an essential component of any strategy aimed at conserving biodiversity in Ghana. There is therefore a need to define monitoring procedures, including parameters to be monitored, institutional arrangements for the monitoring, mechanisms for evaluation and linkages between executive, coordinating and policy making agencies.

## **GENETIC RESOURCES OF WILD ANIMALS**

### **Priority areas for action**

In order to conserve the genetic resources of Ghana's wild animals, there is an urgent need to adopt a strategy or action plan involving activities such as collection and inventory, evaluation, conservation, documentation and data management training as well as organisation and the development of infrastructure.

This should not be done in isolation but in conjunction with existing programmes such as the FAO Global Animal Genetic Data Bank (Simon, 1990), the Inter-African Bureau for Animal Resources of the Organisation of African Unity (OAU-IBAR) and the two CGIAR centers with animal mandates, namely, the International Livestock Centre for Africa (ILCA) and the International Laboratory for Research on Animal Diseases (ILRAD) (Fitzhugh and Strauss, 1992).

### **General research needs**

The current flux in the concept of species has led to the suggestion that molecular, morphological and geographic distribution data be examined to assess the genetic structure of a population and to determine whether separate population units should be considered for management (Ralls and Ballou, 1986). There is a need for the zoological gardens to develop techniques for embryo transfers between animal species, improved artificial rearing methods as well as cross fostering between species. Unfortunately practically all that is known on animal reproductive physiology is based on a few domestic and laboratory species. The technology of sperm and embryo storage in use for domestic cattle is the result of decades of research, millions of dollars and thousands of specimens and workers. A vast amount of research would need to be undertaken before the technology of embryo and sperm storage and transfer as reliable as that in use for cattle could be available for wild species without domestic analogues - at the global level, the basic technique of artificial insemination has been successful with about 20 species of mammals (Conway, 1988; Woodford, 1989).

### **SPECIFIC RESEARCH AREAS**

The area of genetic resources of wild animals in Ghana is untouched. Several specific research areas need immediate attention.

#### ***DN<sub>A</sub> typing***

From observations of colour and size it is possible to distinguish between forest and savanna forms of various species. These phenotypic expressions need to be confirmed at the genetic level. Protein gel-electrophoresis, or similar techniques, would be suitable to assess genetic variability and allozyme divergence of such species as well as species of direct commercial value or conservation status. It is

also possible that genes which confer resistance to animal disease or increase adaptability of stressful environments may be found.

#### ***Cryopreservation of semen and artificial insemination***

Evaluation of the viability of frozen semen. This would involve the freezing and thawing of wild animal semen under different conditions and with different extenders.

The animal husbandry industry has found that optimal extenders for a given species is highly species specific and this is proving true for wild animals as well. Artificial techniques for our local species of wild animals need to be developed in order to propagate captive wild animals that would not breed under normal conditions in zoos.

#### ***Cryopreservation of embryos and embryo transfer***

Development of methods of freezing embryos and techniques of embryo transfer. These methods are of great importance in the maintenance of the genetic diversity of captive populations. Embryos containing new genetic material could be recovered from the wild and brought back to improve the health of populations especially those small isolated populations associated with relict forest habitats.

#### **Programme for conservation and development of wild animal genetic resources**

The development of a 'genetic resources of wild animal programme' (GRoWAP) must be global in scope and integrating both improved use and conservation. Figure 38 presents a conceptual model of the components, interlinkages and institutions which would need to be incorporated in GRoWAP. Many of the techniques and methods used in both genetic mapping of animals and captive breeding have undergone major advances in recent years. Ghana does not have the manpower, at present, to undertake any meaningful work in genetic resource development. The fundamental issue is that of staff training; until this is addressed no further progress can be made. The programme is based on several steps which are tightly networked and centred around the conservation of genetic resources.

#### ***Database requirements***

The spatial distribution of species and features of the environment are both of extreme importance in assessing the genetic resources of wild animals. One way of handling this combination of spatial and environmental information is by a Geographic Information System (GIS) which has proved to be a cheap and versatile option for managing information in developing countries (Gordon & Kapetsky, 1991). A GIS would have several advantages over conventional databases for documenting change in genetic resources. For example, by collating all the information available on species distribution, it would be possible to focus on areas which have high diversity and hence to identify the environmental

conditions which determine these localities. It is anticipated that a specialised data handling centre similar to the Global Animal Genetic Data Bank in Hanover would be established at the national level which would be based in an institution such as the National Science and Technology Library and Information Center (NASTLIC) or the Animal Research Institute.

### ***Monitoring requirement***

A set of indicators for the monitoring of wild species and genetic diversity presented in *National Biodiversity Country Study Guidelines*, show that, at the very basic level, the monitoring needs for the assessment of wild animal genetic diversity can be covered by the parameters selected for species diversity. However it would be advisable, resources permitting, to have in place a more sophisticated programme aimed specifically at genetic change. Based on the results of national distribution studies and ease of obtaining specimens, 4 to 5 key indicator species of wild animal should be selected for detailed work. It would be necessary to set-up an early warning system to inform government when the genetic change of these selected species has started to decline.

## **C) LAND USE**

### **Research Priorities**

In Ghana, agriculture, including livestock rearing, takes up the largest percentage of the land. Traditional agricultural technologies and the emerging socio-economic conditions lead to expansion of agriculture, with negative implications for biodiversity. The situation is rapidly developing to the position where the whole country may be described as one poorly-managed large farm. Obviously priority research should go into the spatial stabilisation of agricultural land use. This requires the development and adoption of suitable technologies that improve the production per unit area of land in Ghana. This calls for increased knowledge of the biophysical environment, the socio-economic conditions of the production systems and spatial planning. Several research initiatives are already under way including the National Agricultural Research Project and the Collaborative Forestry Project of the Forestry Department. Research priorities may need to be implemented within the broad framework of the adoption of agroforestry.

### **Possibility and Cost of Changing Methods of Land Use to Reduce Impacts**

The possibility of changing land use methods to reduce impacts is present in the development and adoption of agroforestry technologies.

Agroforestry is a land use system that intentionally mixes or retains trees in crop and animal production fields in some form of spatial arrangement or temporal sequence. This is considered ideal:

- i. In response to multiple problems of population growth, depletion of forest resources, degradation of the general environment, and the multiplier effects thereby generated, the adoption of agroforestry land use system promises to stabilize an apparently collapsing rural ecosystem.

In fragile ecosystems the most suitable land use ought to provide a many layered vegetational cover to the soil.

- ii. Agroforestry has a great potential role in ameliorating ecological land use problems. It provides a holistic approach to solving land-use problems by integrating forest, agricultural and pastoral components and activities.
- iii. Agroforestry with its outstanding variety of systems and technologies has been practised in all parts of the world since time immemorial.
- iv. The ruling objective of agroforestry is increasing the human-ecological carrying capacity of rural areas, with the priority of improving food production systems.

**The role of agroforestry technologies in a land use system include:**

i) *Products added to the system:*

- fruit trees, fodder, wood products for fuelwood, building poles, and small timber,

ii) *Service Role*

- improvement of soil fertility by using nitrogen fixing species,
- use of leguminous multipurpose trees and shrubs to reduce soil erosion, creation of suitable microclimate through windbreaks, shade, fencing and mulching
- Intensification and diversification with high value products.

The fact that most indigenous smallholder farming systems contain these components in various mixtures suggest that the farmers judge their combinations to be positive and acceptable to them. Indigenous knowledge can be an important complement to formal scientific knowledge. What is required of the scientist is to understand the indigenous practices, and possibly improve upon these technologies which are already adaptable to local conditions.

## ***Agroforestry Technologies in the Ecological Zones:***

### **a) *Savanna Woodlands***

- fruit trees such as in croplands - sheanut,
- boundary planting with multipurpose trees - (neem, mango)
- multipurpose wood lots on individual or community lands - *Parkia, Anogeissus* and Neem.
- fodder banks near homesteads for livestock - *Leucaena, Gliricidia, Prosopis spp.*
- in-situ yam staking
- ex-situ yam staking.
- live fencing recommended for tree and pasture protection

### **b) *The Forest Savanna Transition zone in the north***

- Alley cropping (in which crops are grown between rows of multipurpose trees or shrubs, the latter for fodder or erosion control)
- Fruit trees on cropland - mangoes, cashews
- Windbreaks to protect plantain production
- Woodlots of Teak in tobacco growing areas in the transition zone (Wenchi, Kintampo, Techiman, Nkoranza ) for curing tobacco.

### **c) *The Coastal Savannahs:***

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- Woodlot planting
- Alley cropping
- Fruit trees (mango, cashew)
- Coconut intercropped with food crops

### ***Western Region***

- Oil palm intercropped with food crops
- Coconut intercropped with cassava and maize during the first three years.
- Cocoa intercropped with food crops

## **Costs of Changing Methods of Land Use**

Introduction of a new technology tends to alter social relations and runs the risk of precipitating an even greater polarization of the family economy. These involve social costs of adjustment. Conflicts of interest have often developed in the use of technologies or practice and obstacles to acceptance of new technologies including, among others:

- structure of land tenure giving no assurance of commitment to land development, hence individual investments in new technologies on land being low.
- lack of peasant training and non-acceptance of institutional intervention for fear of its uncertain results.

It will require financial costs to mitigate the social costs through:

- a) effective education and support of the land users; the majority of whom are farmers with high rates of illiteracy. Support will take the form of availability of credit, materials and technical advice from trained extension workers;
- b) training of technical staff and other extension personnel in agroforestry;
- c) the production and distribution of planting materials;
- d) provision for continuing research and experimentation in the various ecological zones.

## **E) AQUATIC AND MARINE RESOURCES: CAPTURE FISHERIES**

### **CAPTURE FISHERIES**

#### **Marine environment**

Physio-geographic classification of coastal and marine habitats

Sea bed bathymetric map

Sediment map of territorial waters

Detailed predictive model for the Gulf of Guinea upwelling

Stock assessment of the territorial waters of Ghana

#### **Coastline and Coastal lagoons**

Fishing intensity in lagoons

Hydrological and bathymetric profiles of lagoons

Frame survey of Keta lagoon  
Assessment of the use of non-traditional coastal resources

**Inland Water bodies**

Stock assessment of the Volta lake  
Stock assessment of lake Bosumtwi  
Frame survey of the Volta lake  
Inventory and mapping of small water bodies

**CULTURE BASED FISHERY AND AQUACULTURE**

National survey of aquaculture facilities  
Documentation of traditional methods of fish stock enhancement

# PART 'E'

## POLICY OPTIONS AND PROPOSED ACTIONS FOR USAID'S CONSIDERATION

### INTRODUCTION

In examining current trends in Ghana with regard to biodiversity and tropical forestry the issues which have come to light indicate not only possible hazards for the future of the nation (arising, among other things, from the continuing deforestation and other forms of habitat destruction and attendant species loss) but also opportunities for judicious utilization and conservation provided identified problems and constraints are vigorously tackled. Despite their impoverishment over the years, Ghana's biodiversity and tropical forests still present a richness and variety which constitute a challenge to the country's policy-makers.

The various options available to USAID for constructive intervention may be discussed under at least two headings. USAID might:

- i. endeavour to bring its influence to bear on Government thinking regarding policy issues and actions (or inactions) relating to the utilization and management of Ghana's biodiversity and tropical forests which have important implications for the livelihood security of her peoples;
- ii. provide donor support or technical assistance with regard to projects concerning the utilization and management of Ghana's biodiversity and tropical forests which would enhance their effective and management and sustainable utilization and conservation for the well being of Ghanaians, preferably through trigger action or multiplier effects and contribution to awareness creation.

Until recent initiatives which were brought into being under the stimulus of UNCED, there was a tendency for the Government and people alike to take the country's biodiversity for granted. Existing policies were often ad hoc, uncoordinated and sometimes riddled with inconsistencies. Policies which pointed in the right direction could not always be effectively implemented because of institutional inadequacies and general lack of resources. Where the private sector might have been enlisted to tilt the balance in favour of effective conservation and sustainable use of the country's biological resources, lack of incentives and an enabling environment have not made it possible for this sector to be enticed to take advantage of the variety and richness of these resources.

Support for the effective utilization and management of Ghana's biological diversity and tropical forests could include public/private sector partnerships within the framework of the two above- delineated approaches.

Having signed and ratified the United Nations Convention on Biological Diversity Ghana has undertaken a study aimed at identifying, documenting and inventorying her biological diversity with a view to providing the requisite baseline information for appropriate action plans. Action has been initiated towards the formulation of a strategic plan, which, among other things, will ensure that (i) gaps in our knowledge of the country's biological diversity are filled; (ii) suitable programmes are put in place for the conservation and sustainable use of this diversity. The time would seem ripe for the USAID (and other donor agencies) to help Government focus on actions which will enable Ghana fulfil her obligations under the Convention. In doing this, Ghana should create an enabling environment and ensure transparency which, together with the requisite incentive schemes, would prove attractive and hospitable to investments by the private sector.

In proposing the following projects the foregoing considerations have been kept in mind.

#### **PROJECT 1: CAPACITY BUILDING IN BIOPROSPECTING INVOLVING COLLABORATION WITH EXTERNAL BODIES**

Justification: Bioprospecting is the exploration of biodiversity for commercial valuable genetic and biochemical resources. It makes possible value-added utilization of biodiversity so as to enhance the usefulness of biodiversity and, as will be shown, can help conserve biodiversity. The major beneficiaries of bioprospecting are the pharmaceutical, biochemical and agricultural industries.

A typical process in the screening of plants for drug manufacture may consist of: (i). field operations comprising plant collection (random and ethnobotanical), taxonomic classification, herbarium cataloguing and (computer) data bases; (ii). screening operations comprising plant exhibition, *in vitro* assay of crude extracts in primary and secondary screens, purification of extracts, isolation and identification of active agents and chemical structure determination; (iii). development phase support activities including bulk collection, cultivation, pilot scale extraction and purification of active ingredients, drug supply for preclinical studies (safety assessment) and human clinical tests; and (iv). commercial production upon successful drug approval involving large scale cultivation, extraction and purification to supply drug substance for formulation into final products.

A successful bioprospecting activity thus involves not only scientists (including ethnobotanists) who can identify appropriate plants and undertake the necessary laboratory work, but also financiers and legal and business or management personnel.

It is known that bioprospecting is currently taking place in Ghana essentially between local individuals and institutions and foreign companies. Unfortunately, the absence of the appropriate policy and legislative framework on which sound agreements can be based means that this country is deriving very little benefit, if any, from this activity.

USAID and other donors (in collaboration with the Private Sector) could assist or encourage the government of Ghana in capacity building in the screening of plants and animal diversity for their pharmaceutical and industrial use within the framework of the Convention on Biodiversity.

It may be noted in this connection that the Convention on Biodiversity encourages the transfer of biotechnologies (which are very relevant to bioprospecting) to countries that provide a genetic resource. Thus it should be possible to enter into cooperative arrangements with appropriate private sector institutions which would provide the opportunity for capacity building in biotechnology and drug screening. Merck, the world's largest pharmaceutical company, entered into a major agreement with the National Biodiversity Institute (INBio) of Costa Rica in 1991, which antedated UNCED, to prospect for promising drugs. Under the agreement, INBio provides extracts from hundreds of wild plants, animals and insects to be screened for their drug potential. While Merck retains patent rights, it pays royalties to be used in part for biodiversity conservation activities and, in addition, provides technical assistance to Costa Rica as it builds up an indigenous research capacity which will enable it exploit its own resources. This agreement has been viewed as a model of its kind. (World Resources, 1994).

One important aspect of bioprospecting is the opportunity it can provide for commercial cultivation (where necessary) on suitable land of plant species that are required in large quantities and of uniform quality for marketing. Although attempts are often made to synthesise drugs from plants artificially, less than ten percent of the more than 100 drug compounds derived from higher plants used in prescription are produced commercially by total chemical synthesis. Furthermore, drugs which have been successfully synthesized artificially are often far more expensive than those extracted from natural sources.

Bioprospecting combined with large-scale cultivation of successful plants enhance the use and conservation of biodiversity. Commercial cultivation of identified plants makes it possible to prevent over-harvesting of such plants which would threaten their commercial exploitation. Plantations of medicinal plants exist in several countries for such plant genera as Dioscorea, Solanum, Rauvolfia, Catharanthus, Camellia, Cassia and others.

### **Local capacity and interest**

In selecting bioprospecting as an area for which Ghana could be considered for encouragement and support and with private sector participation it should be

stated, firstly, that it is essential for the success of conservation of biodiversity and the enhancement of community awareness that the relevant authorities proceed beyond conservation of biodiversity to effective and manifest utilization of such diversity by value-added procedures. That is to say it is essential for the authorities to set their sights beyond the prevention of species loss to effective species utilization on a sustainable basis especially by value-added processes.

Secondly, a skeletal institutional framework exists and groundwork studies have been undertaken in Ghana which should prove congenial to such an enterprise. As far back as the early 1960s the erstwhile National Research Council of Ghana (1958-1962) sponsored a Local Alkaloidal Herbs Scheme at the Faculty of Pharmacy of the University of Science and Technology whose objective was to screen medicinal plants for alkaloids of potential therapeutic importance. The Scheme could not be sustained because the scale of funding required for the success of such an enterprise could not be borne exclusively by the Government. Although the need to encourage external private sector participation was discussed, it was not pursued seriously because it did not fit into a framework of thought in which state enterprises played the dominant role. The situation has changed dramatically. Despite the termination of formal Governmental sponsorship of the Scheme, the evidence suggests that interest in it has not really waned over the years. In fact there are scientists in all three universities whose field of specialization is the chemistry of natural products.

The Centre for Scientific Research into Plant Medicine at Mampong has been doing useful work in extracting raw herbal materials and dispensing them for various ailments with significant results. The Centre undertakes ethnobotanical studies in cooperation with local herbalists and maintains a herbarium of plant collections. The Centre has some capacity for extracting the active chemical constituents of herbal preparations.

Groundwork taxonomic and ethnobotanical studies have been undertaken by Irvine (1961), Ayensu (1978, 1979), Policy Research and Strategic Planning Institute (1992), Dokosi (in press) which should be of value to such a project

There are several herbaria in the country, the most important of which is the Herbarium of the University of Ghana. It has a collection of some 85,000 specimens. The Forestry Department at Kumasi and the Forestry Research Institute of Ghana both have sizeable herbaria.

Interest in the subject of bioprospecting was very much in evidence at recent Workshop on Traditional Medicine held in Accra in March 1995 under the auspices of the Ministry Health. One item on the programme of the Workshop was the commercial cultivation, processing and marketing of herbal products on which a paper was presented by Prof. E.S. Ayensu which elicited exceptional interest.

It should therefore be possible to coordinate or tap the available institutional and information resources for a major national bioprospecting programme involving collaboration with the private sector.

Although attention has so far been focussed on medicinal plants the entire gamut of plant and animal diversity may be screened: microbes, algae, fungi, marine plants, insects, the venom of spiders, among others. (World Resources Institute, 1994). It is hardly possible these days to predict what aspect of a country's biodiversity may become important; hence the need to conserve.

Apart from medicinal plants, plants which yield essential oils, latex, sweeteners, resins, glues and gums required by industry may be cultivated for extraction for local use or for export. For such ventures also private companies which have the relevant expertise may be enticed to team up with local entrepreneurs.

## **PROJECT 2: PREPARATION OF A NATIONAL PLAN OF ACTION FOR REFORESTATION**

Justification: By far the most important action required to restore degraded forests and make good the losses of timber incurred in logging operations is reforestation which may take the form of natural regeneration or plantation production.

It needs to be emphasized that no national programme of reforestation is likely to succeed if it is left to chance or undertaken in an *ad hoc*, uncoordinated manner. Furthermore, any paper plan that does not embody a detailed appraisal of needs of resources and proposals for meeting them is essentially empty. Such a plan has to be supported with an implementation strategy which spells out production targets, various institutional responsibilities, private sector participation, trained human resources requirements for field operations, needed surveys and research, needed inputs of seeds and seedlings etc.

It is proposed that USAID play a lead role in the preparation of a comprehensive long-term Ghana National Plan of Action for Reforestation.

In planning for plantation production it may be noted that a national forest plantation of 590,000 ha was proposed by the FAO in the 1960s and planting to meet this target commenced in 1968 with an annual planting rate of 5000, (FAO, 1987). The programme was reviewed in 1979 and a planting target of 11,000 ha per annum for a forest estate of 550,000 over a 50 year-period, 1980-2030, was proposed. The necessary funding and resources were not forthcoming and a planting rate of only 1000 to 2000 per annum was achieved much of which consisted in the rehabilitation of failed plantations (Laing 1994).

Among the actions required for the preparation of the Action Plan, the following may be considered:

- (i) Preliminary groundwork studies and data collection.
- (ii) Preparation by a joint expert group of Ghanaians, external experts and the FAO of a Draft long-term Strategic Plan for Reforestation which outlines a programme for natural regeneration and embodies a revised plantation programme.
- (iii) A National Workshop to discuss the Draft Plan with a view to finalizing it and creating the needed public awareness and sense of ownership.
- (iv) Preparation of a National Action (Implementation) Plan on Reforestation which sets out in detail the resources needed and how they should be raised based on the tasks to be undertaken (including needed surveys, seed production, maintenance of plantations, monitoring of reforestation sites. etc.) and the needs of executing institutions or agencies, including the roles to be assigned to the private sector, non-governmental organizations and local communities. The involvement of local communities is particularly important in view of the need to institute complementary measures such as the establishment of village woodlots and the promotion of agroforestry.
- (v) The setting up of a full time Secretariat or Unit within the Ministry of Lands and Forestry to oversee the preparation of the National Plan and coordinate its implementation.

It is proposed that USAID support a programme for seeking external donor support and assistance for the implementation of the Plan, possibly involving a donors' conference with private sector participation and community involvement.

### **Implementing Agencies**

Ministry of Lands and Forestry and Ministry of Environment, Science and Technology.

### **PROJECT 3: Strengthening marine fisheries research in support of the rational management of marine fish resources.**

Justification: The objective is to strengthen marine fisheries and oceanographic research embodying effective modern techniques which would provide relevant

information for the rational management of marine fisheries and the sustainable exploitation of fish stocks. Activities would include assessment of demersal and pelagic stocks and the effect of oceanographic conditions on fish stocks. Training in fisheries and oceanographic research would be provided for qualified Ghanaians for the duration of the project. There would be a strong taxonomic component regarding fish fauna.

The Fisheries Research and Utilization Branch of the Department of Fisheries (Ministry of Food and Agriculture) has been undertaking research in this area since 1963. However, the Branch is severely limited in high-level manpower resources while its research facilities need to be upgraded. The programme would focus on the strengthening of the Unit, including the establishment of a data base on marine fisheries and oceanography.

#### **Implementing agencies**

Department of Fisheries in collaboration with the Department of Oceanography of the University of Ghana.

#### **PROJECT 4: Support for aquaculture development in Ghana**

Justification: Aquaculture could make a significant contribution to fish production in Ghana. The Institute of Aquatic Biology (IAB) is undertaking relevant research in this area. Its activities include on-station trials at the Akosombo Field Station and assistance to fish farmers.

There is the need to create more production ponds, promote inter-rice fish culture (which the IAB has initiated in northern Ghana), undertake cage culture in lakes and reservoirs, and aquaculture in large reservoirs and coastal lagoons.

One major problem area is feed formulations for the production of cheap feed from local materials. This should constitute an important component of the project.

IAB's current work on genetic resources of tilapia could be strengthened as a component of this project.

#### **Implementing agencies**

Institute of Aquatic Biology (CSIR) and the Department of Fisheries, Ministry of Agriculture.

## **PROJECT 5: Strengthening and Upgrading the Plant Genetic Resources Centre to enable it fulfil its role as a National Gene Bank**

Justification: The Plant Genetic Resources Centre was, until recently, a substation of the Crops Research Institute of the CSIR. It undertakes the collection, documentation, evaluation and conservation of the germplasm of the country's plant genetic resources. It also serves as a central agency for the introduction and exchange of plant genetic resources. The Centre has a field gene bank for conserving germplasm as living plants. This consists of an arboretum of timber and other forest species, medicinal plants, an orchard of fruit trees and other industrial crops and spices, and a field of vegetatively propagated crops. It has limited cold storage and drying facilities for the storage of seeds.

The Centre is constrained by lack of trained staff. Accordingly, training has to be provided to enable more scientists to man the Centre. The laboratory facilities of the Centre also need to be upgraded to enable it use *in vitro* methods of biotechnology to store a larger collection of germplasm which would not be subject to hazards such as fire. (In 1983 the only stands of Mangosteen, *Garcinia mangostana*, in the fields of the Centre at Bunso were lost to bush fire and replacement has not yet been possible). Facilities for modern genetic characterization including DNA typing are also needed. A modern documentation facility and a data base need to be established at the Centre.

The programme of the Centre is nationwide in scope. However, it is proposed that support for the Centre be initially linked closely with breeding programmes of the Crops Research Institute and the Savanna Agricultural Research Institute involving cereals, legumes and roots and tubers (cassava, yam and other crops) so as to promote these programmes as well as help create an awareness on biotechnological applications of biodiversity.

### **Implementing agency**

Council for Scientific and Industrial Research.

## **PROJECT 6: Commercial Utilization of Woodwaste in Ghana**

Justification: The amount of sawdust, woodshavings and offcuts generated by sawmills is enormous. The amount of wastage is compounded by the low recovery rates in existing sawmills (Plan Consult, 1995). At logging sites large quantities of wood residue are left to rot.

What goes to waste can serve as a basis for small-scale or cottage industries in the field of construction (e.g. chip boards) or energy (eg. charcoal briquettes).

Attempts to explore new uses for woodwaste are exemplified by the research being undertaken by the Forestry Research Institute of Ghana, in collaboration with the Hebrew University of Jerusalem, on the upgrading of lignocellulosic wood waste into ruminant animal feed. This important project, supported by USAID, may take time to achieve results for wide application.

Meanwhile support can be given to projects on the commercial utilization of sawdust and other forms of woodwaste for which knowledge already exists. Eg. the Forestry Research Institute of Ghana undertook studies on the carbonization of sawdust which achieved significant results but could not be sustained owing to lack of funds. The Institute also produced woodwool slabs for construction purposes. Field use of these slabs suffered from bad publicity by virtue of the fact that its non-load bearing character was not sufficiently explained resulting in adverse criticism from knowledgeable sources.

There is also considerable knowledge abroad concerning the use of sawdust, wood shavings and other forms of woodwaste which can be introduced to Ghanaians through technical assistance training involving the use of overseas experts and provision of simple equipment suitable for cottage or small-scale industries.

USAID could undertake a pilot project in Kumasi, an important centre for the timber industry, on the commercial utilization of wood waste from sawmilling industries and logging sites.

### **Implementing Agencies**

National Board for Small-scale Industries, Forestry Research Institute of Ghana and the Technology Consultancy Centre of the University of Science and Technology.

### **PROJECT 7: Study of the biological diversity of selected sacred groves and support for their management by local communities.**

Justification: The most important traditional practice with respect to biodiversity is the institution of sacred groves. A well known example is The Boabeng Fiema Monkey Sanctuary in the Nkoranza District in Brong Ahafo region where the black and white colobus monkey (*Colobus polykomos*) and the mona monkey (*Cercopithecus mona*) are to be found. There are an estimated 2000 to 3000 sacred grove sites in Ghana.

The biological composition of many of the groves has not been studied but in many cases it has been observed that grove species composition is higher than that of the surrounding cultivated lands. The only surviving specimens of the Inner Zone subtype of the Dry semi-deciduous and the Southern Marginal type are in sacred groves (Hall and Swaine, 1981).

In many places, sacred sites are threatened because of the breakdown of traditional beliefs and values of indigenous communities. Ntiamoah-Baidu *et al* (1992) outlined a management strategy for Ghana's sacred groves which includes provision of resources to improve local people's capability to manage their groves.

It is proposed that USAID (i) adopt selected sacred groves in consultation with Environmental Protection Agency, the Forestry Department, and the Wildlife Department; (ii) engage specialists to study their species composition; and (iii) provide resources for their management by local communities. This will not only raise awareness of Ghanaians to the importance of sacred groves but encourage the Government to propose legislation for their protection as has been proposed.

It may be noted that under the UNESCO-funded CIPSEG Project a similar study is being undertaken on selected groves in the Northern Region of the country. A programme in the southern sector of the country in the forest zone will enable further experience to be gained which would contribute to a national programme for the management of sacred groves

#### **Implementing Agencies**

Environmental Protection Agency, Forestry Department, Ghana Wildlife Department.

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## **PART 'F'**

### **SCOPE OF WORK FOR BIODIVERSITY AND TROPICAL FORESTRY ASSESSMENT**

#### **1. Introduction**

USAID is in the process of preparing a strategic plan for assistance to Ghana, covering 1997 to 2001. The 1986 amendments to the U.S. Foreign Assistance Act, Sections 118 and 119 covering tropical forestry and biodiversity, require USAID to address these topics in the preparation of country strategic plans. The principal technical basis for strategic planning in this subject area will be a technical assessment, or background study, to be derived from multi-disciplinary research and in-country fieldwork.

The purpose of the tropical forestry and biodiversity assessment is to:-

- a) Provide a concise evaluation of the status of biodiversity and tropical forest resources in Ghana, focusing on management issues and required actions for conservation, and
- b) Identify the extent to which these required actions for conservation are satisfied by current or proposed Mission programs.

The team responsible for the assessment will accordingly seek to:-

- Clarify the scientific and economic rationale for local concern over biodiversity and tropical forest management;
- Discuss national biodiversity issues, encompassing natural and socio-economic environments, as well as the existing administrative structure for natural resource management;
- Frame these issues in terms of Mission program options and their anticipated impacts; and
- Provide sufficient background description to allow substantive evaluation of the assessment's major assertions.
- The assessment is, first and foremost, a tool to facilitate Mission planning and decision making. The report document should therefore frame

specific Mission program options in terms of their probable effects on those biodiversity and tropical forestry issues identified by the team. The report should also serve as an educational tool, to inform Mission staff on present trends and recent advances in the scientific study of tropical forests, biodiversity and their management.

## **LIST OF APPOINTMENTS AND INTERVIEWS**

<b>Dr Christina Amoako-Nuama</b>	-	<b>Minister of Environment, Science &amp; Technology</b>
<b>Dr Kwabena Adjei</b>	-	<b>Minister of Lands &amp; Forestry</b>
<b>Mr E.O. Nsenkyire</b>	-	<b>Chief Conservator of Forests</b>
<b>Mrs Emma Mitchell</b>	-	<b>Minister of Trade and Industry</b>
<b>Mr Dan Abodakpi</b>	-	<b>Deputy Minister of Trade and Industry</b>
<b>Dr. D.K. Berkoh</b>	-	<b>Ministry of Finance</b>
<b>Dr Don Gordon</b>	-	<b>WCMC, Cambridge, UK</b>
<b>Mr Ian Barnes</b>	-	<b>WCMC “</b>
<b>Ms. Barbara P. Sandoval</b>	-	<b>Mission Director, USAID</b>
<b>Mr Stephen Haykin</b>	-	<b>Mission Economist , USAID</b>
<b>Ms. Denise Rollins</b>	-	<b>Program Officer, USAID</b>
<b>Mr Abraham Usman</b>	-	<b>Economist, USAID</b>
<b>Mr Richard Macken</b>	-	<b>Program Development Office, USAID</b>
<b>Mr Cleveland Thomas</b>	-	<b>Private Sector Adviser, USAID</b>
<b>Mr Daniel Gyimah</b>	-	<b>Private Sector Advisor, USAID</b>
<b>Prof. C. Ameyaw-Akumfi</b>	-	<b>University of Cape Coast, Cape Coast</b>
<b>Dr. K. Gbewonyo</b>	-	<b>Bio Resources International Inc., USA</b>
<b>Mr L. Nylander</b>	-	<b>Bio Resources International Inc., Ghana</b>
<b>Mr Fats Nartey</b>	-	<b>A.M.A.</b>
<b>Dr. P.E. Sekyi</b>	-	<b>Dept. of Parks &amp; Gardens, Accra</b>
<b>Dr. K. Osei-Bonsu</b>	-	<b>N.D.P.C., Accra</b>

## **TEAM MEMBER QUALIFICATIONS**

### **EDWARD SOLOMON AYENSU**

Professor Edward S. Ayensu is President of the Pan-African Union for Science and Technology and an international development advisor. He held many important positions during his 20 years at the Smithsonian Institution in Washington D.C. He is Executive Chairman of Edward S. Ayensu Associates Ltd. - Science, Technology and Economic Consultants. Professor Ayensu was the Secretary General of the International Union of Biological Sciences and the Founding Chairman of the African Biosciences Network. He is Chairman of Ghana National Biodiversity Committee. He is also a member of the International Advisory Council on Global Scientific Communications, UNESCO. He has also held various posts in other international scientific and technical organisations.

For nearly two years he was the Senior Advisor to the President and the Director for Central Projects Department at the African Development Bank.

While in Washington D.C. and later at the African Development Bank, Professor Ayensu developed special skills in debt management, syndication of funds for large infrastructural development and other project financing activities.

He was formerly the Vice-Chairman, and presently advisor, to the Scientific and Technical Advisory Panel of the Global Environment Facility - a multi billion dollar Fund administered by the World Bank, UNDP and UNEP. In addition he is a member of the Energy Sector Management Assistance Programme Consultative Group which is also administered by the World Bank and UNDP.

He obtained his doctorate degree from the University of London, and was appointed a Visiting Fellow at Wolfson College, Oxford University. He is a Distinguished Professor of the University of Ghana and, for many years, a member of the Visiting Committee at Harvard University. He is a Foreign Fellow of the Indian National Science Academy, Fellow of the Linnaean Society of London, Fellow of the Washington Academy of Sciences, Fellow of the Third World Academy of Sciences, Founding Fellow of the African Academy of Sciences, Fellow of the Ghana Academy of Arts and Sciences as well as some other international and technical organisations. He is twice the recipient of the Ghana National Science Award.

Professor Ayensu has travelled extensively the world over. Throughout his travels, he has developed unusual contacts with senior government officials, including Heads of State and Senior Business Executives on how practical environmental and development actions can be sustainably organised to achieve socio-economic advancement.

A prolific writer and photographer, Professor Ayensu has authored 15 books and numerous scientific and technical papers, and hosted many photographic exhibitions of his work.

In the course of his travels Professor Ayensu has been stressing the theme that developing countries should turn their late start in scientific and technical development into an advantage by exploring the possibilities of engaging in the fields of biotechnology, telecommunications and micro-computers as appropriate technologies for their future development. He has developed special interest in housing and environmental issues particularly of the urban poor and the rural population of Africa.

In the area of socio-economic development, Professor Ayensu has stated in his lectures and some of his publications the need for African Governments to allow the private sector to operate more freely. He strongly believes that the job of a government is to create a congenial atmosphere for the private sector to operate freely and constructively within the regulations of the country.

## AMMISHADDAI ADU

Ammishaddai Adu was formerly Secretary to the Council for Scientific and Industrial Research (CSIR) (1985-1991). Educated at the University College of the Gold Coast and Columbia University, he qualified B.Sc (London) in 1956 and M.I. Biol (U.K.) in 1963 and has a Graduate Certificate in Advanced Science Writing (Columbia).

He taught botany at Achimota and was Assistant Examiner in Biology for the West African Examination Council. He has served as Consultant to several international bodies including the following:

- UNEP's Regional Office for Africa (Oct 1983-August 1984): (i) Sole Consultant for the Expert Group Meeting of African National Academies of Science, National Scientific Research Councils and similar bodies to consider a Programme of Action on the African Environment. (ii) Edited country environmental profiles of 45 African countries for the Regional Meeting of the Sub-regional Environment Groups (SREGs) held in Lusaka, Zambia (April 1984).
- UNESCO: "Special Consultant" for UNISIST II, Paris, (1979)
- Pan-African Union for Science and Technology (PUST) (1988-89): Preparation of *Proposals for a Minimum Programme for PUST* (Second Congress of African Scientists). He was also consultant for several follow-up activities of the Congress.

In 1978, he was appointed Chairman of the Natural Sciences Committee of the Ghana National Commission for UNESCO and Ghana's delegate to the Natural Sciences Commission of UNESCO's General Conference. He served in this capacity for the 20th, 21st and 22nd General Conferences (1978 to 1983).

He has served on numerous other Committees and participated in (and contributed to) a wide range of international conferences and workshops (in Africa, Europe, USA, Australia, India and Pakistan) on science and technology policy and scientific information policy.

He was Technical Co-Editor of the *Ghana Journal of Science* (1964-1976) and *Ghana Journal of Agricultural Science* (1970-1976).

He has prepared numerous official CSIR publications and was editor of *Scientific Research in Ghana* (Accra, CSIR, vi+ 299p) based on a workshop co-sponsored by the US National Academy of Sciences, the Council for Scientific and Industrial Research and the Universities of Ghana. He is currently Co-Editor of the Ghana National Biodiversity Country Study.

He is a member of the Association of University Administrators (Ghana).

## **EDWIN PHILIP DANIELS BARNES**

Mr. Edwin Philip Daniels Barnes is the Director responsible for Research, Statistics and Information Management (RSIM) in the Ministry of Environment, Science and Technology. He is also the Secretary of the National Biodiversity Unit of the Ministry with responsibility for co-ordinating biodiversity activities in the country. Before his appointment as Director (RSIM), Mr. Barnes was the Director of the Policy, Planning, Monitoring and Evaluation Division of the Ministry.

From October 1968 to June 1993, Mr. Barnes was a Scientific staff of the Ghana Standards Board, rising to the position of Chief Scientific Officer. He is currently on secondment to the Ministry of Environment Science and Technology.

Mr. Barnes holds the Bachelor of Science degree in Chemistry from the University of Ghana, Legon and a Master of Philosophy degree in Textiles Technology from the University of Leeds, U.K. He is a member of the Ghana Science Association and the Ghana Institute of Management.

Since 1976, Mr. Barnes has been involved with the operations of the former Environmental Protection Council, now Environmental Protection Agency. He was one of the experts involved in the preparation of the National Environmental Action Plan.

In April 1995, Mr. Barnes participated in Workshop on Bioprospecting held in Costa Rica. At the Workshop he presented a paper on "The Evolving National Policy Debate on Bioprospecting in Ghana". As the Project Co-ordinator for a UNEP funded project on Biodiversity Data Management, Mr. Barnes participated in the Induction Course for the Project held in October this year at the World Conservation and Monitoring Centre, Cambridge, U.K.

Mr. Barnes is also the National Project Director of the Gulf of Guinea Large Marine Ecosystem Project involving Benin, Cameroon, Cote d'Ivoire, Ghana, Nigeria and Togo.

At part of the National Biodiversity Country Study being undertaken in the country with funding from the Global Environment Facility, Mr. Barnes is co-ordinating work on the preparation of a Strategy and Action Plan for the conservation and sustainable use of the country's biodiversity.

Mr. Barnes is a member of the Fisheries Commission and the Ghana Export Promotion Council.

## **OSWALD KWESI DZIDZIENYO**

O. K. Dzidzienyo obtained his Master of Arts Degree in Social Anthropology from the University of Sussex in the U.K. He had earlier read Social Anthropology and obtained an honours degree in Social Anthropology at same University. Earlier in his carrier, he worked under Professor A. L. Epstein of the school of Asian and African Studies at the University of Sussex in the area of Law and Anthropology and later under Professor Robin Luckham at the Institute of Development Studies at the University of Sussex for two years. His interest in the politics of chiefship and disputes settlement gained him an opportunity to work with the Chieftaincy Secretariat of Ghana. His work at the Chieftaincy Secretariat offered him the opportunity to travel to many rural areas of Ghana, thus developing interest in rural work.

Dzidzienyo has spent the last ten years working in the area of development and application of appropriate technologies to rural areas. In so doing, he has worked closely with the Industrial Research Institute and Food Research Institute and the Technology Transfer Centre to disseminate and deliver appropriate technology products and devices to farmers and small scale entrepreneurs. He has also developed keen interest in socio-biology, development and environmental issues.

He has undertaken complimentary skills and short courses in Technology Policy for promotion of Public Sector Research and Private Sector, Community Participation and Rural Development, in Ghana, Rural Industries Promotion in Development Economies in India, Rural Research and Rural Development and Technology Transfer in the United Kingdom, Zimbabwe and Kenya.

O. K. Dzidzienyo is currently the Executive Secretary of the Development and Application of Intermediate Technology and a member of Management Board of the Industrial Research Institute.

## **CHRIS GORDON**

Dr. Chris Gordon is a Research Fellow of the Volta Basin Research Project and is attached to the Department of Zoology, University of Ghana. He was educated at Achimota Secondary School and then went on to the University of Ghana to read Zoology at the undergraduate level and Freshwater Zoology at the Masters level; his dissertation, titled "The Limnology of the Amansuri lagoon", won the Ghana Academy of Arts and Sciences Silver Medal for best thesis. He holds a Ph. D. from King's College, London in Human Environmental Science carrying out research on estuarine zooplankton, which was conducted within the Ecotoxicology and Environmental Health and the Environmental Resource Management research groups. He also holds a Post-graduate Certificate in Limnology from the Austrian Academy of Sciences, Vienna.

In the course his extension activities, Dr. Gordon has served as a resource person for many national and international organizations preparing documents such as:

Member of a team of experts commissioned to prepare the document on the Genetic Resources of Ghana. Ministry of Environment, Science and Technology; Member of a team of experts commissioned to prepare the document on the Land Use in Ghana. Ministry of Environment, Science and Technology; Resource Person ODA planning mission for the South East Ghana Mangrove Project; Research Co-ordinator, Environmental Studies, GEF - Ghana Coastal Wetlands Management Project. World Bank; Consultant, Aquatic Ecology, Environmental Studies, GEF - Ghana Coastal Wetlands Management Project. World Bank; Member of a team of experts commissioned by Acres International to provide strategies for agriculture development in South East Ghana (Fisheries sub-sector); Commissioned by USAID to provide an overview of environmental impacts of the development of the prawn and shrimp industry in Ghana; Review of Guide-line for Draft Regulations in Ghana, for the Minerals Commission (Environment); Member panel of experts reviewing document on Ghana's Environmental Profile prepared by the International Institute for Environment and Development; Counterpart local expert to the UNDP on a project to identify potential sites for shrimp culture in Ghana; Commissioned by the International Development Research Centre (IDRC) (Canada) to prepare a bibliography on small scale fisheries in Africa; Counterpart local expert to the FAO (UN) on a project to develop aquaculture in Ghana using Geographic Information Systems (GIS) and remote sensing.

Dr. Gordon has served on many committees and working groups related to the environment in Ghana such as the National Environmental Action Plan Working Group on Coastal and Marine Ecosystems of the Environmental Protection Agency; On the international scene he is a member of the IUCN specialist group on African Reptiles and Amphibians, the IUCN specialist group on Fisheries Management, the Pan-African Ornithological Congress as well as the International Society of Limnology (SIL) Committee for the Development of Limnology in Tropical Countries, the SIL Steering Committee on Biodiversity and the SIL Working Group on Aquatic Birds. Dr. Gordon was a member of an Expert group on Land Use Planning reviewing the FAO Guidelines for Land Use Planning, an invited expert to the Steering Committee for the GEF-UNIDO Large Marine Ecosystem Program for the Gulf of Guinea and has assisted in project development for the Rother/Le Touquet Joint Environmental Estuary Project.

Dr. Gordon is a member of a number of scientific and development organizations including the Ghana Science Association; Freshwater Biological Association; Estuarine and Coastal Science Association; International Society of Limnologists; Volunteers in Technical Assistance; Network of Tropical Aquaculture Scientists; International Association of Ecology and the Institute of Biology.

## YAA NTIAMOA-BAIDU

Dr. Yaa Ntiamao-Baidu holds a BSc Hons. First Class Degree from the university of Ghana and a PhD in Zoology from the University of Edinburgh. She is currently a Senior lecturer in the Department of Zoology, University of Ghana, where she teaches ornithology, west African fauna, wildlife and its management and animal ecology. Her other contribution to academic development include the establishment and co-ordination of a Bird Ringing Scheme in Ghana, organisation and participation in various expeditions for ornithological studies and serving as external examiner to the Inst. of Renewable Natural Resources, University of Science and Technology, Kumasi, (1989 -1991).

Her current research interests include population dynamics and feeding ecology of shorebirds; coastal wetland ecology, utilisation of wildlife resources and traditional conservation strategies and has 38 publications on many aspects of wildlife and biodiversity conservation.

Before joining the University in 1985, she served in various capacities within the Ghana Wildlife Department, starting in 1973 as an Assistant Game Warden and rising to Deputy Head of Dept., in charge of the Department's Research Division. Duties as head of research included advising on wildlife research needs in Ghana, planning and execution of studies on wildlife problems, general administration and supervision of staff of the Research Division. During that period, she worked in almost all wildlife conservation areas in Ghana and undertook several research studies including: faunal surveys; biological and ecological studies for the domestication of the grasscutter *Thryonomys swinderianus*; parasites of wild animals; wildlife exploitation and utilisation; and wild animal pest control.

Dr. Ntiamao-Baidu has undertaken numerous consultancy work in the areas of wildlife management, project evaluation and assessment, faunal inventories, environmental impact assessment for organisations such as the World Bank, USAID, FAO, and WWF and ACRES International, advised on several biodiversity conservation projects and served as resource person for conservation training and project review for Conservation International (USA) and The Royal Society for Protection of Birds (RSPB).

Dr. Ntiamao-Baidu is well known in international conservation circles and she serves on a number of international committees. She is currently the Chairperson of the Pan African Ornithological Congress, African Councillor on Birdlife International Council, member of a number of IUCN Commissions, Senior Advisor on the WWF/Biodiversity Support Programme's Biodiversity Analysis for Africa project and member of the Ramsar Scientific and Technical Review Panel for the Convention on Wetlands of international importance especially as Waterfowl Habitat (Ramsar Convention). She has also served on several committees within the country.

Within Ghana, Dr. Ntiamao-Baidu has contributed significantly to wildlife conservation through her work as the Project Officer of the Save the Seashore Birds Project (SSBP-G). Her research work on shorebirds and coastal wetlands highlighted the international importance of the Ghana coast for birds and provided the justification for the GEF funded Ghana Coastal Wetlands Management Project. As part of the conservation education and public awareness component of The SSBP-G, she has organised numerous conservation awareness programmes including the production of a documentary film on Ghana's coastal birds, essay and wildlife art competitions, and several training programmes for both Wildlife Club leaders and wildlife managers. She introduced the idea of wildlife clubs in Ghana and established the Wildlife Clubs of Ghana which currently has over 14,000 members and also the Ghana Wildlife Society, currently the largest conservation NGO in the country and administers the Society's Secretariat with a staff strength of over 30. She was one of the two recipients of the prestigious Royal Society for Protection of Birds Medal for 1995, awarded to her for her contribution to wildlife conservation in Ghana. She has travelled extensively throughout Africa, Europe and the Americas and is a member of a number of professional bodies.