KENYA NATURAL RESOURCES MANAGEMENT ASSESSMENT

Volume 5

An Overview of Ecology and Biodiversity Conservation in Kenya

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EXECUTIVE SUMMARY

Kenya's biological resources are of considerable domestic and international economic and intrinsic value. Agriculture, livestock, fisheries, and forests, for example, account for most subsistence survival, economic output, employment and export earnings. Tourism is Kenya's largest single foreign exchange earner and is largely based on the presence of wildlife and seashores. More than most other African countries, Kenya has taken full advantage of its ecosystem diversity to build a relatively diversified and resilient economy.

Kenya contains a plentitude of ecological zones, with representative sectors of east coast forests, highland plains, savannahs, montane forests and alpine areas, remnants of lowland West African forest, and mangrove forests, inland lakes, coral reefs and wetlands. Many of Kenya's biological resources are considered to be internationally important as areas rich in biodiversity and endemism. Kenya has a well established and impressive system of 56 national parks and reserves in Kenya, including seven along the Indian Ocean Coastline, encompassing 6.7% of the country. Kenya's achievements in protecting its biological diversity are among the best in Africa, but sustainable conservation of these resources into the future now lies in question.

No problem may be threatening the biological resources of Kenya more than poverty and the proliferation of the human species. Kenya's population growth rate is one of the highest in the world.

Currently, 80% of Kenya's population live in the high potential lands, which cover 20% of the country's land area. The population densities in these areas are among the highest in the world, and the consequent use of resources is intense, forcing migration into forests, onto arid and semi-arid lands, and to urban centers.

In the absence of a comprehensive land use policy, and ineffective environmental regulation, Kenya suffers from inappropriate land use practices that result in land degradation and pollution, and unregulated expansion of urban areas. Poorly regulated agricultural, industrial and urban development are undermining the very ecosystems that generate Kenya's economic base.

The increased demand for land and other resources by humans has also leads to the diminishment of habitats, both in area and quality, for wildlife and coral reefs. Increased population pressures surrounding protected areas has led to conflicts between local communities and wildlife. Migration corridors which permit survival of many species, such as the wildebeest, are being blocked as traditional rangeland becomes converted for more intensive agricultural purposes and fences are erected that block off major dispersal avenues. Conservation areas are increasingly becoming isolated islands. The resulting compression of wildlife in conservation areas has severe ramifications on ecosystems,

species composition and genetic diversity. Local communities perceive the establishment of exclusive protected areas as infringing on their rights to traditional resources.

The loss of species and habitats is becoming one of the greatest problem areas in Kenya. Currently, only 4% of Kenya's land area is forested. The World Conservation Union (IUCN) Red List of Threatened Species (1990) lists 13 mammalian species, representing eight families and four orders, as falling within different categories of threat. With estimates that 10% of the wildlife live in parks, 15% in national reserves, and 75% outside protected areas, the fate of wildlife biodiversity hinges more on what happens outside the protected areas than inside.

It is clear that conservation of biodiversity outside protected areas depends on the good will of the local communities. With increased pressures on land and resources, the government of Kenya and local communities need to be sensitized as to the importance of maintaining resource sustainability. This can only be done through dialogue and finding alternative solutions to the resource needs of the local communities. Finding acceptable alternatives can, therefore, only be possible with their full participation in problem solving and decision making.

The Kenya Wildlife Service (KWS) has undertaken this challenge with the assistance of the USAID / Conservation of Biodiverse Resource Areas (COBRA) project. COBRA provides technical assistance, training, equipment and operational support to the Community Wildlife Service (CWS) Department of KWS. Through participatory rural appraisal techniques with the COBRA team, local communities identify and design activities to help groups of farmers, ranchers, and others living in wildlife areas to sustainably manage wildlife and related resources. COBRA is conducting research on landowners' use rights so that the land owners can benefit from the wildlife. KWS, through funding from USAID and the World Bank, has established a Wildlife Fund for Development (WDF) to support projects in areas with wildlife, even if not near to a protected area.

OPPORTUNITIES and RECOMMENDATIONS for USAID/Kenya:

1. COMMUNITY BASED CONSERVATION OPPORTUNITIES:

a. Continue support for COBRA.

b. A second phase of COBRA should expand the concept of COBRA beyond community wildlife management to include community natural resources management (e.g.: focus on land management, including forest, grassland, and coastal management).

c. A second phase of COBRA should also expand its scope to include regional conservation planning. This would involve collecting biological, sociological, and economic data for conservation within a region to insure that conservation activities proposed by the communities are practical and sustainable and help COBRA prioritize areas where biodiversity is most urgently threatened. As with the current COBRA design, local communities would identify and design activities jointly to suit the needs and opportunities of the region. This would best be facilitated through a local NGO.

d. Every effort should be made to link COBRA with existing local NGOs and enhance the capacity of these NGOs.

e. Enhance COBRA's research, monitoring and evaluation component. Little is known regarding ecosystem management or the biology of wildlife populations. Research into these areas would provide the necessary information for proper management to ensure long term conservation. Background information on economic issues, such as land use choices and alternatives, land pricing, taxation, incentives, tourism opportunities, etc. is also essential to wise decision making. Project monitoring and evaluation will enable COBRA to assess whether it is having the intended impact of linking development with wildlife conservation.

f. Build in-country capacity for training community representatives in community natural resource management.

2. RELATED COMMUNITY BASED CONSERVATION OPPORTUNITIES:

a. USAID should continue to support mechanisms for long-term natural resource conservation financing (such as the Wildlife Development Fund).

b. Support research efforts in natural resource conservation and park management. USAID has supported, with relatively little amounts of funds, several highly successful research projects in natural resource conservation in Kenya, the results of which have proved invaluable to the reestablishment of wildlife populations, overall ecosystem health, and economic well being of local communities.

c. Build Kenyan technical capacity for natural resource management. Several universities have programs that should be investigated as potential areas for supplemental funding for program enhancement.

d. Enhance national economic incentives for natural resource conservation by encouraging development of commercial enterprises based on sustainable use/harvest of resources. Economic returns on conservation of biodiversity to the local community are important. Those who successfully conserve, for example wildlife, should be enabled to trade the surplus.

e. Encourage collaboration and information exchange among donors and NGOs in the natural resource management arena. Other institutions in Kenya have community managed natural resource projects similar to COBRA and all would benefit from the sharing of information. Site visits by USAID staff to these projects to foster cross-linkages are highly encouraged.

f. Develop a Natural Resource Conservation Science Advisory Council to provide USAID/Kenya and the GOK with technical advice on the development of policies and practices that have environmental impact.

g. Encourage policy reform to encompass sustainable natural resource management. Incentives to use natural resources sustainably often depends on the property rights of users. Unless biological diversity is valued, it will be sacrificed to other development goals. Policy changes are needed at all levels, both macro- and micro-economic, socio-legal and in research and training wherever present trends are having a negative impact on biodiversity.

3. ENVIRONMENTAL POLLUTION:

a. Build capacity for environmental monitoring and environmental impact assessments.

4. ENVIRONMENTAL INFORMATION SYSTEMS:

a. Establish a national environment information system to network, coordinate and document the various sources and forms in the Kenya within a central organization (an NGO). The service will be operated on a sound economic basis, with the principal long term objectives of maintaining a reliable and up-to-date and yet responsive information service on natural resources in a central information center. This could also serve as a national focal point for exchange of environmental datasets with neighboring countries and other international databases.

- **Support publication of an annual "Kenya State of the Environment Report"**, covering scientific, political and socio-economic relevant to natural resource management.

b. Support a coordinated Geographical Information System (GIS) activity.

Partial List of People Contacted

Richard Bagine, Director, Center for Biodiversity, National Museums of Kenya
Edmund G.C. Barrow, Community Conservation Coordinator, AWF
John D. Corbett, Agro-ecologist, ICRAF
Matthijs De Vreede, Programme Coordinator, National Museums of Kenya
Jean-Pierre d'Huart, Director, World Wide Fund for Nature
Helen Gichohi, Wildlife Conservation Society, Kenya
Michael M. Gichure, District Warden, Nanyuki
Mohammed Ishakhakia, Director, National Museums of Kenya
Ali A. Kaka, Senior Warden, KWS
Irene Karani, World Wide Fund for Nature
Esther M. Keli, Training Coordinator, KWS
Brian Keating, Principal Research Scientist, CSIRO
Peter Lembuya, COBRA Focal Area Coordinator, KWS
John K. Lynam, Senior Scientist, The Rockefeller Foundation
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Tim Resch, Biodiversity Coordinator, USAID
Hans P.H. Sjogren, Agroforester, ICRAF (Maseno site)
Deborah Snelson, Deputy Director of African Operations, AWF
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Peter G. Viet, Regional Director for Africa, WRI
Frank Vorhies, Resource Economist, AWF
Joyce Wafula, Field Program Coordinator
David Westin, Director, KWS
R. Michael Wright, President, AWF

(other members of the team met with representatives from organizations not listed above)

List of Acronyms and Abbreviations

ARTS	Office of Analysis, Research, and Technical Support
AWF	African Wildlife Foundation
CITES	Convention on International Trade in Endangered Species
COBRA	Conservation of Biodiverse Resource Areas
CPSP	Country Program Strategic Plan
CSIRO	Commonwealth Scientific and Industrial Research Organization, Australia
CWP	Community Wildlife Program
CWS	Community Wildlife Service
EAWS	East African Wildlife Society
EIS	Environmental Information System
FAO	Food and Agriculture Organization
GEMS	Global Environmental Monitoring System
GIS	Geographical Information System
GOK	Government of Kenya
ICRAF	International Center for Research in Agroforestry
IUCN	The World Conservation Union
Kshs	Kenya shillings
KWS	Kenya Wildlife Service
m	million
MOU	Memorandum of Understanding
NEAP	National Environment Action Plan
NGO	Nongovernmental Organizations
NP	National Park
NR	National Reserve
PVO	Private Voluntary Organizations
spp	species
UNEP	United Nations Environmental Program
USAID	United States Agency for International Development
WCI	Wildlife Conservation International
WCS	Wildlife Conservation Society
WDF	Wildlife Fund for Development
WRI	World Resources Institute
WWF	World Wide Fund for Nature

" Economic development in Kenya, which is and will continue to be largely dependent on biological resources, is presently unsustainable, because many of the biological resources are being mismanaged and cannot sustain their present rates of use. Natural ecosystems that store water, protect the soil, or shelter unique plants and animals have been degraded or converted to other uses. Some plants and animals are over-harvested, and a few have become extinct. Conversely, some introduced species have proliferated and become a threat to indigenous biodiversity. Conservation is therefore vital to sustainable growth.

Conservation should not preclude human use. Development needs to be people-centered and conservation-based. Biological resources are renewable if used sustainably and exhaustible if not. Most conventional conservation efforts have advocated resource protection without human use; conversely modern agricultural and industrial systems have emphasized production with little regard for conservation. The move must now be to meet human needs sustainably while preserving the integrity of the environment."

NATIONAL ENVIRONMENTAL ACTION PLAN, Kenya, 1994.

I. Introduction

A. Overall Purpose of Natural Resources Management Assessment

The purpose of the Natural Resources Management Assessment was to provide USAID/Kenya with a basis for program decisions, policies, and guidelines as the Mission undertakes the development of a New Country Program Strategic Plan (CPSP) for 1996-2000. Several areas of natural resources management were assessed; forestry, agroforestry and soils, biodiversity/ecology, and policy and institutions.

This assessment followed upon USAID/Kenya's identification of natural resource management as a "target of opportunity" in its 1990-1995 Country Program Strategic Plan. USAID's recently revised strategic plan and accompanying "objective tree" lists the primary agency-wide strategic goal as "Promote Sustainable Development". Under this goal, the plan defines four major pillars for USAID programs; 1) population, 2) economic growth, 3) democracy and governance, and 4) environment. This report provides information and analyses to support a review and evaluation of concerns and opportunities in the ecology and biodiversity arena for USAID/Kenya's future planning efforts.

This report attempts to present a broad overview of the current status of ecology and biodiversity conservation in Kenya. Threats and opportunities to biodiversity conservation, particularly as related to wildlife conservation, are presented, along with an overview of USAID/Kenya's COBRA project (forest, water, agroforestry and soils, and policy and institutions, are discussed in separate chapters.

B. Specific Purpose of Ecology/Biodiversity Management Assessment

Specifically, the mission requested of the ecology/biodiversity report external technical advice on the following:

- Review and summarize the status of biodiversity and global climate change in Kenya - extent, importance, threats to habitat, human conflicts, and current and future research and implementation activities.

- Assess the impacts of agribusiness in Kenya on the natural resource sector. In particular, examine threats to environment from pesticides, chemicals, etc, and how to mitigate their (adverse) effects.

- Review in-country environmental information monitoring system capabilities. Determine the desirability of USAID assistance in strengthening this sector.

While this report touches on each of these issues, some are addressed in greater depth than others, a reflection in part on the constraints of time, the areas of expertise, the

current status of knowledge on a given topic, and the sense of priorities for Kenya biodiversity conservation developed over the course of the assessment. Given the tremendous importance Kenya places on its wildlife, this sector was given priority in the writing of this document.

This report, "An Overview of Ecology and Biodiversity Conservation in Kenya", essentially constitutes a chapter to a larger report on "Natural Resources Management in Kenya". Accompanying chapters to the main report are referenced in this report and cover "Forestry", "Agroforestry and Soils", "Policy and Institutions", and "Water Resources".

C. Definitions:

The accepted definition of **biological diversity** or **biodiversity** in this report refers to genetic diversity, species diversity, and ecosystem diversity. It can be perceived as an interacting complex of plants, animals and microorganisms in the physical environment.

Biological Resources refers to biological organisms used by humans (for example, in forests, agriculture, medicine, industry and textile production).

Conservation is defined as the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet needs and aspirations of future generations. Thus, conservation embraces preservation, maintenance, sustainable utilization and restoration, and enhancement of the natural environment.

D. Methodology

Information was derived from interviews with individuals having significant experience and knowledge of Kenya's natural resource situation. These individuals were contacted in Washington, DC and in Kenya. In addition, a number of plans, studies, assessments, project statements and materials related to past and present resource conditions in Kenya were reviewed. These documents are noted in the bibliography of the main report.

The assessment entailed site visits to Mombasa/Bamburi, the Maasai Mara National Reserve and Loita Hills, Amboseli National Park, Lake Naivasha, Lake Baringo, a USAID/COBRA site in Laikipia, Mount Kenya, the Aberdares, and surrounding agricultural areas and forest plantations, the Hopcroft game ranch, and the Elangata Wuas project site.

II. BACKGROUND AND ANALYSIS

A. Ecology and Biodiversity Conservation and Development

Kenya's biological resources are of considerable domestic and international economic and intrinsic value. Agriculture, livestock, fisheries, and forests, for example, account for most subsistence survival, economic output, employment and export earnings. Tourism in Kenya is the key foreign exchange earner and is largely based on the presence of wildlife and seashores.

Kenya contains a plentitude of ecological zones, with representative sectors of east coast forests, highland plains, savannahs, montane forests and alpine areas, remnants of lowland West African forest, and mangrove forests, inland lakes, coral reefs and wetlands. Many of Kenya's biological resources are considered to be internationally important as areas rich in biodiversity and endemism. These include five internationally recognized biosphere reserves (Marine: Malindi/Watamu, Kiunga; Terrestrial: Amboseli, Mt Kenya, Mt Kulal) and one Ramsar site at Lake Nakuru.

This ecosystem diversity is an important characteristic of the country's biological resource endowment. These different biomes support vastly different plant and animal communities, which are used in quite different ways by humans. The economic advantages of ecosystem diversity are readily apparent in Kenya. Economic activities are concentrated within particular zones according to elevation, rainfall, and other climatic and soil characteristics. Tea and coffee production dominate the highland areas, zones that support many subsistence farming communities. Indian Ocean beaches and coral reefs draw large numbers of visitors with foreign currency, while commercial ranching for cattle and wildlife, and maize production are found in the lowland areas of the interior. Fisheries are important on the coast and along the shores of Lake Victoria, while a significant dairy industry is found at higher elevations. Wise use of such ecosystem diversity has profound economic implications for Kenya and its government.

Economic downturns in one sector, or natural disasters in one region, are less likely to prove catastrophic when the productive base is more diversified. Ecosystem diversity and maintenance of biological systems thus provides an insurance for economic and food security and mitigates against unpredictable stress and losses from natural disaster, climatic change, wars, and civil strife. More than most other African countries, Kenya has taken full advantage of its ecosystem diversity to build a relatively diversified and resilient economy.

Kenya's achievements in protecting its biological diversity are among the best in Africa, but sustainable conservation of these resources into the future now lies in question.

No problem may be threatening the biological resources of Kenya more than poverty and the proliferation of the human species. Kenya's population growth rate is one of the highest in the world (estimates range between 2.7 and 3.5%) and has resulted in intense pressure on the land and threatens depletion of the available natural resources. It is estimated the during the next 30 years, the population of Kenya will jump from 26 million to 79 million. This increase will create a tremendous demand for land and resources such as food, fuel and water.

Currently, about 80% of Kenya's population live in the high potential lands, which cover about 20% of the country's land area. The population densities in these areas are among the highest in the world, and the consequent use of resources is intense. At the turn of the 1900s, many of the wet highland areas of Kenya which are now cultivated were heavily forested. In the late 1920s and 1930s, settlements started in the highlands. This resulted in significant land clearance and the introduction of intensive mixed farming, commercial livestock husbandry, and plantation crops in large-scale farms. Concurrently, in other high potential areas, the upsurge of human population resulted in more land clearance, more pressure on soils through shortening of fallow periods, and fragmentation of the land. In the 1960s, a massive government resettlement program resulted in fragmentation of the former large scale farms and the settling of small holders. It is estimated that by the 19902, Kenya had lost 2,274,000 hectares (over 70%) of its forest areas.

This subdivision of land has continued until the present time. Currently, average farm size in the highland areas ranges from 1-7 ha, supporting 7-9 people. There are large tracts of land in these regions are not currently in cultivation, but are either privately owned or held in trust by the government. This is forcing migration into forests, onto arid and semi-arid lands, and to urban centers. The future on the already cultivated lands lies in intensified, and perhaps specialized, sustainable agricultural production.

The absence of a comprehensive land use policy and ineffective environmental regulation in Kenya is contributing to inappropriate land use practices that result in land degradation and pollution, and unregulated expansion of urban areas. Poorly regulated agricultural, industrial and urban development are undermining the very ecosystems that generate Kenya's tourism revenue.

The increased demand for land and other resources by humans has also leads to the diminishment of habitats, both in area and quality, for wildlife and coral reefs. Increased population pressures surrounding protected areas has led to conflicts between local communities and wildlife. Migration corridors which permit survival of many species, such as the wildebeest, are being blocked as traditional rangeland becomes converted for more intensive agricultural purposes and fences are erected that block off major dispersal avenues. Local communities perceive the establishment of exclusive protected areas as infringing on their rights to traditional resources.

Rather than becoming an integral component of an existing social system, parks were imposed from the outside, and local communities were perceived as major contributors to resource degradation. Many traditional societies, however, fostered belief systems as well as social norms which encourage, or even enforce, limits to exploitation of biological resources. The Maasai, for example, do not eat meat, although they live among vast herds of wildlife. The coastal Kaya forests have been preserved by local communities due to the continued observance of traditional spiritual beliefs that held these groves sacred.

Inherent in the strategy of park establishment was also a belief that humans were not part of the ecosystem, yet often traditional societies maintained production systems that effectively conserved and even enhanced biodiversity. The pastoralist Maasai developed a system of communal property and seasonal rotation of grazing lands, with certain pastures used only during droughts, which enabled them to survive dry years, avoid serious damage to the ecosystem, and co-exist with wildlife. Seasonal fires were set to control the encroachment of bush and woody species, and encourage new grass growth. The resultant diversity of species allowed for grazers and browsers to feed on different vegetation sequentially on the same pasture. In the Maasai Mara, this succession starts with zebra on newly cleared land, followed by wildebeest and gazelle. The succession also stimulates growth of new vegetation. Even elephants play an important role by browsing and trampling tree seedlings and opening areas to new grass growth. Recent research in Kenya shows that many parks lose diversity when human activity is removed.

The conflict between conservation and economic development is not being won in a way that is sustainable in the long term. The current trends in population, land tenure and resource use policy, and unregulated utilization, threaten the future existence of Kenya's precious biological resources. Biodiversity conservation and rational utilization are vital ingredients to Kenya's future sustainable economic development.

B. Humans - Cultural Diversity

Kenya has a rich mixture of many cultural groups. There are over 50 ethnic groups and sub-groups in Kenya. The largest groups are the Kikuyu, Kamba, Meru, and Embu, (Central Kenya, Mt Kenya vicinity), and the Luhya, Luo, and Gusii (Lake Victoria region). These groups traditionally cultivate most of Kenya's food and export cash crops, most notably coffee and tea. Among the many pastoralist and semi-pastoralist groups, the largest are the Maasai, the Turkana, and the Samburu. There are also numerous Kenyans of Asian, Arab, and European descent.

Cultural knowledge about biodiversity is held by the many different indigenous people of Kenya. Much of this information is local and utilitarian and comprehensive. Different biological species may be given the same name if they serve the same purpose. For example, the Maasai recognize several hundred rangeland plant species and ecotypes; the Suiei Dorobo of Northern Kenya use over 500 plant species; the Bukusu in Bungoma utilize over 100 plants for food. The Nkebotok (Turkwell Riverine Forest) grow 17

varieties of sorghum; each with an individual name and distinctive traits. Farmers experiment with each other's seeds when they need to cultivate new land. Much of this knowledge is orally transmitted, and is rapidly being lost as cultures change. The National Museums of Kenya and KENGO have begun extensive cataloguing of this information.

C. Economy

Agriculture remains at the base of the national economy, providing the main livelihood for 85% of the population and 70% of the work force. Gross revenues from natural resource use in Kenya are estimated to total $2966 million (agriculture and livestock: $2,400 m, wildlife: $455 million, forestry: $76 m, and fisheries: $10 m, UNEP 1992 Country Study).

Tourism ranks as Kenya's largest single foreign exchange earner from 10,000 visitors in 1962 to almost three quarters of a million today. In 1992, the tourist industry brought $444 million in foreign exchange (UNEP 1992 Country study). Wildlife viewing accounts for at least 40% of the tourism, with coastal tourism accounting for the remaining 60%. Some reports say this trend may now be shifting in favor of wildlife tourism.

Other export earnings are mainly from natural based products with little processing. In 1990, total exports of natural resource items accounted for 80% of all exports, and of these only 24% were processed items. Kenya is the third largest tea producer in the world. Tea and coffee are the major agricultural foreign exchange earners, followed by horticulture. Kenya is the biggest pyrethrum producer, and a major exporter of pineapples, as well as a range of other agricultural and horticultural products, such as tomatoes, grapes, mangoes, bananas, avocados, oranges, and flowers. In 1990, the horticultural sector earned $133 m in foreign exchange. The major on-farm food production commodities are maize, wheat, milk, beef, and meat.

The country is heavily dependent on its natural resource base for economic output, both domestically (where agriculture remains dominant) and in the external sector (where agriculture and natural based resource items such as hides and non-fur skins, etc, and tourism are main sources of income). Damage to that base could have serious consequences for the country.

D. Geo-physical Description of Land Base and Vegetation

1. Land Base

Kenya is a country of 582,646 square kilometers, whose altitude ranges from sea level to 5,199 meters. About 72% of the land area receives less than 500 mm of rainfall per year; 13% receives 500-750 mm, 12% receives 750-1250 mm and 3% receives over 1250 mm.

The country consists of eight physiographic regions: the coastal plain, the Duruma-Wajir Belt, the low Foreland Plateau, the Kenya Highlands, the Kenya Rift Valley, the Nyanza Lowlands, and the northern Plainlands.

Kenya is split by the Great Rift Valley which is largely occupied by range lands. The region at the east of the Rift Valley lies at about 2,000 m above sea level, and is dominated by Mt Kenya and the Aberdare mountains. In the west, the country slopes down to Lake Victoria. The highlands, forming most of the south-west and central parts of Kenya, are well watered and fertile. More than half the northern and north-eastern part of Kenya is semi-arid.

2. Water Resources

Kenya has rich aquatic biological resources in both inland and marine waters. The major inland water ecosystems include lakes, rivers, and wetlands. The largest freshwater lakes in Kenya are Lakes Victoria, Naivasha, Jip and Challa. Most other lakes are saline or alkaline, and occur in the Rift Valley. Of these, Lakes Turkana, Baringo, Nakuru, Magadi, and Amboseli are the most important economically and biologically.

Kenya is divided into five drainage or catchment areas of which the Tana river basin is the largest and has numerous dams and storage reservoirs. The four other drainage areas are the Athi and Sabaki River Basin, Lake Victoria Basin, Rift Valley Basin, and Ewaso Ngiro Basin.

Many of the river courses contain water all year round, except in the north, where stream beds are dry for most of the year. The main rivers in the country are the Tana and the Sabaki River, both flowing into the Indian Ocean, the Ewaso Ngiro flowing into Lake Natron in Tanzania, and a number of smaller streams flowing westward into Lake Victoria.

A substantial proportion of Kenya's water resources is found in wetlands, which cover 2-3% of the country's surface area.

The Kenyan coast runs for 560 km between the Somali and Tanzanian borders. A highly productive coral shelf extends up to two km off shore before dropping off into the relatively infertile waters of the Indian Ocean. The shore consists largely of sand beaches in front of limestone terraces. Mangrove forests grow wherever rivers, streams, or shallow aquifers meet the sea.

(see the chapter on "Water Resources" in the "Natural Resources Assessment" report).

E. Status of Existing Resources

1. National Parks and Reserves

Kenya has a well established system of 56 national parks and reserves in Kenya, including seven along the Indian Ocean Coastline. This encompasses 6.7% of the country. National parks vary in size from the smallest, Saiwa National Park, (2 sq.km) to Tsavo National Park (7,800 sq km). National parks are classified as areas in which only scientific, educational, and recreational use compatible with ecological stability and diversity are permitted. Land tenure in National parks is entirely under the jurisdiction of the central government and the land cannot be used for any other purpose. The Kenya Wildlife Service (KWS) has jurisdiction over all wildlife.

Unlike the parks, national reserves are designated as relatively large conservation areas where various degrees of human activity are allowed such as grazing of livestock and collection of firewood. Until recently all National Reserves were owned and managed by local County Councils and have been utilized for a range of activities beyond those initially intended. This poorly regulated use is especially apparent in the marine reserves. KWS has agreed to manage two National Reserves (Shimba Hills and Maasai Mara) jointly with County Councils. This should improve the quality of ecological monitoring, tourism revenue and revenue distribution to suit local needs.

Some of Kenya's protected areas are internationally recognized as Biosphere Reserves, World Heritage or Ramsar sites. Four of the five Biosphere Reserves overlap with already protected areas. Lake Nakuru, Kenya's Ramsar site, is an important site for flamingoes, but is undergoing marked ecological change, both in the lake, through fish introductions, alterations of water input, agricultural and industrial run-off, and on land, where loss and exclusion of browsing herbivores is allowing rapid scrub brush expansion. A second proposed Ramsar site, the Tana River Delta, is already under increased pressure from planned aquaculture expansion, increasing mangrove harvesting and alterations in river flow from dams.

2. Land Use Area

According to FAO (UNEP, 1987), the land area of Kenya can be classified into the following categories:

Semi-arid or arid	(85%)
Meadows and permanent pasture	(7%)
Arable and permanent cropland	(4%)
Forests and woodlands	(4%)

The 15% of the land base that falls outside the semi-arid and arid classification is considered the zone of moderate to high potential for agriculture and supports 75-80% of the population.

3. Species Diversity

The biological diversity of Kenya's natural resources is large. The number of higher plants in Kenya is estimated at 7000 species, of which approximately 1700 are tree and shrub species. The current estimate of the number of bird species is 1079, of butterflies is 875, and of mammals 505.

The World Conservation Union (IUCN) Red List of Threatened Species (1990) lists 13 mammalian species, representing eight families and four orders, as threatened. Among this list, five species belong to the insectivore order, and four to the primate order, occupying mostly coastal or riverine lowland forest habitats. Large plains game such as the African Elephant (*Loxodonta africana*), some carnivores, i.e., the Cheetah (*Acinonyx jubatus*) and the leopard (*Panthera pardus*) were listed in 1978 as threatened, but as of 1990, are no longer listed. In fact, only one savannah species, the Hunter's Antelope (*Damaliscus hunteri*) is currently listed as threatened. This trend is due, in large part, to strengthened wildlife conservation policies, and increased donor support and funding to the wildlife sector. It also corresponds with reduced poaching arising from the banning of trade on elephant ivory, and the establishment of the Kenya Wildlife Society (KWS).

4. Biotic Communities

According to the Wildlife Planning Unit of the Ministry of Tourism and Wildlife, Kenya has 19 biotic communities (grasslands may be further divided into 4 sub-categories). These communities represent a synthesis of a variety of ecological factors such as soil type, rainfall, altitude, and temperature which result in the development of a distinctive community of flora and fauna. These communities incorporate the major plant and animal species in the country and thus are a significant factor in developing a basis for the long-term growth of Kenya's national park and reserve system. The percentage of land occupied by each of these communities varies considerably as does their presence in protected areas (PA) (see Table 1).

Table 1. The 19 biotic communities in Kenya are:

	Biotic Community Type	% Total Land Area	Times Present in PA
1	Afro-Alpine Glacier and Moorland	1.3	6
2	Highland Moist Forest	2.0	7
3	Guineo-Congolean Rain Forest	0.09	2
4	Highland Dry Forest	0.4	3
5	Evergreen and Semi-evergreen Bushland	1.4	4
6	Grassland		
6a	Highland grassland	0.05	0
6b	Fire-induced grassland	3.1	8
6c	Alkaline Volcanic Ash Grassland	0.2	1
6d	Seasonal Floodplain and Delta Grassland	4.7	4
7	Semi-arid Wooded and Bush Grassland	0.2	2
8	Arid Thorn Bushland and Woodland	41.7	30
9	Semi-Desert	16.8	5
10	Coastal Forest and Woodland	0.14	2
11	Groundwater and Riverine Forest	1.5	6
12	Coastal Evergreen Bushland	0.4	1
13	Coastal Palm Stands	0.09	0
14	Permanent Swamps	0.1	2
15	Freshwater Lakes	2.1	1
16	Alkaline Lakes	0.04	2
17	Marine Beaches and Dunes	0.04	0
18	Mangroves	0.16	3
19	Coral Reefs and Islands	0.09	9
(20	Agricultural Land	18.0	-)

Adequate representation of all biotic communities is a major goal of protected area systems, as a relatively sure way to protect a wide range of species. Overall, representation of biotic communities within Kenya appears good (with the exception of three communities). What is not known is the true status of some of the smaller communities, and the likelihood of their survival as viable ecological systems.

5. Major Ecological Plant Zones

a. Forests

Although some forests lies within the National Parks and Reserves, the bulk of the land is managed by the Forest Department. Forest areas fall under different management regimes and have different legal status. A gazetted forest is a forest reserve, legally owned by the government and managed directly by the Forestry Department and/or KWS. Of the 4 percent land area in Kenya that is classified as forest, two-thirds are gazetted forest reserves. Areas which may be taken out of the forest reserve must be formally de-gazetted. Such excisions require the authority of the government and public notification (although notification is typically obscure).

The major and continuing loss to forested land has been through the legal process of excision. Since gazettement began, the loss of forests through excision has amounted to 13% of Kenya's total gazetted land. Most of this land has been excised for agricultural purposes, and is recorded as de-gazetted for "settlement". The biggest alternative use of forested land is tea production.

According to the FAO/UNEP GEMS (Global Environmental Monitoring System, UNEP, 1987), the forests of Kenya consist of the following:

Natural Woody Vegetation:
- Closed broadleaved formations
  (coastal forests, mangroves, upland plateau, mountains)
- Open broadleaved forests
  (upper zone of the upland forest)
- Bamboo formations
  (intermediate and wetter zone of uplands, 1800-3300 m)
- Coniferous forests
  (Eastern slopes of Mt Kenya and the Aberdares, 1700-2400 m)
- Shrub formations
  (semi-arid regions)

Plantations:
Cupress spp., Pinus spp., Eucalyptus spp., Acacia spp.

When managed sustainably, forests are important renewable resources which act as reservoirs for genetic diversity, yield a continual supply of non-wood forest products, help to regenerate soils and protect them from erosion, protect areas downstream from floods and siltation, and buffer variations in climate.

As well as supplying local and industrial timber, woodfuel, and non-timber products, forest regions support the highest densities of biodiversity, including many of Kenya's threatened endemic species. Forty percent of all large mammals occur in the forest, as do 30% of the birds, and 35% of the butterflies. Forests also provide important water catchment areas, regulating soil erosion and seasonal river discharge.

Of the some 7000 plant species that Kenya possesses (UNEP, 1992), most of this diversity occurs on less than one-quarter of the land outside the arid and semi-arid lands. Aside from these arid and semi-arid ecosystems, Kenya lies at the intersection of four major zones of plant species diversity, briefly outlined below:

Guineo-Congolian: Kenya possesses the eastern most fragments of the Guineo-Congolian region. These are now restricted to the degraded forests of Kakamega and the adjacent Bonjogo forest (both now under intense outside pressure and proposed for increased conservation status). Kenya's Guineo-Congolian forests occur in a drier environment than the larger, western tracts of forest in Uganda,

and have somewhat different species composition. Although not rich in national endemics, this region is the only remaining patch of one of Kenya's more species rich biotic communities. Kakamega Forest is a unique habitat for endangered tropical hardwood species not found anywhere else in Kenya. *Podocarpus* (Podo), *Juniperus* (Cedar), and *Vitex* (Meru Oak) are being unsustainably exploited. Kakamega is home for 15 species of birds, including several tropical birds not found elsewhere in Kenya. Several mammals have been exterminated. The last elephant was exterminated in 1912, Buffalo and Uganda Kob were exterminated soon thereafter.

4469 ha of the forest was placed under protection as a National Reserve in 1985, but the entire area remains under intense pressure from encroachment and unsustainable use.

Zanzibar-Inhambane Mosaic: Along the coast, Kenya once possessed a band of vegetation (50-200 km wide) belonging to the Zanzibar-Inhambane Mosaic. Due to population pressure and changes in land use, the forest component of this vegetation is now highly fragmented. Each surviving region shows a high level of endemism and all remaining patches are under threat. Of the total number of threatened forest species, 50% of the plants, 60% of the birds, and 47% of the mammals are found in the Coastal Forests. This shows the importance of this region, despite its relatively small area and its overall lack of forest cover (about 2-3% of the national forest cover).

Only two remaining areas (Shimba Hills National Reserve and Arabuko-Sokoke Forest Reserve) currently receive protection as reserves. Arabuko-Sokoke is the largest remnant of the forest typical of the coastal ecosystem. Arabuko-Sokoke supports several species of rare animals, including the endangered endemic birds, Sokoke Scops Owl and Clarke's Weaver, plus several other rare or endangered species such as Ader's Diuker, the Golden-rumped Elephant Shrew, and the Sokoke Bushy-tailed Mongoose. Shimba Hills contains endemic roan and sable antelopes, as well as 13 threatened forest birds. *Melicia excelsa* (Mvule) has been exploited for timber, and all large individuals of *Brachylaena huillensis* (Sandalwood) have been lost from the population at Arabuko-Sokoke for fuelwood and carving. Shimba Hills supports 19 threatened trees, of which 15 are restricted to forests of the south coast.

Several of the smaller Kaya forests, considered sacred groves by the local communities, are protected as National Monuments for their cultural and biological value.

Somali-Maasai Region: These upland dry evergreen forests now occur only as relic stands along the eastern edges of the Rift Valley of Kenya and N. Tanzania.

The most important protected areas are Ol Doinyo National Park and the Nairobi Forest Reserve. Small parts of the latter lie within Nairobi National Park (80 ha).

Afro-Montane Region: This is the best studied forest type in Kenya, growing on the higher regions of the Rift Valley Escarpment and Central Highlands. These forests all serve important watershed functions. The Aberdare forest is an important water catchment for the Tana, Chaia and Ewaso Ngiro Rivers. Additionally they provide sites rich in plant and animal biodiversity, supporting over one-third of Kenya's threatened species. These forests contain several species of mountain animals including bongo, rhino, elephant, leopard, golden cat, and giant hog. *Ocotea spp.* is being overexploited for camphor, and the *Newtonia* forest formations are rapidly being cleared.

Although some high altitude montane forests are well protected by isolated position and protected area status, others are being eroded at increasingly rapid rates. There are several prime areas for increased protection including Mau Forest and Mt Kenya, where lower slopes threatened by encroachment by small-farm agriculture and illegal logging.

2. Semi-arid and Arid Zones

In addition to containing three-quarters of Kenya's protected areas and well over half of Kenya's large animal wildlife, the semi-arid and arid regions support many pastoralist and crop/livestock farming communities, plus 60% of the country's beef cattle, 70% of the sheep and goats, and almost all of the camel (UNEP, 1992). These large expanses also serve as water catchment areas (e.g.: Mzima Springs in Tsavo supplies the urban area of Mombasa) and as global carbon sinks. These areas are declining in ecological quality and productive value, primarily due to overgrazing, subsequent soil erosion, and desertification.

The Grasslands, which occupy over 8 million ha., are experiencing external pressure and rapid change. Over 10% of original grasslands have been converted to agriculture which is not always sustainable. For example, in 1975, the Mara-Loita-Ngorengore grasslands covered 351,000 ha, with 5,000 ha of wheatland. By 1987, 37,000 ha had been converted to wheat, but 4,000 were abandoned due to persistent crop failure. As the most productive grassland areas are converted to agriculture, livestock farmers and traditional pastoralists are forced to move into marginal lands, increasing soil erosion and degradation in these areas.

6. Wildlife - Status and Trends

a. Introduction

Kenya possesses a unique assembly of "charismatic megafauna" (elephant, rhinoceros, lion, leopard, buffalo), with few parallels elsewhere in the world. While much of the conservation effort in Kenya has focused on these "megafauna", there are many other important smaller, but equally important fauna species, as well as flora, which merit protection (see major ecological plant zones).

The most serious human-induced losses of biodiversity come from: habitat alteration, the introduction of exotic species, overharvesting, pollution, and according to some sources, global climate change. The current discussion will focus on the effects of these impacts on wildlife in Kenya.

b. Habitat alteration

Habitat alteration includes: replacement of entire habitats by settlements, large-scale clearing and burning of forests, indiscriminant use of pesticides, draining of wetlands, destructive fishing practices, air and water pollution, urbanization and conversion of lands for agricultural purposes, and over-extraction of water from rivers for domestic, agricultural and industrial uses.

i. The Tana River Delta Example

The Tana River Delta is an example of a habitat that has been significantly altered. This delta is the largest delta ecosystem in Kenya, covering an area of about 130,000 ha. The delta's habitats include floodplain grasses, bushlands and woodland associations, sand-dune forests, salt marshes, mangroves, riverine forests, coastal waters, and inland freshwater bodies; in short, a complex myriad of ecosystems.

The Tana River Delta site is already under pressure from planned aquaculture expansion, increased mangrove harvesting, and alterations in river flow from the five dams along the Tana River. One project, the Tana River Delta Irrigation project, has proposed to cover 16,000 for paddy rice production. This includes within its boundaries nine villages with an estimated population of 3000 farmers, pastoralists, and fishermen, all of whom would have to relocate. The irrigation project may have significant impacts on the surrounding habitats by altering the hydrological regime of the Tana River, deteriorating the river water quality due to eutrophication and pollution, altering freshwater/saltwater imbalance, and altering the vegetation cover thereby disrupting systems of grazing, small-scale riverine agriculture and fishing, and interfering with migratory movement of large mammals, waterfowl and marine fauna.

Properly managed, the Tana Delta has the potential to become a model for compatible management of human activities with conservation of biological diversity. If left unmanaged, however, conflicting interests in the Tana River Delta are likely to cause irreversible degradation of the delta's biodiversity.

ii. Wildlife Inside versus Outside Protected Areas

Habitat loss for wildlife is becoming one of the greatest problem areas in Kenya. With estimates that 10% of the wildlife live in parks, 15% in national reserves, and 75% outside protected areas, the fate of wildlife biodiversity hinges more on what happens outside the protected areas than inside.

The wildlife of certain protected areas, most notably Amboseli NP, Maasai Mara NR and Nairobi NP, disperse well beyond the boundaries of protected areas during the wet seasons. The wildlife assemblages which underpin much of Kenya's tourist industry are influenced by land use changes in these dispersal and buffer zones. Ecological analysis of the size of these dispersal areas, and the effect their loss would have on National Parks and Reserves should be a high priority. Current estimates of dispersal zones covering 459,407 sq km (79% of the total land area) are too coarse to provide useful information.

Loss of migration corridors and dispersal areas constrains wildlife to specific areas. Conservation areas are increasingly becoming isolated islands. The resulting compression of wildlife in conservation areas has severe ramifications on ecosystems, species composition and diversity.

Amboseli-Kilimanjaro Elephant Corridor

Elephants of Amboseli and Mt Kilamanjaro migrate between the two regions along two well-known elephant trails. This "corridor" ensures that the two populations remain viable in genetic, demographic and ecological terms. The eastern boundary of one of the trails is marked by intensive maize cultivation and the agricultural land near the forest reserve on the Tanzania side is becoming increasingly settled. It is clear that if action is not taken to secure a corridor in the near future, the two populations will eventually become cut off.

The ecosystem of Amboseli has dramatically changed within the last decade. Most of forest/bushland has been converted to grassland. It appears this conversion is due to both the extremely high elephant populations, and the cyclical nature of the ecosystem in which the waters of Lake Amboseli periodically rise or dry out completely. If the population of elephants is not managed, disasters such as the one that occurred several years ago in Tsavo, in which huge numbers of elephants died during the drought, will recur. Better understanding of the ecological systems, and management of wildlife, park lands, and migration corridors is imperative.

Loss of Genetic diversity

Inbred populations of animals loose their genetic diversity and resilience to disease. Studies in the Wildlife Genetics Programme at the National Museums have begun research on the genetic variability and population genetic structure of native wildlife species such as the black rhino. This information will contribute towards better conservation and management of those resources.

c. Overharvesting

Overharvesting (hunting and poaching) leads to population reductions, sometimes so severe that a species becomes extinct. Hunting of rhinos and elephants so drastically reduced their numbers in Kenya in the 1960s and 1970s, that it became an international conservation issue, attracting the concern of conservation groups worldwide. In 1977, KWS placed a ban on hunting.

During the 1970s and mid 1980s, Kenya's black rhino population experienced a decline of 98 percent due to illegal harvesting. In response, in 1984 the Kenya government initiated a plan to conserve the country's rhino population. The establishment of government-run sanctuaries forms the basis of this conservation strategy, with the aim of increasing numbers in these areas as rapidly as possible and using rhinos to re-stock larger unfenced areas of protected rhino habitat. Kenya is one of three countries in Africa that now has stable or increasing black rhino populations. Recent censuses estimate that populations have increased and in 1992, Kenya held an estimated 420 black rhinos. Almost half of these are small sub-populations of rhino numbering 10 or less, typically in remnant groups from formerly much larger populations that have been virtually eliminated through poaching in the 1970s and early to mid 1980s (WWF Fact Sheet, 1994).

d. Introduction of Exotic species

Exotic species which are introduced deliberately or inadvertently usually has adverse effects on native species. For example, in some lakes with very high levels of endemism, introduced species of fish have threatened most native species with extinction. The Nile Perch, a carnivorous fish species that was introduced into the Northern part of Lake Victoria in 1960 to improve the commercial fishing industry, has greatly expanded its range at the expense of endemic species. In 1970, there were approximately 400 species of fish, of which about 250 were endemic species of the cichlid *Haplochromis*. It is estimated that 30 species have already become extinct, this being among the highest rate of human-induced extinctions of vertebrates ever recorded.

e. Pollution

Pollution is emerging as a major environmental concern in Kenya. Among the four types of pollution hazards (water, air, noise, solid waste), water pollution is the most pronounced in Kenya (UNEP country study, 1992). Water pollution is mainly caused by sanitary waste, agricultural chemicals, and industrial effluent that make their way into rivers, lakes and the sea. Modern and intensive agricultural activities involve the use of a variety of chemicals such as insecticides and fertilizers. Industrial activities bring forth gaseous emissions, other by-products and forms of toxic waste materials which pollute the air and water. These significantly degrade the natural resource base upon which wildlife survives (see Environmental Pollution).

f. Global Climate Change

Climate change is today a subject of major concern and interest to many, including government policy makers and international negotiators. Communities have come to accept the ways weather patterns are organized in their own habitats, and have in turn organized their lives along those annual patterns, otherwise called seasons. The pattern also influences the food they grow and eat. National governments have programmed their development priorities and investments based on national seasons. Therefore any change in this order of seasons to influence weather and climate goes to the fabric of organized society.

Actually, climate has changed, is changing, and will change in future. Human alteration of the atmosphere is imposing additional changes, possibly very rapid and large ones, on this naturally variable background. The consequences to climate of increasing atmospheric concentrations of carbon dioxide, methane, and other greenhouse gases are not predictable in detail on a global scale; exact prediction on the regional scale of government policy is even more difficult. Most students of global climate change, however, believe that the world climate will soon be several degrees warmer. The biological consequences of such warming could be very serious (McClanahan, T.R. and T. Young, in press).

Present strategies of conservation depend heavily on preserves (parks and reserves) of limited area, separated by long distances where conserved biota is scarce or lacking. If climatic change makes preserves unsuitable for part of their present biota, the affected species will have to move to suitable new habitats if they are to survive (D.A. Livingstone, in: McClanahan, T.R. and T. Young, in press). Consideration of migration corridors and adequate ecosystem representation (both in terms of quality and area) is an important factor in the planning, design, expansion, and management of protected areas.

7. Wildlife Conservation and Trends

a. Historical

Wildlife conservation has a long history in Kenya, starting in the precolonial period. One of the dilemmas associated with it has been how to deal with land-use conflicts in wildlife areas in a manner that will meet both the wildlife conservation requirements and human needs. The present challenge for Kenya in the wildlife sector is to take into account the needs of local communities and those of wildlife so as to use the sector effectively and alleviate land-use conflicts.

In earlier times, wildlife conservation was closely linked to the imperatives of co-existence between humans and the natural environment. There was plenty of land and a lower human population density than today. Maintaining natural ecosystems in their natural state was relatively easy. Hunting and burning of vegetation kept the balance between humans, wildlife and their habitat.

Prior to the 1960s, parks were created by white colonists exclusively for the purpose of preserving game from extinction for hunting. Wildlife populations had been decimated by unregulated game hunting. The complex patterns of natural resource utilization practiced by the local population were not understood. The fact that specific communities had been subsisting in these areas prior to the establishment of wildlife sanctuaries was ignored. Although the assumption then was that the arid and semi-arid lands were best suited for wildlife conservation since they were too dry for agriculture, there were people like the Maasai, Samburu, Turkana, Akamba, Taita and others whose livelihood was obtained from these lands. At the coast too, there were traditional fishermen who depended on the sea for their livelihood. The areas put into national parks and game reserves were obtained from the local inhabitants either by treaties or by force. It is not surprising that the parks and reserves were negatively regarded by the local communities. Game sanctuaries were regarded by the surrounding communities as waste lands that could be put to better use.

Although the Kenyan government has profited from the tourism generated by these parks and reserves, the benefits were not adequately shared with the surrounding communities, furthering resentment on the part of the local people. In some of the more antagonistic cases, wildlife was seen as direct competition for land and resources, such as in Amboseli, where local communities deliberately killed "protected" wildlife.

The challenge has become to find ways of using the land which benefits the local populations.

b. Governance of Parks, and Reserves and Sanctuaries

Parks - Kenya Wildlife Service

In the early 1960s, responsibility for the parks was turned over to the newly formed Kenyan government, who pledged to conserve wildlife and wilderness. The Kenya Wildlife Service (KWS) was established in 1989 as a parastatal organization in charge of wildlife conservation and management. KWS has responsibility for only 1/4 of the wildlife protected areas, the rest lies under various local councils. KWS, with the support of USAID, established the Community Wildlife Service (CWS) Department, whose main objective is to ensure proper utilization of wildlife outside the protected areas for the benefit of the communities which tolerate the impact of wildlife in their farms. A Community Wildlife Program was established within CWS, which allows, among other things, revenue sharing, in which communities living adjacent to national parks and reserves benefit from the revenues generated at the gates. Projects initiated through revenue sharing include sinking of bore holes, building of schools, road improvement, building of health centers, and cattle dips.

Reserves and Sanctuaries - County Councils

Local County Councils run the wildlife sanctuaries in the game reserves of Maasai Mara, Amboseli, and Samburu. The local inhabitants practice their traditional cattle rearing in the reserves. Proceeds obtained from tourism are paid to the county council, the body entrusted with sharing the revenue among the local inhabitants in the game reserves. This mode of land-use is intended to involve the local people in wildlife conservation efforts and ensure that they share in the benefits. There have, however, been several problems associated with this arrangement.

First, by entrusting the people's benefit to the county council, a large share of the revenues has been retained and used by the councils. Second, the funds have been mismanaged. Rather than build amenities for the local communities, the councils have used the revenue to satisfy their own administrative needs. The local people have started viewing the game reserves as islands for tourists where they have been denied access to their normal grazing. As a result of the mounting tensions, KWS agreed to manage two National Reserves (Shimba Hills and Maasai Mara) jointly with County Councils. This should improve the quality of ecological monitoring, tourism revenue and revenue distribution to suit local needs.

Despite these difficulties, reserves do provide local people with alternative sources of income. Some group ranches outside the reserves are generating revenue through the construction of camp sites, tented camps, and hotels on their land (e.g.: Olgulului Group Ranch near Amboseli). Other ranches (especially around Maasai Mara) acquire income through the lease of land to outside tour companies (e.g.: Kimana Group Ranch, Amboseli, Imbiridan Group Ranch, Chyulu Hills). Local employment in parks and reserves has been encouraged. All personnel in the junior group categories recruited to work in parks and reserves must come from the park locality. Furthermore, land in some

range areas is being used as private game sanctuaries (Solio, Ol Pejete, Ol Jogi ranches in Laikipia).

c. Hunting

Due to diminishing wildlife populations, in 1977, Leaky (then the director of KWS) placed a ban on hunting. Populations appear to have recovered significantly since then, and game bird shooting has been opened. In some cases, such as Amboseli, wildlife populations have increased so much that they threaten to exceed the carrying capacity of the protected area's ecosystem. To the limited extent that wildlife management occurs in the parks and reserves, populations are currently controlled by culling. As an alterative to culling, controlled sport hunting (trophy hunting) is a option that should be permitted. If well managed and regulated, it can provide substantial revenue to local communities, and encourage conservation through sustainable harvesting and game population control. A few game ranches have received licenses for limited hunting (e.g.: Hopcroft Ranch), but efforts to expand this type of operation and acquire the necessary policy changes have not yet succeeded.

d. Land Use Changes and Governmental Policy

Agricultural expansion is one of the greatest threats to wildlife conservation in Kenya. The GOK has power over land distribution, and laws exist that permit protected land to be converted for agricultural purposes. In fact, natural resource protection has been viewed as a mechanism to guard the resources for future potential agricultural use. Government policy favors increased agricultural production to meet both local demand and export market. Among the areas targeted for agriculture and livestock rearing are the arid and semi-arid lands where it is hoped that improved services, including output-increasing technology, will maximize agricultural output. Efforts are being made by KARI (Kenya Agricultural Research Institute) to develop crops which are suited for drier areas. Furthermore, efforts are being made to produce breeds of livestock which can be profitably ranched in these areas.

Without a land use management policy, resettlement in these areas raises several issues. First, the long-term sustainability of agricultural production is a major concern. In many cases, resettled land has been abandoned after several seasons during to crop and livestock production failure. Irrigation practices may make more of the marginal lands arable, but, again, the long-term sustainability of this remains questionable.

Secondly, the semi arid areas receive only erratic rainfall and have been primarily rangeland for grazing and capable of supporting only sparse nomadic populations, such as the Maasai and the Samburu. As the GOK encourages resettlement from the densely populated highlands, more and more people are settling closer to wildlife habitat (e.g.: Kitengela, Athi River, and Mai Mahiu, Naivasha), and encroaching on traditional grazing lands. At present, many wildlife dispersal areas surrounding parks and reserves are

unfenced and owned communally. Livestock in these areas, like wildlife, depend for survival on flexibility of movement. Now, with these changes in land use patterns, both wildlife, and nomadic people and their livestock, are loosing their traditional land areas and food/water resources. Without provision of alternative sources, conflicts seem imminent.

Apart from the increased cultivation in these areas, other activities such as pesticide and fertilizer use, charcoal-burning, bee-keeping, burning of forests and grasslands, and irrigation can also adversely affect wildlife habitat. Although pesticide use in not a noticeable problem in the wildlife areas at present, it may become a problem when more land is changed to farmland.

e. Land Privatization

Another element of change in land-use patterns is the increasing trend towards privatization of land, favoring individual title to land ownership. The resulting units of sub-divided land, without significant change in land management practices lead to both overgrazed land (destroying the environment for both livestock and wildlife) and elimination of wildlife from rangelands (contributing to overpopulation, genetic inbreeding, deterioration of vegetation, soil erosion, and desertification in the parks). Subdivision encourages fencing, which blocks wildlife migration routes and prevents the flexibility of movement which is a survival strategy for life in the semi-arid and arid areas.

Game control is important for farmers and ranchers. Fencing is one way of reducing conflict with wildlife, but if used, must be installed in such a way that corridors are left for wildlife movement, especially in migratory routes and dispersal areas. A variety of methods are being used, including high tension fences, stone walls, and inexpensive electric and solar fences (e.g.: Baringo Fodder and Fuel Project, Mt Elgon, parts of Liakipia). None of these methods are entirely adequate for certain wildlife species, such as elephant, eland, kongoni, ostrich, and Thompson's gazelle. Alternative suggestions include fencing the areas actively cultivated, rather than the park or reserve boundaries. Wildlife barriers should be an area of research and encouragement of appropriate land management practices is of the utmost priority.

f. Compensation

Compensation for crop and livestock damage could come from an insurance scheme generated from tourism funds.

Some studies (Irene Karani, WWF, pers. comm.) indicate that the economic loss from livestock depredation may actually be far less than that resulting from improper veterinary and herding practices. Encouraging the use of cattle dips and vaccines, and changing

herding practices may provide substantial compensation for the relatively smaller livestock losses due to wildlife predation.

In legal terms, wildlife is communal property over which the government has jurisdiction. Wildlife not only live in national parks and reserves, but also on land that belongs to individuals or to group ranches and private parks. In particular, the migratory herds from parks stay in the dispersal areas on private land during the wet season. The government should ensure that land owners allowing wildlife to stay and feed on their land receive some economic incentive to do so. This has been one of the predominant issues in wildlife conservation in Kenya. Cuurently, Maasai living around the Maasai Mara receive less than one percent of the revenues generated by tourism in the reserve. It cannot be expected that land owners, whether individual or group ranches, will tolerate wildlife on their rangelands unless they can receive some financial returns from their contribution to the maintenance of wildlife.

III. CONSTRAINTS and OPPORTUNITIES

A. Wildlife

Wildlife constitutes an important resource with substantial socio-economic, cultural, scientific, and environmental values.
Conflicts arise when wild animals destroy crops and kill livestock and people. In addition, some protected areas do not encompass complete natural ecosystems, and are highly dependent on land beyond their boundaries. Such land is under pressure for conversion to other uses. It is therefore important to promote environmentally sound and sustainable development in areas adjacent to protected areas. It is equally important to involve local communities in conservation of wildlife, as already demonstrated by the Kenya Wildlife Service / Community Wildlife Service.

While Kenya has an extensive and impressive network of protected areas, conservation of biodiversity outside these areas depends on the good will of the local communities. With increased pressures on land and resources, communities need to be sensitized to the importance of maintaining resource sustainability. This can only be done through dialogue and finding alternative solutions to their resource needs.

Although communities are usually depicted to be the cause of habitat destruction, protected areas have had negative impacts on those who are marginalised, having lost access to land and natural resources. Finding acceptable alternatives can, therefore, only be possible with their full participation in problem solving and decision making. KWS has undertaken this challenge.

1. COBRA and the Community Wildlife Service

In 1990, KWS developed a framework for community conservation. The USAID / Conservation of Biodiverse Resource Areas (COBRA) project was designed to help KWS establish a Community Wildlife Service (CWS) Department. COBRA, funded by USAID, began in April 1992 with a grant agreement with KWS.

> The goal of COBRA is to promote socio-economic development through conservation and sustainable management of Kenya's natural resources.
>
> The purpose of COBRA is to increase the socio-economic benefits to communities living adjacent to Kenya's parks and reserves from conservation and sustainable management.

The COBRA project was designed to test specific approaches to community wildlife conservation, initially in certain focal areas, namely Tsavo/Amboseli, Laikipia, Samburu, and the Coast. COBRA provides technical assistance, training, equipment and operational

support to the CWS unit of KWS staff as an integral part of the five-year multi-donor Protected Areas and Wildlife Services (PAWS) program. The project is helping KWS to establish the headquarters and field capacity to implement and coordinate a strong Community Wildlife Program that, through extension, can stimulate understanding and cooperation between KWS and communities living adjacent to the Parks and Reserves.

The project was designed to support development and enterprising activities identified by local communities in conjunction with various Non-Governmental Organizations (NGOs) and Private Voluntary Organizations (PVOs). However, upon initiation of the project, the capacity among the local NGOs to implement these ideas was found to be lacking.

A multi-disciplinary team was thus assembled with strong community development backgrounds to address key community wildlife issues. Through participatory rural appraisal techniques, local communities identify and design activities to help groups of farmers, ranchers, and others living in wildlife areas to sustainably manage wildlife and other related biological resources to their benefit. Wildlife management units are to be established that will incorporate the concerns of community members, women, scouts, and other local groups.

In areas where wildlife exist on private land, COBRA is conducting research on landowners' use rights so that the land owners can benefit from the wildlife. This may include initiating tourist activities, or through harvesting wildlife on their ranches through KWS guidance based on a quota system. This consumptive use is being tested on a pilot basis and requires research on wildlife management.

KWS/COBRA also assists community ranch owners and small scale owners to get the use rights. The landowners must prepare a plan for sustainable management of the wildlife over an area that is large enough to be economically viable. Groups are have been encouraged to venture into game ranching, such as ostrich, crocodile, guinea fowl, butterfly, and frog farming.

KWS, through funding from USAID and the World Bank, has established a Wildlife Fund for Development (WDF) to support projects in areas with wildlife, even if not near to the park. Projects based on wildlife such as tourism enterprises or community projects (e.g.: water points, schools, dispensaries) are supported through the multi-donor WDF. Individual entrepreneurs can get loans or grants from the fund depending on the nature of the project.

Examples of groups that have been assisted by the WDF are:

- the Mombasa Boat Operators Association: received technical assistance in management and accounting training, establishment of revolving funds, skills training and public relations.

- Various Wildlife Forums: received assistance in the formation of fora to set out priorities for wildlife use (consumptive and non-consumptive) and for sharing benefits.

- Ndovu Clinic (Tsavo East): received assistance in community organization, donor coordination, proposal development and budget for funding, framework for beneficiaries, cost-recovery mechanisms.

COBRA has added a component to design practical monitoring and evaluation mechanisms for CWS, however few resources have been made available for this activity.

2. COBRA Constraints (as identified in the Interim Contract Report, May 1994 and through staff discussions (2/95)):

- Project implementation was delayed for nearly one and a half years while KWS underwent changes in leadership and donors withheld funding. This set back initial progress that had been made in the field with local communities, where expectations were not met in a timely fashion.

- Lack of NGO/PVO capacity to implement extension, has made training become a larger component of the project than had been initially intended.

- Political will has hampered progress on revenue sharing issues in some cases (Narok). Clear guidelines regarding the distribution of revenues were recently signed by D. Western (KWS Director).

- Some target groups have perceived the WDF/revenue sharing as a "right" without concomitant "obligations" and responsibilities. It is unclear whether communities are developing a relationship with KWS for the sustainable conservation of wildlife, or whether they are simply making the best short-term use of available outside money.

- The monitoring and evaluation component has received very few resources, and is not yet fully institutional.

- Research has not been a primary focus of COBRA, nor of KWS. Without sufficient background information on the resources (wildlife, land, water, etc) as they exist, it will not be possible to assess whether COBRA is having the intended impact of linking development with wildlife conservation.

3. COBRA Opportunities

Overall, in spite of the delays and setbacks that the COBRA project has endured in the last two years while KWS was undergoing changes in leadership and donor funds to

Kenya were withheld, COBRA has made admirable progress. It is being very well received within the donor, NGO, and local communities.

RECOMMENDATIONS for USAID/Kenya:

a. Continue support for COBRA.

b. A second phase of COBRA should expand the concept of COBRA beyond community wildlife management to include community natural resources management.

(e.g.: focus on land management, including forest, grassland, and coastal management. This would entail exploring and expanding MOU's such as the current MOU between KWS and the Kenya Forestry Department.)

c. A second phase of COBRA should also expand its scope to include regional conservation planning.

This would involve collecting biological, sociological, and economic data for conservation within a region to insure that conservation activities proposed by the communities are practical and sustainable. This information would also help COBRA prioritize efforts in areas where biodiversity is more urgently threatened than others.

As with the current COBRA design, local communities would identify and design activities jointly to suit the needs and opportunities of the region.

This would best be facilitated through a local NGO, such as the now forming African Conservation Center, East African Wildlife Society, Wildlife Clubs of Kenya, or some other appropriate NGO.

d. Every effort should be made to link COBRA with existing local NGOs and enhance the capacity of these NGOs.

(such as the now forming African Conservation Center, East African Wildlife Society, wildlife Clubs of Kenya)

e. Enhance COBRA's research, monitoring and evaluation component.

Little is known regarding ecosystem management or the biology of wildlife populations (movement, resource use, etc). Research into these areas would provide the necessary information for proper management to ensure long term conservation.

Background information on economic issues, such as land use choices and alternatives, land pricing, taxation, incentives, tourism opportunities, etc. is essential to wise decision making.

Without sufficient monitoring and evaluation, it will not be possible to assess whether COBRA is having the intended impact of linking development with wildlife conservation.

f. Build in-country capacity for training community representatives in community natural resource management.

This involves training trainers, for example 7-8 researchers from the Museums, or Moi university.

4. Related Opportunities, but not necessarily tied to COBRA:

RECOMMENDATIONS for USAID/Kenya

a. USAID should continue to support mechanisms for long-term natural resource conservation financing (such as the Wildlife Development Fund).

Biodiversity initiatives are complex, long-term endeavors. Two or three years, even five years, is not a sufficient amount of time to make real progress in conserving biodiversity. Biodiversity conservation requires long-term commitments. Research, training, and environmental education take time to conduct and years to produce. The same is true of protected area management, community activities, and tourism development. Short funding cycles force project implementors to focus on the short term, and the need to demonstrate positive results fast to obtain a favorable evaluation and necessary follow-up funding. Short funding cycles can also negatively influence the continuity and stability of a project. Project implementors devote a great deal of time and energy gaining the trust, understanding and involvement of the community. Stoppage or long delays in project activities brings the project's credibility into question.

In its report summarizing the results from five years of USAID support for improved natural resources management in Africa, the USAID Africa Bureau emphasized the need for a longer-term approach. It states, for example, that the long-term benefits from biodiversity conservation can only be assessed in terms of decades, not years (USAID/ARTS 1993, in: Conserving Biodiversity in Africa: A review of the USAID Africa Bureau's Biodiversity Program, 1994.)

b. Support research efforts in natural resource conservation.

USAID has supported, with relatively little amounts of funds, several highly successful research projects in natural resource conservation in Kenya, such as the coastal resources research done by Dr. T. McClanahan. The results of this project have proved invaluable to the reestablishment of fish populations, overall coral reef health, and economic well being of the fishing community. In terms of building local capacity, the training component of this project has successfully trained several East Africans, some of who have gone on to assume positions of considerable responsibility in their respective countries. Continuation of support to projects like this is highly recommended.

c. Build Kenyan technical capacity for natural resource management.

Moi University offers courses in forestry, wildlife management, fisheries, tourism, and environmental sciences. Kenyatta University has a programme in Environmental Science, and the University of Nairobi offers training courses in agriculture, range management, and conservation biology. Egerton University has programs in natural resources management and agriculture, and Jomo Kenyatta University has programs that address agricultural and other landuse questions. These programs should be more thoroughly investigated as potential areas for supplemental funding for program enhancement.

(e.g.: land, wildlife, forestry, and coastal management for maintaining sustainable populations, as well as sustainable levels of harvest).

(see also 2b above).

d. Enhance national economic incentives for natural resource conservation by encouraging development of commercial enterprises based on sustainable use/harvest of resources.

Economic returns on conservation of biodiversity to the local community are important. Those who successfully conserve, for example wildlife, should be enabled to trade the surplus.

(e.g.: controlled hunting and harvesting on game ranches, tanneries for export of skins, veterinarian services for game meat inspection for local consumption and export, cottage industry enterprises based on natural resource extraction).

e. Encourage collaboration and information exchange among donors and NGOs in the natural resource management arena.

Other institutions in Kenya have community managed natural resource projects similar to COBRA (e.g.: WWF/Kenya in Lake Nakuru, the National Museums of Kenya in

Elangata Wuas) and all would benefit from the sharing of information. Site visits by USAID staff to these projects to foster cross-linkages are highly encouraged. Several of the conservation groups in Kenya expressed interest in the COBRA project, but were relatively uninformed about the project.

(e.g.: Establish regular meetings (biannual at the least) to exchange information, project papers, status, etc). In Kenya, donors do meet somewhat regularly to discuss natural resource management. USAID/Kenya should be encouraged to participate in these meetings, and/or to initiate such meetings.)

f. Develop a Natural Resource Conservation Science Advisory Council to provide USAID/Kenya and the GOK with technical advice on the development of policies and practices that have environmental impact (composed of Kenyan and foreign scientists and managers).

B. Agricultural Policies and Wildlife - (Opportunities and Constraints)

Currently, poorly regulated expansion of agriculture into marginal lands is leading to a loss of biodiversity. Wheat, maize and sugar self-sufficiency has yet to be attained. Present agricultural policies do not promote land use which is compatible with wildlife. Policies promoting conservation uses of marginal land by raising returns from forestry and wildlife-compatible activities (e.g.: tourism) must be developed. This will require development and more effective sharing of commercial benefits from wildlife, so it is in the interests of agro-pastoralists not to cultivate land in key dispersal areas.

Where agricultural expansion is required, the comparative valuations of alternative sites needs to be assessed to insure that the expansion will be economically viable and sustainable over the long term. Expansion pressures should be minimized by policy changes to increase yields.

(see: "Agroforestry and Soils Chapter" and "Policy and Institutions" in the "Natural Resources Assessment" Main Report for recommendations).

C. *In-situ* Conservation - (Opportunities and Constraints)

1. Background

On paper, Kenya possesses a respectable and impressive network of protected parks and reserves covering over 7% of the total land area. In reality, these protected areas are biased towards savannah/semi-arid areas. Many of these areas are ecologically unstable, either through encroachment, tourist pressure, or perturbations caused by fluctuations in herbivore populations. Most protected areas do not encompass complete natural

ecosystems; they are therefore critically dependent upon areas beyond their boundaries.

Plant endemism is not restricted to one or a few sites in Kenya; rather it is widely scattered at many sites and in increasingly fragmented patches. This poses a difficult conservation dilemma. Many of the sites and threatened, and while only one or two rare/endemic species may disappear with each site lost, the cumulative effect will be a significant decline in species richness. Floristic surveys, with an emphasis on mapping total species distribution, are an essential first step in Kenya's plant conservation program.

Proposed extensions to the present system, such as those put forth by KWS, especially in forest regions and migratory corridors, would improve total biodiversity protected and provide the much needed land area for wildlife migration and dispersal. The 1992 UNEP Country Study summary details these proposed extensions.

Poor park management results in the destruction of the species that tourists pay to see. Many parks and reserves are already overcrowded and experience heavy congestion around prime attractions. In Amboseli, for example, it is reported that over 30 vehicles might be located around a single predator. One of the greatest problem with increased visitation to the wildlife parks is that the sights and sounds of humans are antithetical to the tourist's purpose in visiting wild Africa. This could result in tourists choosing African destinations other than Kenya. Furthermore, heavy tourism as currently occurs, disturbs the ecosystems of the parks. Off-road driving destroys vegetation and may lead to soil erosion. Noise may cause stress to sensitive species such as the cheetah and scare away ostriches from their eggs. Careful planning is essential if short-term gains are not to diminish either the longevity of the parks as viable wildlife habitats, or the potential revenues from tourism in Kenya.

Wildlife populations must also be carefully monitored, and a system of proper management put in place that manages population density and ecosystem health.

2 (1.) Opportunities

RECOMMENDATIONS for USAID/Kenya:

a. Support research efforts in natural resource conservation and park management. (see: Recommendations related but not necessarily tied to COBRA).

b. Build technical capacity for natural resource management.

University programs should be thoroughly investigated as potential sources of supplemental funding for program enhancement (see: Recommendations related but not necessarily tied to COBRA).

c. **Encourage policy reform to encompass sustainable natural resource management.**

Incentives to use natural resources sustainably often depends on the property rights of users. Unless biological diversity is valued, it will be sacrificed to other development goals. Policy changes are needed at all levels, both macro- and micro-economic, socio-legal and in research and training wherever present trends are having a negative impact on biodiversity.

(e.g.: reform land tenure and property rights policies, policies that advocate arbitrary use of natural resources for agricultural productivity, bans on sport hunting and export of game products, etc.).

D. ***Ex-situ* Conservation** - (Opportunities and Constraints)

This aspect of conservation is under-developed and under-utilized in Kenya. There are about 20 public and 10 private botanic gardens/arboreta in Kenya. Most are in need of improved maintenance and species documentation (UNEP Country Study, 1992).

There is a need for a set of regional arboreta/botanic gardens capable of holding the hundreds of plant species already, or likely to become threatened in their natural habitat within the next 20 years. Ex-situ conservation of plant genetic resources exists within the Kenya Forestry Research Institute (forest genetic resources) and the National Gene Bank of Kenya (crop genetic resources). Equivalent new or expanded facilities are required for agricultural, livestock and forest genetic resources.

In Kenya, where so much wildlife co-exists with human populations, traditional zoos are considered inappropriate. But Kenya's expanding urban population will require a new kind of exposure to its biodiversity if they are to become aware of the benefits arising from its conservation. Plans for improved local access to protected areas, a national aquarium and additional mechanisms for school level exposure to conservation needs and values must be encouraged. Several institutions fulfill some of the traditional functions of a zoo, but are very specialized and don't capture a full ecological picture. These include the Nairobi animal orphanage, the Institute of Primate Research at the National Museums, rhino sanctuaries, and private ventures, such as snake, crocodile, and ostrich farms.

On the legal front of intellectual property rights, improved implementation of current legislation is needed to strengthen breeders rights, allowing indigenous knowledge to be more effectively exploited by local groups, and to capture economic benefits from genetic resources distributed to international collections. With respect to crop species biodiversity, documentation, collection and development of indigenous material should be emphasized.

E. Forest Conservation and Management - (Opportunities and Constraints)

Forests are contracting rapidly from pressures of expanding shifting agriculture, spontaneous settlement, clearance for plantations and ranching, and cutting for fuel and logging. The principal causes of deforestation are: increasing population pressure, land ownership patterns that force peasant families and landless people into forests and marginal areas, commercial agricultural operations, and commercial logging which opens up previously inaccessible forests to cultivation and fuel wood harvesting are a rate that exceeds the regeneration capacity of the forest.

The economic use of forestry in Kenya has been stagnant and will be unable to meet predicted demand through sustainable use without significant improvement. Poor management and economic performance has left the Forestry Department without the resources to maintain the biological wealth of Kenyan indigenous forests. Most gazetted forest is seriously depleted; some no longer exists. The Forestry Department has only recently been allocated an increased role in forest conservation. KWS plans, through joint management ventures with the Forest Department, to increase the importance of forest protected areas in its tourist development of Parks and Reserves.

Biodiversity conservation in forests depend on, among other things, effective land use and management policies. At the national level, programs to inventory and monitor resource use must be amplified and accelerated. In some cases, where damage is already so great, and the possibility of saving the forests so small, increased *ex-situ* conservation will be required. Strengthening management of forests through socio-legal and institutional changes is an imperative.

(Forest use and trends are discussed in further detail in the "Forest Resource Management in Kenya" chapter of the Natural Resources Management Assessment report.)

F. Donors' Activities

ACTS has recently published a list of the donors activities in the biodiversity area. A copy of this document will be left at the USAID/Kenya Mission.

IV. ENVIRONMENTAL POLLUTION

A. Background

Pollution is emerging as a major environmental concern in Kenya. Among the four types of pollution hazards (water, air, noise, solid waste), water pollution is the most pronounced in Kenya (UNEP country study, 1992). Water pollution is mainly caused by wastes which find their way into rivers, lakes and the sea. Modern and intensive agricultural activities involve the use of a variety of chemicals such as insecticides and fertilizers, Industrial activities bring forth gaseous emissions, other by-products and forms of toxic waste materials which pollute the air and water.

1. Industrial

Some of the major water polluting industrial activities in the country include coffee, sugar, paper and pulp mills, tanneries, vegetable processing, chemical and pharmaceutical plants. Some industries emit excessive heat which adversely changes the ecology. Others discharge water rich in organic matter which can ultimately reduce the oxygen content in water and adversely affect aquatic fauna and flora. Industrial pollution poses a great threat to both marine and human health. Striking examples of activities which produce strong organic pollutants are tannery plants, chemical factories and paper mills. A tannery plant and a chemical factory in Thika were temporarily closed in the 1980's for failing to control pollution caused by chemical discharge into the nearby river and residential areas. A paper mill which uses water from the Nzoia river is said to have contributed to massive fish deaths in these waters. Corroded roofs in the area surrounding the paper mills provide evidence of the polluting effects of this industrial activity.

Lake Victoria and the Athi River Basin (Nairobi region) have the highest pollution levels. The Lake Victoria Basin has 8 major urban centers with a population of over 30,000 each. The region's main industries are agro-based and are among the heaviest water using industries in the country. These industries are based on the production of sugarcane, tea, pulp and paper, beer, and coffee. In 1990 there were 28 agricultural manufacturing industries, 15 of which were food processing. There were also 20 non-agricultural manufacturing industries. Among the heavy users responsible for emission of water pollution into Lake Victoria are coffee processing mills in Kisii, Bungoma, and Nandi; six sugar mills in the sugar belt; a molasses plant producing power alcohol, textile and cotton seed oil mills in Kisumu.

The Lake Basin Development Authority (LBDA), the relevant district development committees and the relevant government departments have done little to reduce pollution emanating from these industries (UNEP Country Study, 1992).

The Athi River Basin includes Mbagathi, Mathari Nairobi, Getathuru, Karura, Gatharaini, Riara, Kamiti and the Kin rivers. Some of these rivers pass through Nairobi and Athi

River industrial centers where they collect substantial industrial wastes. They collect inadequately treated sewage effluent and illegal discharge to the surface sewers. The waters of the Athi river have excessive biochemical oxygen demand (BOD) with levels exceeding 10 mg per liter. The river has excessive chemical wastes such as sulphide, sulphate, cyanide, grease, suspended solids, and prohibited substances. Waters receiving acids and bases discharged from factories often have Ph values outside of the range established by the World Health Organization.

The Ministry of Water Development is the overall government agency charged with the responsibility of controlling water pollution. The Water Appointment Board has established some standards for industrial effluent entering public sewers in Kenya, but environmental monitoring and regulatory measures appear to be severely lacking.

2. Municipal

Rapid growth of urban population has made urban centers unable to cope with proper sanitary facilities. The result has been a rapid growth of slums and spillage of detergents, oil and raw sewage into rivers, raising the frequency of gastroenteric diseases such as cholera and typhoid.

The high pollution levels in Lake Victoria waters are attributes to: 1) the Nzoia river which is polluted by a textile firm and a pulp and paper mill; 2) Nyando River which is polluted by three sugar factories; 3) community and industrial wastes from the Kisumu municipality (Timbo-Oeri, 1982, in UNEP Country study, 1992).

The use of mercury in small scale gold mining along rivers and lakes poses health risks both to miners and water users. Mercury accumulates in animals and human tissues, leading to long term poisoning.

3. Legislature

There are various pieces of legislation dealing with the management of effluents in Kenya. These are implemented by various ministries. The implementation is however not effectively harmonized and thus they do not provide for efficient management. The statutes include the following: the Water Act, the Public Health Act, the Pest Control Act; the Radiation Protection Act; the Mining Act; and the Factories and Other Places of Work Act.

4. Opportunities

As increased population places pressure on urban and coastal areas, environmental quality should be carefully and consistently monitored.

RECOMMENDATIONS for USAID/Kenya:

a. Build capacity for environmental monitoring and environmental impact assessments.

Currently, Egerton University has water quality monitoring capabilities that could be explored for further augmentation. USAID has previously funded programs at Egerton University.

(e.g.: water, air, soil quality for pollution from pesticides, sewage, sediment load, etc).

V. Environmental Information Systems

A. Background

Environmental Information Systems refer to systems used to collect, store, analyze, display and disseminate environmental information. This includes all forms of knowledge needed to understand or manage the environment. The need for an environmental information system (EIS) is acute when consideration is given to the fact that recent and current economic, social, political, and technological activities have and continue to contribute to rapid and potentially stressful changes in Kenya's environment.

Kenya lacks a national information policy and a national information system. The government, parastatals, private companies, research institutes and centers, educational institutions, NGOs, and other institutions have progressively established departments to generate data required to manage particular resources. However, up to 70% of the information remains unanalysed and uninterpreted, thus its value is significantly diminished (NEAP, 1994). It is difficult to gain access to information from many national organizations because of problems of confidentiality and organization.

Information pertaining to the characteristics, biodiversity, dynamism, and economic value of natural resources (wildlife, forests, land, water, etc.) is required for strategic priority setting, efficient management, and conservation.

There is no land use policy in Kenya. Land use information is held by various organizations, thus the available information is of varying (and incompatible) types, formats and scale.

Information management is stored in a variety of media and forms. This includes analogue (bibliographies, reports, journals, etc.), digital (GIS, remote sensing and information held in computer databases), microfiche, and audiovisual. Oral information (indigenous information) is also a key media.

There are limitations which hinder optimal use of all environmental information generated in Kenya. Some of the reasons include: fragmentation of the information in various institutions and organizations, undefined confidentiality for some information generated, differing storage media and analytical tools between different organizations, limited number or trained personnel to handle, manipulate and disseminate the information, technological limitations, limited funds committed to information collection and systems development, lack of awareness on what and which information is available, where available and in what format, and absence of consultations, coordination and linkages between the relevant information producers and users.

Kenya has a number of libraries and documentation centers, most of which exist as isolated information services (e.g.: university, school, public, research centers, NGOs,

archives and herbaria). Computerized databases have been developed over the last several years by a number of government departments, companies, NGOs, research institutes, international organizations, etc. Most of these databases are still in their early development stages, and therefore access to them is still restricted. Furthermore, their development suffers from serious handicaps including inadequate or lack of trained personnel, inadequate backup service, lack of funds to upgrade hardware and software.

Most local organizations having GIS lack appropriately trained personnel. Information exchange between these institutions is also minimal. Institutions without GIS facilities have other computerized databases with environmental and related information. The information is held in different media and stored in different formats. The facilities are mostly located in the headquarters of these institutions making accessibility by most Kenyans difficult.

This condition is reflected by infrequent publication of research and survey reports. Similarly, periodic reviews such as annual reports and ecologic reviews are published irregularly. In recent years, many sectoral agencies have vastly increased their capacities in data collection, however, their coverage and periodicity are often inadequate for monitoring of trends.

It should be noted that much of the information used in this report was collected from documented information. It was difficult to obtain much technical information on Kenya's biodiversity and ecology. What little documented information exists varies widely in content and quality. Units of measure vary considerably and are difficult to compare, analyze and/or assess, further demonstrating the need for a coordinated environmental information system.

1. Opportunities

RECOMMENDATIONS for USAID/Kenya:

a. Establish a national environment information system to network, coordinate and document the various sources and forms in the Kenya within a central organization (an NGO).

The service will be operated on a sound economic basis, with the principal long term objectives of maintaining a reliable and up-to-date and yet responsive information service on natural resources. All data on a resource would be collected and placed in a central information center. This could also serve as a national focal point for exchange of environmental datasets with neighboring countries and other international databases.

- **Support publication of an annual "Kenya State of the Environment Report",** covering scientific, political and socio-economic relevant to natural resource management.

b. Support a coordinated Geographical Information System (GIS) activity.

GIS can be used for monitoring, planning and natural resource management. For example, encroachment on wildlife habitat can be monitored. Encroachment is controlled by a number of spatial factors that vary greatly in and around Kenya's protected areas, thus, certain places will be geographically predisposed to these types of pressures and conflicts. Some controlling factors may include existing population concentrations and growth rates; the cultural characteristics of the population; land quality related to soil type, terrain, and vegetation; availability of surface water, existing livestock numbers; and the perceived threat from wildlife. A combination of these and other factors will play a role in deciding which land is more likely to be settled with migrants. Many of these factors can be mapped using GIS techniques.

KWS has some GIS analyses underway to examine the conditions in several high-conflict areas. GIS can thus play a role in developing strategies for sustaining local populations residing in the vicinity of the parks and reserves. Many other organizations also have GIS capabilities, but not many are coordinated, thus the information generated is of limited value. A centrally coordinated GIS activity could pool all of this information, thus providing information for sound and rational strategic planning.