



THE REPUBLIC OF GHANA

National Biodiversity Strategy For Ghana

MINISTRY OF ENVIRONMENT AND SCIENCE

2002

EXECUTIVE SUMMARY

Ghana signed and ratified the Convention on Biological Diversity since 1992. She is therefore under obligation to develop a national strategy for the sustainable use of the country's biological resources.

The entire country falls within three main biogeographical zones, namely: the south western portion within the Guineo-Congolian, the middle belt within the Guineo-Congolian/Sudanian Transition zone, while the northern-tip of the country falls within the Sudanian zone.

Despite the lack of information on the full coverage of the biological resources of the country in such areas as the marine and other aquatic ecosystems, so far, about 2,974 indigenous plant species, 504 fishes, 728 birds, 225 mammals, 221 species of amphibians and reptiles have been recorded. Three species of frogs, 1 lizard, and 23 species of butterflies have been reported to be endemic.

Sixteen percent (16%) of Ghana's land surface area has been set aside to conserve representative samples of her natural ecosystems in the form of forest reserves, national parks and other wildlife reserves including various traditional forms of conservation.

Despite this effort, increasing pressure from agricultural expansion, mining, timber extraction and other socio-economic factors have negatively impacted the biological resources of the country. It is estimated that the country is experiencing a rapid deforestation rate of about 22,000ha annually. The economic loss to the nation of loss of biodiversity through deforestation and land degradation has been estimated at about US\$54bn (about 4% of the Gross Domestic Product) (Tutu, et al. 1993).

This is partially as a result of uncoordinated implementation of sectoral socio-economic development policies. The biological resources of the country are therefore seriously under threat and warrants urgent action if the situation is to be averted.

The Government of Ghana, recognizing the fact that to ensure sustainable utilization of the country's biological resources and the need to integrate biodiversity issues into national development planning programmes, has proposed several actions. Some of the actions that have been identified include capacity building to ensure an in-depth assessment of biological resources, promotion of community participation in sustainable management of biodiversity and the strengthening of the management of forests and protected areas as well as other off-reserve biological resources.

For the effective implementation of the National Biodiversity strategy, the establishment of a National Biodiversity Commission has been recommended. The Commission is to harmonize all biodiversity related policies and co-ordinate the implementation strategy among all implementation agencies under the Ministries, NGOs, CBOs and local communities. It is also to pursue and promote the necessary international co-operation with donor organizations, development partners and neighboring countries to ensure that sound policies are implemented for the sustainable use of biological resources of the nation, and of the sub-region.

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INTRODUCTION

Our planet is currently experiencing an unprecedented loss of biological diversity. The local and global extinction of species of plants, animals, fungi and microbial organisms, that we are witnessing on this planet constitute a major environmental problem that requires urgent attention.

The term biodiversity is the short form for *biological diversity* and it is defined by Article 2 of the Convention of Biological Diversity (CBD) as:

“the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystem”. CBD (1992)

Biodiversity incorporates the ideas of distinctiveness at every level of life from molecules, to cell, to individuals, to species, to assemblages of species and to ecosystems. Species vary in genetic uniqueness and play diverse functional roles of greater or lesser significance in ecosystems; consequently, the loss of some species will be more critical than others. Ecosystems regulate the flow of energy, ultimately derived from the sun, both on a local and on a global basis. The functioning of these ecosystems directly influences the concentrations of atmospheric gases, determines the nature of soils, and profoundly affects the condition of water bodies. They also regulate the cycling of the nutrients on which life depends. It is the source of food and other materials critical to the survival of humanity.

Ghana was the 12th of the 157 countries which signed the Convention on Biological Diversity during the Earth Summit, in June 1992. Subsequently, she has since August 29, 1994 ratified the Convention on Biological Diversity. In line with her programme for implementation of the Convention, a Biodiversity Country Study was undertaken. The study, in addition to providing the baseline information on the country's biological diversity, also identified a number of measures that have to be put in place to ensure the conservation and sustainable use of the country's biological resources.

Article 6 of the Convention provides for countries to develop national strategies for the conservation and sustainable use of their biological diversity. This document, the National Biodiversity Strategy for Ghana, has been prepared in fulfillment of this provision. It is an indication of the plans envisaged for activities that have to be undertaken by the country to achieve the goal of conservation and sustainable management of the country's biological diversity. At he Action Plans are provided in a separate document

Chapter 1 of the document presents the geographical and ecological background of Ghana. **Chapter 2** discusses the current status of Ghana's biodiversity touching on the economic importance of biodiversity. **Chapter 3** presents the main threats to biodiversity conservation while **Chapter 4** focuses on the impact of current policy on biodiversity management. **Chapter 5** considers the strategic framework for biodiversity conservation

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and management, and isolates issues that need to be considered to achieve sustainable management.

The discussion culminates in a statement of vision, guiding principles and the basis for the biodiversity strategy in **Chapter 6**. **Chapter 7** distils the issues that require action, while **Chapter 8** presents the implementation strategy.

This document is a summary of the Ghana National Biodiversity Country Study report, which in turn was a distillation of the background document prepared by national experts covering the relevant disciplines of biological diversity.

Chapter One

GEOGRAPHICAL AND ECOLOGICAL BACKGROUND

1.1 THE PHYSICAL ENVIRONMENT

1.1.1 Territorial Area

Ghana lies along the Gulf of Guinea in West Africa. It lies within longitudes 3° 5'W and 1° 10'E and latitudes 4° 35'N and 11° N. It covers an area of about some 239,000 km², with the Exclusive Economic Zone (EEZ) constituting an additional 110,000 km² of the sea to the territorial area. Ghana has a southern coastal shoreline of 550km. The country is bordered by Togo to the east, La Cote d'Ivoire to the west and Burkina Faso to the north. See Fig 1 below.

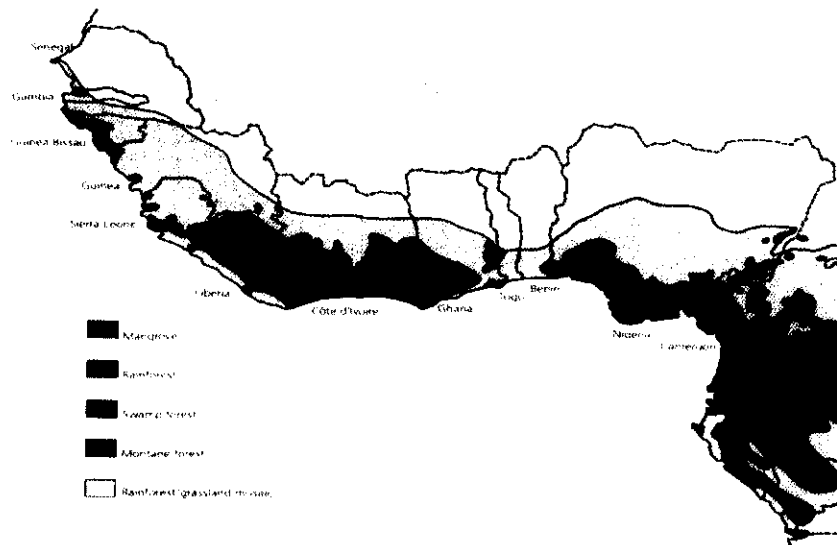


Fig. 1 Tropical Rainforest of West Africa

Source: Martin, (1990)

1.1.1 Topography

The relief of Ghana has been influenced considerably by its geological history. The land is generally below 600m. A ridge and furrow topography is evident on Pre-Cambrian rocks reflecting the fold trends. The lowest lying areas occur in the middle Volta Basin and in a broad belt along the coast. Physiographic regions include the coastal plains, the Buem-Togo ranges, the forest dissected plateau, the southern Voltain Plateau, the Savanna High Plains and the Gambaga scarp (Fig. 2).

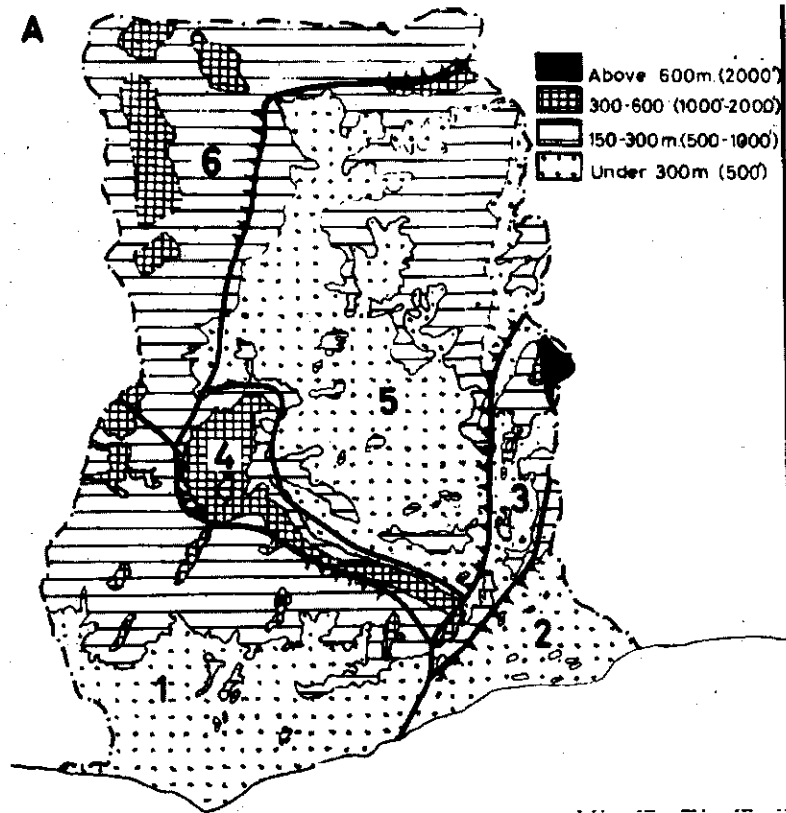


Fig. 2: Relief and Physical Regions

1.2 BIOGEOGRAPHY

1.2.1 Biogeographical Zones

Ghana extends over three main biogeographic regions: the Guinea Congolian in the south-west, the Sudanian in the north and the Guinea-Congolian/Sudanian transitional zone in the middle and in the south-east (Fig.3). A fourth region, the Volta, has recently been identified based on the butterfly fauna in the country (Larsen, 1994).



Fig.3: Biogeography Zones
Source: Olivier & Adjei, 2002

- 1&2: Guinea-Congolian Zone
- 3 : Guinea-Congolian/Sudanian Transition Zone
- 4 : Sudanian Zone
- 5 : Sub-Saharan Zone

1.2.2 Phytogeography of Ghana

The distribution of vegetation throughout the West African sub-region tends to be banded in zones running approximately parallel to the equator, a phenomenon which is largely explained on the basis of climatic factors, mainly rainfall and temperature, which are limited to the Inter-Tropical Continental Zone (ITCZ) position. The tropical forests of West Africa occupy a band approximately 320km wide, the southern limit of which is defined by the Atlantic coastline. The southern half of Ghana lies within this belt.

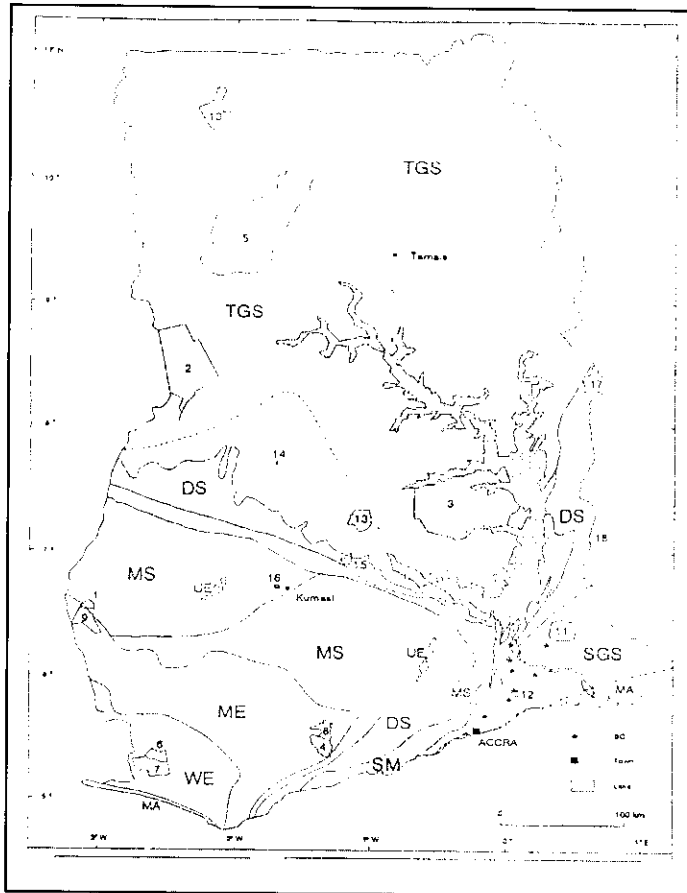


Fig. 4: Major Phytocoria and Vegetation types of Ghana (WD, 1994)

- TGS – Tall Grass Savanna
- SGS – Short Grass Savanna
- DS – Dry Semi-deciduous
- UE – Upland Evergreen
- MS – Moist semi-deciduous
- ME – Moist Evergreen
- MA – Mangrove Forest
- SM – Southern Marginal

The two major biomes represented in Ghana are the tropical high forests (comprised of various associations) and the savannas. The southern half of the country supports the closed forest whereas the northern half supports savanna and woodland vegetation. The northern savanna is mainly of the Guinea type but an area of Sudan savanna occupies the north-easternmost corner of the country (Fig.4). These major vegetation types are by no means uniform or homogeneous; many variants occur in each type. Thus, there are, for instance, swamp forests where the ground is waterlogged in the forest zone and gallery forests along the edges of rivers in the savanna zone.

1.2.2.1 High Forest Zone

The high forest zone (Fig.4) is made up of different types of forest, ranging from the wet evergreen (WE) rain forest, which experiences the highest amount of rainfall throughout the year, to the dry semi-deciduous (DSD) type, which experiences lower amounts of rainfall distributed only at certain times of the year and a well-defined dry season. See Plate 1.

The wet evergreen (WE) forest type is found in the south-western corner of the country. Annual rainfall here ranges between 1700 to 2030mm. Typical species include *Cynometra ananta*, *Tarietia utilis*, and *Tieghemelia 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 mountainous areas. They are therefore referred to as mount forests. They receive up to 1700mm of rainfall and are wet throughout the year, often forming forest clouds. The moist evergreen (ME) forests located experience a somewhat lower amount of rainfall, 1500 to 1700 per annum, but do not differ in structure from the WE forest although there are important differences in their floristic composition.

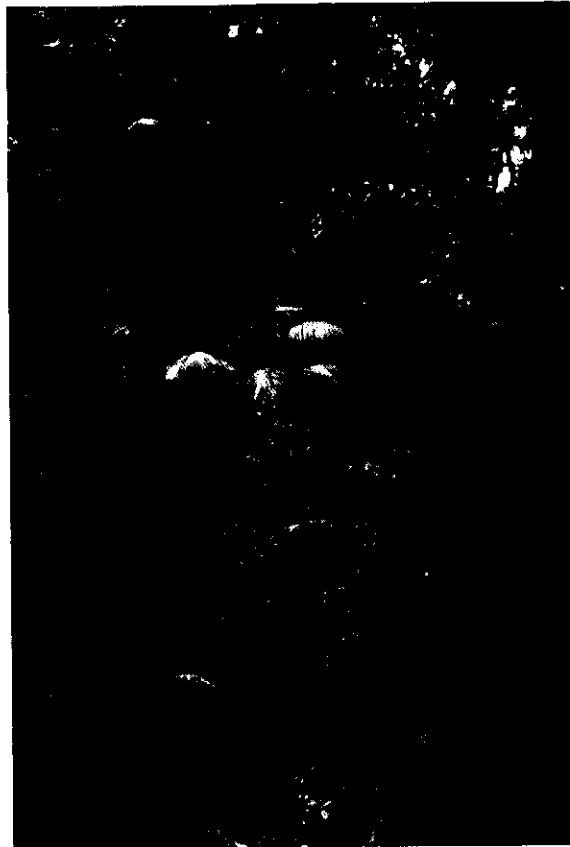


Plate 1: Tropical High Forest

The moist semi-deciduous (MSD) forest receives lower amounts of rainfall, 1200 to 1500mm annually, as compared to the evergreen sub-types and there is also a more clearly defined dry season. This forest type may be conveniently divided into north-western (NW) and south-eastern (SE) sub-types (Fig.4). Together, these two sub-types contain most of the country's valuable timber species. The species composition in the MSD forest type, 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 can be recognized by the nature of the vegetation, the low amount of rainfall, 1100mm to 1200mm annually, and the pronounced dry season with its associated high temperatures. This forest type is 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, Odum (*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 characterized by the occurrence of periodic fires, especially during the dry season.

The South-east outliers (SO) represent the driest of forest types, with an annually rainfall of about 750-1275mm. It is also the least extensive, occupying an area of approximately 20km² in small scattered patches. South-east outliers are found on the Accra Plains, one notable example being at the Shai Hills Game Production Reserve. A low floral diversity and trees with low canopies characterize this forest type. Within this forest type there are several rare tree species such as the charcoal tree, *Talbotiella gentii*, and few commercial timber species.

1.2.2.1 The Savannas

About two-thirds of the country is covered by savanna vegetation (Fig. 4). Two of the three major types of savanna are represented in Ghana. The Guinea or Tall Grass Savanna (TGS), and the Sudan or Short Grass Savanna (SGS). The Guinea savanna, which receives an annual rainfall of about 1000mm to 1100 mm, occupies an area of about 144,948 km², consists of mostly broad-leaved trees some of which are also found in the DSD (FZ) forest sub-type. The Guinea savanna is by no means uniform or homogeneous. Many local variations exist and this has resulted in a variety of nomenclatures. This distinction is basically based on floristic composition.

The Sudan or Short Grass Savanna (SGS) 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 extreme northern part covering an area of about 10,540 km². The natural vegetation is characterized by short grasses interspersed with low-density woodland of drought and fire-resistant species. This vegetation type is also not homogeneous.

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Table 1: Area of Land covered by the vegetation types of Ghana

Formation Group	Abbreviation	Area (sq.km)	Percentage Cover
Wet Evergreen	WE	6,570	2.75
Moist Evergreen	ME	17,770	7.45
Upland Evergreen	UE	292	0.12
Moist Semi-deciduous	MS	32,890	13.79
Dry Semi-deciduous	DS	21,440	8.99
Southern Marginal	SM	2,360	0.99
Southeast Outlier	SO	20	0.0083
Total Forest		81,342	34.1
Tall-grass Savanna	TGS	144,948	60.77
Short-grass Savanna	SGS	10,540	4.42
Total savanna		155,488	65.19
Mangrove forest*	MA	1,670	0.7
Total Ghana		238,500	99.99

*Includes open water areas; actual area of mangrove vegetation is unknown but is now very limited

1.2.2.1 Minor Vegetation Formations

In addition to the two major biomes, other minor vegetation types are found in the southern part of the country. These are:

- i) the *coastal savanna*, usually referred to as the Accra-Winneba Plains in the south-eastern part of the country;
- ii) the *strand or coastline* vegetation along the seashore; and
- iii) 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 percentage cover of land by various vegetation types are shown in Table 1 above.

1.2.3 Zoogeography

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 such as the Forest Elephant (*Loxodonta Africana cyclotis*) and the Chimpanzee (*Pan troglodytes*);
- ii) species which are limited to the Upper Guinea block of forest, such as the Zebra Duiker, Jentinks Duiker; Red Colobus Monkey (*Procolobus badius waldronii*) and Diana Monkey (*Cercopithicus diana*). Bird species here include Wattled Cuckoo-

- Shrike (*Campephaga lobata*) and White-breasted Guinea Fowl (*Agelates meliagrises*)
- iii) species which are found in the Guinea-Congolian Forest/Savanna Transitional zone; such as the Tawny Eagle (*Aquila rapax*)
 - iv) species which are found in only the Sudan savanna such as the Korrigum (*Damaliscus lunatus korrigum*)

While the broad biomes of forest, Coastal, Guinea and Sudan savannas are the major ecological zones for biodiversity considerations, the relative isolation of the Guinea block explains the great affinities between Ghanaian fauna and those of the 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/Liberia area and Cote d'Ivoire/western Ghana border areas which have the highest precipitation and the richest faunal diversity, represent forest refugia from past dry periods.

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 farm, roads and other human activities (Booth, 1959). Species with specialized habitat requirements, such as the forest elephant and many of the primates, have become threatened as a result of various human activities.

Chapter Two

CURRENT STATUS OF GHANA'S BIODIVERSITY

2.1 INTRODUCTION

The National Country Study report together with the background papers, remain valuable reference documents on the current status of Ghana's biological diversity at the ecosystem, species and gene levels. Generally, knowledge and information on genetic diversity of various life-forms and organisms existing in the country are diffuse, incomplete and inaccurate. However, the amount of information available on the terrestrial ecosystems, is greater and more complete than that of the marine and other aquatic systems. Furthermore,



Plate 2: Cocoa farm in the forest

there is a fair to good knowledge and information base on the species diversity of plants and animals (both wild and domesticated) and ecological processes within the terrestrial habitats. In contrast, information on plants and animals of the marine and aquatic world and the processes that determine the resilience of such organisms is barely available. Currently, very little is known about the entire microbial diversity of terrestrial, marine and aquatic ecosystems in the country.

Lack of up-to-date knowledge and information gaps and inaccuracies exist because of a number of constraints. Notable among these are the limited technical capabilities and inadequate logistics support, low financial resource allocations as well as the general lack of appreciation for the worth of biodiversity conservation.

Well-defined and implementable programmes for biodiversity conservation (notably genetic conservation) such as the establishment of captive breeding

programmes, *ex-situ*, *in-situ* and gene banks are not very well developed. Even the Plant Genetic Resource Centre at Bunso is ill-equipped to maintain a large spectrum of the country's plant genetic resources. It, however, has to be said that substantial amounts of good work have been done to collect and conserve a number of germplasm, notably those of agricultural cash and staple crops such as cocoa (*Plate 2*), coffee, kola, sheanuts, maize, millet, sorghum, cassava and yams in fields and gene banks, as much as possible.

The benefits of plant, animal and microbial biodiversity to the people of Ghana are enormous. These range from economic (source of rural and urban income, export earnings), social (as sources of food and food security, medicine for health maintenance and cure of diseases and ailments), religious and cultural (avenue for spiritual inspiration), aesthetic and recreational to ecological (watershed and catchment area protection, wind/storm break, forest regeneration, soil fertility maintenance, etc.) and environmental (maintenance of atmospheric carbon levels, absorption of pollutants, etc.).

2.2 BIODIVERSITY OF THE TERRESTRIAL ECOSYSTEM

The terrestrial ecosystem of the country may be seen to be spread in two major biomes, namely, the tropical high forest and the savannas (Sudan and Guinea savannas). The tropical rain forest may be subdivided, according to Hall and Swaine (1981), into various vegetation types in relation to annual precipitations and keystone plant associations. See Section 1.2.2.1 and Table 1 respectively.

2.2.1 The flora of Terrestrial Systems

Both indigenous and introduced species have been considered in the assessments of the country's floral diversity. A total of some 3,600 species of the major regional centres of endemism (see White, 1965) represent the three major taxonomic groups. Floral diversity is more pronounced among the angiosperms represented with well over 2,974 indigenous and 253 introduced species (Table 2).



Plate 3: Closed Canopy Forest

Table 2: Vascular Plant Census of Ghana

(a) Indigenous			
Group	Families	Genera	Species
Pteridophytes	15	43	124
Gymnosperms	1	1	1
Angiosperms:			
Monocotyledons	30	227	780
Dicotyledons	127	806	2069
	173	1077	2974
(b) Introduced (Naturalised)			
Group	Families	Genera	Species
Monocotyledons	15	42	53
Dicotyledons	63	149	200
	78	191	253

Among the various vegetation types of the tropical rain forest, it is the wet evergreen forest type in the south-western part of the country that exhibits the highest level of endemism and species richness. Information on species diversity and endemism in the savanna biomes is very sparse. Biological diversity of species in the savanna woodlands and gallery forests of the savannas may show greater species richness than the dry savannas.

Table 3 gives the list of forest species thought to be endemic to the country.

Table 3: Forest Species thought to be Endemic in Ghana

<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 umbractilis</i> Brenan & Keay	Sterculiaceae	WE	Small tree	Neo
<i>Commiphora dalzielii</i> Hutch	Burseraceae	SO	Shrub	Palaeo
<i>Dalbergia setifera</i> Hutch & Daiz	Papilionaceae	SM	Small tree	Neo
<i>Diaphoranthus suborbicularis</i> Summeth	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 & Daiz	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 swainii</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 = West Evergreen

MS = Moist Semi-deciduous (Source: Hall and Swaine, 1981)

SO = South-East outlier

SM = Southern Marginal

DS = Dry semi-deciduous

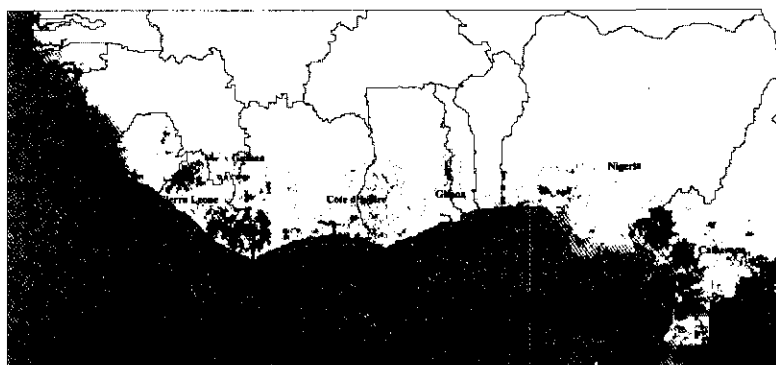


Fig5: Remaining Fragments Guinea Forest Hotspot

Within Ghana there are areas of high biological diversity, referred to as “biological hotspots”. The most notable of such areas is the Ankasa and Nini-Suhien Conservation Area in the south-western portion of Ghana (CI, 2002). The apparent climatic diversity and inherent stratification of this type of vegetation explains why biological diversity is greatest here. See Plate 3.

In West African, the Upper Guinea Forest Ecosystems is also recognized as one of the 25 global biodiversity hotspots. This is attributable to the fact that even though there is a very high concentration of biological diversity, the entire area has lost about 80% of the original forest cover and the remnants continued to be threatened with destruction.

There is only one known gymnosperm, *Encephalartos barteri*, which is indigenous to Ghana.

The few others growing in various ecological zones in the country are introduced species for purposes including aesthetics and economic. The third taxonomic group, pteridophytes, is well represented with 124 known species.

2.2.2 The Fauna of Terrestrial Systems

The fauna of the terrestrial ecosystem, though relatively impoverished, comprise a diverse array of species including several of conservation concern. Current records show that there could be as many as 221 species of amphibians (Plate 4) and reptiles, 724 species of birds, 225 mammalian species (with 93 recorded to inhabit the savanna ecological zone). Threatened species recorded in the country include four species of marine turtles and three species of crocodiles. Bird species of conservation concern include seven threatened species, including four species endemic to the Upper Guinea forest block and seven near-threatened species. Keystone species such as hornbills, parrots and birds of prey are well represented in the country.



Plate 4: Tree Frog, *Hyperolius cf. torrentis*

Of the 728 birds species confirmed to be occurring, 408 are non-passerines and 320 passerines, of which 494 are known or thought to be resident and 176 are regular seasonal migrants, including 100 from the Palaearctic. Of the total number of species occurring, 180 restricted to the Guinea-Congo Forests Biome and 37 restricted to the Sudan-Guinea Savanna biome have been recorded (Ntiama-Baidu *et al*, 2001; Ntiama-Baidu *et al*, 2000 a & b). Furthermore, eleven of the 15 endemic bird species within the Upper Guinea Forest occur in Ghana (See Plate 5). Six of the total species are considered threatened and 12 near-threatened (BirdLife International, 2000). The country is also important for water-birds being on the boundary of the East Atlantic Flyway and the Mediterranean Flyway (Smit and Peirisma, 1989; Ntiama-Baidu *et al*, 2001).

Endemism among terrestrial fauna has been observed in three species of frogs, *Hyperolius baumanni*, *H. fusciventris* and *H. sylvaticus* and the lizard, *Agama sylvanus* found in the Bia Forest Reserve and the Atwema Range Forest Reserve.



There is high degree of butterfly endemism in Ghana where about 23 species are classified endemic or near-endemic. As with floral diversity, "hot spots" for faunal diversity may be located in the high forest areas (accounting for 83% of the total number of species recorded), where canopy stratification and micro-climatic differentiation have provided habitats and niches for specific faunal organisms.

Plate 5: Forest Bird –Western Wattled-Cuckoo Shrike

Table 4: Threatened Species of Wild Animals Occurring in Ghana

	Scientific Name	Common Name (status*)
REPTILES		
Crocodylidae	<i>Crocodylus cataphractus</i>	Slender-snout Crocodile (I)
	<i>Crocodylus niloticus</i>	Nile Crocodile (V)
	<i>Osteolaemus tetraspis</i>	West African Dwarf Crocodile (I)
Testudinata	<i>Lepidochelys olivacea</i>	Olive Ridley Turtle (E)
	<i>Chelonia mydas</i>	Green Turtle (E)
	<i>Eretmochelys imbricata</i>	Hawksbill Turtle (E)
	<i>Dermochelys coriacea</i>	Leatherback Turtle (E)
BIRDS		
Phasianidae	<i>Agelastes meleagrides</i>	White-breasted Guineafowl (E)
Strigidae	<i>Scotopelia ussheri</i>	Rufous Fishing Owl (E)
Campephagidae	<i>Campephaga lobata</i>	Western Wattled Cuckoo Shrike (V)
Pycnonotidae	<i>Criniger olivaceus</i>	Yellow-throated Olive Greebbul (V)
-do-	<i>Bleda eximia</i>	Green-tailed bristle-bill (V)
Muscicapidae	<i>Picathartes gymnocephalus</i>	White-necked Picathartes (V)
MAMMALS		
Ceropithecidae	<i>Cercopithecus diana rolloway</i>	Diana Monkey (V)
-do-	<i>Colobus badius waldroni</i>	Red Colobus (E)
-do-	<i>Cercocebus torquatus</i>	White-collard Mangabey (V)
-do-	<i>Colobus verus</i>	Olive Colobus (E)
-do-	<i>Colobus polykomos</i>	Black and White Colobus (V)
Pongidae	<i>Pan troglodytes</i>	Chimpanzee (V)
ARTIODACTYLA		
Suidae	<i>Hylochoerus meinertzhageni</i>	Giant Forest Hog (K)
Bovidae		
Tragilaphinae	<i>Tragelaphus euryceros</i>	Bongo (K)
-do-	<i>Tragelaphus spekii</i>	West African Sitatunga (E)
Cephalophinae	<i>Cephalophus dorsalis</i>	Bay Duiker (K)
-do-	<i>Cephalophus ogibyi</i>	Ogiby's Duiker (V)
-do-	<i>Cephalophus sylvicultor</i>	Yellow-backed Duiker (K)
-do-	<i>Cephalophus spadix</i>	Abbot's Duiker (K)
Alcelaphinae	<i>Damaliscus korrigum</i>	Topi (K)
Gazellinae	<i>Gazella rufifrons</i>	Red-fronted Gazelle (K)
Tragulidae	<i>Hyemoschus aquaticus</i>	Water Chevrotain (K)
Hippopotamidae	<i>Choeropsis liberiensis</i>	Pigmy Hippopotamus (V)
SIRENIA		
Trichechidae	<i>Trichechus senegalensis</i>	West-African Manatee (V)

Dolphinidae	<i>Delphinus capensis</i>	Long-snout dolphin
	<i>Globicephala macrorhynchus</i>	Short-finned pilot whale
	<i>Grampus griseus</i>	Risso's Dolphin
	<i>Orcinus orca</i>	Killer whale
	<i>Lagenodelphis hosei</i>	Fraser's Dolphin
	<i>Peponocephala electra</i>	Melon-headed whale
	<i>Pseudorca crassidens</i>	False killer whale
	<i>Stenella clymene</i>	Clymene dolphin
	<i>S. frontalis</i>	Atlantic spotted dolphin
	<i>Steno bredanensis</i>	Rough toothed dolphin
	<i>Tursiops truncatus</i>	Bottlenose dolphin
<i>S. longirostris</i>	Spinner dolphin	
<i>Pseudorca crassidens</i>	False killer whale	
PROBOSCIDEA		
Elephantidae	<i>Loxodonta africana</i>	African Elephant (V)
Rodentia	<i>Protoxerus stangeri</i>	Giant Forest Squirrel (E)
	<i>Anomalurus peli</i>	Pel's Flying Squirrel (V)
	<i>Anomalurus beecrofti</i>	Beecroft's Flying Squirrel (V)
	<i>Idiurus zenkeri</i>	Zenker's Flying Squirrel (V)
CARNIVORA		
Viverridae	<i>Genetta johnstoni</i>	Johnston's genet
	<i>Poiana richardsoni</i>	African Linsang (K)
Pantherinae	<i>Panthera leo</i>	Lion (V)
	<i>Panthera pardus</i>	Leopard (V)
Fellidae	<i>Laptailurus serval</i>	Serval Cat (E)
	<i>Profelis aurata</i>	West African Golden Cat (E)
	<i>Caracal caracal</i>	Caracal (E)
Hyanidae	<i>Crocota crocota</i>	Spotted Hyena (E)
Canidae	<i>Lycaon pictus</i>	Hunting Dog (E)
-do-	<i>Canis adustus</i>	Side-striped Jackal (E)
PHOLIDOTA		
Manidae	<i>Manis gigantea</i>	Giant Pangolin (E)
	<i>Manis tricuspis</i>	Whitebellied Pangolin (V)
Tubulentata		
Orycterpodidae	<i>Orycteropus afer</i>	Aardvark (E)

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

2.3 BIODIVERSITY OF THE MARINE AND FRESHWATER SYSTEMS

Work on diversity of organisms in marine and aquatic systems has concentrated mainly on those exploited for food (principally mammals, reptiles, fishes and large shelled invertebrates). In cases where certain animal species are found to be disease-causing, as in many water-borne vectors, some limited study on the organisms' biology and possible eradication have been done. Aquatic plants (mostly those considered weeds and noxious to man) have been better studied than marine ones and little or no work appears to have been done on micro-organisms that inhabit such ecosystems.

2.3.1 Marine Systems

Indications of extremely high biodiversity of the benthos of the shallow waters of the continental shelf have been reported in recent studies by the Department of Oceanography & Fisheries of the University of Ghana. About 60% of the soft bottom benthic macro-fauna encountered are believed to be new and unrecorded. There is virtually no information on meio-fauna (dominated by worms, oligochaetes and crustaceans) and micro-fauna (such as ciliates, amoebas and foraminiferans) organisms in benthic waters.

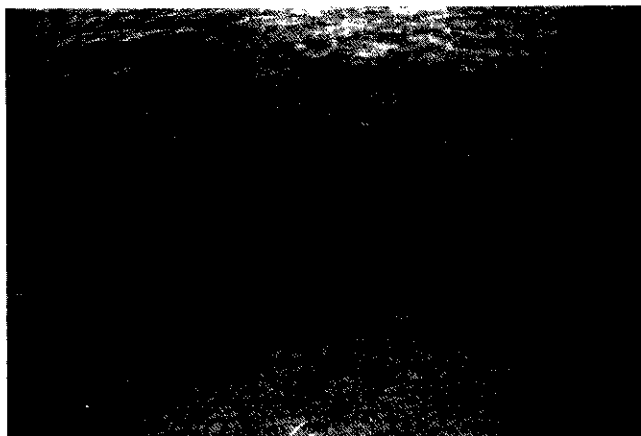


Plate 6: Marine Life

About 392 marine species of organisms comprising 347 fish species belonging to 82 families has been recorded. There is also evidence available that the coastal waters of the country are being invaded by marine algae, a typical example is *Enteromorpha flexuosa*, which is believed to have drifted eastward from areas west of Ghana. See Plate 6.

Although the entire Ghanaian coast environment is devoid of any living coral reefs it has been established that the entire continental shelf is traversed by the belt of dead madreporarian coral at a depth of 75cm.

2.3.2 Fresh water and other near Aquatic Systems

Ghana's freshwater fish fauna includes 28 families, 73 genera and 157 species. About 121 species have been recorded from the Volta system within Ghana, which drains more than a third of the entire country. About nine species viz. *Barbus subinensis* (Cyprinidae), *Irvinea voltae* (Schilbeidae), *Chrysichthys walkeri* (Clariidae), *Synodontis arnouliti*, *S. macrophthalmus*, *S. velifer* (Mochokidae), *Limbochromis robertsi*, *Steatocranus irvinea* (Cichlidae) and *Aethiomastacembelus praensis* (Mastacembelidae) are endemic to freshwater system of Ghana (Dankwa et al, 1999).

Economically, 81 species are of food importance. Species of cultural importance include *Heterotis niloticus* (Osteoglossidae) *Clarias gariepinus*, *Heterobranchus longifilis* (Claridae) *Chrysichthys nigrodigitatus* (Clariidae), *Oreochromis niloticus* (Cichlidae) and *Lates niloticus* (Centropomidae). Some species need to be protected because of their restricted distribution or their habitat degradation or destruction.

Lake ecosystems are scarce in Ghana. The only natural lake system is the Lake Bosomtwi which covers an area approximately 50 square kilometers and has eleven (11) fish species belonging to nine (9) genera and five (5) families. The Volta Lake created in 1964 and inundating some 4,840 square kilometers of pristine natural forest and the two dams on the Volta river at Akosombo and Kpong have indisputably altered the biodiversity and ecology

of the river and adjacent areas. The original Volta River was found to consist of at least 100 fish species (Petr, 1967). Recent studies in Yeji sector of the lake encountered 66 species representing 39 genera belonging to 19 families. Fish species including *Brycinus nurse*, *B. macrolepidotus*, *Eleotris senegalensis*, the bivalve, the Volta clam (*Egeria radiate*), the shrimp, *Macrobrachium spp.*, the West African manatee, *Trichechus senegalensis*, etc. are under severe threat of extinction (Ofori-Danson & Agbogah, 1995).

Other freshwater ecosystems include the major rivers such as the White Volta, Black Volta, Lower Volta and Oti. Others are Pra, Tano, Ankobra, Bia and Todzie-Aka. Also included are other impoundments serving as drinking water sources and/or for irrigation. It is estimated conservatively that about 124 fish species from 62 genera and 26 families inhabit the major rivers.

The coastline of Ghana is lined with about 90 lagoons, several estuaries and rocky shore habitats that exhibit distinct array of biological diversities. Information on faunal, microbial and floral diversity is sparse, except for the five (5) Ramsar sites namely the lagoons of Keta, Songor, Sakumo, Densu delta and Muni-Pomadze where an appreciable amount of knowledge is available. The sixth Ramsar site, the Owabi Wildlife Sanctuary, is the only aquatic protected ecosystem. The Site protects the source of drinking water for Kumasi and its environs.

Access to, use and exploitation of biodiversity is therefore free and uncontrolled. The consequence is over-exploitation, pollution, weed invasions, habitat destruction, and eventual loss of biodiversity and possible extinction.

2.4 ECONOMIC ANALYSIS OF GHANA'S BIODIVERSITY

In Ghana, as in many other countries, people associate biodiversity with the direct economic values that can be derived from it. To some extent, there is appreciation for its indirect use value with regards to ecological and environmental functions of watershed and catchment protection, erosion control, carbon sequestration, air pollution reduction and soil fertility restoration by forests and trees.

In the conservation and use of biodiversity in Ghana, little premium is put on its option existence values. This is the result of the growing demand of people to satisfy present socio-economic needs by exploiting resources at rates and levels that jeopardize the system's ability to sustain these rates and levels. In addition, the entire spectrum of biodiversity values is unknown to many Ghanaians given also that the mode of value assessment is generally cumbersome, unreliable and unsophisticated. Annex I gives an indication of the elements constituting the apparent total economic value of a forest ecosystem. Tutu et al. (1993) conservatively estimated the annual cost of deforestation and land degradation to the Ghanaian economy at about 4% of Gross Domestic Product, approximately US \$54 billion.

Chapter Three

MAIN THREATS TO BIO-DIVERSITY

3.1 GENERAL THREATS

Deforestation: Ghana was once renowned for its extensive forests and wooded savanna, but that has changed drastically. Tropical moist forests originally extended over 145,000 km² of Ghana. By the turn of the century it was estimated that 88,000 km² of forests remained, occupying 35% of total land area. Between 1938 and 1981, the area of closed forest in Ghana was reduced by 64% from 47,000 km² to 17,200 km² and open woodland declined by 37% from 111,000 km² to 69,800 km². By the mid-1970s, more than 90% of the country's high forests had been logged since the late 1940s. The current area of intact forest is now estimated at between 15,800 km² and 17,200 km² which represents between 10.9 and 11.8% of the original cover and 6.9% of the country's total area.

Current deforestation rates average 22,000 ha/annum or about 1.3%. Very little closed forest remains outside the forest reserve network. It is estimated that less than 1% of forest cover is found outside forest reserves much of it in small scattered patches in swamps and sacred groves such as Boabeng-Fiema and Pinkwae forest.

Deforestation is associated with population growth and economic development and is directly linked to clearance for subsistence farming/shifting cultivation (yams), settled agriculture (cocoa), fuelwood and settlement. Fire is commonly used to clear forests. Deforestation of savanna is particularly serious in the Upper East region.

Forest degradation through timber extraction simplifies the structure of forest habitats and removes ecological niches leading to the diminution of species diversity. However not all forest species are threatened by loss of primary forest habitats; species such as bushbuck, Maxwell's duiker and royal antelope can adapt to and thrive in degraded forest habitat and farm fallow. The most serious forest and savanna degradation is occurring outside reserves and these complex systems are being replaced by simpler less diverse ones as a result of continuous destructive farming and fires.

Desertification: Desertification is largely brought about through deforestation resulting from farming practices and fuel wood collection and is a major concern in the semi-arid parts of Ghana. It is estimated that 35% of the land area is subject to desertification. Evidence of increasing aridity includes lowered water tables, siltation of river courses and increased flooding.

The areas of greatest risk are the Upper Eastern Region (where incidentally there are no wildlife protected areas established) and the eastern parts of the Northern Region.

Land degradation is also extensive in the coastal short grass savanna of the Accra plains largely due to the urban demand for fuel wood.

Serious soil erosion is evident in the heavily settled areas of the northern tall grass savanna and has reduced agricultural productivity, carrying capacity, groundwater recharge, regeneration of vegetation. Soil erosion leads to increased sediment loads reducing the useful life of dams and reservoirs. The Volta Lake with its shallow depth (average 19m) is

particularly vulnerable to siltation leading to a lowered generating capacity for the Akosombo dam.

Mining and Quarrying: Mining for gold, diamonds, bauxite and iron ore are long standing and important commercial activities in Ghana. Mining represents a serious threat to forest in certain areas, several which are of high conservation interest such as Afao Hills, Atewa, Cape Three Points and Tano Ofin. Iron ore extraction around Awaso (Afao) led to forest destruction. Gold mining is expanding and together with its associated pollutants, particularly arsenic oxide, represents a serious threat to forest reserves in the genetically rich wet evergreen forest zone.

Bushfires: In 1982-83, following severe droughts, uncontrollable bushfires accompanied by strong harmattan winds, devastated large tracts of land in Ghana and caused widespread famine. It is estimated that approximately 50% of Ghana's vegetation cover and about 35% of standing crops and cereals were destroyed. Prior to 1982 the Bomfobiri Wildlife Sanctuary was covered by Dry semi-deciduous high forest; this was largely destroyed by fires and now consists of open savanna communities and isolated forest remnants. Faunal diversity has been significantly reduced.

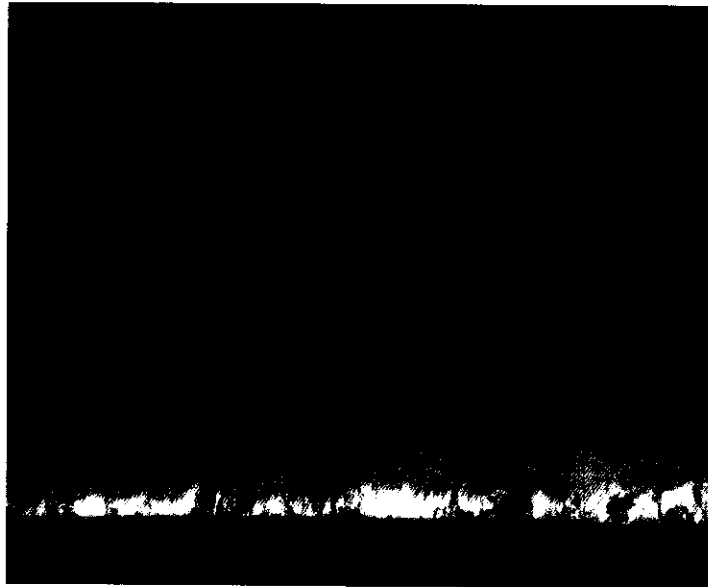


Plate 7: Bushfires

Bushfires spread from local fires used to flush game, clear fields and induce a dry season growth of grass for stock. Legislation controlling bushfires is poorly enforced and regulations widely disregarded. The incidence of bushfires is on the increase in the high forest zone where many plant and animal species are not fire-resistant and are therefore highly susceptible to destruction when bushfires occur. The result is habitat degradation and serious loss of biodiversity. See Plate 7.

Wildlife Hunting: In Ghana, the meat from wild animals is a major source of protein and hunting is important for rural subsistence. Though all species of mammals are eaten cane rats (grasscutter), antelopes and primates are the favoured bushmeat. In 1991, the volume of annual bushmeat hunted was estimated at about 384,000 metric tonnes. In many areas over hunting has contributed to a steep decline in species numbers and diversity. Hunting both within and outside wildlife and forest reserves threatens several species, particularly primates, with local extinction (C.I-Ghana, 2002 a).

There are very few areas outside conservation areas where viable populations of larger mammals are now found. Though protected by law several marine species are locally threatened. Sea turtles, notably green, leatherbacks and hawksbill, are killed for food, either at sea or when they come to nest.

Hunting at night using lights, the tradition of group or communal hunting, the use of fire, chemicals and snares have contributed to a precipitous decline in wildlife in Ghana.

Sedimentation The amount of suspended matter in flowing, due to natural and anthropogenic factors, clearly affect the velocity of the current in our rivers and streams.. This has many repercussions both for the morphology of the rivers and the biodiversity therein. The amount of suspended matter also affects the penetration of light into the water and likely affect productivity. High sedimentation occurs during run-off from rainfall an at points of discharge from drains/sewers and other waste pipes. Fauna most affected are filter feeders or those with life-stages employing respiratory/feeding. Their feeding organs get clogged. This action is detrimental to their survival. Other aquatic animals that rely on sight for feeding, migration or reproduction are also negatively affected.

Siltation: Increases in silt load resulting from changes in land use (eg. Agriculture and urbanosatio) or water use, accelerate the natural evolutionary processes of river and stream ecosystems, but in doing so cause a number of problems. The deposition of fine particles of silt on substrates, suffocates bottom organisms and cut down availability of their food. Such choking of the substrate may also render it unsuitable for spawning by those species requiring swift, well-aerated flows and clear pebble or gravel bottoms. The silt provides anchorage for vegetation, blocking flow order of streams and even may divert them into new courses. Siltation of freshwater ecosystems leads to reduction in flow resulting in the progressive restriction of these water bodies to smaller bed within the original channel with a concomitant loss of habitats for fish and other aquatic organisms.

Flooding: Flooding originates from overspill, river channels, local rainfall and tides. It may either introduce nutrients into an ecosystem or wash away both nutrients as well as vulnerable fauna especially' juvenile stages. This may lead to complete loss of and entire generation of a species.

Soil Erosion Soil erosion occurs when the rate of removal of soil by water and/or wind exceeds the rate of soil formation. It is important to differentiate between natural erosion and erosion which has been accelerated largely as a result of human activity .Land use is perhaps the most significant factor influencing soil erosion in the country. This is because many land-use practices and construction of infrastructure leave the soil devoid of a protective vegetation cover, or with only a partial cover, for significant periods of time. Also there is mechanical disturbance of the soil. Specific aspects of land use often associated with accelerated soil erosion include expansion and intensification of arable cultivation, overgrazing, deforestation, unhealthy forestry practices, increasing demand for fuel-wood, site clearance in preparation for urban and industrial construction. They lead to changes in the soil ecology and hence the diversity of species in soils.

Coastal erosion destroys life in the inter-tidal area as well as disturbs life in near-shore coastal waters. For instance, essential sandy habitats for sea turtles may be lost. Extensive coastal erosion is also not only detrimental to the activities of artisanal fishermen for fish landing sites but also may in the long term degrade vital fish spawning sites.

Eutrophication: This refers to nutrient enrichment of surface waters often resulting in the growth of algal blooms and reduced oxygen levels in water. This is a process that affects Ghana's lakes and other bodies of water. Studies undertaken in the Department of Oceanography and Fisheries, University of Ghana indicate harmful marine algae in Ghanaian

waters, which have potential to bloom at high nutrient values. During eutrophication, the quality of the affected water deteriorates until it becomes unfit for use by human beings. The lakes and rivers become foul smelling and can no longer support many fish and other aquatic species. Fish kills may result and biodiversity will decrease. Many waters in Ghana may undergo eutrophication as they continue to be polluted by upsetting the nutrient balance. Much of the excess nutrient material that enters our bodies of water comes from sewage. In particular, the use of detergents that contain phosphate greatly increases the quantity of phosphates entering our rivers and lakes through sewage. Rain washes nitrate from fertilizers off farms and into ponds and streams. Nitrates from automobile exhaust enter the water in the rain, and industrial plants discharge nutrients in wastewater, livestock wastes and agricultural run-off. All these favor eutrophication and serve as threat to biodiversity in the country.

Drought: In areas commonly affected by drought, lack of irrigation and lack of rain cause vegetation to wither and die. Higher than normal temperatures usually accompany drought. These high temperatures beyond threshold levels that can normally be tolerated increase stresses on plants and animals and add to tremendous loss of biodiversity.

Over-exploitation The demand for natural resources (fishing, fuel-wood gathering, charcoal making, hunting for birds and mammals, grazing etc) due to increasing population has led to over-exploitation of many fisheries resources of Ghana. Overexploitation of wetland forests (mangroves) and fisheries can cause changes in biodiversity of wetland habitats. Clear cutting of swamp or mangrove forests exposes the wetlands to erosion, produces change in the soil fauna, and causes loss of protection and food for juvenile fish species.

Water Pollution: The threats to biodiversity due to water pollution arise from municipal, agricultural and industrial activities. These include solid waste refuse, siltation, sewage-faecal, mining, pesticides, fertilizers and salinisation of soils.

Urbanization: The biodiversity of Ghana is under enormous threat due to the quest for socio-economic development, especially urbanisation, industrialization and tourism (eg. provision of hotel facilities, influx of people on our beaches for recreation etc). There is an urgent need to exploit our natural resources in a manner that may not cause irresponsible loss of biodiversity. A critical look at the impact of these development-oriented activities on the fragile ecosystem is required.

Forest Conversion Floral biodiversity “thinning” or loss as experienced in Ghana may be attributed to a number of factors including permanent conversion of natural forests into other land-use forms such as crop cultivation, grazing, mining, infrastructure and settlement development. Since these activities increase with rising population growth, the rate of biodiversity loss accelerates. Though plant domestication (for instance, agricultural and forest plantation monocrops) may bring tremendous benefits to communities and the nation as a whole, its impacts on the country's biodiversity may be disastrous as indigenous species are threatened, displaced and replaced with, most often, fast-growing and genetically and phenotypically inferior introduced species and improved varieties. It is documented that such species as the African yam bean, *Sphenostylis sternocarpa*, hungry rice, *Digitaria exilis*, Casting's groundnut, *Kerstingiella geocarpa* and the rice species, *Oryza glaberrima* are being pushed into extinction through the introduction of exotics which are mostly high-yielding. Similar observations have been made in relation to woody forest

species where fast-growing exotics such as *Leucaena leucocephala*, the neem, *Azadirachta indica*, etc., have spread vigorously mainly in the savanna zones displacing virtually all indigenous plant species.

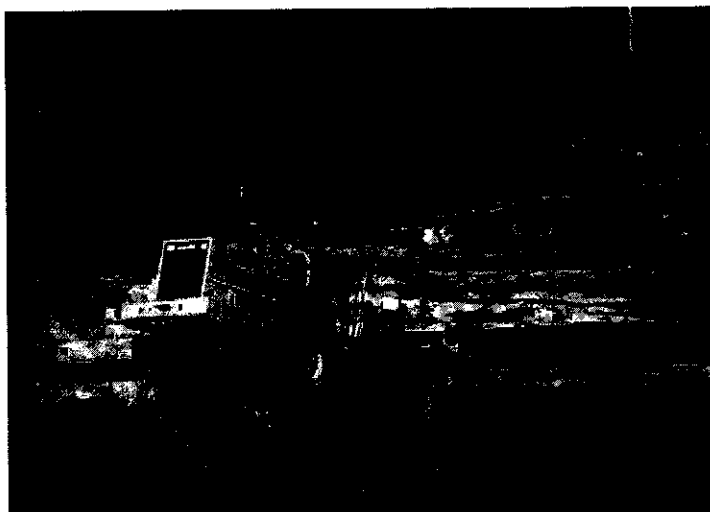


Plate 8: Logging in High Forest

The same factors that account for the “thinning” or loss of plant biodiversity may result in decline and loss of animal biodiversity. Forest conversions into other land use forms such as for timber harvesting, fuelwood gathering, crop cultivation, tree plantation establishments, mineral ore extraction and wildfires set deliberately or inadvertently may alter significantly species numbers and diversities as habitats and food sources are removed and other tropic

relationships are disrupted. See Plate 8. A number of species of wild animals have been identified as vulnerable or under threat in Ghana (see Table 4).

Gene dilution among wild animal populations is generally and expectedly low due to the insignificantly low numbers of introductions with exotic species (an exception has been the escape of the introduced European rabbit, *Oryctolagus cuniculus* into wild).

In the case of domesticated animals (e.g. cattle, sheep, goats, pigs, poultry, horses, donkeys, cats, dogs, etc.) indiscriminate crossbreeding with exotic species appears to be the main threat to the gene pool of indigenous domesticated animals as certain survival potentials against biotic and abiotic agents associated with the indigenes get lost. The importance of domesticated animals to most people in Ghana as protein source is not to be denied and, therefore, the need to ensure an implementation of an animal production programme that guarantees the lowest minimum of gene dilution cannot be overemphasized.

Weak legislation and institutional structures: Environmental legislation in Ghana is fragmented, much of it has been initiated in an ad hoc manner due to the lack of coherence in environmental planning and policy process. This has resulted among other things in the poor co-ordination of management between wildlife and forestry departments and often contradictory policies and activities (CI-Ghana, 2002b).

Past forest management was focused on only the reserved forest which constitutes the 20% of Ghana's land surface area. The result has been the loss of the rest of the 80% unreserved forest to other forms of land use. Consequently, the reserved forest and protected areas are now highly fragmented (Fig.6).

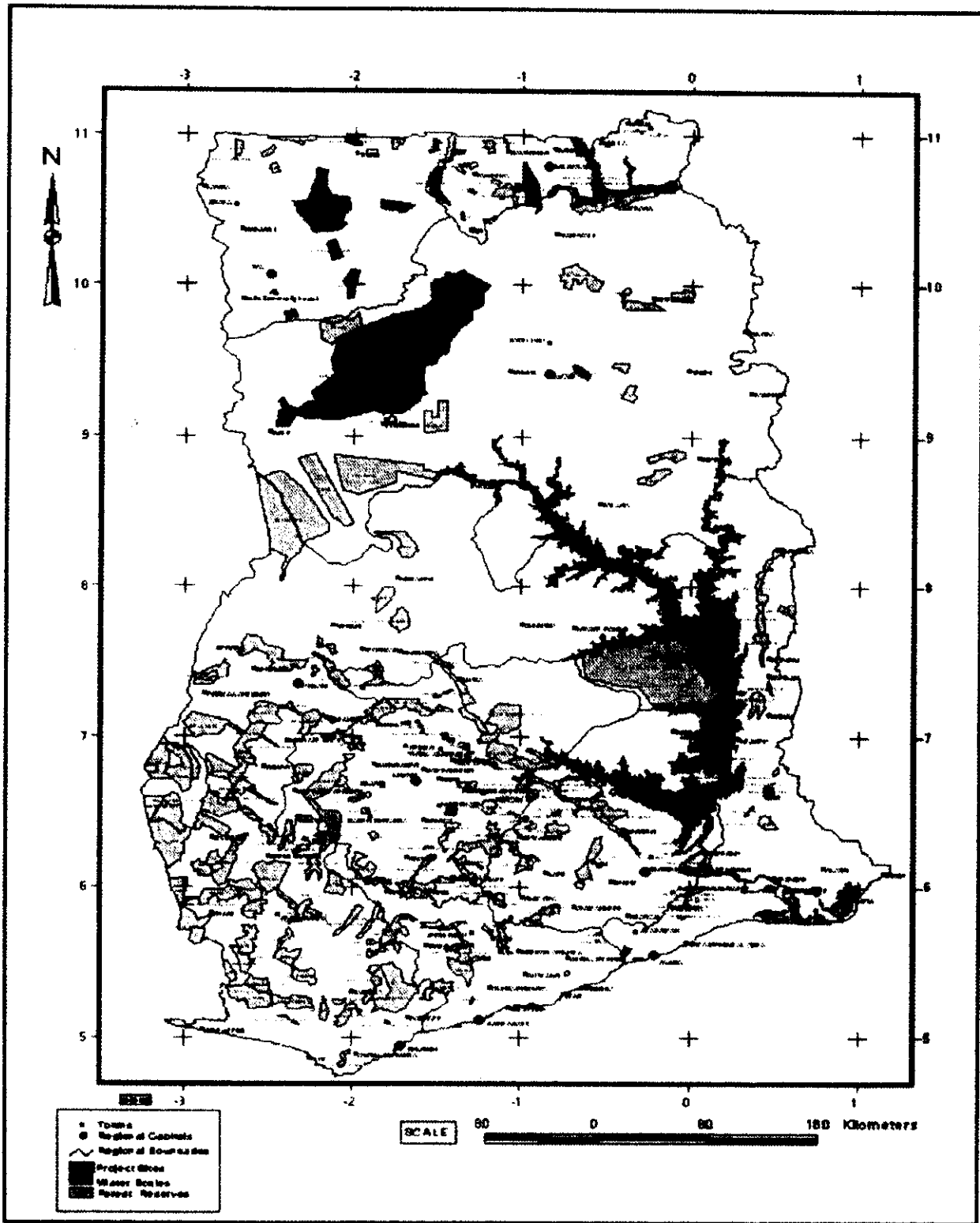


Figure 6: Remaining Forest Fragment in Ghana (Forest & Wildlife)
(Forests And Protected Areas)

CHAPTER FOUR

IMPACT OF POLICY, LEGISLATIVE AND INSTITUTIONAL FRAMEWORK ON BIODIVERSITY MANAGEMENT AND CONSERVATION

4.1 INTRODUCTION

Ghana's socio-economic development and growth in the past had been achieved almost exclusively at the expense of the physical and non-physical environment. As indicated above, the cost of environmental degradation on yearly basis had been estimated conservatively at about 4% of the country's gross domestic product. It is a truism that the country's biodiversity is threatened as the physical environment gets degraded.

Although little or no work has been done to identify the impact on the country's biodiversity management and conservation of underlying factors such as government policy failures, legislative inadequacies and non-enforcement/non-compliance and institutional deficiencies and weaknesses, there are convincing indications that these factors have led to marked decrease in the country's biodiversity. Good implementable policies, enforceable legislative arrangements and better-strengthened institutions may be the key to ensuring a decline in the rate of biodiversity loss and consequently the strengthening of management and conservation potentialities.

4.2. GOVERNMENT AND SECTORAL POLICIES

Government socio-economic policies, especially its macro-economic policies (e.g. Economic Recovery Programme, Structural Adjustment Program, trade liberalization and subsidies) may have contributed to accelerated natural resources (including biodiversity) degradation and loss. Macro-economic and industrialization policies of past and present governments have led to conversion of forested lands into other land use forms, mainly agriculture, mining, timber and fuel-wood exploitation.

Sector policies in the past were developed and implemented in isolation from others and were therefore non-integrative and non-holistic. Sectoral interests dominated at the expense of the 'global'. See Annex II. The 1948 Forest Policy, for instance, encouraged the conversion of off-reserve forests into non-forest land use forms, led to serious degradation and loss biological diversity. To correct the anomaly, a new Forest and Wildlife Policy has been formulated which seeks to promote the sustainable management and conservation of forest and wildlife resources. Other innovations include the Ghana Poverty Reduction Strategy and the establishment of the Forest Plantations Development Fund to develop alternative fuelwood resources that would reduce the pressure on the natural forests.

The rationale for a new policy direction in sound biodiversity management, development and conservation is indisputable: Ghana loses annually over 22,000 ha of its forests and as these are turned to 'wastelands', biodiversity declines and possibly gets lost. Economically, ecologically and even ethically the status quo can not be upheld because generations yet unborn will hold the present one accountable for biodiversity loss or decline.

It is evidently possible to develop socio-economically and culturally without putting insurmountable stress on the very system on which the development and growth depends. It is worth noting that development can take place without necessarily harming the environment, so that we can continue to maintain health and functional ecosystems.

In charting a new direction for the conservation and sustainable use of biodiversity, the following considerations become imperative:

- i) conservation and biodiversity use programmes and activities should take full account of the area in its totality with regard to its natural characteristics, social and economic features;
- ii) recognition and appreciation of traditional conservation and exploitation practices and their integration into modern conservation and exploitation methods;
- iii) developing and strengthening capacities to gather and manage scientific biodiversity data and information;
- iv) full and active participation of communities, traditional authorities and local people in decision-making, design, implementation and monitoring of conservation programmes;
- v) defining what constitute sustainable exploitation levels;
- vi) impact of new technologies such as biotechnology;
- vii) assessment of the country's development path and vision and its effect on the country's biodiversity;
- viii) defining the appropriate status of all entities with stake in the country's biological resources;
- ix) implementing appropriate regulation, management and monitoring systems and tools, such as, impact assessment, precautionary approach and the polluter-pays-principle;
- x) individual policies should not conflict but lend themselves to integration to ensure effective implementation;
- xi) empowerment of owners of biodiversity in the conservation and sustainable use of its resources; and
- xii) equitable and fair sharing of benefits accruing from the conservation and sustainable use of components of biodiversity.
- xiii) Recognition of the fragmented nature of Ghana's forests and the need to promote the development of biological corridors so as to maintain the flow of appropriate genetic resources essential for their sustainability;

- xiv) Protect traditional knowledge systems (eg. Ethno-botany) through patent rights.

4.3 Legislative Framework

There are a number of legislation governing management, development and conservation of specific natural resources. Most of the legislation tends to be sector-based; they may be conflicting, obsolete, deficient and unenforceable. More so, there is no single comprehensive legislation in the country that handles all natural resources in totality. Neither is there a

Box 1: PARTIAL LIST OF LEGISLATION RELEVANT TO BIOLOGICAL DIVERSITY

Forest Protection Decree, 1974 (NRCD 243)
Trees and Timber Decree, 1974 (NRCD 273)
Trees and Timber Regulations, 1961
Sections 1 and 16 of the Concessions Act, 1962 (Act 124)
Wild Animals Preservation Act, 1961 (Act 43)
Wildlife Conservation Regulations 1971 (LI 685)
Wildlife Reserves Regulations 1971 (LI 710), 1983

Oil in Navigable Waters Act, 1964
River, Lakes and Beach Law (under review)

Fisheries Decree (1972)
The Fisheries (Amended) Regulations (1977)
The Fisheries (Amended) Regulations (1984)
The Volta River Development Act 1961
The Ghana Water and Sewerage Act 1965

Land Planning and Soil Conservation Act, 1957
Town and Country Planning Ordinance 1945 (Cap 84)

Minerals and Mining Law 1986 (PNDC 153)

Prevention and Control of Bushfires Law (1990)

Economic Plants Protection Decree, 1979 (AFRCD 47)

Forest Ordinance 1902
Forest Ordinance 1927 (Cap 157)
Trees and Timber Ordinance, 1949
Forest Fees Regulations 1976 (LI 1098)
Forest Protection (Amendment) Law 1986 (PNDCL 142)
Timber Resource Management Act, 1997 (Act 547)

specific elaborate legislation on biological diversity. There are some legislation that have relevance to biodiversity use and conservation. Some of these are outlined in Box 1.

Despite the existence of various legislation, the conservation and management of the country's biological resources still leaves a lot to be desired. While legislation on the use of resources of the terrestrial systems abound, there exist only a few national legislation that deal with the protection of the marine environment. The consequence of this is the misuse and abuse of the marine environment for the discharge of domestic and industrial waste from land, ships and aircraft.

Although Ghana is signatory to and has ratified a number of international conventions and agreements relating to the environment in general and biological resources in particular, she has failed to translate many of them into national legislation for implementation purposes. (A partial list of conventions to which Ghana is signatory has been provided in Box 2).

There is, however, a ray of hope as efforts are being made to first review and reconcile all existing legislation on natural and environmental management, development and conservation in the country with the aim of developing omnibus laws on the environment and on forest and forestry. The Act establishing the Environmental Protection Agency (Act 490 of 1994), a regulatory body, for the first time, requires that all developments and policy directions be subjected to an environmental/strategic impact assessment. The District Assemblies Law prescribes an

eventual take-over of or participation by District Assemblies in the management and development of natural and environmental resources under their respective jurisdiction. It is expected that the devolution of management authority to the real custodians and local level administration would ensure rational use of these biological resources and the associated conservation of biological diversity. District Assemblies are empowered to enact bye-laws on natural resources management and conservation.

Despite the existence of various legislation, the conservation and management of biodiversity is far from satisfactory due to poor compliance and enforcement of these.

Box 2: Conventions Related to Biodiversity Conservation to which Ghana is Signatory

1. *International Convention for the Prevention of Pollution of the Sea by Oil: 21 October 1962.*
2. *Convention on the African Migratory Locust: 25 May 1962.*
3. *Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water: 5th August 1963.*
4. *International Convention for the Conservation of Atlantic Tunas: 4 May 1966.*
5. *African Convention on the Conservation of Nature and Natural Resources: 15 September 1968.*
6. *International Convention on Civil Liability for Oil Pollution Damage: 29 November 1969.*
7. *International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualities.*
8. *Convention on Wetlands of International Importance, Especially as Waterfowl Habitat: 2 February 1971.*
9. *Treaty on the Prohibition of the Emplacement of Nuclear Weapons of Mass Destruction on the Seabed and the Ocean Floor and in the Subsoil Thereof: 11 January 1971.*
10. *International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage: 18th December 1971.*
11. *Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxic Weapons and on their Destruction: 10 April 1972.*
12. *Convention Concerning the Protection of the World Cultural and Natural Heritage: 16 November 1972.*
13. *Convention on International Trade in Endangered Species of Wild Fauna and Flora: 3 March 1973.*
14. *Convention Concerning Prevention and Control of Occupational Hazards Caused by Carcinogenic Substances and Agents: 26 June 1974.*
15. *Convention on the Military or Any Other Hostile Use of the Environmental Modification Techniques: 10 December 1976.*
16. *Convention Concerning the Protection of Workers Against Occupational Hazards in the Working Environment due to Air Pollution, Noise and Vibration: 20 June 1977.*
17. *Convention on the Conservation of Migratory Species of Wild Animals: 23 June 1979.*
18. *United Nations Convention on the Law of the Sea: 10 December 1982.*
19. *International Tropical Timber Agreement: 18 November 1983.*
20. *Montreal Protocol on Substances that Deplete the Ozone Layer: 16 September 1987.*
21. *Vienna Convention for the Protection of Ozone Layer: 24 July 1989.*
22. *Convention on Biological Diversity, June 1992.*
23. *Convention to Combat Drought and Desertification.*
24. *Framework Convention on Climate Change, June 1992.*

4.4. Institutional Arrangements

A number of governmental and non-governmental institutions, associations and groups exist in the country. Among the state institutions, which have policy and legislative functions, are the ministries and some commissions. Notable among these are:

- National Development Planning Commission;
- Ministry of Environment and Science;
- Ministry of Lands and Forestry;
- Ministry of Food and Agriculture;
- Ministry of Works and Housing;
- Ministry of Mines and Energy;
- Ministry of Justice;
- Ministry of Local Government and Rural Development;
- Ministry of Trade and Industry;
- Forestry Commission;
- Minerals Commission;
- Fisheries Commission; and
- Water Resources Commission.

The National Development Planning Commission has overall responsibility for developing the national development framework within which all sectoral programmes, policies and attendant legislation have to converge. Basically, it is at this Commission that harmonization and integration of sector policies and programmes into a holistic composite is carried out to ensure sustainable socio-economic, cultural and environmental development.

The implementation of composite national or sector policies, programmes and legislation is undertaken by specialized departments, research institutions and agencies under the policy making institutions the ministries. While individual departments or agencies are mandated to manage, develop and conserve specific natural resources, it is the Environmental Protection Agency that is entrusted with the overall responsibility of environmental regulation and, to some extent, the regulation of the management and conservation of biodiversity. Other institutions and agencies which also have research responsibilities include:

- Water Resources Commission
- Fisheries Commission;
- Forestry Division of the Forestry Commission;
- Wildlife Division of the Forestry Commission;
- Fisheries Directorate ;
- Mines Department;
- Universities of Ghana;
- Council for Scientific and Industrial Research;
- Centre for Scientific Research into Plant Medicine;
- Biotechnology and Nuclear Agricultural Research Institute of the Atomic Energy Commission
- Cocoa Research Institute of Ghana
- Registrar Generals Department;

- Trades Union Congress;
- Non-Governmental Organizations;
- District Assemblies;
- Local communities and associated community-based organizations;
- Youth and women's groups; and
- Ghana Federation of Traditional and Alternative Medicine (GAFTRAM)

In spite of the existence of a number of institutions and departments, biodiversity management and conservation has been far from satisfactory. A major constraint has been the lack of coordination, collaboration and networking between and among policy developing institutions on one side and policy-implementing institutions on the other side. The consequences have been overlaps, duplications, conflicts, unhealthy competitions, disharmony, etc.

Furthermore, there are undeniable weaknesses in the capacities and capabilities of some institutions. Lack of baseline data and deficiencies in information management constrain resource management. However, emerging high technology information systems such as remote sensing and satellite imageries, geographic information systems, global positioning systems are becoming accessible now in the country. These tools will assist in ensuring excellent monitoring of trends in the management and development of biodiversity in the country.

The role played by local community participation and traditional knowledge in resource use and biodiversity conservation, are recognized as a first step towards ensuring the implementation of policies and programmes. Another innovative step that has been taken by the Government of Ghana is the development of an environmental education strategy being implemented under the leadership of the Environmental Protection Agency.

Ghana recognizes the important role of international cooperation and linkages in biological diversity conservation. It is a member of a number of international organizations such as the United Nations and its Commissions and agencies, International Tropical Timber Organisation, African Timber Organisation, the World Conservation Union (IUCN), The African Union, ECOWAS, etc. Ghana works with the convention secretariats and the multilateral and bilateral development institutions such as the World Bank, International Monetary Fund and the African Development Bank in her various programmes aimed at the sustainable development of her natural resources.

Chapter Five

STRATEGIC FRAMEWORK FOR BIODIVERSITY CONSERVATION AND MANAGEMENT

5.1 INTRODUCTION

Ghana's policies relating to the conservation of biodiversity and the sustainable utilization of biological resources are guided by the three objectives of the Convention on Biological Diversity, namely:

- the conservation of biological diversity;
- the sustainable utilization of biological resources; and
- the fair and equitable sharing of benefits arising from the use of genetic resources.

5.2. CONSIDERATIONS FOR CONSERVATION AND SUSTAINABLE MANAGEMENT OF BIODIVERSITY

5.2.1 *Conservation of Biological Diversity*

Issues which need to be considered include:

- a) Conservation taking full account of the natural characteristics of the area;
- b) Traditional conservation practices;
- c) Acquisition, compilation and dissemination of scientific knowledge and information;
- d) Getting all stakeholders involved in conservation measures as well as in monitoring and evaluation all levels of biodiversity.

5.2.2 *Sustainable Management of Components of Biodiversity*

The following have to be considered in the sustainable use of biodiversity:

- (a) Acquisition, compilation and dissemination of scientific knowledge and information;
- (b) Impact assessment/precautionary approach;
- (c) Assessment of traditional methods of exploitation;
- (d) Exploration of new technologies, such as biotechnology; and
- (e) Assessment of what constitutes sustainable levels of exploitation.

5.2.3 *Fair and Equitable Sharing of Benefits*

- a) Formulate effective agreement for regulating biospecting;
- b) Evaluate all benefits sharing mechanisms;

5.3 LONG-TERM GOALS

The long-term goal of the country's strategy is to achieve the conservation and sustainable management of the country's biological diversity. This must be achieved throughout the whole country and within all representative ecological zones.

5.4 THE IMMEDIATE OBJECTIVES OF THE STRATEGY

The immediate objectives for achieving the above goals are as follows:

- a) No species must be threatened with extinction;
- b) Areas critical for the conservation of biodiversity must be properly conserved, with the active participation of all stakeholders;
- c) The use of components of biodiversity must be in a sustainable manner, with due consideration being taken of the sharing of benefits arising from the use of these resources; and
- d) The public sensitized as to their rights and responsibilities.

Chapter Six

VISION, GUIDING PRINCIPLES AND BASIS FOR THE BIODIVERSITY STRATEGY

6.1 THE VISION

The vision of the government of Ghana is to transform the country into a middle-income country where the people live in harmony with their natural environment, with the population deriving optimum benefits through sustainable use of the country's rich tropical biological diversity.

The policy statements and objectives are provided in Box 3 and 4 respectively.

6.2 GUIDING PRINCIPLES

Conservation and sustainable utilisation of the nation's biological diversity will be based on the following principles:

- The conservation ethic, including the inherent right to existence of all living forms, is deeply rooted in the indigenous socio-cultural values of Ghanaians.
- Biological resources are natural capital and their conservation should be an investment that will yield benefits locally, nationally and globally for the present and future generations.
- Benefits accruing from the utilisation and conservation of biological diversity are to be shared equitably and fairly among all stakeholders. Benefits arising from the innovative use of traditional and customary knowledge of biological diversity will also be equitably shared with those from whom the knowledge has been acquired.

BOX 3

POLICY STATEMENT

The Government of Ghana's policy on biological diversity is to conserve the country's biological diversity while ensuring that the biological resources provide lasting social, economic and environmental benefits to the population through their efficient and equitable use.

The policy will be an integral part of an iterative process for managing the country's resources and development efforts and will be monitored and reviewed regularly. Strategies for implementation will be responsive to social, economic and environmental change, as well as to technological advances. Due concern will be given to the sustainable management of the resource.

The interdependence of nations on biological diversity and in the utilization of its components for the well-being of mankind is recognised. Ghana will thus exercise a proactive and constructive role in promoting international cooperation and collaboration as vital tools for the fair and equitable sharing and management of biological resources and of technology.

- The sustainable management of biological diversity is the responsibility of all sectors of society.

- Government will formulate and implement the policy framework for sustainable management and utilisation of biological diversity in close consultation with and the active participation of all stakeholders.
- The conservation and sustainable utilisation of biological diversity will be integrated at all levels into national, regional, district and sectoral planning efforts to implement the goals and objectives of the policy effectively.
- Decisions on the conservation and sustainable utilisation of the country's biological resources will be guided by pragmatic approaches which assess the full social, economic and environmental costs and benefits of projects.
- Decisions relating to the conservation of biodiversity and the sustainable utilisation of biological resources will be based on the best applicable knowledge available. Information to ensure the conservation and sustainable utilisation of biodiversity will be available in an accessible form.
- Where there are threats of serious or irreversible damage to biodiversity, the inadequacy of scientific knowledge will not be used as a reason for postponing cost-effective measures to prevent degradation or loss.
- The role of local communities and the wealth of traditional knowledge in the conservation, management and utilisation of biological diversity must be recognised, protected, maintained, promoted and used with the approval and involvement of those who possess this knowledge.
- Public awareness and education is essential for ensuring the conservation of biological diversity and the sustainable utilisation of its components.
- The success of the programmes for the conservation and sustainable utilization of the country's biodiversity will be supported by a number of economic and social incentive measures and sanctions.

Box 4

OBJECTIVES FOR CONSERVATION AND SUSTAINABLE MANAGEMENT OF BIOLOGICAL DIVERSITY

- *To identify conservation priorities based on assessment of biodiversity and threats.*
- *To maintain and improve environmental stability for proper functioning of ecological systems.*
- *To optimise utilisation of the components of biological diversity for sustainable socio-economic benefits to ensure long-term food, shelter and health security.*
- *To ensure preservation of the unique biological heritage of the nation for the benefit of present and future generations.*
- *To enhance scientific, traditional and technological knowledge, as well as educational, social, cultural and aesthetic values of biological diversity.*

Chapter Seven

KEY ISSUES REQUIRING ACTION

7.1 INTRODUCTION BASIS FOR ACTION

As discussed extensively in Chapter 3, biological resources remain the cornerstone of the country's march towards achieving socio-economic and cultural development and growth. They are undoubtedly a major capital asset with an excellent potential for yielding sustainable benefits.

At the same time that there is the recognition of the immense potentials of biological resources, Ghana's biological diversity continues to be destroyed and lost. This realization about the possible consequences of degradation or loss of biodiversity to mankind in general and Ghana in particular calls for urgent and decisive actions towards the sustainable management and use of biological resources as well as the conservation of biodiversity. Any time a portion of the forest is lost, a habitat for various species of animals and plants gets destroyed. At the same time, a few species, including rare, endemic and already threatened ones, also perish and die out.

7.1.1 The Main Issues

At the national and local levels, there are issues that need to be considered now once the country has agreed to put the utmost premium on the conservation and maintenance of genetic resources, species and ecosystems/habitats, with the view to harnessing the natural resources endowment for development and growth. Such issues may, among others, include:

- a) building and enhancing capacities at both national and local levels for the assessment, study and systematic observation and evaluation of biodiversity needs, as well as exchange of data and information;
- b) identifying and implementing effective national actions and soliciting and promoting international cooperation for biodiversity management and conservation, particularly for in-situ ecosystem protection and ex-situ protection of genetic resources, species as well as for the enhancement of ecological functions and processes;
- c) effectively empowering and granting full and active participation and soliciting for the support of local communities, traditional authorities, youth and women's groups and other stakeholders in the sustainable management of biodiversity and the use of its components;
- d) promoting the effective and efficient use of recent advances in environmentally sound technologies, including biotechnology, in fields such as agriculture, health and welfare, and instituting appropriate channels and mechanisms for their transfer;
- e) incorporating the useful wealth of traditional resource use and conservation knowledge and skills into modern technologies and making these available to all stakeholders;

- f) educating the public and creating awareness among all stakeholders about the status and importance of biodiversity as well as the need to wisely use and conserve these;
- g) developing appropriate measures and structures for the fair and equitable sharing of benefits derived from the use and conservation of biodiversity as well as from research and development;
- h) redefining and asserting tenurial rights that guarantee fair and equitable sharing of benefits from and access and rights to the use of biological resources.
- i) establishing a National Biodiversity Commission in the medium term future, to ensure effective coordination of all issues related to biodiversity conservation and management.

7.2 CREATION AND STRENGTHENING OF THE MANAGEMENT OF PROTECTED AREA SYSTEMS

The rationale for the creation of forest and wildlife reservation under the British colonial administration in the early 1900s was undoubtedly not to ensure protection or conservation of these systems from anthropogenic threats, but was to ensure sustained timber yield, ready game hunting opportunities and protection of humans from wild animals classified as harmful and dangerous. The creation of institutions such as the Departments of Forestry and Wildlife and the empowerment of traditional authorities to set aside reservations were done with the aim of ensuring that they fully provided certain functions and services.

These laudable intentions of forest reservations for economic and ecological purposes were occasionally threatened as forest lands were forcibly put under reservation by the colonial authorities without offering the rightful owners adequate compensations.

Owners were alienated from the resource. They were denied access to their lands and required permits to enter and use the resources. Clearly, these arrangements were unsatisfactory to the land owning entities and disregard (i.e. non-compliance) of laid down legislation and regulations became the order of the day.

7.2.1 Permanent Protected Forests (Forest Reserves)

To date there exist over 280 forest reserves spread over all ecological zones of the country. These make up about 11% of the total land surface area of Ghana. All identified vegetation types of the country are represented.

Reserves have been created in the forests of the wet evergreen, moist semi-deciduous and dry semi-deciduous, as well as in the northern and southern savannas, coastal and mangrove vegetation types. These reserves are designated mainly as productive and/or protective. Some 75% of forest reserves are exploited for timber and non-timber forest products including fuel-wood, herbal medicines, cane and rattan. Designated protective forest reserves provide protections for watersheds and catchment. Entry into forest reserves is entirely through a permitting system administered by the Ministry of Lands and Forestry or any of its departments.

Though there is legislation prohibiting using lands at both sides of rivers and streams, most of the banks of these water bodies have little vegetation and consequently of few or no wild

animals. A mandatory distance of 50 m from banks of rivers must be kept not and to be encroached upon. Most of the forest reserves have been badly logged or cleared for crop production and mining, or degraded as a result of sweeping bush fires. The alien plant species, *Chromolaena odorata*, has colonized many degraded forests, displacing indigenous species. *Leucena leucocephala*, a fast growing and an easily dispersible plant species, out-competes with indigenous species in degraded savanna woodlands. Current level of knowledge about the status of the reserves in terms of size and composition is inaccurate, unreliable and obsolete.

7.2.2 Other Innovations in Biodiversity Conservation

Globally Significant Biodiversity Areas (GSBAs) The Forestry Division of the Forestry Commission has re-designated about 29 of the existing forest reserves, covering an area of about 117,322 ha, as Globally Significant Biodiversity Areas (GSBAs). The creation of the GSBAs was attributed to the fact that those reserves were found to harbor a high concentration of biological resources of global conservation importance. Logging and other commercial extractive activities are excluded, while new management plans are being developed to ensure community participation and effective conservation and sustainable management of the biological resources of these areas. The recognition of the need to manage some of the existing forest reserves with emphasis on biodiversity conservation, is an innovative step by the Forest Services Division in terms of appreciating the need to conserve the biological resources of the nation (NRMP, 2001).

Important Bird Areas (IBAs) The Important Bird Areas (IBAs) concept uses birds as indicators of habitat quality. The concept also provides a practical index of the diversity and condition of an ecosystem on a site-by-site basis. Therefore, it is believed that conserving and managing such sites will result in the wise use of some of the most sensitive, fragile and ecologically rich habitats in the world. The concept was developed in Europe to advocate the conservation of sites that are nationally and globally important, and considered to be of critical importance for naturally occurring bird population, as well as biodiversity in general. There are 36 of such areas of global significance made up of protected areas and forest reserves covering an area of about 11,494 km² (4.8% of the country's land surface area) identified by BirdLife International in Collaboration with the Ghana Wildlife Society. Of the total area covered by IBAs 42 % is forest, 48% is savanna and the 9.2 is wetland. With the exception of the Mount Afadjato and the Amansuri wetland, all the other IBAs, fall within the protected areas, forest reserves or Ramsar sites. The Ghana Wildlife Society has initiated Community-based site conservation actions in and around the two unprotected IBAs to manage them as community nature reserves (Ntiama-Baidu *et al*, 2001)

Biological Corridors In December, 1999, Conservation International, together with other collaborators, organized a biodiversity priority setting workshop, to establish priority areas for biodiversity conservation within the Upper Guinea Forest Ecosystem (CI, 2001). The outcome of this process was the identification of some which were designated as Biological Corridors. The south-western portion of Ghana and the south eastern portion of Cote d'Ivoire constitutes one such corridors. Conservation International is promoting the use of innovative biodiversity conservation tools, such as ecotourism and cocoa agro-forestry (forested farms), to support biodiversity conservation in the defined biodiversity corridor.

Actions Required:

- a) expand protection area system by including inland and coastal wetlands, fringe and riverine forests, sensitive areas such as steep slopes, sacred groves, etc.;
- b) develop new or strengthen existing strategies, plans or programmes of action for the conservation of biological diversity and the sustainable use of biological resources;
- c) intensify/strengthen human capacity in ecosystem management through long and short training courses, in-service training and review curriculum at the tertiary levels of training to take cognizance of ecosystem management approaches;
- d) build, strengthen data and information management capacities;
- e) promote proper forest management and avoid clear cutting of forests, enhance fire prevention and control;
- f) promote forest tree breeding;
- g) promote research in ecosystem management and protection;
- h) take stock and review traditional skills in the management of protected area systems and incorporate these, where appropriate, into modern technologies;
- i) inventorize existing forest reserves and their resources using modern technologies, such as, remote sensing, Geographical Information Systems and prepare a Red Data List;
- j) regulate entry into forest reserves and ensure compliance of regulations, standards, guidelines, etc.;
- k) pay full compensation to landowning stools and skins from whom forest lands were taken;
- l) ensure full and active participation of landowners, communities and other stakeholders in protected area management;
- m) strengthen education and awareness creation at all levels of society especially among those whose life depend on the forests;
- n) review and update forestry legislation, and harmonize these with non-forestry legislation;
- o) strengthen and ensure networking between and among various forestry and non-forestry institutions;
- p) involve local communities in the management of protected area systems;
- q) identify areas of biological diversity hot spots and promote their status;

- r) rehabilitate degraded systems by new establishments, introductions and enrichments using preferably indigenous species;
- s) promote gene flow through the creation of biological corridors to provide connectivity between forest fragments including the Important Bird Areas and other protected areas;
- t) seek collaboration with both local and external institutions in information exchange, science and technology e.g., Bionet International.

7.2.3 Wildlife Reserves

Ghana is home to a large variety of wild animals and plants including endemic, threatened and vulnerable species. Major threats to wildlife in Ghana include the conversion of forestlands into other land use forms such as crop farming, pastures, mining, infrastructural development and bush fires. Habitat destruction and over-exploitation of wildlife for subsistence or gain are two main causes of wildlife loss.

Currently, there are sixteen (16) legally constituted wildlife reserves covering about 5.3% of the total surface land area. These are categorized into:

Box 5: Wildlife Reserves

- *Strict Nature Reserve (1);*
- *National Parks (6);*
- *Wildlife Sanctuaries (2);*
- *Resources Reserves (6) and*
- *Biosphere Reserves (1).*

In addition, there are six (6) wetlands which have been declared as Ramsar sites.

The reserves spread from the coastal savanna through the forest and transition vegetation types to the northern savannas. Currently, there is a problem of under-representation of a number of habitats including inland wetlands, mangrove forests, peat swamps and freshwater swamps. While terrestrial wildlife reserves are relatively better managed, a number of coastal wetlands are severely polluted to the extent that biological life is highly threatened. The Chemu and Korle lagoons represent near lifeless water systems whose biological composition is currently questionable.

7.2.4 Other Innovative Initiatives

Community Resource Management Areas (CREMA) The Wildlife Division of the Forestry Commission, under the Protected Areas Development Programme (PADP), has pilot-tested a new concept of community participation in wildlife management. This concept dubbed the Community Resource Management Areas (CREMA) allow those communities fringing the protected areas, to manage and sustainably utilize the wildlife resources within a defined area. This concept is the first step of empowering the local communities to actively participate in the conservation of wildlife outside the forests and protected areas systems (WD, 1998).

Actions Required:

- a) expand protection area system by including the marine habitats, inland and coastal wetlands, gallery and riverine forests, and water impoundments;
- b) inventorize existing wildlife reserves using modern technologies, such as remote sensing, Geographical Information Systems;
- c) regulate entry and access into protected areas and ensure compliance of regulations, standards, guidelines etc;
- d) settle all pending compensation claims and review modalities for claim calculations;
- e) build capacities at the tertiary education level in wildlife resource management and emphasize training in eco-system management;
- f) strengthen data and information management capacities;
- g) enhance capacities to prevent and control fires;
- h) promote economic and social incentive measures;
- i) ensure full and active participation of land owning entities and other stakeholders;
- j) empower traditional authorities, district assemblies and other local structures in the management of wildlife reserves and resources;
- k) review and update wildlife legislation and seek harmonization with wildlife-related legislation and ensure compliance of such laws;
- l) identify areas of biological diversity hot spots and promote their status;
- m) rehabilitate degraded systems by introduction of preferably indigenous species;
- n) strengthen education, training and awareness creation at all levels of society;
- o) promote captive breeding for later introduction in degraded areas;
- p) prepare a Red Data List of threatened and extinct species;
- q) seek collaboration with both local and external institutions on various management issues;
- r) restrict exploitation and export of wild animals and plants by fixing quotas and sustainable removal figures;
- s) protect reserves by creating fire belts around them;
- t) promote communal management of wildlife resources through the CREMA concept;
- u) protect wild animals by creating corridors for movement and migration;

- v) spearhead research on all aspects of wildlife management and protection;
- w) promote international cooperation and information exchange.

7.2.5 Off reserve areas

The portion of non-reserved land mass of Ghana, classified as off-reserve areas and therefore open to free access, contains important components of biological diversity. These areas include the wetlands, farmlands, water bodies and urban forests. The biodiversity of these areas is diminishing fast as a result of the unsustainable farming methods practised, human settlement development, bush fires, fuelwood harvesting, gathering of minor forest products and over-exploitation of timber. See Plate 9



Plate 9: Typical forest fringe settlement near Bia National Park

Actions Required:

- a) adopt and practise cultural agronomic practices such as mixed cropping and agroforestry, rotations and cover cropping;
- b) promote minimal use of agricultural chemicals and adopt integrated pest management practices, as well as other agriculturally sound practices;
- c) create urban forests or tree belts around farms, settlements, dams as refugia for various life forms in areas such as cemeteries, residential areas, sewage sites, etc.;
- d) restore aquatic systems by reclamation of sites, re-stocking with preferably indigenous species;
- e) undertake basic and applied research into the socio-economic and cultural importance and opportunities as well as the ecology and the dynamics of ecological process and how they affect the various systems and biodiversity;
- f) study the impact of inter - and intra-specific interactions as well as alien species introductions on biodiversity;
- g) educate and create public awareness about the importance of off-reserve areas for the sustainable use of biological resources and the conservation of biodiversity;
- h) develop policies to encourage the conservation of biodiversity and the sustainable use of biological and genetic resources on stool/skin and private lands;
- i) introduce appropriate environmental management and monitoring tools;

- k) minimize the conversion of forested off-reserve areas into non-forest land uses, such as crop production, grazing, etc;
- l) Biodiversity Implementation/Compliance Units should liaise with other agencies/stakeholders to demarcate sensitive and fragile areas, such as slopes, fringe forests and wetlands and protect these;
- m) empower grassroot (local level) administration structures to enact bye-laws for the management, use and protection of biological resources and biodiversity;
- n) promote economic and social incentive measures;
- o) inventorize the biodiversity and biological resources status and prepare a Red Data List;
- p) build and manage databases on biodiversity and biological resources.
- q) promote the protection of endangered and critically endangered species off reserve.

7.3 CREATION AND STRENGTHENING OF MANAGEMENT OF EX-SITU CONSERVATION SYSTEMS.

Ex-situ conservation systems seek to complement in a limited manner, in-situ conservation arrangements. The objective of keeping species of animals, plants and micro-organisms in areas outside the natural habitats may be to breed through multiplication populations for later introduction into the wild to restock a dwindling wild population. In some cases, ex-situ conservation aims at producing opportunities for research, study and observation. The rationale behind the ex-situ conservation of genetic resources is to maintain samples of such fast vanishing and displaced landraces by a few original or genetically modified and improved varieties and cultivars or as a result of destruction of tropical forests which are believed to be the world's hot spot for biodiversity.

Major centres for ex-situ conservation in Ghana include the two zoos in Accra and Kumasi; botanical gardens in Accra, Aburi, Mampong-Akwapim and Bunso; the Plant Genetic Research Centre at Bunso as well as various facilities in the Botany and Zoology Departments and Agriculture faculties of the Universities of Ghana. There is no known ex-situ conservation arrangement for genetic resources of micro-organisms currently in the country, although some research institutions such as the Nogouchi Medical Research Centre and the medical laboratories attached to some hospitals, Food Research and Water Research Institutes may maintain small colonies of micro-organisms for research and teaching purposes.

Actions Required:

- a) build new and strengthen capacities of existing institutions to be able to effectively conserve species, cultivars, landraces of plant and animals and micro-organisms;

- b) promote studies and research into micro-organisms in soil and water as well as the marine environment with regard to their importance in agriculture and forestry, health and welfare, food security, etc;
- c) develop codes of conduct, standards and guidelines for the handling, storage, management and conservation of ex-situ resources especially genetically modified or engineered organisms;
- d) ensure safe use of micro-organisms and genetically modified organisms to avoid their possible use in warfare;
- e) encourage the use of ex-situ facilities to educate and create awareness among the public about threats to biodiversity conservation and sustainable use of its components;
- f) promote and ensure an effective network of ex-situ conservation facilities.

7.4 INCENTIVE MEASURES AND SANCTIONS FOR THE CONSERVATION AND SUSTAINABLE UTILISATION OF BIOLOGICAL DIVERSITY

7.4.1 Economic Incentive Measures

The government will introduce a number of economic measures to support and promote activities for the conservation and sustain-able utilisation of her biological resources. These measures will include tax incentives, grants and subsidies. The incentives will be continuously monitored to ensure that they are effective in promoting the conservation and sustainable utilisation of the country's biological diversity. For example, in Ghana, ecotourism development at Kakum National Park, has been found to contribute enormously to socio-economic development. See Plate 10.

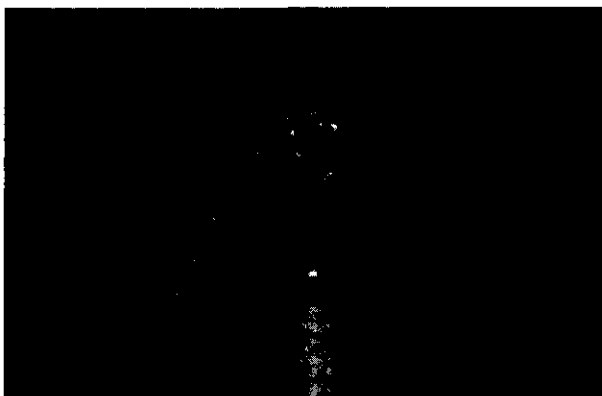


Plate 10: Tourism Attraction

However, where any measure is found to have an adverse impact on the country's biological diversity, then it will be necessary to review and initiate the appropriate steps to address the situation.

7.4.2 Social Incentive Measures

Various measures will be put in place to show recognition for activities undertaken by chiefs and other traditional authorities (Plate 11), individuals, corporate bodies and communities engaged in the sustainable use and management of the country's biological resources.

These could include national awards and naming of specific areas after such individuals and bodies. Occasions such as the World Environmental Day, World Biodiversity Day, Arbor Day, National Farmers Day and World Day to Combat Desertification and Drought will be used to honour such individuals and bodies.

Traditional laws and sanctions, which promote biodiversity conservation, should be accorded legal backing so as to ensure effective enforcement. See Plate 11

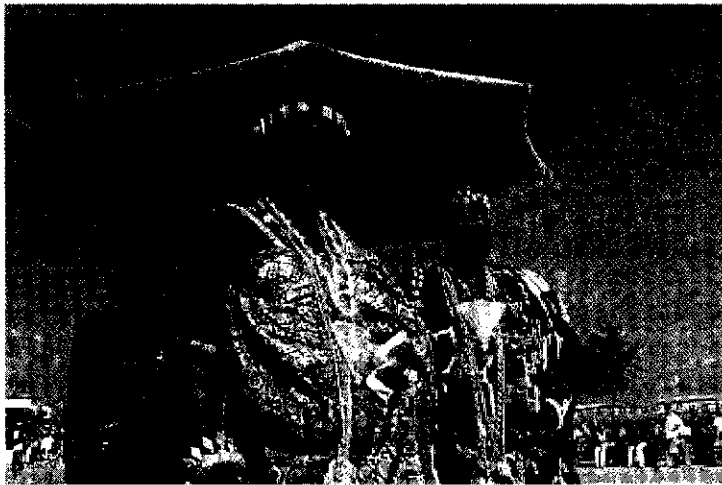


Plate 11: Chiefs at a durbar

7.4.3 Sanctions

Appropriate legislation, both at the national and district levels, should be developed to provide sanctions against individuals, corporate bodies and communities which engage in activities deemed not to be promoting the sustainable use and management of the country's biological resources.

Chapter Eight

EFFECTIVE IMPLEMENTATION OF THE STRATEGY

8.1 INTRODUCTION

The Convention on Biological Diversity recognises countries' sovereignty rights to the exploitation of biological resources within their respective country boundaries. The Convention suggests though that exploitation should be within the confines of sound environmental policies and that implementation of actions towards ensuring sustainable management and use of biodiversity should be country-driven and people-centred. Grass-root participation in decision-making and implementation of decisions and actions on biological resources is critical for ensuring sustainability.

8.2 IMPLEMENTATION SCHEME AND COMMUNITY-WIDE PARTICIPATION

This document describes Ghana's basic policies and development measures for the conservation and sustainable management of the country's biodiversity, as required by the Convention on Biological Diversity. The Government will promote the implementation of the Strategic Plan. However, in view of the relation between the conservation and sustainable use of biodiversity to other socio-economic activities, it is important that the Ghanaian society as a whole public and private, including civil society and all the major groups co-operate with each other and act towards achieving the objectives of the Strategic Plan.

Local community participation in these activities is very critical for the various activities. See Plate 12

Implementation of the Plan will be the sole responsibility of the Ministry of Environment and Science (MES), funding through the National Biodiversity Committee. Implementing agencies under the Ministries as well as local communities, NGOs and CBOs will be responsible for the implementation.

These will include:

- Centre for Scientific Research into Plant Medicine;
- Cocoa Research Institute of Ghana;
- Council for Scientific and Industrial Research;
- Department of Parks and Gardens;
- Environmental Protection Agency;
- Forestry Division of the Forestry Commission;



Plate 12: Women at a Forum

- Ghana Atomic Energy Commission;
- Wildlife Division of the Forestry Commission;
- Lands Commission;
- The Universities of Ghana;
- Town and Country Planning Department;
- District Assemblies;
- Environmental NGOs;
- CBOs;
- Private sector institutions.
- Ministry of Trade and Industry
- Registrar General's Department
- Traditional Authorities;
- Ghana Federation of Traditional and Alternative Medicine (GAFTRAM)

Box 6: MES Role

- *Promoting global, regional and national co-operation and co-ordination with respect to the conservation and sustainable use of biodiversity;*
- *Strengthening communication networks with the districts and other national departments and institutions;*
- *Promoting and facilitating the integration of biodiversity considerations into sectoral and cross-sectoral plans, programmes and policies;*
- *Promoting the development of national legislation based on the various international agreements and conventions which the country ratifies;*
- *Establishing, administering and managing required co-ordinating structures; and Organising the participation of national and district governments in relevant international fora;*

To this end, the Ministry of Environment and Science will play a proactive role as indicated in Box 6:

District Assemblies are also expected to implement similar and other specific measures in accordance with the natural and social conditions in the districts, following the guidelines in the document. In view of the critical role played by the districts in the national development process, they will have greater responsibility for the execution of the Strategic Plan and this has to be recognised.

Civil society, traditional authorities and other major groups, are also to recognise the importance of conservation and sustainable management of biodiversity in their activities, taking into account not only the economic benefits but also the social implications of their actions. They are to be active partners in the various

activities that will be undertaken towards the implementation of the Plan. The private sector especially should recognise the economic benefits to be associated with the implementation of the Plan and actively participate in the various programmes. Their involvement will, however, not be at the expense of the social and environmental aspects of the programme which will ensure their sustainability.

The Government will co-operate with all Contracting Parties to the Convention on Biological Diversity in the implementation of the Convention to promote the conservation and sustainable management of global biological diversity.

8.3 CO-ORDINATION WITH OTHER NATIONAL PLANS AND POLICIES

The Strategic Plan will be implemented in accordance with the National Environmental Action Plan, the Forest and Wildlife Policy of Ghana and the Ghana Poverty Reduction Strategy, with regard to the conservation and protection of the environment as well as the country's natural resources.

All existing Plans and Policies which do not deal directly with natural resources, are to be made compatible with the principal goals of the Plan. There should, therefore, be harmonious co-ordination with the Strategic Plan.

8.4 IMPLEMENTATION OF OTHER BIODIVERSITY-RELATED CONVENTIONS

Ghana has ratified a number of other biodiversity-related conventions. It is important that the implementation of the Convention on Biological Diversity be linked with the implementation of these other conventions. With the National Biodiversity Committee comprising representatives of all stakeholders involved in the management of the country's biological diversity, the Committee will also be charged with co-ordinating activities with respect to the implementation of these other conventions and agreements. It has to be borne in mind that the current institutional arrangements for the implementation of these conventions and agreements will be maintained.

One of the Committee's primary responsibilities will be to ensure that there is no duplication of efforts in ensuring that Ghana's biological diversity is managed in a sustainable manner for the good of the population and that the national and international obligations with respect to all biodiversity-related conventions and agreements are satisfied.

8.5 INTERNATIONAL CO-OPERATION

The conservation of the global biological resources is a common responsibility of the world. This cannot be done by only one country. Ghana will thus join the global community in all efforts towards ensuring that the world utilizes her biological resources in a sustainable manner. In this regard, Ghana will secure global support for its various conservation and other management programmes. Some of the specific activities Ghana will be involved in will be information exchange and technical and scientific co-operation with various countries and regional/international bodies, including joint research programmes.

Where there are international agreements, conventions or arrangements relevant to the conservation and sustainable utilisation of biodiversity, efforts will be made to ensure that these are ratified and appropriate measures taken for their national implementation. Ratification will be undertaken where these agreements, conventions or arrangements are in line with the country's needs and priorities.

8.5.1 Transboundary Conservation Areas

The report of the first scientific consensus-based conservation priority setting process in West Africa has established a solid foundation for the future of biodiversity conservation in the Upper Guinea ecosystem (Fig 7). It has established a base-line on the "state of knowledge" of the forest ecosystem, marine ecosystem and defined geographic consensus-based priority areas (CI, 2001).

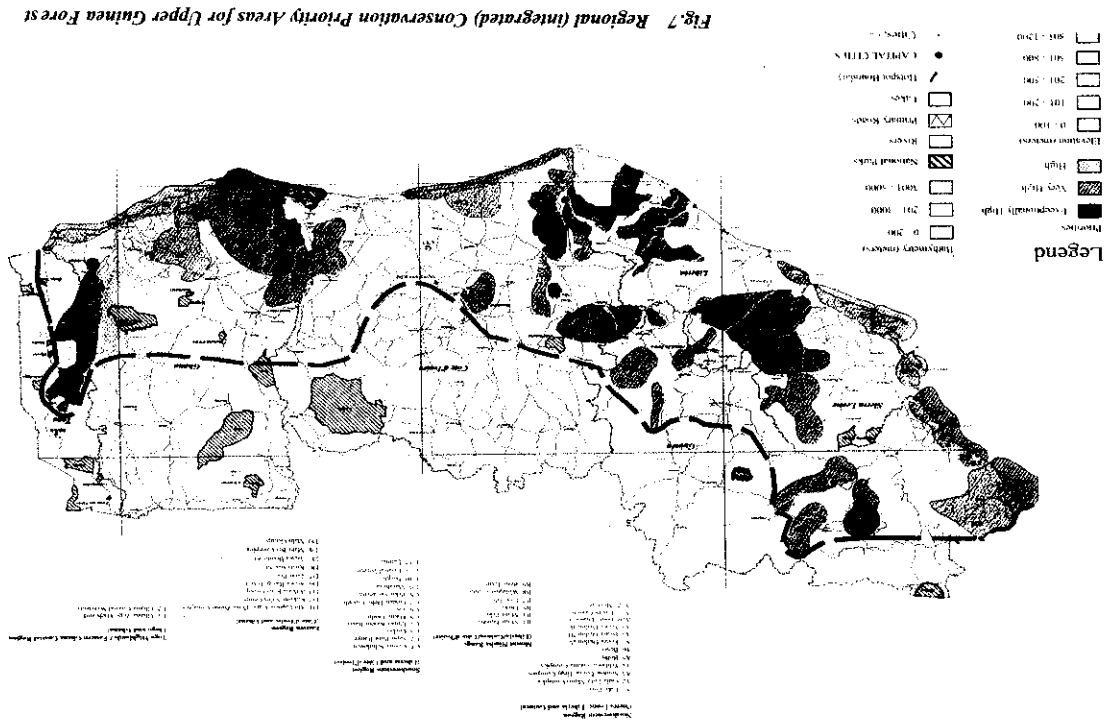


Fig. 7 Regional (integrated) Conservation Priority Areas for Upper Guinea Forest

Source: CI, 2001.

Within the context of the ECOWAS Treaty and appropriate protocols, the two trans-frontier corridors:

- i) South-western Ghana and south-eastern Cote d'Ivoire;
- ii) Ghana-Togo highlands and eastern Ghana coastal region;
- iii) Ghana-Burkina Faso wildlife corridor;

Will be improved and consolidated. Specific actions to be undertaken include:

1. Bilateral agreements to be signed between:
 - i) Ghana and Cote d'Ivoire for the south-western corridor;
 - ii) Ghana and Togo for the Togo highlands corridor;
 - iii) Ghana and Burkina Faso for the Northern Ghana wildlife corridor.
2. Joint projects established to update the scientific information through quick assessments and ecological studies of each corridor.
3. Undertake habitat restoration and improvement of the existing protected areas within the corridors.
4. Development of management plans for the conservation and sustainable utilization of the biological resources within the corridors.

8.6 PRIORITY ACTIONS REQUIRED

Though all the various actions outlined above may be deemed to be important, it is realized that certain issues need to be concluded first. In this regard, the following priority activities should be carried out within the short term:

- a) political commitment from the Government towards achieving the objectives of this Strategy and Action Plan. Sectoral ministries are to express their commitment in the form of approved sectoral plans and budgets in relation to their specific activities;
- b) a strengthened and rationalized protected areas system;
- c) established legislative and administrative mechanisms to control access to the country's genetic resources and the equitable sharing of the benefits from these resources;
- d) institution of a national biodiversity education, training and awareness programme for all sectors of the economy and all levels of the political structure;
- e) ratification of the Biosafety Protocol, with its attendant institution of the appropriate framework for its implementation ;
- f) institution of mechanism for financing the country's biodiversity management activities;
- g) institution of a system for assessing the economic value of the country's biological resources;
- h) development of the framework for a biodiversity management system.

8.7 EDUCATION, TRAINING AND PUBLIC AWARENESS CREATION

The successful implementation of the Strategic Plan will be very much determined by the active involvement of all stakeholders in the biodiversity agenda. This presupposes that all these groups will be aware of the Plan and its implications. Education, training and awareness creation will, therefore, be the bedrock of the implementation process. Education will be directed to all institutions and individuals whose activities affect are affected by the country's biodiversity. Training in the country's educational institutions will be strengthened or structured to ensure that adequate personnel are trained to cater for all aspects relating to the conservation and sustainable management of the country's biological resources.

All sectors of the national economy and political organizations would be sensitized by the educational and awareness creation programmes. Educational institutions, especially the first and second cycle ones, will be encouraged to adopt species of plants and/or animals in their locations for which they will implement specific aspects of the Plan applicable to them. Data collection will be a critical element in this endeavor. Nature clubs will be formed in all educational institutions to promote these activities. Districts and traditional areas will be encouraged to undertake similar programmes which should lead them into having specific plants and/or animals as their symbols.

Generally, the education and awareness creation programmes should lead to the general public being made better informed about the importance of the country's biological diversity and helping to ensure that these resources are conserved and used in a sustainable manner.

8.8 FUNDING OF ACTIVITIES

With the integration of biodiversity activities into sectoral plans and programmes, funding for the implementation of the Plan will be expected to be primarily from the respective sectors. However, it should be possible to seek additional funding mechanisms to support these budgetary allocations.

At the national level, fees from visits to national parks as well as bio-prospecting activities could be sources of funding. A Biodiversity Trust Fund will also be established to be managed by the National Biodiversity Committee for specific activities in the area of conservation and sustainable utilization of the country's biological resources.

At the international level, the Global Environment Facility (GEF), which is the funding mechanism for the Convention on Biological Diversity (CBD), will continue to serve as a principal source of funds for activities which have international implications. Multilateral and other international financial institutions, donor countries and non-governmental organizations have created windows for direct funding of biological diversity activities.

The private sector, as the major user of the country's biological resources, will be encouraged to contribute to the various conservation and sustainable use programmes.

8.9 DEVELOPMENT OF ACTION PLAN

As a follow-up to the implementation of the Strategy, an Action Plan will be developed within the short-term. The Plan will specify the areas, outline the activities, the time frame and the institutions responsible for their implementation.

8.10 MONITORING, EVALUATION AND REVIEW OF STRATEGIC PLAN

To ensure the implementation of the National Biodiversity Strategy, the National Biodiversity Committee will develop a system for monitoring, evaluating and reviewing annually the measures and publicize its findings. The report will also be submitted to the Conference of Parties to the Convention.

The Committee will promote the development of indicators for assessing progress in the implementation of the measures.

The Plan will be reviewed after five years. This review will involve all stakeholders in the conservation and the sustainable management of the country's biodiversity.

Because of the important role the National Biodiversity Committee is expected to play, it has to have a legal framework to work from. This will obviously imply the change of name from a Committee to a Commission to enable it discharge its obligations effectively.

BIBLIOGRAPHY

1. Booth, A.H. (1959). On the mammalian fauna of the Accra Plains, West African Sci Assoc J, 5: 26-36.
2. BirdLife International (2000). Threatened birds of the world. Barcelona and Cambridge, UK: Lynx Edicions and BirdLife International
3. CBD (1992) Report on the United Nations Conference on Environment and Development (Rio de Janeiro, 3-14, June, 1992).
4. CI (2001) From the forest to the Sea: Biodiversity connections from Guinea to Togo.
5. CI (2002a) Zero Biodiversity Loss: A handbook for the designing and managing conservation strategies. Conservation International Regional Strategic Planning Dept. Washington DC.
6. CI-Ghana (2002a) Assessment of bushmeat trade during the Annual Closed Season on Hunting in Ghana. CI-Ghana-FAO.
7. CI-Ghana (2002b) Endangered bushmeat species in Ghana. CI-Ghana. Conservation Priority-Setting Workshop, December, 1999.
8. Dankwa, H. R, Abban, E.K and Teugels, G.G (1999). Freshwater Fishes of Ghana: Identification, distribution, ecological and economic importance. Annales Sciences Zoologiques, Vol. 283.
9. Ofori-Danso, P.K and Agbogah, K.(1995) Survey of aquatic mammals in Ghana. Institute of Aquatic Biology Technical Report, 143. A report to UN Environment Prog, Oceans and Coastal Areas.
10. Hall, J.B and Swaine, MD (1981) Distribution and ecology of vascular plants in a tropical rain forest. Forest vegetation in Ghana. Junk Pub. The Hague, 383p.
11. -Danso, P.K (1999) Stock Assessment of five major commercial fish species in Yeji area (stream VII) OF THE Volta Lake. Ph.d thesis submitted to University of Ghana, Legon
12. Jefferson, T.A, Curry, B.E., Leatherwood, S and Powell, J.A. (1997). Dolphins and porpoises of West Africa: a review of records (Cetacea: Delphinidae, Phocoenide) Mammalia, t.61, 1, 87-108.
13. Larsen, (1994) The Butterflies of Ghana-their implications for conservation and sustainable use. Ghana Wildlife Dept; Mimeo. 52pp
14. Martin, C (1990) The Rain Forest of West Africa: Ecology, threats and conservation. Berhauser Verlag, Basel.

15. Ntiamoah-Baidu, Y., Owusu, E. H. and Daramani, D. T. and Nuoh, A. A. (2001). Ghana. Pp 367-402 in L. D.C Fishpool and M. I. Evans eds. *Important Bird Areas in Africa and associated islands: Priority sites for conservation*. Newbury and Cambridge, UK: Pisces Publications and BirdLife International (BirdLife Conservation Series No 11)
16. Ntiamoah-Baidu, Y., Asamoah, S. A., Owusu, E. H., and Owusu-Boateng, K. (b) (2000). *Avifauna of two upland evergreen forest reserves, the Atewa Range and Tano Offin, in Ghana*. *Ostrich* **71** (1 & 2): 277-281
17. Ntiamoah-Baidu, Y., Owusu, E. H., Asamoah, S. and Owusu-Boateng, K. (a) (2000). *Distribution and abundance of forest birds in Ghana*. *Ostrich* **71** (1&2): 262-268
18. NRMP (2001) Implementation Manual of the Natural Resources Management Programme (NRMP), Ministry of Lands and Forestry, Ghana.
19. Ofori-Danso, P.K and Debrah, J.A and Waerebeek, K.V (2001). A survey for the conservation of dolphins in Ghanaian coastal waters. Final Report for the Columbus Zoological Park Association, Ohio, USA.
20. Petr, T. (1967). Food preference of the commercial fishes of the Volta Lake. VBRP Tech Rep 22.
21. Smit, C. J., and Piersma, T. (1989). Numbers, midwinter distribution and migration of wader populations using the East Atlantic Flyway. Pp. 24-63 in H Boyd and J. Y. Pirot, eds. *Flyways and reserve networks for water birds*. Slimbridge, UK: IWRB
22. Tutu, K. A. Ntiamoah-Baidu, Y. and Asuming-Brempong S. (1993). The economics of living with wildlife in Ghana. Report prepared for the World Bank, Environment Division, 85.pp.
23. White, C.M.N (1965). A revised Check-list of African Non-Passerine Birds. Govt of Zambia: Lusaka.
24. WD (1998) Community Participation in Wildlife Management. Wildlife Dev. Plan, Ghana. Wildlife Dept. Ghana.
25. WD (1994) Wildlife Systems Plan, Ghana. Wildlife Dept. Ghana.

GLOSSARY

Strict Nature Reserve: Generally, relative small areas containing fragile habitats, outstanding ecosystems or natural features in and/or Natural features in a relatively undisturbed state and which are prime representatives of the scientific study, monitoring, education or conservation of biological or cultural resources. Such areas are to be maintained in an evolutionary dynamic state and will require strict protection with minimal human disturbance, i.e. no management interventions will generally be permitted. Tourism, recreation and public access will be generally proscribed except for educational, scientific and cultural reasons, when only non mechanised access will be allowed.

National Park: Generally, large and relatively undisturbed areas of outstanding natural containing representative samples of major natural regions, features or scenery and containing one or several entire ecosystems and not materially altered by man (or reflecting long-standing cultural land management practices). The areas should be accessible to the public have high recreational, educational, inspirational and cultural potential of clear benefit to the local people, the region and the nation.

The highest competent authority i.e. WD will administer and manage these areas so as to prevent or eliminate exploitation or intensive occupation in order that they might be maintained in perpetuity in national or near natural state.

Wildlife Sanctuary: Relatively small areas used to protect plant or animal species, either resident or migratory, of exceptional conservation interest, from any form of destruction. Such species will be protected from any form of exploitation which is inconsistent with their conservation status, except where that intervention is necessary to secure the continued survival of particular species. These areas are opened to public access for cultural, touristic, education, scientific, spiritual or inspiration reasons. Forms of traditional land use which are compatible with and will contribute to the conservation objectives will be encouraged. Some of the traditional sacred formally gazetted or registered; central government's legal support would thereby be extended to local and traditional institutions to ensure the continued protection of such sites.

These areas would be administered through a variety of mechanisms ranging from the Wildlife Department, other level of government, to establish or delegate community of private institutions.

Resource Reserve: Area of variable size in which are managed of guarantee condition essential to the well being of selected species for the sustained production of wildlife products (meat, timber, pasture, fruit, honey and other Non Timber Forest Products (NTFPs) for cultural practices, tourism and trophy hunting. The conservation priorities will involve the manipulative management of species and their habitats to ensure the protection and propagation of the target species, including introduced indigenous or exotic species. Management will be conducted in such a way as to preserve the areas natural aspects as far as possible. Other forms of land use compatible with these goals may be allowed.

These areas may be managed by a central authority, or through agreement, by other levels of government, species trusts or local community institution as appropriate under the overall supervision of Wildlife Department.

Ramsar Site: A wetland set aside for conservation because of its international importance according to set criteria. They are normally managed to provide maximum benefit to the local communities living within and around the area.

Table 5: Total Economic Value of Forests (TEV)

TEV = Use Value + Non-Use Value

1	2	3	4
Direct Value	Indirect Value	Option Value	Existence Value
Sustainable Timber	Nutrient	Future uses	Forests are of intrinsic
Non-timber Products	Cycling		value as a gift to
			others, as
			responsibility and
			stewardship.
Recreation	Watershed Protection		
Medicine	Air pollution reduced		
	Microclimate		
Plant			
Genetics			
Education			
Human habitat			

Table 6: Impacts of sectoral activities on biological diversity in Ghana

Impact Economic Sector	Habitat Loss and Fragmentation Conservation	Loss and Extinction of Species	Air, Water and Soil Pollution and Degradation	Alien Species Colonisation
Agriculture-Crop and Livestock Production	Primarily through crop cultivation requiring the removal of natural vegetation and through bush encroachment and bush fires	Overgrazing in parts of the country may result in certain species being overexploited. Use of agro-chemical	Largely through the use of agrochemicals, erosion and siltation, and bushfires	Through the introduction of high yielding exotic species for cultivation or pastoral purposes.
Forestry	Through the replacement of natural vegetation with tree monocrops. Logging and fuelwood gathering	Overexploited at both commercial and subsistence levels for fuelwood and other purposes	Through, inter alia, the pulp and paper industry and the use of agro-chemicals, logging and fuel wood gathering	Through the introduction of high yielding exotic species for commercial forestry and recreational purposes.
Fisheries (Aqua and mariculture, artisanal)	Through physical damage to habitats from certain fishing gears. Establishment of aqua and mari-culture.	Over-exploitation of target and non-target species, with ramifications for other species and supporting ecosystems	From mariculture and aquaculture enterprise, as well as from fishing gear erosion siltation.	Introduction of alien species for mariculture and aquaculture
Manufacturing industry (chemical, food and beverages, pharmaceuticals)	Pollution and contamination with solid and liquid wastes	Pollution and contamination with industrial wastes, especially gaseous discharges	Gaseous, liquid and solid waste discharges and deposits	Eutrophication of water bodies
Water Abstraction	Through dam construction, and water course transfer schemes, irrigation, dredging	Damming and changes of water courses, irrigation, dredging	Salination, Pollution of groundwater, Changes in water table level and seepage	Through inter-basin schemes which unintentionally introduce alien species
Transport (Rail, Road, Water, Air)	Through road and rail construction and shipping related activities	Road and rail construction, shipping	Through the dumping of land generated waste from ships, or from oil spilled or discharged from ships. Air pollution through gaseous emissions from vehicles and aircraft. Oil leakages during water transport.	Through the unintentional introduction of alien species in ship ballast water. Waterway transport
Tourism and Recreation	Through the construction of tourist-related facilities, particularly along the coast. Through exceeding the tourist's carrying capacity in certain areas.	Through recreational fishing and the overexploitation of "collectable" species	Through litter, principally plastic waste.	Through the introduction of exotic fish species for angling. Through introduction of alien animals species for captive breeding
Housing and Infrastructure	Through the clearing of land for development of rail and roads, human settlements, harbours and airports, telecommunication and electricity transmitting lines	Through the clearing of land for development of rail and roads, human settlements, harbours and airports, telecommunication and electricity transmitting lines	May occur from construction activities: Sedimentation; Siltation, Turbidity; Biological Oxygen Demand; Chemical Oxygen Demand. Waste treatment	Through the use of harmful alien species in gardens and parks
Trade	Some trade policies may encourage resource overexploitation leading to ecosystem destruction	Excessive trading in a particular species	Through trade in chemical and other harmful substances	Through the unintentional introduction of harmful alien species from imports.

National Biodiversity Strategy For Ghana

Trade	Some trade policies may encourage resource overexploitation leading to ecosystem destruction	Excessive trading in a particular species	Through trade in chemical and other harmful substances	Through anthropogenic dispersals from one area to the other.
Defence	Through the use of land and sea for weapons testing and training. Wards and landmine	Overexploitation of species in areas used for purposes of defence	Through the production and use of various weapons; soil compaction	Through the use of harmful alien species in gardens and introduction of alien species for ornamental purposes.
Domestic Households	Indirectly, through requiring the range of different economic and social services described above	Through the harvesting of certain plants and animals for food, building, fuel or medicinal purposes	Through the generation of sewage and household waste, as well as pollutants associated with cooking and heating.	Introduction of monocrops for rehabilitation of degraded areas. (Monocrops + exotics)
Mining and Energy Sector	Deforestation through surface mining. Conversion of landscape. Dumping of tailings	Removal of topsoil, Devegetation, Fauna migration	Use of chemicals, Gas emission, Dust, Diversion of water courses, Erosion, Siltation, Pollution in any form	Introduction of microorganisms for bioremediation.