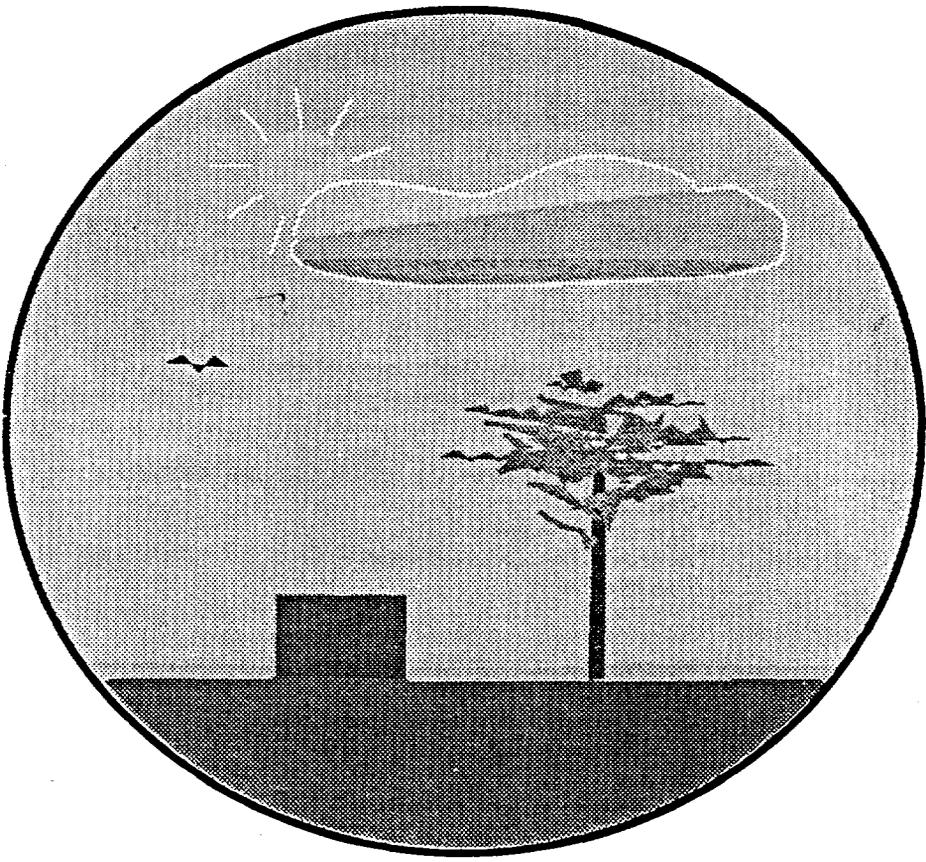


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# THE KENYA NATIONAL ENVIRONMENT ACTION PLAN (NEAP) REPORT



THE KENYA NATIONAL ENVIRONMENT ACTION PLAN (NEAP)

MINISTRY OF ENVIRONMENT AND NATURAL RESOURCES  
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June 1994

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## ACRONYMS

AA	-	Automobile Association of Kenya
AFC	-	Agricultural Finance Corporation
AIC	-	Agricultural Information Centre
AIS	-	Anthropogenic Information System
AMREF	-	African Medical and Research Foundation
Arc/Info	-	A GIS vector data software
ASALs	-	Arid and Semi-Arid Lands
ASK	-	Agricultural Society of Kenya
AT & H	-	African Tours and Hotels
AVHRR	-	A Very High Resolution Radiometer
AWF	-	African Wildlife Fund
CBK1	-	Central Bank of Kenya
CBK2	-	Coffee Board of Kenya
CBS	-	Central Bureau of Statistics
CITES	-	Convention on International Trade in Endangered Species
CNA	-	Climate Network Africa
DANIDA	-	Danish International Development Agency
DAOs	-	District Agricultural Officers
DDC	-	District Development Committee
DDC	-	District Development Committee
DDOs	-	District Development Officers
DIDCs	-	District Information and Documentation Centres
DLPOs	-	District Livestock Production Officers
DNA	-	Deoxyribonucleic acid
DRSRS	-	Department of Resource Surveys and Remote Sensing
EATEC	-	East African Tanning and Extract Company
EAWLS	-	East African Wild Life Society
EI	-	Environmental Information
EIS	-	Environmental Information System
FAO	-	Food and Agricultural Organisation of the United Nations
FP	-	Family Planning
GEF	-	Global Environmental Facility
GEMS-PAC	-	Global Environment Monitoring System
GIS	-	Geographical information system
GMO	-	Genetically Modified Organism
GOK	-	Government of Kenya
GTZ	-	German Agency for Technical Cooperation
HPA	-	High Potential Areas
IAS	-	Institute of African Studies (University of Nairobi)
IATA	-	International Air Transport Association
ICIPE	-	International Centre for Insect Physiology and Ecology
ICRAF	-	International Centre for Research in Agro-Forestry
IDS	-	Institute of Development Studies (University of Nairobi)
IFAD	-	International Fund for Agricultural Development
IGADD	-	Inter-Governmental Authority on Drought and Development
IIED	-	International Institute for Environment and Development
IK	-	Indigenous Knowledge
ILCA	-	International Livestock Centre for Africa
ILRAD	-	International Laboratory for Research on Animal Diseases
IPAL	-	Integrated Project on Arid Lands
IPR	-	Institute for Primate Research

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IS	-	Information Systems
ISNAR	-	International Service for National Agricultural Research
IUCN	-	International Union for the Conservation of Nature and Natural Resources
JICA	-	Japanese International Cooperation Agency
JKUCAT	-	Jomo Kenyatta University of Agriculture and
KADOC	-	Kenya Agricultural Documentation Centre
KARI	-	Kenya Agricultural Research Institute
KATO	-	Kenya Association of Tour Operators
KBC	-	Kenya Broadcasting Corporation
KEFRI	-	Kenya Forestry Research Institute
KEMFRI	-	Kenya Marine and Fisheries Research Institute
KEMRI	-	Kenya Medical Research Institute
KENGO	-	Kenya Energy Non Governmental Organization
KENRIK	-	Kenya Resource Centre for Indigenous Knowledge
KETRI	-	Kenya Trypanosomiasis Research Institute
KEVEVAPI	-	Kenya Veterinary Vaccine Production Institute
KFFHC	-	Kenya Freedom From Hunger Council
KIFCON	-	Kenya Indigenous Forest Conservation Project
KIPO	-	Kenya Industrial Property Office
KIRDI	-	Kenya Industrial Research and Development Institute
KMA1	-	Kenya Manufacturers Association
KMA2	-	Kenya Medical Association
KMC	-	Kenya Meat Commission
KMD	-	Kenya Meteorological Department
KNLS	-	Kenya National Library Services
KNUT	-	Kenya National Union of Teachers
KPC	-	Kenya Power Company
KSS	-	Kenya Soil Survey
KTDA	-	Kenya Tea Development Authority
KTDC	-	Kenya Tourist development Corporation
KTN	-	Kenya Television Network
KWS	-	Kenya Wildlife Service
KWWG	-	Kenya Wetlands Working Group
LBDA	-	Lake Basin Development Authority
LIS	-	Land Information Systems
LONRHO	-	London Rhodesia Company
MALDM	-	Ministry of Agriculture Livestock Development and Marketing
MENR	-	Ministry of Environment and Natural Resources
MIRCEN	-	Microbiological Resource Centres
MLRRWD	-	Ministry of Land Reclamation, Regional and Water Development
MOE	-	Ministry of Energy
MRTTT	-	Ministry of Research, Technical Training and Technology
MTW	-	Ministry of Tourism and Wildlife
NACBAA	-	National Advisory Committee on Biotechnology Advances and their Applications
NCPD	-	National Council for Population and Development
NCST	-	National Council for Science & Technology
NDVI	-	Normalised Differential Vegetation Index
NEAP	-	National Environmental Action Plan
NEIS	-	National Environmental Information Service
NES	-	National Environment Secretariat
NGOs	-	Non-governmental Organisations
NMK	-	National Museums of Kenya

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NOAA	-	National Oceanographic and Aeronautic Administration
NOCK	-	National Oil Corporation of Kenya
ODI	-	Overseas Development Institute
PPCSCA	-	Permanent Presidential Commission on Soil Conservation and Afforestation
RCSSMRS	-	Regional Centre for Services in Surveying, Mapping and Remote Sensing
RPD	-	Rural Planning Department
RTPC	-	Rural Trade and Production Centre
SIDA	-	Swedish International Development Agency
SOK	-	Survey of Kenya
SRF	-	Systematic Reconnaissance Flights
TARDA	-	Tana and Athi Rivers Development Authority
TSC	-	Teachers' Service Commission
TV	-	Television
UNCED	-	United Nations Conference on Environment and Development
UNDP	-	United Nations Development Programme
UNEP	-	United Nations Environment Programme
UNESCO	-	United Nations Educational Scientific and Cultural Organisation
UNICEF	-	United Nation's Children Emergency Fund
UNSO	-	United Nations Sudano-Sahelian Office
WCI	-	Wildlife Conservation International
WCMC	-	World Conservation Monitoring Centre
WFP	-	World Food Programme
WHO	-	World Health Organisation
WLIS	-	Wildlife Livestock Information Systems
WMO	-	World Meteorological Organisation
WRI	-	World Resources Institute
WWF	-	World Wide Fund for Nature

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## FOREWORD

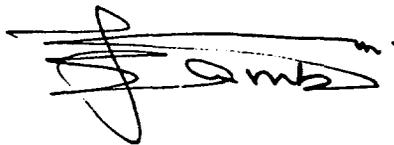
In Kenya, and elsewhere in the world, there is a growing public concern that many forms of economic development activities damage the natural resources upon which the economies are based. A major environmental and developmental challenge today is how to maintain the equilibrium between population, ecosystems and development.

Current development efforts emphasise production with little regard for environmental conservation, while conventional environmental conservation advocates resource protection without human use. Environmental damage, which is evidently widespread, undermines future development efforts. It is now time to meet human needs in ways that do not destroy the environment.

Kenya has physical and biological resources that are of considerable domestic and international economic and intrinsic value. The country possesses an estimated total of 35,000 known species of animals, plants and micro-organisms. This wealth is fundamental to Kenya's economic prosperity in many ways, including as a source of income for subsistence, source of employment and source of foreign exchange earnings. Life, and the economy, are based on natural resources such as water, air, rocks, minerals and soils. These resources are increasingly under pressure from unsustainable use, resulting in pollution, soil erosion, and depletion. Biological resources which are sources of food, fuel, medicine, wood, shelter and income, are only renewable if they are used sustainably.

The challenges presented by the conflicting demands of economic growth, sustainability and quality of life are formidable, both in their rate and geographical extent.

The Government of Kenya, being very concerned with the impact of these conflicts, has decided to put in motion this dynamic National Environmental Action Plan which provides coherent instruments for integrating environmental considerations into economic planning and programmes for sustainable development.



*Hon. J. K. Sambu, EGH, MP  
Minister for Environment and Natural Resources*

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# THE NEAP PROCESS IN KENYA

## THE NECESSITY AND SCOPE FOR THE NEAP

Environment and development issues have been at the top of national and international agenda in the recent past. These issues will continue being at the top of the agenda for many years to come. Nearly all countries have been deliberating and developing strategies on approaches of conserving, protecting, using, and managing the limited resources and the environment. In Kenya, substantial work on selected environmental issues such as soil erosion, deforestation, desertification, biological diversity and others have been carried out. Many of these initiatives have been started without much consultation and a coordinated planning; thus generating a wide body of information that is scattered and not harmonised. The NEAP aims at providing a broad framework for the co-ordination of environmental activities by all actors: private sector and government to guide the course of development activities. It is a step towards integrating environment and development for a better management of resources.

The Kenya NEAP Report addresses environmental issues in a cross-sectoral and in an integrated fashion. The NEAP provides not only a strategy for achieving sustainable development in Kenya, but also a basis for translating Agenda 21 - the Global Programme of Action on Environment and Development, which is one of the outcomes of the United Nations Conference on Environment and Development (UNCED).

## MAJOR ELEMENTS OF NEAP

The main feature of the NEAP process is its participatory nature. The preparation of the plan was carried out by nine task forces whose membership included a broad representation of institutions and sectors including public, private, NGOs and local communities. The preparation of the Report went through several drafts in an active participatory process. At the same time the Report was presented and thoroughly debated in an interactive process by all partners at all levels in the Kenyan society. All these took place at five regional workshops throughout the Republic of Kenya; the comments, criticisms, and recommendations from these workshops were incorporated into the final Report. These efforts contributed to the Report that can be positively used by all. Consultations were also carried out at the district field level. This approach established a holistic way of thinking into the management of the limited natural resources through the inter-disciplinary and inter-working groups at all levels. To steer and guide the Kenya NEAP process the following institutional structure was adopted: the Ministerial Level Policy Steering Committee, the NEAP Co-ordinating Committee, the Secretariat headed by the Co-ordinator, task forces that addressed the key environmental issues contained in the Report and the NEAP Advisory Committee comprising of donors, government representatives, private sector, NGOs and international organisations.

## STRUCTURE OF THE NEAP REPORT

The Report begins with the challenges of change for Kenya and underscores the sustainability of Kenya's economic and social development which depend ultimately on proper and responsible management of the natural resource base and the environment in general. Chapter two of the Report describes the physical environment and basically follows the thematic areas of the nine task forces. These task forces were constituted along the following environmental issues:

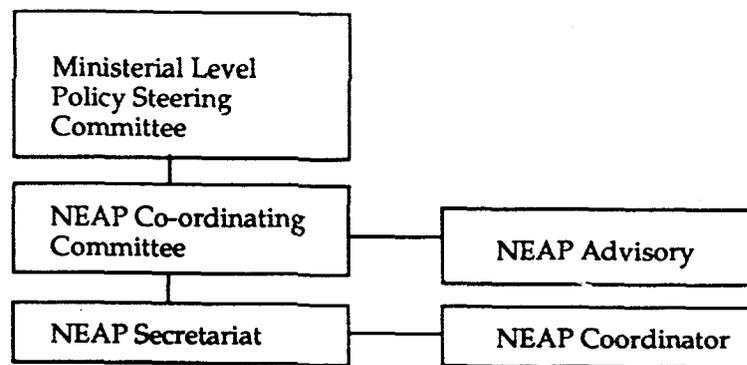
- Water Resources (Inland Water Resources, Coastal and Marine)
- Biodiversity (Including Forestry, Wildlife Biotechnology, and Indigenous Knowledge)
- Sustainable Agriculture and Food Security
- Desertification and Drought
- Environmental Pollution and Waste Management
- Human Settlements and Urbanisation
- Public Participation and Environmental Education
- Environmental Information System
- Policy, Institutional, Legislative Framework and Economic Incentives

The Report is further supplemented by background documents including detailed individual task forces reports. All these documents are available at the NEAP Secretariat. These reports can be of immense value to government and other institutions involved in implementing environmental projects and programmes. In addition, the five Regional Workshops Reports which contain the views of the local communities are also available and should be consulted by all implementors.

The NEAP Report has made some concrete recommendations including the need for a new institutional framework, review and harmonisation of environmental legislation, implementation of environmental impact assessment for all investment programmes and development of environmental programmes to mitigate/reduce environmental degradation.

The approval of the Report by the Government of Kenya represents a major commitment by the Government to the implementation of the action plan in partnership with stakeholders outside the Government. The challenge is for the sectors to incorporate the recommended actions within their existing programmes including planning and budgetary activities in order to achieve sustainable development.

#### INSTITUTIONAL STRUCTURE OF NEAP



TASK				FORCES				
1	2	3	4	5	6	7	8	9



CHAPTER ONE

**CHALLENGES OF CHANGE: POLICY,  
STRATEGIES AND ECONOMIC INCENTIVES**

**1.1 POLICY OBJECTIVES**

The Government's commitment to conservation and sustainable use of resources has been stated in all national development plans since independence. Sessional papers and presidential directives have frequently emphasised proper management of the national resource base. The 1994-96 National Development Plan details Government commitment to integrate environmental considerations in development programmes and projects. The plan calls for increased efforts towards management and conservation of the environment.

A national environmental policy will provide guidance for actions in all sectors. Some of the broad objectives of Kenya's environmental policy include:

- a) Facilitating optimal use of the national land base and water resources in improving the quality of the human environment.
- b) Promoting sustainable use of natural resources to meet the needs of present generations while preserving their ability to meet the needs of future generations.
- c) Treating environmental conservation and economic development as integral aspects of the same process of sustainable development.
- d) Generating income and meeting national goals and international obligations by conserving biodiversity, reversing desertification, mitigating effects of disasters, and maintaining the ecological balance of the earth.

**1.2 MAJOR STRATEGIES TO REALISE OBJECTIVES**

- 1.2.1 Enhance the harmonisation, implementation and enforcement of laws for the management, sustainable use and protection of the environment.
- 1.2.2 Provide economic incentives and penalties to encourage sustainable use of natural resources and to minimise pollution.
- 1.2.3 Assess and evaluate in economic terms the value of standing, unexploited natural resources and ecological functions. For example, a standing tree should be worth more than a cut one.
- 1.2.4 Institutionalise the process of environment impact assessment and monitoring for public and private projects and programmes.
- 1.2.5 Provide strong and effective environmental co-ordination and monitoring, by creating a single autonomous organisation.
- 1.2.6 Enhance the involvement of local communities in the management of natural resources and their living environment. In addition, promote the participation of all parties - local communities, district committees, business, industry and NGOs - in projects and programmes for conservation and development.
- 1.2.7 Enhance environment management capacities by training professionals and raising awareness at all levels.

- 1.2.8 Conduct research in a wide range of disciplines, including biodiversity, biotechnology, indigenous knowledge, waste management, gaseous emissions, disaster management, human settlements development and alternative forms of energy.
- 1.2.9 Maintain the system of protected areas and create others to conserve biodiversity, generate income and provide recreation.
- 1.2.10 Address underlying causes of desertification, including socio-economic factors, and establish mechanisms to mitigate the effects of drought.
- 1.2.11 Formulate a comprehensive land use and settlements policy to regulate human activities in order to minimise their negative impacts on the environment.
- 1.2.12 Improve decision-making processes by developing an efficient national environment education and information system within easy reach of users in all parts of the country.
- 1.2.13 Enhance co-operation with regional and international environment programmes, and treaties and agreements.

### **1.3 ECONOMIC CHALLENGES**

#### **1.3.1 Current Status**

Kenya is in the midst of rapid changes: changes in the size of the population and their quality of life; changes in traditions, literacy levels, family structures; changes in political systems; and changes in the foundations of its economy.

Kenya is largely a rural society. Its people have been surviving on a subsistence economy, and its cash economy has been small and dependent on the export of a small number of crops. Over the last three decades, Kenya's population has tripled, commercial and

industrial activity have grown tremendously and tourism has become the single largest source of foreign exchange, while horticulture has rapidly become a major export earner.

The population increase together with economic and industrial development have had considerable impact on the country's environment and natural resource base.

#### **1.3.2 Economic Performance**

Kenya's economy, in the early years of independence, grew at an impressive annual average rate of 6.6% in real GDP. The impressive growth in agriculture and manufacturing sectors in the 1960s in particular was stimulated by an expansion in smallholder cultivation, adoption of high-yielding agricultural technologies, an import substitution strategy, local industrial development, a liberal foreign investment policy, government investments in industry, and a wider East African Community market.

Then in 1973-1974, the country's real growth in GDP dropped from 4.4% to -0.2%. Performance in the manufacturing sector dropped from 14.4% to 5.9% during the same period. Similar trends were observed in 1979/80, 1984 and 1992/93. The deterioration in the level of economic performance in earlier years was mainly a response to petroleum price shocks, while the latter ones were due mainly to drought conditions. The result was low to very low levels of growth in real GDP as for example, 0.8% in 1979/80, 0.4% in 1984 and 0.4% in 1992.

Recently, Kenyans have been going through a very trying period. Drought in many areas of the country led to a decline in agricultural output; and since many industries are agro-based, industrial output also declined. A world recession further weakened the country's economic performance. Prices of Kenya's agricultural produce fell drastically, fewer tourists visited, and earnings were not sufficient to sustain imports required for industrial and agricultural development.

### 1.3.3 Resource Base

Kenya's natural resources such as water, rocks, minerals, soils, plants, animals, micro-organisms and ecosystems are increasingly under pressure from unsustainable use. This can result in pollution, soil erosion, resource depletion and extinctions.

Kenya faces a major challenge in planning for sustainable natural resource management in the face of limited arable land, water and mineral resources, rapid population growth, poverty, and limited finance capital. All these are compounded by degradation of the environment on which development depends.

### 1.3.4 Technology

Kenya has been enhancing its scientific and technological capacity through education and training, aimed at being wholly responsive to technological change and environmental management. However, some advances in technology, may threaten the environment and human life. Weak bargaining power and lack of understanding of the complex terms and conditions of technology agreements is a major disabling factor in making decisions and acting on transfer of technology.

Currently, the country lacks a strong legal environment to protect intellectual properties; venture capital; and comprehensive technology transfer guidelines. There is therefore a tendency to use inappropriate and often environmentally unfriendly technologies in many production processes. Similarly, technologies that allow recycling of wastes are not widely used.

To achieve sustainable development, the planning and decision-making process must carefully consider alternative strategies.

## 1.4 ECONOMIC INCENTIVES

### 1.4.1 Issues

Economic and financial incentives have the potential to influence human behaviour towards the environment in a

positive or negative way. Economic incentives are usually more cost-effective than regulatory measures. Yet current development policies have few incentives for environmental protection, and retain some negative provisions.

A new system of valuation of natural resources has to be developed. At present, a tree's worth is usually measured in terms of its timber value when it is cut. A source of water begins to be measured in monetary terms when it becomes polluted and needs to be cleaned up. The real value of the standing tree, however, includes its worth in improving soil fertility and texture, trapping rain water, preventing soil erosion from rain and wind, absorbing carbon dioxide and therefore mitigating climate change, releasing oxygen, providing shade, food, fodder, and ornaments for people and animals, creating a habitat for other species of living things, and also a scarcity value as offset against all the trees that have already been cut elsewhere. A healthy natural wetland has enormous actual and potential value in a world where water is scarce, salty or polluted, as well as value in protecting biodiversity, cleaning and storing runoff water, creating new soil and maintaining the hydrological balance of the area and the water cycle of the planet. To encourage sustainability, a standing tree should be worth as much, or more, to its owner than a cut one.

In the long run, public education and improved standards of living will influence the behaviour patterns of the Kenyan population in as far as environmental conservation and resource utilisation are concerned. But in the short term, there is need for a system of economic and financial incentives and sanctions (dis-incentives), aimed at directing the behaviour of individuals as well as public and private institutions towards sustainable resource utilisation.

In the Finance Bill 1994 the Government has initiated some action to integrate environment concerns into the planning and management of the economy by making changes in taxation on machinery used in generation, transformation and distribution of electricity; clean-up and

disposal of effluents and other waste products; reduction of environmental damage; and water supply or disposal.

#### **1.4.2 Recommendations**

##### **1.4.2.1 General Guidelines**

- a) Use markets, prices, and government fiscal and other economic instruments, including tax-based incentives and sanctions to protect the environment and influence attitudes and behaviour towards sustainability. Initiate the proposed incentives package in cooperation with the private sector.
- b) Re-orient the national budget to prioritise sustainable projects.
- c) Use pricing policy to reflect actual worth of natural resources, and the cost of utilisation, taking into account their long term scarcity.
- d) Treat biological resources as capital resources and invest accordingly to prevent their depletion.
- e) Increase government expenditure on environmental management.
- f) Analyse the effects of structural adjustment programmes (SAPs) on the environment, and take remedial measures, if necessary.
- g) Formulate ways in which the world can contribute to maintain healthy tropical ecosystems.
- h) Change the behaviour of people and institutions so that they become conservers of natural resources and not overusers.
- i) Recognise and affirm the role of culture as part of conservation.

##### **1.4.2.2 Institution Related Incentives**

- a) Create an enabling environment, including an information bank for use by environmental managers and environmental impact

assessors.

- b) Include environmental performance as a criterion in tender evaluation in the government tendering system.
- c) Share benefits accruing from proper use of natural resources with the local communities.
- d) Coordinate and harmonise economic planning and instruments to support sustainable development.
- e) Continue to build capacity within the public and private sectors for integrating environmental concerns, and calculations of benefits and costs, into project design, implementation, evaluation and monitoring.
- f) Strengthen the financial base of local authorities and increase expenditure on environmental management.
- g) Introduce environmental research and/or environmental protection awards.

##### **1.4.2.3 Economic and Financial Incentives**

- a) Make adjustments in taxation to encourage sustainable use, management and protection of natural resources. For example, provide tax relief and other benefits to encourage business and industry to use environmentally friendly technologies, while imposing penalties/fees on polluters; and reduce or waive duty for chemicals and equipment used in effluent treatment. In addition, identify and remove/reduce those subsidies/incentives that work against sustainable development objectives.
- b) Develop and apply a system of valuation of natural resources to reflect their true value to the country and to local communities.

- c) Make adjustments in prices to reflect not only the relative scarcity of resources, but also to contribute towards the prevention of environmental degradation. Avoid commodity pricing that aggravates environmental damage.
- d) Review energy policy and evaluate costs and benefits of electrification, paraffin subsidy, and development of alternative energy sources such as wind and solar power to reduce heavy reliance on wood fuel.
- e) Give concessionary charges on electricity used in effluent treatment and disposal.
- f) Adjust budgetary allocations to reflect overall national environment issues and enhance budgetary allocations to undertakings geared towards environmental management and protection. This will support preventive rather than curative measures.
- g) Charge economic rates for water use and effluent treatment.
- h) Establish and apply standards to estimate the quality and quantity of emissions for which a charge is levied. Impose pollutant emission charges on the basis of the "polluter pays principle."
- i) Provide soft loans for those purchasing and installing equipment for pollution prevention or abatement.
- j) Provide social and economic incentives to the private sector to decentralise and relocate in economically and environmentally depressed regions.
- k) Provide basic infrastructure necessary for efficient disposal of effluents and pollutants (sewerage systems, etc.).
- l) Estimate, and include in national accounting, the cost to the economy of environmental pollution and degradation caused by such sectors as agriculture, fishing, tourism, forestry, industry and mining.
- m) Emphasise user rights and economic returns to the local communities to promote sustainable resource utilisation. Accordingly, allow access to biological resources on which people's livelihood depend for food, fuel, medicine, housing materials and economic security; and develop regulations to promote sustainable use.
- n) Identify and adopt modes of resource management that take account of the people's local knowledge and long term social and economic aspirations.
- o) Establish a system to compensate local communities living on Trust or State land when the land or other resources are alienated for public use.
- p) Promote the use of indigenous species in food production, medicine, biotechnology, landscaping etc. and establish markets for these products.
- q) Establish standards of performance and enact realistic penalties for environmental crimes, including fines, sanctions and custodial sentences that are sufficiently heavy to act as deterrents.
- r) Make use of international agreements to promote sharing of benefits from Kenya's genetic resources and transfer of technology from industrialised nations to the country.
- s) Encourage and support development of environmentally sound technology, and/or improve the transfer of such technology.

- t) Review and adjust economic incentives and policies to keep up with technological and environmental changes.

## **1.5 PLAN OF ACTION**

### **1.5.1 Actions Which Can Be Taken Immediately**

- a) Use markets, prices, and government fiscal and other economic instruments, including tax-based incentives and sanctions, to protect the environment and influence attitudes and behaviour towards sustainability. Initiate the proposed incentives package in co-operation with the private sector.
- b) Use pricing policy to reflect actual cost of natural resources, taking into account their long term scarcity.
- c) Include environmental performance as a criterion in tender evaluation in the government tendering system.
- d) Create an enabling environment, including an information bank for use by environmental managers.
- e) Share benefits accruing from proper use of natural resources with local communities.
- f) Provide social and economic incentives to the private sector to decentralise and relocate in economically and environmentally depressed regions.
- g) Review and update fines and penalties for environmental crimes, in order to make them more effective deterrent to environmental abuse.

- h) Increase government expenditure on environmental protection and management.

- i) Measure the true value of biological resources and incorporate in the national accounts.

- j) Make use of international agreements to promote sharing of benefits from Kenya's genetic resources and transfer of technology from industrialised nations to the country.

### **1.5.2 Selected Priority Activities Requiring Funding**

- a) Support the Social Dimensions study analysis of the effects of structural adjustments programmes (SAPs) on the environment.
- b) Analyse ways in which the world can contribute to maintain healthy tropical ecosystems.
- c) Introduce environmental awards which carry financial benefits.
- d) Provide basic infrastructure and soft credit lines to targeted sectors.
- e) Build capacity within the public and private sectors for integrating environmental concerns, and calculations of benefits and costs, into project design, implementation, evaluation and monitoring.

### **1.5.3 Some Long-Term Priorities**

- a) Change the behaviour of people and institutions so that they become conservers of biological resources and not overusers.
- b) Recognise and affirm the role of culture in conservation.

## CHAPTER TWO

# PHYSICAL ENVIRONMENT

### 2.1 GEOGRAPHY

#### 2.1.1 Location

The Republic of Kenya lies on the eastern side of the African continent; between latitudes 50° 40' north and 4° 4' south and between longitudes 33° 50' and 41° 45' east. The equator bisects the country in almost two equal parts. The country has an area of 590,000 km<sup>2</sup> and a coastline 608 km long. Administratively, Kenya is divided into eight provinces including Nairobi (Fig. 2.1). All provinces except Nairobi are divided into districts. Nairobi is the capital city, Mombasa the main sea port and Kisumu the lake port.

#### 2.1.2 Physiography

Kenya has diverse landforms ranging from the coastal plains through the dry Nyika Plateau to the savanna grasslands and the highlands on both sides of the Rift Valley. The highlands which are traversed by the Rift Valley are dominated by Mount Kenya, the Mau Ranges, Mount Elgon, and the Aberdare or Nyandarua Range. The vast expanse of the North-Eastern Province varies from flat semi-desert in the east to the more rugged country west of Lake Turkana.

#### 2.1.3 Drainage and Water Resources

The major drainage basins in Kenya include the Lake Victoria Basin, Rift Valley Basin, Athi (and coastal areas south of the Sabaki River) Basin, Tana River Basin and the Ewaso Nyiro and North-Eastern Basin. The pattern of drainage is influenced by the country's topography. The main rivers drain radially from the central highlands into the Rift Valley and eastwards into the Indian Ocean. Rivers to the west of the

Rift Valley drain westwards into Lake Victoria, while those north of Mount Elgon and from the highlands along the Sudan-Ethiopia border drain mainly into Lake Turkana.

#### 2.1.4 Rivers, Lakes and Wetlands

Although Kenya has numerous rivers, a comparatively small number are permanent, among them the Tana, Athi, Nzoia, Yala, Sondu, Nyando and Mara. Of these rivers, River Tana is the longest, draining the slopes of Mount Kenya and the Aberdares Range into the Indian Ocean. Several of the rivers have been dammed upstream to provide hydro-electric power, irrigation water or for domestic water use. This has caused various environmental problems which include: lack of natural flooding downstream; increased incidences of pollution and water borne diseases; changed river courses; and natural habitat destruction.

Kenya's lakes include part of Lake Victoria, Africa's largest fresh water lake. Most other lakes are within the Rift Valley, and many of these lakes are small and/or alkaline to some extent, and unsuitable for use in agriculture or for domestic water supplies. The levels and volume of these lakes fluctuate periodically. The Rift Valley lakes including Nakuru, Naivasha, Baringo, Bogoria etc. are valuable tourist attractions, some have fishery resources, and Lake Naivasha's fresh water is used for intensive horticulture. Lake Magadi is almost solid sodium sesqui-carbonate, which is mined for soda ash, an important export.

Wetlands include swamps, small lakes, seasonal ponds, floodplains and intertidal marine wetlands. They provide groundwater recharge and discharge, water purification, water storage and

shoreline stabilisation. They also act as breeding grounds for fish and birds, dry season grazing grounds for livestock and wildlife, sources of building materials and ceremonial sites and are very rich in biodiversity.

There is insufficient information on the volume of groundwater, the extent of the aquifers, and their structure. Generally, groundwater in the country is extremely variable in chemical composition and quantities. This severely limits full exploitation of groundwater resources.

### 2.1.5 Geological Resources

Metamorphic rocks of the Mozambique Belt are found in a zone extending from the Kenya-Sudan-Ethiopia border in the north to Kenya-Tanzania border in the south. These are rich in gemstones like ruby, topaz, aquamarine, garnets, etc., which are mined in many areas. There is also quarrying of marble used for the manufacture of cement and as decoration.

Precambrian basic/ultrabasic intrusive rocks are found in the central parts of Kenya, associated with the Mozambique Belt rocks, while more recent intermediate intrusive rocks are found along the coast and northern Kenya. The acidic igneous rocks include the granites of western Kenya and those associated with the Mozambique Belt rocks, both Precambrian in age. These intrusives often contain economically important minerals.

The volcanic igneous rocks are of more recent Nyanzian, Tertiary and Quarternary ages. The Tertiary/Quarternary volcanics which are mainly associated with the Rift Valley have a wide spectrum of chemical composition. Most of the building materials in Kenya are tuffs, compacted volcanic ash. Geothermal power production and carbon dioxide mining are associated with the Tertiary volcanics.

The sedimentary rocks also vary in age

Table 2.1 A summary of the broad soil groups in Kenya

Soil group	Areas in hectares	Natural fertility status	FAO, 1974 classification
Weakly developed soils	3,638,235	Low	Xerosols and Yermosols
Shallow/juvenile soils	6,697,809	Moderate to high	Lithosols, Regosols, Rankers and rendzinas
Sodic and/or saline soils	13,489,985	Low	Solonetz, Solonchaks and Solodic Planosols
Alluvial soils	1,936,582	High	Fluvisols
Deep to very deep soils	3,796,669	Moderate	Nitisols and Andosols
Sandy soils	436,683	Very low	Arenosols
Poorly drained soils	5,604,302	Moderate	Vertisols, Gleysols, other Planosols, Greyzems, Chernozems & Vertoluvic Phaeozems
Moderately deep to deep soils	7,408,426	High	Luvisols, Cambisols, Phaeozems and Chernozems
Deep red, strongly weathered acid soils	6,839,464	Low	Ferralols, Acrisols and Ironstone soils
Shall to moderately deep soils	7,688,796	High	Shallow Cambisols, Luvisols and Phaeozems

Source: Kenya Soil Survey

Table 2.2: Distribution of Rainfall in Kenya

Mean Annual Rainfall (mm)	Land Area (Km <sup>2</sup> )	% Total Land Area
>1000	64,070	11.2
800-1000	32,960	5.8
700-800	24,260	4.3
500-700	73,140	12.8
300-500	270,410	47.4
<300	105,730	18.4
Total	570,570	99.9

Source: IGADD (1990)

### 2.1.7.2. Temperature

Altitude exerts the greatest influence on temperature in Kenya. There is a wide range between the maximum and minimum temperatures; from below the freezing point on the snow-capped Mount Kenya to over 40°C in some of the north and north-eastern parts of the country. Generally, the low-lying northern plains are the hottest areas. Here maximum temperatures commonly exceed 35°C. The temperature regimes determine the major crop production zones. Maize varieties are for example temperature dependent and hence there are highland maize and lowland maize.

## 2.2 LAND USE

Land use in Kenya is controlled by several factors which include climate, soils, labour, technology and markets. The land cover/land use types can broadly be grouped into two main categories, namely: those occurring in the medium to high rainfall and high potential areas and those occurring in the ASALs.

### 2.2.2 Land Use in Medium to High Potential Lands

The medium and high rainfall areas (zones I-IV) cover approximately 165,243 km<sup>2</sup>. Land use is primarily agriculture, including dairy farming. The same lands also support forests, lakes, urban centres and industry. Cash crops follow an ecological pattern defined by temperature limits: cashew and coconuts

for the lowlands, sugar cane and cotton for the lower midlands, Arabica coffee for the upper midlands, tea for the lower highlands, pyrethrum for the upper highlands. The zones are roughly parallel with precipitation/evaporation climatic zones.

Population increase over the years and the need for more food and cash crops has exerted immense pressure on the resources of these areas. Unfortunately, the technologies currently used do not allow sustainable exploitation of the resources. Continued use of these technologies and strategies continue to cause environmental degradation which include: soil erosion; pollution from excessive use of fertilisers and pesticides; deteriorating soil conditions; surface and groundwater pollution; deforestation; loss of indigenous plant and animal species; and destruction of water catchment areas.

Some of the specific problems which have been experienced include: falling agricultural productivity due to over exploitation of the soil resources; land sub-division to unsustainable sizes; land degradation due to inappropriate soil conservation technologies and soil erosion; land use conflicts caused by urban and industrial expansion; and prolonged unpredictable droughts.

### 2.2.2 Land Use in ASALs

The arid and semi-arid lands (ASALs) occupy about 80% of the total land area of Kenya and support up to 20% of the country's population, and 50% of the national livestock herd. A major portion of the nation's wildlife resources also occur in the ASALs. The ASALs constitute a last frontier to take in population spilling from high potential areas, a factor threatening sustainable land use in the ecosystem.

ASALs contribute more than 3% of the annual agricultural output and 7% commercial production. The ASALs consist of two distinct sub-units. Zones IV and V are characterised by agro-

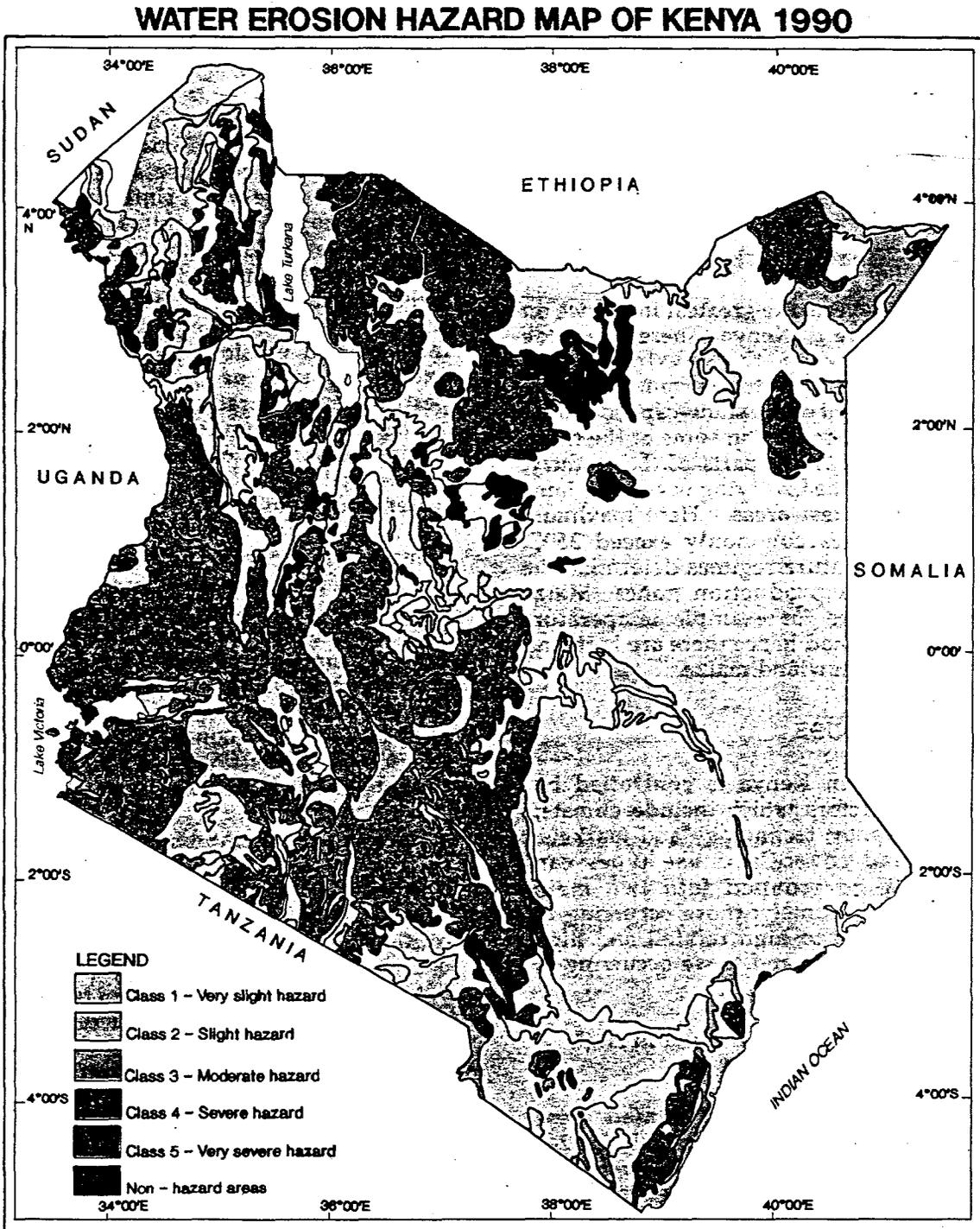


Figure 2.2 Water Erosion Hazard Map of Kenya 1990 Preparation M.G. Mwago and P.F. Okoth

pastoralism, while zone VI and VII (the most arid) are primarily pastoral areas.

The provision of additional water without comparable increase in the availability of biomass (food for stock) is counter productive, particularly in zones VI and VII. Access to dry season forage and grazing is the ultimate critical constraint in these driest areas.

Upland water resources utilisation strategies determine water resources availability in ASALs. Expansion and intensification of agriculture in the highland catchments is reducing volume and quality of water received in the ASAL; thus affecting the prosperity and viability of downstream communities. The lower communities cannot grow crops anymore because there is no flood water due to hydropower dams upstream. Tourism remains underdeveloped in the ASALs.

### 2.2.3 Land Use Planning and Policy

In order to achieve sustainable management of the land resources, the land use policy must provide a system of laws, rules, regulations and practices that govern the rights and obligations of land owners together with appropriate guidelines on optimal utilisation of available land. There are good reasons for land use planning. First, it is needed to identify changes required in land use practices which will increase productivity and opportunities. Second, it is used to decide where the changes should be; and third, to avoid misuse of land resources.

Some of the issues that require attention include: harmonising utilisation types within a given area; allocating land for use according to suitability; reducing land use conflicts; harmonising land use technologies according to their appropriateness; and encouraging and educating the public to support safe and sustainable land utilisation.

### 2.2.4 Recommendations

- a) Review land use legislation and planning with a view to

increasing productivity, protecting water catchments and fragile ecosystems, and reducing land use conflicts.

- b) Place greater emphasis on conservation of undamaged resources (such as indigenous forests and functioning wetlands) than on rehabilitation.

## 2.3 CULTURE, DEVELOPMENT AND ENVIRONMENT

The population of Kenya is estimated at about 25 million. Only about 20% live in urban areas, one of the lowest percentages in the world. The population has been growing at a rapid rate of over 3.5 per year. Kenya's people include a wide variety of ethnic groups, languages and lifestyles.

Although Kenya has a very diverse cultural heritage, each community developed land use systems which integrated environmental conservation strategies. Agricultural farming communities practiced shifting cultivation which allowed resource regeneration, and communal control of resources including sacred forests and special (cultural) species. Among the pastoralists, communal grazing systems e.g transhumance, designed to conserve land resources in which livestock and wildlife coexisted were practiced. These traditional conservation strategies were passed from generation to generation.

### 2.3.1 Development and Environmental Conflicts

Development has caused certain conflicts with the environment. Pressure on land resources due to population growth coupled with the introduction of exotic production technologies is causing erosion of traditional conservation strategies. Commercialisation of production systems has also encouraged unsustainable use of land resources.

Local communities, including those living adjacent to national parks, are

often excluded from the use and management of resources which they have traditionally considered "theirs." Besides fencing of individual land parcels has interfered with the seasonal migration of livestock and wildlife. Provision of infrastructure, for example, permanent watering points following sedentarisation and subsequent change in life styles of pastoral communities, has also caused degradation of natural resources around the settlement through over-grazing and tree cutting for construction and wood fuel around the settlement.

With increasing western influence, resource exploitation strategies have put survival first. Thus, development and environment have been treated in isolation rather than as integral parts. Our forestry and aquatic resources are being exploited without due consideration to their biodiversity, their ecological functions and developments in biotechnology. Lack of an environmental impact assessment (EIA) policy on development projects has also led to degradation of natural resources and poverty, and has heightened the country's debt crisis.

### **2.3.2 Recommendations**

- a) Involve local communities in resource management and incorporate indigenous management whenever appropriate.
- b) Integrate conservation in development planning.
- c) Plan for the long-term as well as the short-term considerations, especially environmental impacts.

## **2.4 ENERGY AND THE ENVIRONMENT**

Energy is a vital input in sustaining and fostering Kenya's economic activities, including agricultural production, industrial processing and transport.

The breakdown of energy consumption is as follows: wood fuel (firewood and charcoal) 63%, petroleum products 24%, electricity 12%, and coal 1%. The country has been spending over 60% of total foreign exchange earnings on petroleum imports. Other sources of energy, though not contributing significantly to the total energy balance, include wind, solar, biogas and ethanol.

### **2.4.1 Wood Fuel**

Wood fuel provides about 65% of the nation's energy requirements and 95% of rural energy requirements, and is expected to maintain this position well into the next century. The current consumption stands at about 5.4 tonnes of oil-equivalent, mainly in form of firewood and charcoal. The demand for wood fuel is estimated to continue to grow steadily, posing a major threat to existing forest resources and biodiversity. The main constraints to sustainable wood fuel supply include depletion of forest resources, inefficient utilisation technologies and poor forest management.

Firewood is the dominant source of energy. The rural poor tend to use firewood directly, and therefore efforts to improve the availability of energy to the rural poor must involve planting trees in their localities.

Kenya is facing a charcoal/wood fuel crisis, since most forest land is being cleared and settled for agriculture and urbanisation. The harvesting of trees for charcoal has therefore moved to more ecologically fragile areas, impacting negatively on soil and water resources.

### **2.4.2 Petroleum**

Kenya is dependent on oil and coal imports for a large share of the country's commercial energy requirements. Petroleum fuels provide over 80% of commercial energy used in the country and are the main source of energy used by transport, industrial, commercial and agricultural sectors. The bulk of this

energy is consumed by the transport sector. Increased use of petroleum products coupled with improper handling and management leads to greenhouse gas emissions in addition to land, air and water pollution which are all environmental hazards.

### **2.4.3 Electricity**

Electrical energy accounts for about 12% of the total national energy supply. The installed electrical capacity is 804MW distributed as follows: hydro, 603.5 MW; thermal, 156.3 MW; and geothermal, 45 MW. Imports from Uganda amount to about 240 MW per year. The demand for thermal power in the country is occasional and depends on incidences of drought when it is used to supplement hydro-power. Under the Rural Electrification programme established in 1974, the government, through the Kenya Power and Lighting Company, has supplied some rural trading centres with electric power to stimulate development. Considering that Kenya is bracing itself for an industrial takeoff, there is need to find means and ways to avail cheap and affordable electrical energy to facilitate the country's industrialisation.

Hydro-electric power generation is renewable and generally clean. However, negative impacts include the displacement of local communities and interruption of their socio-economic activities, loss of biodiversity when valleys are dammed, breeding grounds for disease vectors, and disruption of hydrological systems. The negative environmental impacts of geothermal energy development include carbon dioxide and hydrogen sulphide discharge to the atmosphere.

### **2.4.4 Other Energy Sources**

Solar energy is increasingly being used. However, this technology has not been widely adopted yet despite the fact that it is a clean and environmentally friendly energy source. The major

constraints include high initial capital costs, import duties, lack of local manufacturing facilities of some materials and absence of adequate research. Besides, there is limited testing and development facilities; there is a general lack of effective promotional campaigns and economic incentives; and existing legislation does not require the building industry to incorporate solar systems in new buildings.

Wind energy is used primarily for water pumping. There is potential for its utilisation to generate electricity, particularly in wind prone areas. Its development is, however, constrained by high installation costs; lack of adequate wind energy data and lack of research, testing and development facilities for quality control, demonstration and training; and lack of after sales maintenance of windpower machines.

Biogas is used for cooking and lighting while producer gas provides mechanical or electric power to a stationary internal combustion engine. The dissemination of biogas technology is hampered mainly by lack of economic incentives and research and development of standards. Biogas technology is one of the overall strategies which seeks to address both the country's energy and environmental needs.

Power alcohol from molasses, or ethanol, was introduced in the country in 1983. It has effectively been used in combination with petrol to run petrol engines. However, it has since been discontinued due to pricing problems. The country has the potential of developing vegetable oils for blending with diesel oil though adoption has been hindered by lack of conversion technology and sufficient vegetable oil supplies.

### **2.4.5 Energy Conservation**

Energy conservation is an important way of reducing pressure on energy supplies in the industrial, commercial,

domestic and transport sectors. Its potential is high, especially in large industrial establishments where it is estimated that efficiency can be improved by about 20-25% through refitting of existing equipment. Similarly, 15% efficiency is said to be easily attainable in electrical use through simple housekeeping measures. Energy conservation thus contributes significantly to environment management, especially in utilisation of petroleum based fuels.

#### **2.4.6 Recommendations**

- a) Increase wood fuel supplies by encouraging: on-farm forestry; improved forest management; improved wood utilisation; and improved stoves and fireplaces.
- b) Reduce petroleum imports by encouraging efficient utilisation and minimising on wastages.
- c) Assess the benefits and costs of hydro-power, geothermal power, and electricity imports.
- d) Promote solar power, wind power, and biogas through economic incentives, research and development; marketing and service and building regulations.
- e) Study and develop other alternative energy sources to broaden the national energy mix.
- f) Promote energy conservation by households, transport, industrial, agricultural, and service sectors.

#### **PLAN OF ACTION**

##### **2.5.1 Actions Which Can Be Taken Immediately**

- a) Review land use legislation to provide for land use zones;

protection of water catchments and fragile ecosystems; and reduction of land use conflicts.

- b) Integrate conservation into all development programmes and plans.
- c) Involve local communities in resource management and incorporate indigenous knowledge systems in all planning and management efforts.
- d) Give priority to conservation of undamaged resources especially forests, wetlands, biodiversity and soils.
- e) Institutionalise the process of environment impact assessment and monitoring for public and private projects and programmes.
- f) Provide social and economic incentives to the private sector to decentralise and relocate in economically and environmentally depressed regions.
- g) Initiate incentives for individuals business and industry to increase woodfuel by encouraging on-farm forestry, improved wood utilisation, and improved stores and fireplaces.
- h) Review and update fines and penalties for environmental crimes, in order to make them more effective deterrent to environmental abuse.
- i) Increase government expenditure on environmental management.
- j) Make use of international agreements to promote sharing of benefits from Kenya's genetic resources and transfer of technology from industrialised

nations to the country.

**2.5.2 Selected Priority Activities Requiring Funding**

- a) Promote research into more economic, and environmentally friendly sources of energy.
- b) Assess the benefits and costs of the various sources of energy and promote the least expensive both monetarily and ecologically.
- c) Promote efficient utilisation of petroleum and minimise wastages by providing incentives and penalties.
- d) Continue to build capacity within

the public and private sectors for integrating environmental concerns, and calculations of benefits and costs, into project design, implementation, evaluation and monitoring.

**2.5.3 Some Long-Term Priorities**

- a) Change the behaviour of people and institutions so that they become conservers of biological resources and not overusers.
- b) Recognise and affirm the role of culture in conservation.
- c) Broaden the national sources of energy supplies.

## CHAPTER THREE

## BIODIVERSITY

including Forestry, Wildlife, Biotechnology and Indigenous Knowledge

## 3.1 OVERVIEW

Kenya's biodiversity is all of its plants, animals and micro-organisms, the genes they contain and the ecosystems of which they are part. It includes variations within species and interactions among them. Plants, animals and microbes help maintain the chemical balance of the earth, stabilise climate, protect watersheds and renew soils. All societies, urban and rural, industrial and non-industrial, draw on a wide array of ecosystems, species and genes to meet their ever-changing needs.

Kenya has biological resources that are of considerable domestic and international economic and intrinsic value. The country has about 35,000 known species of animals, plants and micro-organisms. These are fundamental to human well-being. Agriculture, livestock, fisheries and forests, for example, account for most subsistence survival, economic output, employment and export earnings. Tourism in Kenya is a key foreign exchange earner which is largely based on the presence of wildlife and seashores. Kenya will continue to be dependent on its biological resources for food, fuel, medicine, shelter and income.

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 emphasised production with little regard for conservation. The move must now be to meet human needs sustainably while preserving the integrity of the environment.

Kenya's biodiversity is of value not only to the nation but to the world. Its remarkable variety is mainly due to the great range of habitats, from coral reefs below sea level to the glaciated top of Mount Kenya. In some of these habitats live certain plants and animals that occur

nowhere else in the world and therefore require special protection. Since much of Kenya's biodiversity exists outside protected areas, conservation should not be limited to them.

## 3.2 ISSUES AND RECOMMENDATIONS

## 3.2.1 Genes, Species and Ecosystems

## 3.2.1.1 Current Status

Economic development in Kenya, which is and will continue to be largely dependent on exploitation of biological resources, is presently unsustainable, precisely, 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 actually become extinct. Conversely, some introduced species have proliferated and become a threat to indigenous biodiversity. Conservation is therefore vital to sustainable growth.

Currently, several species of plants and animals are threatened because of over-exploitation or loss of habitat (Table 3.1).

Table 1 Species of trees, birds and mammals (1993 estimates)

	National	Total	Forest species <sup>2</sup>	Threatened Species	
				National	Forest
Trees		2000+	1045+	159	104
Birds		1079	299	71	35
Mammals <sup>1</sup>		130	57	30	21

1 - only species weighing over 500g

2 - including forest species that also occur in other habitats

Source: A National Profile of Kenya's Indigenous Forests - KIFCON.

### 3.2.1.2 Issues

Conservation should not preclude human use. The present task is to measure the true value of biological resources; widen the use of indigenous species; establish sustainable harvest levels; develop microbial resources; protect threatened ecosystems; and integrate the conservation of biodiversity with other resource use. Development needs to be people-centred and conservation-based.

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. Combinations of incentives and penalties can promote conservation. Incentives could include shares of entrance fees to protected areas and the proceeds of fines for illegal use of wild resources. Indirect incentives may include exemptions from taxes, food security and assistance for community development. Social incentives include measures to maintain strong communal organisations for resources management, and supporting projects that combine rural development and the conservation and sustainable use of natural ecosystems and wild species.

Incentive to use natural resources sustainably often depends on the property rights of users. Where rights to graze livestock extend into the future there is an incentive to manage the rangeland for continued productivity; but where these rights are limited to one season there is no such incentive. Thus the exclusivity, duration and other characteristics of property rights influence the incentives of users to conserve resources.

Business, industry and government departments are more likely to choose development options that conserve biodiversity if they are encouraged by a system of incentives and penalties. Polluters should pay the cost of cleaning up pollution; but equally, individuals, communities and companies which manage resources sustainably should derive benefits such as tax relief or concessions. There is therefore need to develop appropriate incentives to

stimulate local and private sector participation in biodiversity conservation, and for development programmes to give realistic value to the nation's resources.

### 3.2.1.3 Recommendations

- a) Include representative, viable samples of all habitat types within protected areas, with particular attention to habitats high in biodiversity and endemism. Priority areas for conservation include wetlands, especially seasonal wetlands, forests, highland grasslands and natural areas near large urban centres.
- b) Devise a system to measure in economic terms the value of standing, unexploited natural resources and ecological functions and processes, especially biodiversity.
- c) Provide technical and financial support to compile inventories of plants and animals, especially those with social, spiritual, cultural, aesthetic, economic and scientific values, and including indigenous crop diversity, through ecological and ethno-biological surveys.
- d) Create conditions and incentives for effective conservation of biodiversity by local communities. Recognise and affirm the value of local knowledge and local communities' rights to genetic resources and benefits from tourism in their areas.
- e) Estimate sustainable levels of production for economic benefits from biological resources including fish, timber, wildlife, medicinal plants and other goods and services, and place limits on harvests, including regulatory mechanisms.
- f) Support projects which provide immediate and sustainable economic returns to the

communities concerned.

- g) Encourage users to grow species which are under intense pressure ex situ to provide an alternative source of supply.
- h) Encourage local communities to develop a larger market share for wild products harvested sustainably and so develop the role of traditional medicines and ensure their appropriate and sustainable use.
- i) Promote the establishment of botanical gardens in every province and ecological zone, stocked with indigenous plant species, in consultation with institutions which already have botanical gardens or arboreta.
- j) Promote the use of indigenous species of plants and animals, applying the knowledge of local communities to select them.
- k) Expand ex situ conservation efforts, gene banks, zoos, aquaria and captive breeding of endangered species. This is particularly important for wild plants harvested for food, medicines, cosmetics, building materials, ornaments, etc., and where a plant or animal species is only represented by small, inviable populations.
- l) Promote recycling wherever possible to reduce the rate of use of natural resources.
- m) Carry out research into the management of alien species which threaten biodiversity, and control the import and use of exotic aquarium fish.
- n) Establish a biodiversity information database as a central repository of data generated by inventories and surveys.

### 3.2.2 Forestry

#### 3.2.2.1 Current Status

The government forests in Kenya cover 2,359,767 ha (1,662,472 ha gazetted and 697,295 ha ungazetted) and the total woody biomass in the country is 433,330,000 ha (DRSRS 1989). Closed canopy indigenous forests account for some 1.2 million hectares. Woodlands cover over 2 million hectares, and the bulk of the country is arid and semi-arid bushland and scrubland. About 30% of the nation's wood supply is in indigenous forests and industrial plantations, combined. A further 40% is in the ASAL areas. The Forest Department manages the country's forests (see map 3.1).

Protected forests include:

- a) Forest reserves managed by the Forest Department. Forest reserves have been managed to produce wood and other forest products, and as water catchments. Nearly 40% of forest reserve land does not have indigenous forest cover.
- b) Nature reserves, usually within forest reserves, in which no extraction of forest products is allowed.
- c) Forest areas within national parks and national reserves.
- d) National monuments, including the small Kaya forests at the coast, protected for their cultural and biological values.
- e) County Council forests, mainly in ASAL areas.

At present an average of 5,000 ha of forest reserve land are being lost annually through excision. Forest degradation through over-exploitation has led to a 40-60% loss of standing wood volume from most forest reserves in the last 30 years.

Non-wood products from indigenous forests include honey; fruits; medicines (58 tree species have been identified as supplying medicinal bark); weaving and basketry materials; thatch; and others. In general these are low impact activities, but repeated and intensive extraction may cause loss of the resource. Forests also have important cultural, ceremonial and recreational value.

Forest plantations have approximately declined from 170,000 ha to 164,000 ha as per 1994 inventory reports. Yet the demand for all wood products is increasing at three to five per cent per annum. Wood fuel consumption amounts to about 20 million cubic metres per annum and industrial roundwood and polewood utilisation to about 2.3 million cubic metres.

Substantial areas of woodland and bushland can be found in the County Council areas in the drier parts of the country. These supply considerable volumes of wood products, and require careful management to ensure long term supplies.

### 3.2.2.2 Indigenous Forest Issues

Over-exploitation and illegal cutting of indigenous forests is a matter of great concern. The lack of appropriate technology for maximum utilisation of the raw materials, low recovery, poor silvicultural practices, and low budgetary provision for recurrent forest operations have all hampered effective management. As a result, timber, wood fuel, polewood and carving wood are being exploited at unsustainable levels.

Over 80% of all households use wood fuel or other biomass fuels for their domestic needs. Roughly one third of biomass fuel consumption is in the form of charcoal. A considerable portion of woodfuel, including charcoal, still comes from indigenous forests, especially from arid and semi-arid lands (ASAL). Without intervention, a deficit between supply and demand for woodfuel is projected to increase, and the imbalance is estimated to lead to a severe loss of savannah woodlands and closed canopy high forest.

Bamboo forests at high altitudes and mangroves along the coast are fragile and threatened ecosystems. Bamboo forests support some of Kenya's rarest large mammals, but are easily cleared and converted to agriculture. Mangroves are cut for high quality poles and cleared to make room for tourist and industrial developments.

One area that deserves immediate attention is the coastal forests. Coast Province forests constitute less than 10% of the nation's forests, but they contain nearly half of the country's rare trees. There are animals and plants found in remnant coastal forests that occur nowhere else. Kaya forests are sacred places to the local communities, and other sites have cultural or ceremonial importance. Many forest areas have been destroyed for crop and livestock production, mining, wood fuel, human settlements, tourist developments, etc.

### 3.2.2.3 Recommendations

- a) Integrate forest management systems to conserve plant and animal species, and provide forest produce for subsistence and commercial needs on a sustainable basis. Seven forests are particularly important to biodiversity conservation: Kakamega, South West Mau/Trans Mara, Aberdares/Kikuyu Escarpment, Mt Kenya, Shimba Hills, Arabuko-Sokoke and Tana River riverine forests.
- b) Manage the bamboo and mangrove ecosystems for conservation and sustainable use.
- c) Identify and manage important forest areas for watershed protection.
- d) Stop further degazettement and excision of forest land.
- e) Inventory Kenya's indigenous forests. Then develop silvicultural systems and draw up management plans for each forest area. These plans to include conservation measures.



- f) Expand forestry planning to include sustainable management in ASAL areas. Conduct a study of the standing volume of wood and the rates of offtake of wood products from the ASAL areas, and draw up management plans.
- g) Strengthen forestry planning to include ecological protection, biodiversity conservation, subsistence collection of forest produce, high impact commercial use, watershed protection, ecotourism, and community participation.
- h) Involve herbalists more fully in the management of areas which supply medicines, and encourage agronomic and silvicultural practices in growing indigenous herbs and trees of medicinal value.
- i) Encourage the development of solar power and other alternative forms of energy.
- j) Encourage major industries using indigenous trees to establish their own plantations to ensure sustainability.
- k) Encourage use of top bar, non-log hives in the forest.
- l) Start immediate research programmes on indigenous tree germination and growth rates; suitable silvicultural systems for managing indigenous forests; and species trials for industrial plantations.
- m) Continue the biodiversity and socio-economic studies around indigenous forests that have already begun.
- n) Devise ways to involve people who live within 2 km of forest boundaries to participate in and support forest management. A fair and lasting solution must also be found for the problem of forest dwellers (over 3,500) and forest squatters.

- o) Take into account the global agreements to which Kenya is a party, especially those relating to forests, biodiversity or climatic influences, in forestry planning and management.

#### 3.2.2.4 Forest Plantation Issues

Plantation forests, established to provide wood and wood products, are not well maintained. New plantation establishment is failing (up to 90% of all seedlings die). Timber does not reach wood processors in time, and outdated equipment wastes upto 60% of wood during processing.

The Forest Department, through the Kenya Forestry Master Plan, anticipates that the demand for roundwood will exceed supply by the year 2025 if the management of industrial plantations is not improved. Sustainable woodfuel production from forests is estimated to be only about one quarter of national requirements. To meet needs for wood and woodfuel, trees will have to be grown on-farm.

Pricing and marketing are very powerful tools in implementation of government policies, and taxation is also an important part of an intervention package. Intervention in the market place must be done with concern about poorer sections of the society.

#### 3.2.2.5 Recommendations

- a) Develop plantation forestry that is financially self-supporting or profit-making. This requires realistic royalty rates, and reinvestment of revenues.
- b) Establish incentives and regulatory mechanisms to support sustainable utilisation of forest resources outside gazetted areas.
- c) Conduct feasibility studies before issuing new licences in the timber industry.

- d) Enhance plantation management efficiency by gradually separating the commercially managed forestry enterprise functions from the forestry authority as proposed in the Kenya Forestry Master Plan. Specific forest operations such as harvesting, transport or replanting could be handled by specialised, financially independent sub-units. It is essential to achieve better integration of wood use.
- e) Expand the pulp and paper industry by incorporating alternative raw materials and improving management of existing forest plantations.
- f) Expand the area under industrial plantations and conduct research into new tree species for plantations.
- g) Review and adopt the most suitable methods of establishing forest plantations.
- h) Improve the integrated processing of timber, with better recovery rates of processed wood products from roundwood inputs, to cut down on wastage.
- i) Increase support for, empowerment of, and incentives to farmers and local communities for planting trees on-farm and in community woodlots.

### 3.2.3 Wildlife and Fisheries

#### 3.2.3.1 Current Status

Wildlife and fisheries constitute important resources with substantial socio-economic, cultural, scientific and environmental values. About 8% of Kenya's land area is set aside for wildlife conservation. In addition, the country has rich aquatic biological resources in both inland and marine waters. Inland and marine fisheries provide food, employment, recreation and foreign exchange.

As outlined in the 7th and earlier National Development Plans and policy

documents, the objective of the wildlife sector is to optimise returns from wildlife in terms of aesthetic, scientific, cultural and economic gains, subject to the various sectoral constraints. The government, through the Kenya Wildlife Service, is responsible for the survival, conservation and sustainable use of wildlife and contributes to the economic development of the country by encouraging tourism.

Kenya has a well established system of parks and reserves. National parks vary in size from the smallest, Saiwa National Park, covering only 2 km<sup>2</sup>, to the largest, Tsavo National Park, which accounts for over 70% of the total park area and 47% of the total protected area system (Map 3.2). Some of Kenya's protected areas are internationally recognised as Biosphere Reserves, World Heritage or Ramsar sites in accordance with the IUCN criteria for classifying protected areas.

Kenya was one of the first countries in the world to establish marine national parks in 1968 when Malindi and Watamu national parks and reserves were established, setting a world standard in designation of protected area status to its marine system. There are now four marine national parks and five national reserves, covering 76,009 ha.

The major inland water ecosystems include lakes, rivers and permanent and seasonal wetlands. Lake Bogoria, Lake Nakuru, islands of Lake Turkana, and mountain river ecosystems are among the protected areas.

In unprotected fresh water ecosystems, fishing is allowed for economic gains and for sport. Nearly a million people depend directly or indirectly on fishing for their livelihood. Fish is a major source of protein intake in Kenya, and an important export.

#### 3.2.3.2 Wildlife and National Parks and Reserves Issues

Conflicts occur when wild animals destroy crops and even kill people. In addition, a number of important habitats are not yet protected. 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, with a view of furthering protection of these areas. It is equally important to involve local communities in conservation of wildlife as already demonstrated by the Kenya Wildlife Service which has established a Community Wildlife section with projects that are chiefly to benefit residents in the neighbourhood of protected areas. A tourism master plan that will address some of these issues is under preparation.

### 3.2.3.3 Recommendations

- a) Assess the status of all vital habitats in the country and prepare plans for conservation and management.
- b) Enhance involvement of local communities in wildlife conservation and ensure that wildlife contributes to their welfare.
- c) Establish zones, such as buffer zones, protection zones, grazing zones, etc., to permit multiple-use management of protected areas.
- d) Strengthen programmes to prevent transmission of diseases between wildlife and livestock, including research.
- e) Harmonise different wildlife development and conservation activities in protected and dispersal areas and determine optimal land use with a view to ensuring sustainable land use planning and management.
- f) Undertake research aimed at enhancing conservation and management of wildlife populations.

### 3.2.3.4 Aquatic Resources Issues

At present, Lake Victoria produces over 90% of Kenya's fish catch. Pollution and ecological disruption of the lake is

therefore a major concern. The use of unauthorised fishing gear is another threat to conservation of aquatic resources. Over-harvesting of resources through uncontrolled licensing of fishermen and fishing vessels exert pressure on sustainability of the resources.

Currently, fish species like *Oreochromis esculentus*, *Labeo victorianus*, *Barbus altianalis* and haplochromines are endangered. Other species which could be threatened include lung fish, mud fish and river eels. Kenya needs to continuously update the inventory of aquatic wildlife stock. In addition, the introduction of alien species of fish and plants threaten the variety and productivity of the nation's fisheries (see Table 3.2).

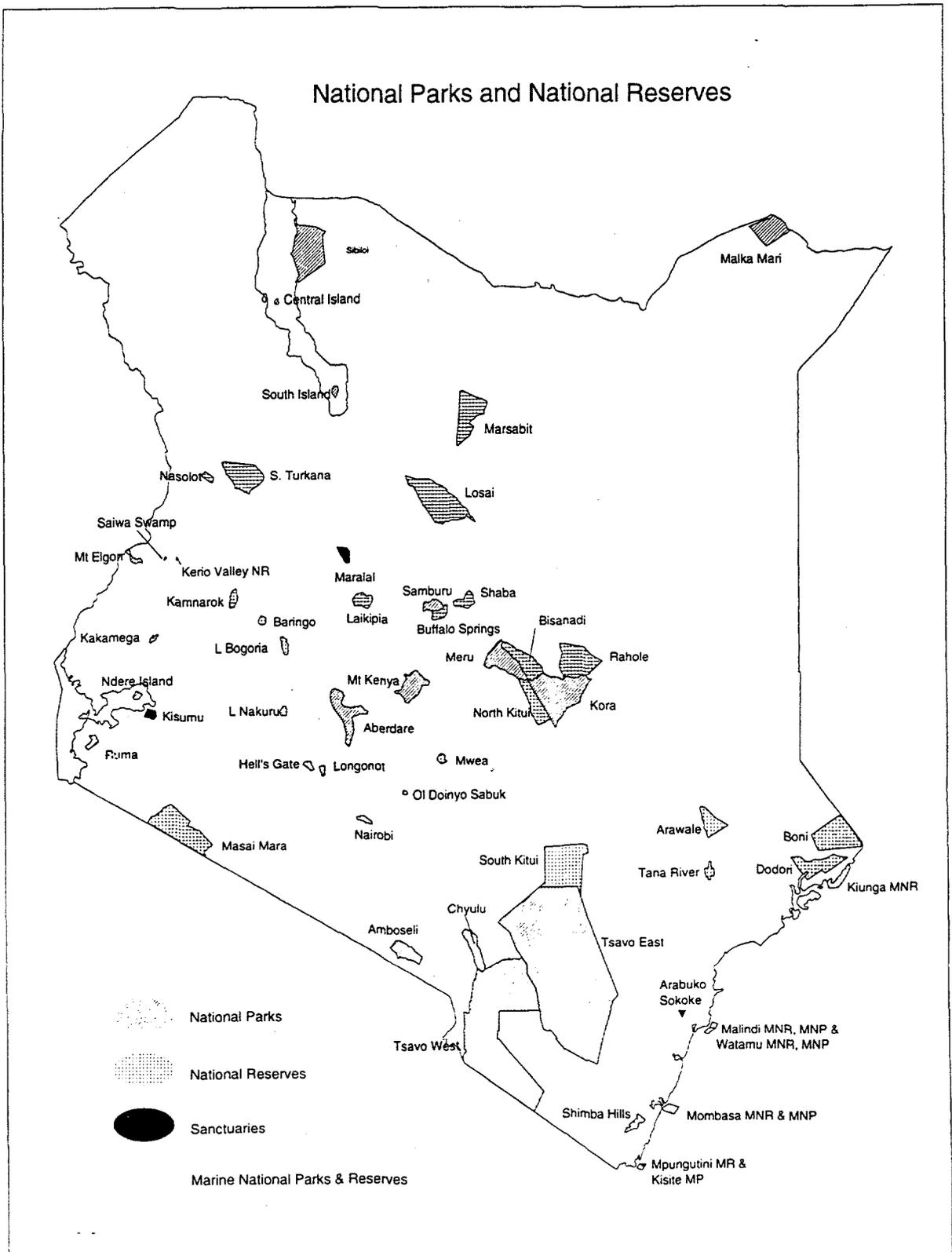
Table 2 Species of fish, reptiles and amphibians in Kenya, 1991 (approximate known numbers)

Category	Fish	Amphibians	Reptiles
Total species	683	101	211
National endemic	54	13	17
Known extinctions	7	-	-
Endangered	60	2	11
Vulnerable	7	-	2
Rare	16	1	3
Introduced	13	-	-

Source: *The Costs, Benefits and Unmet Needs of Biological Diversity Conservation in Kenya, 1992*  
Government of Kenya

Marine fisheries for sport and commerce also contribute significantly to national development, including employment, protein sources, and foreign exchange earnings. Lack of appropriate technology has limited the local ability to exploit this resource, especially offshore. There is need to maximise the sustainable exploitation of the fisheries.

The coastal marine ecosystems, which include mangroves, coral reefs, creeks and estuaries, are important in the production of marine fisheries. These ecosystems are breeding grounds for lobsters, prawns, crabs, oysters, squids, octopus and a variety of coral related fish species. They include habitats for the endangered dugong. The open waters, both territorial and high seas, accommodate many species of fish, shark,



Source: Compiled by KIFCON from KWS Planning Unit maps

Figure 3.2. National Parks and National Reserves

and threatened marine turtles.

Mangroves, however, are cleared for developments such as salt pans, tourism, agriculture and large-scale prawn farming, thus threatening marine life breeding grounds. Agricultural activities up-country resulting in washing down of agro-based pollutants and soil, threaten the survival of estuarine and coral fish species. Oil spills and domestic waste discharge are also of concern. Major oil spills have destroyed mangroves and marine organisms in the past. Threats to conservation also include use of unauthorised and inappropriate fishing gears, incorrect baits, overfishing by vessels outside national control, pollution from commercial and sporting vessels and waste dumping.

### 3.2.3.5 Recommendations

- a) Develop strategies for conservation of endangered fish species, with special attention to Lake Victoria.
- b) Promote implementation of integrated coastal management, including protection of more mangrove and coral reef areas.
- c) Use incentives and education to empower fishing communities use and manage local fishery resources more sustainably.
- d) Monitor and control the operation and movement of fishing vessels, including international vessels.
- e) Strengthen the National Oil Spill Response Committee's capacity to control emergency oil spills.
- f) Develop fish ladders or other means to enable fish to move up and down rivers with hydro-electric dams.
- g) Encourage establishment of sustainable prawn, oyster and seaweed farming, especially by local communities.
- h) Expand research on aquatic species and ecosystems.

### 3.2.4 Biotechnology

Biotechnology is the use of molecular genetics, biochemistry, microbiology, and of processes using micro-organisms or the cells and tissue of living things, to produce goods and services. Advances in biotechnology have revolutionised developments in agriculture, human health, forestry, and industry. Although Kenya is rich in genetic resources, biotechnology is undeveloped. This is due to insufficient finances, lack of enough trained scientists and technicians, lack of well equipped facilities and poor linkages between research organisations and end users. Kenya's people and environment also need protection against some technology imported from abroad, which may be hazardous.

#### 3.2.4.1 Current Status

The following are biotechnological research programmes which have been carried out in Kenya, among others.

In-vitro propagation has been used for rapid multiplication of plants such as pyrethrum, ornamental flowers and citrus fruits. It is now possible to produce 200 plantlets in two months. At the Plant Quarantine Station the technology is being applied to clean plant material which is infected with virus and bacteria. At KEFRI, tissue culture is used for multiplication of recalcitrant seed plants, such as *Ocotea usambarensis* and *Podocarpus milanjanus*.

The University of Nairobi has been producing rhizobium inoculant to improve nitrogen fixation in legumes through the MIRCEN Project. About 216 bacterial strains have so far been collated locally and from other centres for preservation.

Kenya's 12 million cattle, 19 million sheep and goats, 875,000 camels, 18 million poultry and 113,000 pigs require protection against diseases. Research on tick-borne diseases, viral diseases, helminth and bacterial diseases is being carried out in several organisations, e.g., Veterinary Research Laboratory, KARI, ILRAD, ICIPE, etc. Already at KARI 13

bio-engineered vaccines have been produced.

Another type of research involves the cloning of populations of *Theileria parva*, and identification of parasites through the use of DNA probes. At ILRAD and at KETRI, diagnosis of trypanosomiasis is being done through diagnostic methods based on recombinant DNA and monoclonal antibody techniques.

Through artificial insemination the production of livestock animals has been improved greatly. However, 93% of the semen produced at the Artificial Insemination Centre is from only four cattle breeds. As a result, the genetic base of most of the animal species of economic importance is very narrow.

The Kenya Medical Research Institute (KEMRI) has been involved with the production of monoclonal antibodies which are used in kidney tissue matching between donor and recipient. The institute is also carrying out work on production of genetic markers and research on traditional medicines, drug resistances, contraceptives and screening of hepatitis B virus in donated blood.

In Kenya much of the production of industrial products is in the private sector. For instance, products for the livestock industry are manufactured mainly by Kenya Veterinary Vaccine Production Institute (KEVEVAPI) and Wellcome Kenya Ltd.; and private companies manufacture pharmaceutical products for human use, and household products. Kenya Breweries is involved in the production of beer through the fermentation process.

#### 3.2.4.2 Issues

Biotechnology in Kenyan public research institutions has not been developed to sufficiently high levels to ensure self sufficiency in sectors such as agriculture, health and industry. Research and development has faced various constraints including lack of finances, lack of well trained cadres of scientists and lack of up to date equipment and facilities.

There are poor linkages between research

institutions, the private sector, and users of biotechnology. This has hindered commercialisation of research results. Biotechnological activities have largely been developed on a sectoral basis and there has been little inter-institutional coordination and collaboration. Biotechnological data already exists in the country but to a large extent it is not co-ordinated, having been gathered by different organisations and institutions for specific purposes.

Genetic resources that have been conserved by local communities as well as indigenous knowledge that is later utilised for biotechnological development has rarely benefitted the original custodians of those resources.

With regard to industrial applications, genetically modified organisms (GMOs) could cause potential risks in the laboratory and during industrial processes and handling of the products obtained. Still, it is easier to handle such GMOs in the laboratory than in the field. The field situation is completely different because genetically engineered organisms are expected to survive there and as a result they could cause adverse environmental or public health impacts such as: ecological disruption due to lack of natural enemies; exchange of genetic material with other organisms; disruption of the ecosystem; or infectivity, pathogenicity or toxicity to non-target organisms (plants, animals, microbes).

#### 3.2.4.3 Recommendations

- a) Develop a comprehensive policy on research and development in biotechnology. The report from National Advisory Committee on Biotechnology Advances and their Applications (NACBAA) should form a base for the development of such a policy.
- b) Establish a national commission on biotechnology and biosafety.
- c) Prepare a register of existing resources for biotechnology, including a directory of professionals.
- d) Create a biotechnology enhance-

- ment fund to provide venture capital.
- e) Create an enabling environment for biotechnology that would involve data bases, extension services, improvement of communication, networking and marketing.
- f) Formulate scientific criteria for the safe use of genetically modified organisms (GMOs), including methods of hazard identification and exposure assessment before GMOs are released into the environment; measures to provide biological containment and physical containment of GMOs; and mechanisms to monitor the organisms, genetic material and environmental processes exposed to GMOs.
- g) Encourage research and development institutions dealing with GMOs to establish an institutional committee to oversee the activities related to research, development and field releases of GMOs.
- h) Consider the ethical aspects of biotechnological application regarding people and animals, and put into place measures for dealing with possible default. Litigation costs should be clearly articulated in policy and the investor should carry the burden of litigation.
- i) Make prior informed consent a pre-requisite for all field testing of genetically engineered organisms.
- j) Develop strong linkages between various organisations, including international organisations, research institutes, universities, private industry, NGOs, extension services and consumers of biotechnological products. Kenya should become a member of the International Centre for Genetic Engineering and Biotechnology (ICGEB).
- k) Review intellectual property rights as they relate to biotechnology in Kenya. Harmonise the Breeder's Rights and Industrial Property Rights to enable the protection of inventions arising from biotechnological activities at both primary and secondary level.
- l) Develop regulatory mechanisms and guidelines to minimise biotechnology risks.
- m) Support research and development of biotechnology in agriculture, animal production, health and industry, including tissue culture; new diagnostic techniques and genetically engineered vaccines; crops and animals resistant to environmental stress; and microbial treatment of environmental pollutants.
- o) Develop policies and institutional frameworks to enhance the application and commercialisation of biotechnology research.
- p) Support research and development of: genetic markers for use in tissue typing; mapping of genetic diversity in wildlife species; rapid propagation of disease free crops; molecular marker assisted plant breeding; in vitro conservation of germplasm of indigenous and commercial vegetatively grown crops; and genetic conservation and improvement, especially for fish, and local varieties of domestic animals.

### 3.2.5 Indigenous Knowledge and Local Communities

#### 3.2.5.1 Current Status

Indigenous knowledge is a knowledge base that local communities have developed over time. Its role in the conservation and utilisation of biological diversity is immense. It includes knowledge of food and medicinal plants, animal movements, cyclical climate patterns, and many others. For example,

farmers have developed and sustained local varieties of plants and animals, thus maintaining genetic variability in crops and domestic animals.

Different cultures have lived with, sustained themselves from, and conserved and managed biodiversity, with respect for nature. Understanding cultures and indigenous knowledge may therefore offer the needed options for future biodiversity conservation and development. Yet too often local communities have not been consulted or involved in development or conservation projects and programmes.

### 3.2.5.2 Issues

While the country has an extensive 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 sensitised 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.

Other community issues are discussed in Chapter 9, Public Participation and Environmental Education.

### 3.2.5.3 Recommendations

- a) Provide incentives to farmers to maintain local varieties of plants and animals.
- b) Promote utilisation, marketing and conservation of indigenous food crops and use indigenous food plants to fight poverty, disease and malnutrition and improve food security at the household level.

- c) Empower local people in rural areas to participate in the management of biological resources.
- d) Encourage alternative income-generating activities or livelihoods that do not over-exploit natural resources, to reduce overdependence on declining resources; and develop alternative sources of fuel and power.
- e) Protect sacred places and areas of cultural importance under present legislation or new types of protected areas.
- f) Collect and record indigenous knowledge throughout the country.
- g) Carry out research to identify examples of biodiversity conservation and management techniques among rural communities, and incorporate it into conservation programmes.
- h) Document cultural and religious beliefs and other ideologies that relate to conservation.
- i) Work out mechanisms to assist communities to benefit from the knowledge that they provide.
- j) Facilitate research in community related programmes, including research and development of indigenous food crops, dyes and medicines.
- k) Plant indigenous species in afforestation, landscaping, soil conservation and urban parks programmes, and identify indigenous plants that can be planted to satisfy local needs such as hedges, shade and wood for fuel, using indigenous knowledge.
- l) Extend and increase public demonstration gardens of indigenous plants used for food, medicine, timber, carving wood, wood-fuel, shade and ornament.

### 3.2.6 International Cooperation

#### 3.2.6.1 Issues

Kenya has been acknowledged as a rich pool of germplasm. As a result many scientists and commercial entrepreneurs have collected germplasm with potential for economic value. This biodiversity prospecting has been done without much economic return to the country. Kenya has to address properly the issue of conservation and sustainable use of its biological diversity for biotechnology innovations.

Developing countries provide genetic resources for research to developed countries while they themselves lack the expertise and investments needed to develop biotechnology. They are therefore not likely to benefit greatly from the results and benefits of such research carried out in developed countries. As a result the Convention on Biological Diversity, to which Kenya is a signatory, calls for legislative, administrative or policy measures that would take into consideration the question of sharing of benefits from genetic resources and the transfer of technology.

Many of Kenya's biological resources are considered to be internationally important. These include coral reefs, wetlands, forests, and areas rich in biodiversity and high in endemism. It is therefore important that some of the resources needed for conservation, management and sustainable utilisation of biodiversity should be contributed by the international community.

#### 3.2.6.2 Recommendations

- a) Implement international conventions and protocols dealing with conservation of biodiversity, and champion the need to integrate biodiversity conservation into international economic policy.
- b) Strictly regulate the transfer of species and genes and their release into the wild.
- c) Support efforts to bring about

equitable sharing of benefits derived at international level from the use of genetic resources.

- d) Implement internationally recognised conservation obligations such as the Convention on International Trade in Endangered Species (CITES), Biosphere Reserves, World Heritage sites, Ramsar, and Convention on Biological Diversity.

### 3.3 CAPACITY BUILDING: HUMAN AND INSTITUTIONAL RESOURCES AND PUBLIC AWARENESS

#### 3.3.1 Genes, Species and Ecosystems

##### 3.3.1.2 Current Status

Institutions currently involved in biodiversity conservation and utilisation include, among others, National Environment Secretariat, National Museums of Kenya, Centre for Biodiversity, Kenya Wildlife Service, Forest Department, Fisheries Department, Kenya Agricultural Research Institute, Kenya Marine and Fisheries Research Institute and the Department of Resource Surveys and Remote Sensing. Many NGOs, such as the East African Wild Life Society, KENGO and the East African Natural History Society, are also involved.

##### 3.3.1.2 Issues

Although Kenya has produced a good number of scientists and wildlife managers, many more are needed to assess, manage, utilise and conserve the country's biodiversity. Strengthening training and institutional frameworks will assist decision and policy makers, and those involved in economic and environmental analysis, to use information in an appropriate manner to support sustainable development. In most cases, it is the existing personnel who will implement new technologies and policies; hence they will require re-training.

### 3.3.1.3 Recommendations

- a) Increase the number and/or make more efficient use of trained personnel in scientific and technological fields. In particular, invest in education of microbiologists and related areas of study.
- b) Maintain or develop programmes for scientific and technical education and training of managers and professionals, especially in the fields of taxonomy, conservation of biological diversity and sustainable use of biological resources. Develop training materials that are appropriate to the Kenyan situation.
- c) Promote understanding of the importance of biodiversity conservation and sustainable use of biological resources at all policy and decision-making levels in the government, business enterprises and lending/donor institutions, and encourage inclusion of the topic of biodiversity in training programmes.
- d) Recruit social scientists to help institutions operate more sensitively and effectively by putting people's needs first. This calls for a dramatic change in the methods of planning, designing and implementing biodiversity programmes.
- e) Strengthen existing institutions and if necessary create new ones responsible for conservation of biological diversity.
- f) Enhance legal and institutional capacities for effective law making and enforcement, policy analysis, resource economics and related fields.
- g) Build capacity within government and the private sector for integrating biodiversity concerns, and calculations of benefits and costs, into project design, implementation, evaluation and monitoring, as well as assessing the impact of proposed projects on biological diversity. Donor agencies should be encouraged to do the same.
- h) Enhance cooperation between institutions responsible for protected areas and other governmental institutions, NGOs, indigenous people, local communities, youth and women.
- i) Strengthen the national institutional capacity to collect, store, organise, assess and use data and information for planning and decision making, through government, local non-governmental organisations and private institutions, with the support of the international community.
- j) Encourage partnership among the public, private and community sectors in managing biodiversity resources for human development.

### 3.3.2 Forestry, Wildlife and Fisheries

#### 3.3.2.1 Current Status

Many foresters are being produced by the Forestry College and Moi University, but most are not employed. This is partly due to the fact that training is not in line with the manpower requirements in the private sector.

The Kenya Forestry Research Institute (KEFRI) undertakes research in many fields of indigenous, plantation, on-farm and social forestry. Other institutions involved in research include Moi and Egerton Universities, Londiani Forestry College, and the National Museums of Kenya, and inter-governmental agencies such as the International Centre for Research in Agroforestry (ICRAF).

The management of Kenya's indigenous forests falls under various institutions and individuals. The Forest Department has responsibility for the largest portion of the country's forests. The Forest Department and Kenya Wildlife Service

manage selected forest reserves under a Memorandum of Understanding. Some forests occur in national parks, on county council land, and on private farms and ranches. Local communities may also exercise traditional management of local forests through community regulated prohibitions or controls on extraction.

Training in wildlife and fisheries resources is available at Moi University, and Naivasha Wildlife and Fisheries Institute. The Kenya Wildlife Service manages the country's wildlife, and the Fisheries Department manages fish resources.

### 3.3.2.2 Recommendations

- a) Rationalise manpower development in the forestry sector, taking into account all aspects of management and utilisation.
- b) Strengthen forestry institutions to enable them conduct forest research and monitoring.
- c) Increase institutional cooperation, liaison and linkages.
- d) Develop management frameworks for individual forests, involving a broad spectrum of interested parties.
- e) Expand human resource development in the management and conservation of aquatic resources.
- f) Enhance cooperation and harmonisation in the management of fish and wildlife resources.
- g) Strengthen the national capacity to monitor marine and coastal areas.

### 3.3.3 Biotechnology

#### 3.3.3.1 Current Status

Biotechnology research and development in Kenyan institutions is at a rudimentary stage except in a few cases. The reason for this is the lack of qualified scientific manpower, institutional capacity and

financial resources.

#### 3.3.3.2 Issues

At the moment there are several post graduate programmes in the areas of agriculture, veterinary sciences and medicine. Although molecular biology, gene-cloning, cytogenetics, chemical engineering and advanced biotechnology are covered slightly in these programmes, they have yet to receive adequate attention.

There are not enough trained technicians and technologists to satisfy demand. Several institutions which have been training this category of cadre nationally have been upgraded to degree institutions. It is to be noted that the National Council of Science and Technology (NCST) has recommended a ratio of 5 technicians for one scientist. However, training of this necessary category of manpower, especially in biotechnology is seriously constrained by the lack of funds.

With adequately trained manpower in biotechnology, it will be possible to assess any new biotechnology and determine if it is appropriate for Kenya. Trained personnel would also determine priorities and design research projects which have biosafety considerations.

#### 3.3.3.3 Recommendations

- a) Train a biotechnologically based cadre to facilitate adoption, application and development of biotechnological advances for agriculture, medicine, industry, veterinary and environmental use.
- b) Evaluate regularly the manpower needs in biotechnology, and monitor availability and development of necessary equipment and instruments for biotechnology programmes.
- c) Consider using externally available training programmes in areas where the public universities have a shortage, such as tissue culture, cytogenetics, fermentation

technology, embryo transfer, immunology, recombinant DNA technology, etc.

- d) Expand the training of technicians and technologists.
- e) Develop a monitoring and evaluation capacity in institutions dealing with biotechnology research.
- f) Strengthen the capacity of biotechnology research and management institutions to adequately enforce legislation.
- g) Strengthen institutional capacities to collect, store and disseminate information.
- h) Encourage relevant institutions to promote public awareness, especially in the area of biosafety.
- i) Intensify coordination and collaboration in biotechnology research and development.
- j) Provide facilities, equipment and funds for biotechnology development.
- k) Promote and undertake research in risk assessment and management.
- l) Establish a biotechnology education centre, to act as a data centre and to facilitate dissemination of information and awareness materials.

### 3.3.4 Indigenous Knowledge, Local Communities, and Public Awareness

#### 3.3.4.1 Issues

Capacity building for community involvement in biodiversity issues is a necessity for enhancing the management and sustainable use of natural resources. Decision makers also need to understand and appreciate the role of indigenous knowledge.

#### 3.3.4.2 Recommendations

- a) Establish and expand a network of people and organisations dealing with indigenous knowledge systems.
- b) Enhance the ability of local communities to participate in project development and management.
- c) Educate development agencies to appreciate the communities' point of view.
- d) Coordinate research in utilisation of biodiversity at the community level.
- e) Involve women and youth at all levels of resource management.
- f) Train mass media and other communicators to understand, explain and report on biodiversity conservation issues.
- g) Integrate conservation of biological resources into the curricula of educational institutions at all levels.
- h) Increase the participation of local authorities and the public in conserving terrestrial and aquatic wildlife resources.
- i) Inform the media on conservation issues.
- j) Inform the public, the media and decision-makers/policy-makers at all levels about the benefits, costs and risks of biotechnological innovations and the possible dangers that genetically engineered organisms may pose to humans and other living things.
- k) Encourage the public, especially at the grassroots level to become educated on all biotechnological innovations, to be able to participate in decision making concerning their adoption.

- l) Preserve indigenous knowledge and teach it at all educational levels.
- m) Inform local communities about conservation issues, especially the status of rare and endangered species. Radio programmes, leaders' barazas (meetings), plays and workshops can be used.
- n) Produce educational materials targeted at different audiences of different literacy levels, written in a language understandable by the target groups. As far as possible, use pictures and local names.
- o) Develop standard names for the most common species of plant and animals species. Where the English name is lacking, the Swahili name should be used. If this too is lacking, use the commonest local name. Scientific names should be used alongside these standard names for specificity.
- p) Establish education centres inside or near the boundaries of national parks and national reserves.

### **3.4 POLICY AND LEGISLATION**

#### **3.4.1 Genes, Species and Ecosystems**

##### **3.4.1.1 Current Status**

Kenya's environment policy aims at integrating various facets of environment into the national development plan. Existing legislation on environmental management is being reviewed. Those environmental conservation whose implementation have often been conflicting, are therefore expected to be harmonised.

##### **3.4.1.2 Recommendations**

- a) Formulate a national environment policy based on the interdependence of environment and sustainable economic development.

- b) Formulate a biodiversity strategy to maintain, use and preserve Kenya's remarkable biological diversity.
- c) Review agricultural, energy, land use and population policy to incorporate biodiversity conservation; and strengthen environmental planning in the ministry responsible for planning and development.
- d) Involve local communities and local authorities in formulating policy for renewable resource management.
- e) Require environmental impact assessment and monitoring for all development projects, including agriculture, irrigation, land allocation and tourism.
- f) Factor the value of standing, unexploited resources, in terms of watershed protection, influences on climate, cultural and aesthetic value, as well as actual and potential genetic value, into development planning.
- g) Recognise and quantify the local economic value of wild products in development and land use planning.
- h) Treat biological resources as capital resources and invest accordingly to prevent their depletion.
- i) Review tax laws to incorporate biodiversity conservation. For example, give tax breaks to industries that clean up their waste products and preserve their natural surroundings, and impose heavy fines and sanctions (including possible closure) on industries that pollute or destroy natural resources, particularly biodiversity. Review these measures frequently to keep pace with changes in knowledge and technology.

- j) Provide a mechanism to compensate local communities for water, land or resources set aside for public use.
- k) Review and enforce regulations concerning land use and allocation, and drainage and pollution of wetlands.
- l) Enact realistic penalties for environmental crimes, including indexing fines to inflation.

### 3.4.2 Forestry

#### 3.4.2.1 Current Status

The Kenya Forest Policy was published in 1994. It replaces the policy formulated in 1957 and revised in 1968.

The policy proposes to increase the forest and tree cover of the country in order to ensure an increasing supply of forest products and services and thus enhance the role of forestry in socio-economic development. Forestry is also expected to alleviate poverty and promote rural development by providing employment, and by promoting equity and participation by local communities.

The policy expects forests to contribute significantly to the conservation of the remaining natural habitats and the wildlife therein, rehabilitate them and conserve their biodiversity. In addition, forestry will contribute to sustainable agriculture by conserving soil. Forestry will also support efforts to fulfil national obligations under international environmental and forest-related conventions and principles.

Management of forestry should be efficiently undertaken, taking into account all direct and indirect economic and environmental impacts. The main considerations of management is to review the ways in which forests and trees are valued, in order to facilitate management decisions; and to maximise benefits from the forest industry.

#### 3.4.2.2 Issues

Currently, several sectoral policies exist

on forest management. These need to be reviewed with a view to removing conflicts and correcting the deficiencies in the current legislation, especially relating to use of forest and wood products. More trained and motivated personnel are needed to implement them. The penalties for infringement in most of these Acts are very low compared to the potential gains from illegal activities, and hence do not act as effective deterrents.

#### 3.4.2.3 Recommendations

- a) Adopt and implement the forest policy revised in 1994.
- b) Review, revise and enforce regulations to support the national forest policy.

### 3.4.3 Wildlife and Fisheries

#### 3.4.3.1 Current Status

The rangelands of Kenya occupy about 80% of the total national land area. Rangeland resources are enormous and include livestock, wildlife and plant communities. Livestock production through pastoralism has been the main form of land use. The associated ecosystems are fragile requiring appropriate management strategies to ensure sustainable productivity.

Land use policies in the marginal lands need to support comprehensive and integrated land use planning based on the value and status of representative and unique ecosystems. Different areas need specific land use plans addressing human population growth and changes in land use patterns.

Conservation and development need to be integrated in the management of the nation's inland, coastal and marine resources.

#### 3.4.3.2 Recommendations

- a) Conserve and manage protected areas, and establish others where necessary.
- b) Develop wildlife conservation and management strategies in

unprotected areas that are compatible with other forms of land use, such as tourism, to provide economic justification for conservation and sufficient revenue to pay for the management of the resource.

- c) Formulate a wildlife utilisation policy.
- d) Develop a policy for integrated coastal and wetland management.
- e) Develop the necessary subsidiary legislation under the Fisheries Act and the Maritime Zones Act and the Wildlife Act in order to implement the provisions of these laws to regulate the management of terrestrial and aquatic resources.
- f) Review land legislation provisions relating to wildlife conservation in multiple land use areas.
- g) Review policies and legislation on provision of compensation for damages and deaths caused by wildlife.

### 3.4.4 Biotechnology

#### 3.4.4.1 Issues

Biotechnology is rapidly gaining importance in all spheres of development. Kenya is involved both as a rich genetic resource base and future recipient of biotechnological innovations. Yet policies on biotechnology development have not been well articulated, particularly the biosafety policy. Legislation in the area of biotechnology is inadequate.

#### 3.4.4.2 Recommendations

- a) Formulate a comprehensive policy pertaining to the development of biotechnology, including the strengthening of institutions and human resource development.
- b) Share results and benefits arising from biotechnologies based upon genetic resources from the country.

- c) Formulate a biosafety policy and regulations.
- d) Improve and strengthen the existing legal and administrative machinery to ensure that biotechnology-related processes and products are relatively safe with regard to both human health and the environment, in particular genetically modified organisms.

### 3.4.5 Indigenous Knowledge and Local Communities

#### 3.4.5.1 Issues

Local communities have used, managed and conserved natural resources over the centuries. They have developed cultivated plants, domestic animals, medicines, perfumes, dyes, building materials, etc from the biodiversity surrounding them. Once the land or its products are used by other cultures, however, the local communities rarely get any recognition or remuneration. In fact, many traditional communities are pushed away from the land resources they nurtured in the name of development or conservation.

#### 3.4.5.2 Recommendations

- a) Involve local communities in management and use of biological resources.
- b) Respect and incorporate the values, knowledge systems and priorities of local communities in biodiversity conservation and management.
- c) Protect and incorporate indigenous intellectual property rights of local communities within the law as a step towards sustainable development through the involvement and empowerment of local communities.
- d) Protect sacred places and areas of cultural importance as communal land or village parks, as national monuments under the Antiquities

- and Monuments Acts, or other long-term protection.
- e) Devise a new category of protected areas, where local communities are the managers of their environment. These areas will become resource centres for genetic material and for information on how to manage the ecosystem.
- f) Incorporate traditional values and knowledge systems into biodiversity conservation programmes.

### 3.5.1.2 Selected Priority Activities Requiring Funding

## 3.5 PLAN OF ACTION

### 3.5.1 Genes, Species and Ecosystems

#### 3.5.1.1 Actions Which Can Be Taken Immediately

- a) Formulate a biodiversity strategy to maintain, use and preserve Kenya's remarkable biodiversity.
- b) Treat biodiversity conservation and economic development as integral aspects of the same process of sustainable development.
- c) Measure the value of standing, unexploited resources, and especially biodiversity, in economic terms.
- d) Establish a system of incentives and dis-incentives so that resource conservers are rewarded and resource abusers are penalised.
- e) Take urgent action to conserve areas of outstanding biodiversity value. Place critical and fragile unprotected forests, including coastal forests, under some form of protection, with provision for sustainable use by neighbouring communities. Coastal sites in need of immediate protection include some Kaya forests, Mwangea Hill and Kilibasi Hill, and sites with unique plants (especially the rock outcrops of Chasimba, Mwarakaya, Pangani and Kambe, and river gorges of the Rare, Njora, Ndzovuni, Lwandani and Kombeni rivers).
- a) Survey and document the composition, distribution, structure, functions, use and value of biodiversity.
- b) Assess causes of threats to biodiversity, including population pressures, food production methods such as irrigation in arid and semi arid lands, foreign debt servicing, commercial land use practices, over-harvesting, vulnerability of populations of certain species, climatic changes and the introduction of alien species.
- c) Control and reverse loss of biodiversity, and take measures to protect genes, species, habitats and ecosystems, on site whenever possible, and off site where necessary.
- d) Expand ex situ conservation efforts, such as gene banks and botanical gardens.
- e) Promote the use of native species, establish realistic harvest levels of wild species, including ex situ plantations and regulatory mechanisms, and explore new markets for wild products.

#### 3.5.1.3 Some Long-Term Priorities

- a) Change the behaviour of people and institutions, so that they become biodiversity conservers and not overusers.
- b) Review agricultural and energy policy to take biodiversity conservation concerns into consideration.

### 3.5.2 Forestry

#### 3.5.2.1 Actions Which Can Be Taken Immediately

- a) Use the guidelines set out in the Kenya Forestry Master Plan, Kenya Indigenous Forest Conservation Project, Kenya Forestry Development Project, etc. to determine the future management strategies of the forest sector.
- b) Conserve unique ecosystems and control excisions of forest reserves. Strictly enforce the policy on protection of forests important for biodiversity, soil and water, and support low impact eco-tourism in the same areas.
- c) Involve industry and the private sector in policy development, planning, management, etc.

#### 3.5.2.2 Selected Priority Activities Requiring Funding

- a) Encourage the use of other sources of bioenergy other than woodfuels, and more efficient use of energy.
- b) Encourage local authorities, government departments, and industries, etc., to conserve indigenous forests.
- c) Encourage use of non-wood forest products such as honey and eco-tourism.
- d) Improve forest management to maximise production, including better use of non-forested land (no more indigenous forest should be cleared for plantations), and multiple use of planted areas. Allow recovery of over-exploited areas.
- e) Review plantation establishment methods, to reverse the current decline in areas under production.
- f) Provide incentives for on-farm tree planting; for development of industrial plantations; and for

wood production on private land.

- g) Improve management of large-scale subsistence and commercial use of forest produce through appropriate marketing, licensing and policing. Maximise revenue collection for sustainable management.
- h) Encourage more efficient use of wood through integrated industrial use.

#### 3.5.2.3 Some Long Term Priorities

- a) Strengthen institutional collaboration for forest management; particularly planning in all aspects of the forestry sector at local, district and national levels; to incorporate recommendations of different parties, including rural communities; and to develop strategies for multiple-use combining conservation with utilisation.
- b) Develop methods for involving forest-adjacent communities in forest management; and find lasting and fair solutions to the problems of the landless forest-dwellers and forest squatters.
- c) Political commitment and adequate budgetary provisions are essential for the implementation of this action plan.

### 3.5.3 Wildlife and Fisheries

#### 3.5.3.1 Actions Which Can Be Taken Immediately

- a) Encourage local communities' participation in wildlife conservation and ensure that wildlife contributes to their welfare.
- b) Formulate a national wildlife utilisation policy.
- c) Develop strategies for conservation of endangered fish species, with special attention to Lake Victoria.

**3.5.3.2 Selected Priority Activities Requiring Funding**

- a) Assess the status of all vital habitats in the country and prepare plans for conservation and management. Include viable, representative samples of all habitat types within protected areas.
- b) Compile inventories of plants, animal and microbial species with special emphasis on identification of species that are vulnerable, threatened and endangered.
- c) Protect local communities and their properties from injury and damage from wildlife.
- d) Undertake a cost benefit study on wildlife conservation with a view to equitably sharing wildlife, fish and marine life benefits with local communities.
- e) Undertake research into wildlife diseases and their impact on livestock, and research on conservation and management of wildlife populations.
- f) Strengthen the National Oil Spill Response Committee and the national offshore monitoring capacity.
- g) Develop fish ladders or other means to enable fish to move up and down rivers with hydro-electric dams.

**3.5.3.3 Some Long-Term Priorities**

- a) Harmonise the different wildlife conservation and development activities, and programmes in protected and dispersal areas and determine optimal land use. Harmonise the contributions by various institutions to minimise conflict and increase efficiency.
- b) Promote the development, diversification, conservation and management of the nation's fisheries resources.

**3.5.4 Biotechnology**

**3.5.4.1 Actions Which Can Be Taken Immediately**

- a) Develop and strengthen linkages between research institutions and the private sector.
- b) Review existing and proposed intellectual property rights systems to provide access to biotechnology.
- c) Formulate scientific criteria for the safe use of genetically modified organisms (GMOs); and make prior informed consent a prerequisite for all field testing of GMOs.
- d) Promote public education and awareness at all levels on the relative benefits and risks of biotechnology.

**3.5.4.2 Selected Priority Activities Requiring Funding**

- a) Enhance research and development and monitoring in biotechnology and biosafety.
- b) Train more scientists and technicians in biotechnology.
- c) Create a biotechnology enhancement fund to provide venture capital for biotechnology research and innovation.
- d) Create institutions or committees to manage biosafety issues including implementing provisions of the Convention on Biological Diversity while at the same time ensuring the safety of both humans and the environment.
- e) Develop inexpensive biofertilizers for common food crops incorporating known rhizobia and mycorrhiza strains, increase animal resistance to pests, disease and drought conditions; and develop other practical applications of biotechnology.

### 3.4.5.3 Some Long-Term Priorities

- a) Use Kenya's microbial resources to develop an industrial base.

### 3.5.5 Indigenous Knowledge and Local Communities

#### 3.5.5.1 Actions Which Can Be Taken Immediately

- a) Protect sacred places and areas of cultural importance as communal land, village parks or as national monuments under the Antiquities and Monuments Act.
- b) Involve communities, especially women, in decision-making and in management of local conservation and development issues and projects.
- c) Encourage dialogue between conservation agencies and communities.
- d) Sensitise Kenyans on the value of biological resources, indigenous knowledge and cultural practices.

#### 3.5.5.2 Selected Priority Activities Requiring Funding

- a) Devise a new category of protected areas, where local communities are the managers of their environment. These areas will be resource centres for genetic material and for information on how to manage the ecosystem.
- b) Re-organise community training programmes to cover all aspects of biodiversity conservation, including indigenous knowledge, and management using the participatory approach.
- c) Produce educational materials for communities and extension

workers, targeted at different audiences of different literacy levels, written in a language understandable by the target groups and using their local species and names.

- d) Encourage local communities to develop projects that promote conservation work; such as tree nurseries for medicinal and food plants, kitchen gardens for local vegetables, seed gathering for sale.
- e) Reduce degradation by livestock and charcoal burning in marginal areas by encouraging alternative forms of livelihood.
- f) Establish a system for breeders to buy seed and stock from farmers for breeding programmes. Farmers should be given incentives to maintain varieties of seeds of indigenous plants and local varieties of crops for planting.
- g) Document traditional knowledge in the use and management of biological resources.
- h) Establish mechanisms to reward communities for useful indigenous knowledge imparted.

#### 3.5.5.3 Some Long-Term Priorities

- a) Develop standard names for most species of plants and animals. Where the English name is lacking, the Swahili name should be taken, or failing that the commonest local name.

*Other recommendations affecting communities can be found in Chapter 5, Chapter 6, and Chapter 9.*

## CHAPTER FOUR

# WATER RESOURCES

### Inland Water Resources, Coastal and Marine Environment

#### 4.1 CURRENT STATUS

##### 4.1.1 Water Availability

Water is a scarce resource, yet it is vital for the sustenance of all life. The estimated total annual water potential in Kenya far exceeds the total annual demand. However, in reality access to water is restricted in space, time and quality.

The mean annual rainfall over Kenya is estimated at 621mm while the mean annual volume of rainwater is estimated as 360,000 million cubic metres. The amount of rainfall that contributes to the surface and groundwater resources is estimated to range from 250mm to 750mm in arid and semi-arid areas, and from 1000mm to 1690mm in the coastal belt, the highlands and the Lake Victoria basin. However, the actual contribution is less due to evapo-transpiration.

The surface water potential from the perennial rivers has been estimated as 19,590 million cubic metres, which represents about 18% of the national annual rainfall. Its availability for socio-economic and ecological demands is primarily influenced by its quantitative distribution in space and time, and its quality. The distribution countrywide varies from one drainage basin to another. The surface runoff and groundwater recharge rate are influenced by variation in rainfall intensity, soil types, vegetation cover, and presence or absence of wetlands.

The annual groundwater potential has been estimated as 619 million cubic metres 31% of which is in deep seated aquifers, exploitable through boreholes and 69% located in shallow aquifers exploitable through shallow wells. Supply and distribution of groundwater is influenced by geomorphological factors and seepage rates which are influenced by rainfall intensity, type and expanse of vegetation cover, and presence of wetlands.

Underground water exists in most parts of the country. However, there are constraints in tapping this resource, wide variations in water quality, and uncertainty over the rate of recharge.

Poor distribution and unreliability of rainfall coupled with lack of planning for the rising water demand results in water shortages.

Generally, the quality of river water in Kenya is good. However, there has been cases of local pollution, particularly where there are intensive industrial, agricultural or human settlement activities. River water is generally neutral to slightly alkaline with some rivers having slightly acidic headwaters. The concentration of metal ions in most rivers is low.

Soil erosion is a major problem in many river catchment areas. In fact the total sediment load transported by many rivers is very high in the middle and lower reaches, particularly during the rainy season. This has direct impact on the water quality and the life of reservoirs and irrigation channels, and the life of aquatic ecosystems in general.

The information available on bacteriological quality of most river waters is scanty. However, with the increased use of river water by people, livestock and wildlife, the total coliform counts is expected to be high.

The fresh water Lake Victoria supports a large population, farming activities, fishing for subsistence, sale and export, and light industries. The fresh water of Lake Naivasha is used for intensive horticulture. Water quality in most other Kenyan lakes ranges from moderately to highly alkaline, and hence most lakes are of little importance as sources of water for immediate use. However, they have economic, hydrological and ecological importance, including their richness in biodiversity.

A substantial proportion of Kenya's water resources is found in wetlands (including smaller lakes and seasonal wetlands) which cover 2 to 3% of the country's surface area. Wetlands also play an important role in groundwater recharge and discharge, water purification, pollutant removal and sediment trapping. The area of wetlands in Kenya has been shrinking, due to climatic changes, overuse of wetland resources, and conversion to agriculture and other uses.

#### 4.1.2 Drainage Basins

The drainage system of Kenya is determined and influenced by the Great Rift Valley running approximately north to south. From the flanks of the rift valley, water flows westwards to Lake Victoria and eastwards to the Indian Ocean with the rift valley itself having an internal drainage system. Kenya's drainage systems consist of five major basins, namely: Lake Victoria; Rift Valley; Athi and coastal area south of Sabaki; Tana River; and Ewaso Ngiro and north eastern. These basins contain the bulk of Kenya's inland water resources. The geological, topographical and climatic factors influence the natural availability and distribution of water with the rainfall distribution having the major influence. The quality and quantity of water varies seasonally from basin to basin, but their average yields have been estimated (Table 4.1).

Table 4.1: The Distribution of water resources by major drainage basins in Kenya.

Basin	SAFE YIELD IN M <sup>3</sup> PER DAY	
	Surface Water	Ground- water
Lake Basin	11,993,184	118,622
Rift Valley	211,680	318,192
Athi River	582,336	222,319
Tana River	71,841,600	431,499
Ewaso Ng'iro	674,784	602,281

Source:-National Water Master Plan Study 1992.

The basins have become focal points of regional development, thereby attracting intensive multiple land use which has accelerated environmental degradation through siltation, water pollution and changes in flooding frequency. Further,

the multi-sectoral uses of water have created competition among the various water users without due regard to the need for ecological sustenance or the needs of downstream users. This pattern poses serious management problems.

#### 4.1.3 Recommendations

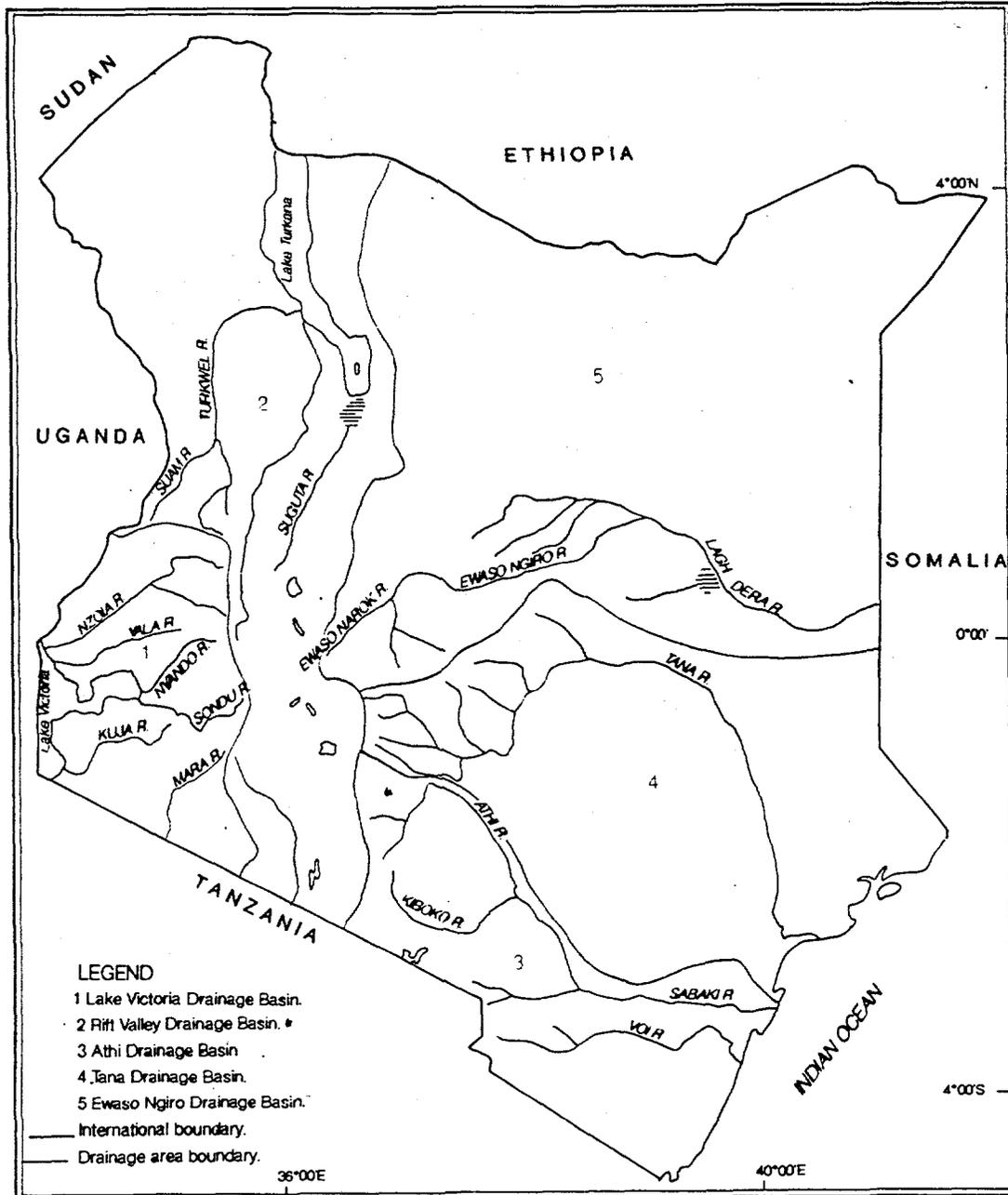
- a) Diagnose the relationships between climatic factors and stream flow variability of the major drainage basins in the country, and develop and evaluate specific quantitative indicators of the vulnerability of hydrologic systems to climate.
- b) Undertake water quality assessment throughout the country.
- c) Conduct a survey to determine the full potential of water resources in the country.
- d) Prioritise water allocation in quantity and quality according to domestic, commercial, agricultural and industrial needs and ecological sustenance.
- e) Assess underground water availability and quality, especially in ASAL areas.
- f) Identify, map, and protect water catchment areas.
- g) Make environmental impact assessment (EIA) a pre-condition for approval of water related projects; and require post investment impact assessment for all water related operations.
- h) Conduct a survey to identify, map and describe wetland resources.

## 4.2 GROUNDWATER

### 4.2.1 Current Status

Groundwater is the most universally available supply of water. It is the subsurface water that accumulates in the

### THE MAIN DRAINAGE BASINS OF KENYA



source : National Water Master Plan (1992)

Figure 4.1. The Main Drainage Basins Map of Kenya

rocks of the earth's structure by percolation from the surface. It is usually clean and free from pathogens as it has been naturally filtered as it passes through subsurface rock materials. Its surface discharge include fresh water springs and hot springs, among others.

The water may, however, be contaminated as a result of the abstraction method or polluted by surface water entering the well. Where the water collects, is referred to as an aquifer. Aquifers are of two types, confined and unconfined. In a confined aquifer, the water-bearing layer is covered by an impermeable confining rock layer. The water in the aquifer is under pressure, which is released only when the confining layer is punctured. An unconfined aquifer is one in which the ground water pressure is equal to atmospheric pressure.

Groundwater is extremely variable in chemical composition. The variation occurs both spatially and seasonally. The water's chemistry is essentially influenced by the geological formation in which the aquifer occurs.

#### 4.2.1.1 Hydro-geological Areas

The hydrogeological areas of Kenya can be classified into the following three categories: volcanic rocks, pre-cambrian metamorphic basement rocks and pre-cambrian intrusive rocks; and sedimentary rocks.

Volcanic rocks cover about 26% of the country, more commonly in the western half of Kenya. Groundwater is stored typically in the old weathered surfaces between lava flows and older formations as well as between successive lava flows. Fractures, faults, fissures and joints are also suitable for groundwater storage. The groundwater in the volcanic area is generally of bicarbonate type with low total dissolved solids. There are local pockets of high fluoride content which are believed to be of volcanic and fumarolic origin.

Pre-cambrian rocks are widely distributed in the central, western and north-western parts of Kenya and cover approximately 17% of the country. Where

faults and fractures occur, groundwater occur in deep horizons. Aquifers are confined. Yield, depth to aquifers and static water level vary within rocks.

Sedimentary rock areas cover 55% of Kenya, predominantly in the eastern, parts. The sediments are loose and permeable. The aquifers are generally shallow and unconfined. The water in these rocks is salty but the origin of its salinity is not fully known, but is believed to be due to accumulation of solute evaporate minerals within the sediments.

#### 4.2.2 Issues

Available data which is generally inadequate, indicates that most groundwater supplies in Western, Central and Nyanza Provinces are generally soft with moderate alkalinity; chemically, the water is satisfactory for domestic purposes. In the Coast, Eastern and North Eastern Provinces, the water is often saline and of poor quality. In these areas the water in most of the unprotected shallow wells is of poor bacteriological quality because of contamination by animal droppings and poor drainage/sanitary practices.

One major problem limiting groundwater exploitation is its mineral content. Fluoride concentrations exceeds the World Health Organisation (WHO) drinking water guideline of 1.5 mg/l in many areas, especially in Nairobi, North Eastern and Rift Valley Provinces. Removal of fluoride is technically difficult.

In the western and south-eastern parts of the country, high contents of iron is common. Iron concentrations of more than 0.3 mg/l is evidenced by stains on laundry and plumbing fixtures in addition to causing an undesirable taste. It is often deposited in pipes. Sodium content in the ASAL waters far exceeds the WHO taste threshold value of 200 mg/l. In fact, groundwater is classified into high or very high salinity and high or very high sodium content in ASAL areas.

There are several environmental impacts which require consideration when setting

up boreholes. First, lowering of the groundwater head may affect the yield of other wells. For example, shallow (hand dug) wells may fall dry; free flowing artesian wells may stop flowing. Second, lowering the groundwater level may cause damage to agricultural crops or the natural vegetation.

#### 4.2.3 Recommendations

- a) Assess the full potential of groundwater countrywide.
- b) Enhance institutional capacities to assess and determine water quality throughout the country.
- c) Protect boreholes, wells, and springs from pollution by, among others, improving sanitation around them.
- d) Require a brief environmental impact assessment, or at least consultation with other water users in the area, before drilling a borehole, especially in the ASAL and coastal areas.
- e) Develop appropriate and affordable technologies for removing chemicals, salts, and other impurities from underground water.
- f) Carry out studies of aquifers and ground water levels before undertaking major agricultural schemes.
- g) Take water availability and management into consideration when planning industrial developments or manufacturing zones.

### 4.3 WETLANDS

#### 4.3.1 Status and Issues

A substantial proportion of Kenya's water resources is found in wetlands, which cover 2 to 3% of the country's surface area. Wetlands are places where water dominates the ecosystem for at least some of the year. These are defined by the

Ramsar Convention on Wetlands of International Importance as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six metres".

Wetlands are rich ecosystems which provide essential livelihood products and services, though their attributes that are not directly related to human use are often not appreciated until a wetland is destroyed or modified and when the restoration of wetlands to revive those functions proves very expensive or inconvenient.

The functions and values of Kenyan wetlands include: Groundwater recharge and discharge, water purification, pollutant removal and sediment trapping, water storage, storm protection and windbreak, shoreline stabilisation, biomass export in both marine and freshwater wetlands and microclimate stabilisation.

Some of the main products and uses include: water for people and livestock; fishing grounds and fish larval feeding grounds; mangrove timber, firewood and other products; wildlife support, especially for survival in dry seasons and as habitats for water birds; sources of biodiversity - plants, animals, microbial and genetic resources; provision of food for livestock, especially those in drier areas which act as refuges and sources of green feed; seasonal agriculture that does not convert wetlands or alter their hydrological functions; wetland foods and plant products such as reeds, papyrus, rushes, ambatch, sedges and grasses which are used for making roofs, walls, thatching, mats, baskets, ropes, boats, fish traps, and beehives, among others; medicinal wetland plants; water purification; transport; tourism and recreation; sport fishing; mining for magadi and salt; clay for pottery and brick-making; and cultural and ceremonial values.

Wetlands in Kenya are diverse in type and distribution, but no national inventory of their types, status and

location currently exists.

The management of wetlands is currently under various institutions whose activities and mandates are uncoordinated, overlapping and hence ineffective. These ecosystems, having multiple use values, require integrated management and conservation approaches.

#### 4.3.1.1 Important Lakes

Lake Victoria has numerous wetlands on the edges of its shore and islands in Kenya. These range from papyrus swamps to rocky or sandy beaches. The wetlands are important for fish breeding and growth; for filtering river waters; for building materials and food; for wildlife; and occasionally for tourism.

Lake Kanyabole occupies an area of around 10.5 km<sup>2</sup> adjoining the eastern side of the Yala Swamp near Lake Victoria. It is a refuge for some species of fish that have disappeared from the main Lake Victoria. Thus, it is especially important for biodiversity.

Lake Jipe is an internal drainage basin in Taita-Taveta District, on the Kenya/Tanzania border. The lake and its swamps cover approximately 75 km<sup>2</sup>. Lake Jipe contains significant fisheries resources and is a refuge for wildlife from Tsavo West National Park. The wetland is changing from a lake to a swamp as watershed erosion accelerates siltation. It requires joint management between the two countries.

Lake Chala is a crater lake north of Lake Jipe, also on the border with Tanzania. Its surface area is approximately 5.2 km<sup>2</sup>. The hotel/tourism developments on the rim of the crater threatens the quality of the water and the biodiversity it supports, especially the small fisheries. There is need for developing joint management strategies between Kenya and Tanzania.

Lake Magadi lies 85 km south-west of Nairobi. It is 29 km long and 4.5 km wide. The sodium sesqui-carbonate deposits of the lake bed are commercially exploited; and it has no protection status. Lake Naivasha is a fresh-water lake on the floor of the Rift Valley. The lake is a

popular tourist resort. There is increasing water abstraction for agriculture, particularly commercial flower, fruit, vegetable and dairy farming. Consequently, the lake is suffering from increasing deposits of agro-chemical residues. The farming activities have significantly contributed to the destruction of the riparian vegetation and pose a serious threat to the quality of lake water. A 1929 agreement between the government and the farmers governs the management of the lake, and the riparian owners are now drawing up plans for more sustainable use.

Lake Elmentaita is a shallow alkaline and unprotected lake with a depth of about 1 m and an area of 18 km<sup>2</sup>. It often hosts a large number of flamingoes and is used as a breeding ground by White Pelicans and Greater Flamingoes. However, recent human settlements and associated activities around the lake, particularly poor cultivation methods, removal of vegetation, uncontrolled grazing and mining for magadi and salt contribute to environmental stress in and around the lake. There is need to consider a protection status for the lake.

Lake Nakuru is a feeding ground for large numbers of flamingoes estimated sometimes up to two million, and other species of water birds. The lake is one of the Ramsars convention sites. The major threats to the Lake Nakuru ecosystem include industrial wastes, domestic sewage, agricultural wastes from the surrounding farmlands and heavy tourism impact. Lake Nakuru National Park provides protection status to the lake, but cannot protect it from pollution from outside the park.

Lake Baringo is another of the Rift Valley lakes. It is rich in avifauna and scenic beauty. Consequently, the lake is an important and growing tourist destination. Presently, this lake is unprotected. The lake annually receives heavy deposits of silt as a consequence of the widespread soil erosion on its rainfall catchment zone. Its water is turbid and its surroundings have no protection status; there is need to consider protected status for the lake.

Lake Bogoria is an alkaline lake fed by

hot springs, geysers and fumaroles along its shore. It is protected as a national reserve by the Baringo County Council. Lake Turkana, the largest lake in the Rift Valley Basin, receives most of its water from River Omo, with a catchment which include parts of the Ethiopian highlands. Fisheries resources of the lake are currently under-developed for commercial exploitation. There are extensive seasonal floodplains around the lakeshore and in the Omo delta. Protected areas include Sibiloi National Park on the north east shore, Mount Kulal Biosphere Reserve and South Island and Central Island National Parks.

Lake Ol'Bolossat is a shallow fresh-water lake consisting mainly of marshes and located in Nyandarua district at an altitude of 2340; the lake is a breeding site for many species of water birds. It has been recommended that this lake and swamp be protected by gazettelement as a national park; however, much of the lake area has recently been demarcated for settlement.

Lake Kamnarok is situated on the border of Elgeyo Marakwet and Baringo Districts. It is part of the Kamnarok Game Reserve. There is need for more studies to characterise its values, functions and potentials.

#### 4.3.1.2 Important Swamps

Saiwa Swamp National Park is a protected riverine wetland swamp which has a good diversity of wetland vegetation. It is famous for its sitatunga antelopes, and is a refuge for riverine gallery forest primates and wetland birds - including Crowned Cranes - in a largely farming area. The swamp is threatened by land use activities upstream which might alter the river inputs and consequently the integrity of the wetland.

Yala swamp is a riparian lake wetland that is notable for its biodiversity. It is formed by the lower reaches of the Yala River and the delta of the Nzoia River in Siaya and Busia Districts. Much of the wetland is a papyrus swamp and various submerged and floating plants give rise to many habitats for fish and other wetland animals. Part of the swamp has

been reclaimed for agriculture. Reclamation is a serious threat to the future of this unique ecosystem.

Shompole swamp and floodplain is located south of Magadi. It is an important area for livestock grazing and wildlife. Both the floodplain and the swamp are threatened by the development of a water project which will alter the flow and flood regime of the Uaso Nyiro River. This development is now under review following a comprehensive environmental impact assessment.

Lorian swamp is an extensive wetland situated in north eastern Kenya, fed by the northern Uaso Nyiro. It supports a large population of livestock and wildlife. The Lotikipi Plain, west of Lake Turkana, is a flat floodplain in a semi-desert zone. It is fed by seasonal rivers. There is little human activity on it at the moment, but there is need to consider its protection status.

#### 4.3.1.3 Seasonal and Temporary Wetlands

Seasonal and temporary wetlands occur where internal drainage allows water to collect in some seasons or in some years. Seasonal wetlands are found all over the country, and in different ecosystems. Some examples are the seasonal rock pools and springs in the southern part of Nairobi, the Indachant Swamp west of the Ngong Hills, and Manguo Swamp in Limuru. These small wetlands are important in collecting and storing rainfall and providing support to wildlife. They have a remarkably high level of biodiversity, and many are worthy of conservation. At the moment, however, they are largely ignored by land use planners.

#### 4.3.2 Important Coastal Wetlands

The Tana Delta is the largest delta ecosystem in Kenya and encompasses a large number of habitats, including riverine forests. The delta acts as a barrier against tidal action and maintains the fresh/salt water balance of the area. It is a habitat for endemic species as well as migratory birds from Europe and Asia.

Human impact is mainly traditional land-use practices of small-scale agriculture and pastoralism; the delta is an important dry season grazing ground for livestock from all over the region. Outside the delta proper, areas of high biodiversity are the Tana River riverine forests and numerous permanent and seasonal oxbow and spring fed lakes.

**Mangroves, sea grass beds and coral reefs** are important inter-tidal marine wetlands that are widespread on the Kenya Coast. They are vital for the reproduction of many marine organisms, including growth of commercially-important marine fish. Sea grasses and seaweeds also play a significant role in the transfer of energy in the lagoon and reef areas.

These intertidal wetland systems must be regarded as some of Kenya's most valuable ecosystems - both for their products and for their intrinsic values and biodiversity. Some of the coral, mangroves and sea grasses ecosystems are protected by the several marine national parks and reserves.

Sandy beaches are important nesting sites for five species of sea turtles found along the Kenyan coast. Sea turtles are endangered worldwide. Beaches are also important areas for recreation and tourism development.

The coastal wetlands of Kenya face serious environmental threats. The main threats include over-fishing, pollution, destruction of corals, dynamiting, and illegal harvesting of marine resources such as coral and shells.

#### 4.3.3 Integrated Approach to Wetland Management and Conservation

Fresh water wetlands have abundant water and alluvial soils which are good for agriculture. Wetlands also harbour commercially exploitable species, are rich in biodiversity and have immense potential for tourism development. These qualities make them attractive for exploitation. On-going development programmes, land use activities and recent initiatives are seriously threatening sustainable management and

conservation of wetland resources.

A national wetlands conservation and management programme should aim to: minimise net loss of the nation's wetlands and maintain their ecological functions and values; utilise the existing wetlands sustainably and restore those which have become degraded; develop community wetland conservation programmes, and train wetland scientists and managers.

In order to reduce conflicts in wetland use, it is necessary to carry out an assessment of the physical suitability, expected benefits, community preferences and environmental impact prior to the initiation of large scale programmes involving wetlands.

The following guidelines should be considered in wetlands management and conservation. Target wetlands to be demarcated into clear zones for different uses, to provide for multiple use and reduce user conflicts. Strategies to be formulated should provide for long-term sustainable use and management of water catchments, watersheds and wetlands. Management strategies for wetlands shared between Kenya and her neighbours require harmonised implementation through regional cooperation and coordination.

The effectiveness of the above strategies can be enhanced by strengthening the capabilities of implementing and management institutions under whose jurisdiction the wetlands are presently occurring e.g. KWS, local authorities, DDC, LBDA, TARDA, CDA, etc. Those wetlands which occur in forest reserves should be managed by the Forest Department.

These institutions can enhance the sustainability of their programmes by involving communities in the management of wetlands. For example, alternative livelihood should be considered in light of envisaged management strategies for sustainable utilisation of wetland and small lake resources. Local communities that have exclusive rights to their adjacent wetland resources have typically evolved effective conservation measures and therefore

management of such wetlands by the community should be given serious consideration.

#### 4.3.4 Wetlands Information Systems, Training and Institutions

The available information on Kenya's wetlands is limited and there is urgent need to gather, store, analyse, document and disseminate such information. In order to realise this objective, there is need to establish a national institution that will undertake this responsibility as well as coordinate activities carried out on wetlands by local and international organisations. In the meantime, research and conservation activities being undertaken by institutions such as the World Conservation Union (IUCN), International Wetlands and Waterfowl Research Bureau (IWRB), and Kenya Wetlands Working Group (KWWG), should be encouraged.

Training for managers and researchers on wetlands and lakes is important. Because none of the courses taught in state universities in East Africa are specifically targeted for wetland managers or researchers, there is need for East African universities, institutes and polytechnics to cooperate to train wetland managers and researchers.

The assessment of Kenya's marine resources is carried out by several government institutions, mainly the Kenya Marine Fisheries Research Institute (KEMRI) whose primary concerns are research on marine biota limited to the continental shelf. The Kenya Forestry Research Institute (KEFRI) is primarily interested in the conservation and management of the mangrove and lowland forests; while the Kenya Wildlife Service (KWS) is responsible for the assessment and management of marine resources within the marine parks and reserves.

Kenya's wetlands and marine resources are managed on an ad-hoc basis as presently there is no single institution legally mandated to develop and manage these resources. The institutions involved are limited in their scope and capacities. This situation needs to be reviewed with

a view to identifying or establishing appropriate institutions with adequate capacities to effectively develop and manage wetlands and marine resources.

#### 4.3.5 Recommendations

- a) Conduct a national survey and establish an inventory of wetlands in order to identify, map, and describe existing wetland resources.
- b) Formulate a national policy on the management and conservation of wetlands.
- c) Develop integrated management plans for sustainable and multiple use of wetlands.
- d) Develop integrated management plans for wetlands shared between Kenya and her neighbours through regional cooperation.
- e) Promote community participation in wetlands conservation and management.
- f) Make environmental impact assessment (EIA) a pre-requisite for development projects that may affect wetlands, and carry out post development environment monitoring.
- g) Take environmental considerations into account during inter-basin water transfer.
- h) Minimise net loss of the nation's wetlands and water catchments.
- i) Develop an integrated coastal management plan to address biodiversity, water resources, tourism, pollution, human settlement and industry.
- j) Implement mitigating measures to reduce the magnitude of land-based pollutants discharging into the coastal and marine environment.
- k) Establish an information and documentation centre to enhance data and information gathering,

analysis, compilation and dissemination.

- l) Study and incorporate traditional management of wetlands by communities.
- m) Train more wetland scientists and managers.

#### 4.4 IRRIGATION AND HYDRO-ELECTRIC POWER DEVELOPMENT

##### 4.4.1 Irrigation Status and Issues

Irrigation has been seen as a way to deliver water to potential cropland at an acceptable cost. The adverse impacts are poorly understood and usually overlooked. They include: waterlogging, salinisation or alkalinisation of soil; diversion of water from downstream users and ecosystems; concentrations of mineral salts and agro-chemicals discharged into receiving waters; an increase in diseases such as malaria and bilharzia (schistosomiasis); and loss of plant and animal habitats.

Diversion of water into irrigation schemes usually has a negative impact on the downstream human and ecological communities. Such impacts are seasonally variable. In addition, diversions which drastically reduce the dry season flows in rivers also pose health hazards if stretches of stagnant water are created where disease vectors can breed and multiply. Other factors causing water-related diseases in irrigation areas include inadequate supply of drinking water and poor environmental awareness of the communities.

As rivers become increasingly used as receiving waters for effluents of various kinds and from various sources the need to maintain adequate volume in the river for dilution purposes becomes more critical. Thus the demand for irrigation water must not be given overriding priority over compensation flows if the river is to continue to cleanse itself adequately and be fit for use by downstream consumers.

Water leaving an irrigation scheme is of a

degraded quality. It contains high concentration of salts, and residues of agro-chemicals including pesticides and fertilisers. Some of the more persistent chemicals remain active and in solution in the irrigation water and pass out of the irrigation scheme and into the receiving water where their presence may limit the uses to which the water can be put.

Irrigated agriculture has been practised worldwide for a long time without the use of agricultural biocides (insecticides, herbicides, fungicides and molluscides), but since their development and widespread availability these chemicals have become an integral part of modern agricultural practice. Although immediate high yields have been realised from the use of biocides, it has been accompanied by pest resurgence, development of insect resistant strains, destruction of agriculturally useful insect predators and aquatic biota.

It is also important to note that many of the biocides commonly used in agriculture are extremely toxic to humans, livestock, other mammals, birds and fish. There is accumulation of these biocides in food products and in certain cases this has been exceeding WHO recommended levels.

##### 4.4.2 Hydro-electric Power Status and Issues

Five dams turn water into power as River Tana falls from the mountains to the sea. They are Masinga, Kamburu, Gitaru, Kindaruma and Kiambere. Another dam is planned at Grand Falls on the Tana. Together the five dams supply 60% of the electricity used in Kenya. The dam on Turkwel Gorge also supplies electric power, while the one at Ndakaini supplies water to the city of Nairobi for domestic and industrial consumption. They also provide other services; the dams store water and control floods; supply water for horticulture and livestock; and form wetland habitats and recreational sites.

The dams also create a number of social and environmental problems. People are displaced and plants and animals lost when the valleys are flooded. Flood control has disrupted downstream

agriculture and ecosystems adapted to periodic flooding. Soil erosion in the catchments deposit silt in the dams, reducing their "lifespan" and sometimes clogging turbines.

#### 4.4.3 Recommendations

- a) Require environmental impact assessment for all irrigation and hydro-power projects and a post investment environmental impact monitoring programme.
- b) Plan irrigation and hydro-power projects with careful assessment of soil types and suitability, dry and wet season water flow, and biodiversity.
- c) Provide extension services in irrigation projects to promote judicious use of agro-chemicals, and if possible, reduce their use.
- d) Encourage maintenance of irrigation channels to avoid stagnation of water, and establish infrastructure such as clinics to treat diseases and facilities (including constructed wetlands) to clean up effluents.
- e) Involve local communities in planning and management of irrigation projects.
- f) Provide adequate flow downstream to maintain downstream ecological habitats and water supplies to users, especially in the more critical dry season low-flow periods.
- g) Maintain adequate volume in the river for dilution purposes.
- h) Enhance public awareness on the health, sanitation, and environmental impacts of irrigation water and systems.
- i) Study the ecological and agricultural benefits of periodic flooding, and adjust dam management to allow for regulated flooding downstream.

## 4.5 WATER RESOURCES MANAGEMENT

### 4.5.1 Current Status

There are over 30 institutions, both governmental and non-governmental, that play various roles in the water sector. These institutions lack policy guidelines, elaborate legal framework, human and fiscal capacity to effectively undertake their respective responsibilities. This scenario can generate duplication of efforts, conflicts, and non-accountability.

Management of water resources in Kenya is governed by the Water Act, Cap. 372, whose custodian is the Water Apportionment Board. The Ministry of Land Reclamation, Regional and Water Development (MLRRWD) is the overall authority charged with planning and management of water resources. Other major players in the water sector are the Water Conservation and Pipeline Corporation (WCPC), the Tana and Athi Rivers Development Authority (TARDA), the Lake Basin Development Authority (LBDA), and the National Irrigation Board (NIB). The local authorities (municipalities, towns, counties) and several NGOs are also involved in water management. A national water master plan has recently been prepared.

In order to quantify available water and to sustainably exploit and apportion the resource, water level gauging stations have been established countrywide to monitor hydrological and water quality variations and characteristics of springs, rivers and lakes. Data processing and interpretation is carried out by MLRRWD. The data is utilised by the Water Apportionment Board in issuing permits for water use. Abstractions are controlled by the Water Apportionment Board through officers of the MLRRWD. Groundwater assessment is being done on demand basis. Monitoring is based on available information from operational boreholes.

The Water Apportionment Board has gazetted certain areas as groundwater conservation areas in order to prevent over-abstraction. In all cases,

authorisation from the Board is required for sinking boreholes and abstraction of groundwater from deep based aquifers.

Some of the problems which have been experienced in water resources management in this country can be attributed to the weaknesses of the Water Act. They include: over-abstraction without due regard to the needs of downstream users and ecological sustenance; lack of legally binding environmental requirements to be complied with in water development activities; and duplication of responsibility leading to lack of accountability.

#### 4.5.2 General Management and Sanitation Issues

The country's existing hydrological and water quality monitoring network is inadequately equipped and funded. The gauging network lacks sufficient financial resources for maintenance and service. The stations are also short of appropriately trained personnel for the demanding jobs they are expected to perform.

Existing water facilities under the management of municipalities, counties, cooperatives, NGOs and community groups are usually small, some are poorly equipped and others are lacking altogether. These facilities require rehabilitation, expansion, and equipping, especially within municipalities. Towns lacking these facilities should be provided with such facilities in the shortest time possible.

Some of the problems affecting water facilities are due to the people charged with managing them. For example, many of them do not have the training and experience to maintain and service the facilities. In some instances, maintenance personnel are lacking altogether.

The quality of sanitation provided affects the quality of both underground and surface water in densely populated areas. In urban areas, most sewerage systems have been unable to cope with population increase. Design standards are outdated. In rural areas, use of on-site sanitation

and especially latrine building campaigns do not involve the community adequately, and fail to take account of cultural practices and customs as they relate to sanitation.

#### 4.5.3 Recommendations

- a) Introduce suitable tariffs for water usage and sewage discharge.
- b) Develop and/or improve the existing water resources monitoring systems.
- c) Introduce incentives for recycling water.
- d) Improve sanitation in municipalities, towns, urban centres, and trading centres to be in line with development of water supply.
- e) Review and enforce the national drinking water standards, and effluent discharge standards, taking into account WHO guidelines, available water quality and use of appropriate technology.
- f) Delineate institutional responsibilities and clear operational terms of reference to avoid duplication of roles and conflicting interests, and strengthen institutional capacities.
- g) Strengthen and promote the role of community groups, women and youth to fully participate in health, sanitation, water resources and environmental management and conservation.
- h) Strengthen the various water testing laboratories through the provision of adequately trained personnel and necessary laboratory equipment, these in turn would strengthen field operations, especially water quality monitoring and hydrological surveys. The laboratories should also research into suitable technologies to support standards on drinking water, effluent discharge, solid waste disposal and waste water management.

- i) Introduce incentives for installing proper facilities for pollution control, and for the usage of cleaner process technologies. Likewise, promote use of penalties and sanctions to deter pollution of water resources.
- j) Establish a water resources department to develop modalities for integrated water resources management at basin level; and to review and harmonise existing legal instruments that directly or indirectly relate to water, including the Lands Act, with a view to making them more effective and responsive to water and other environmental issues.
- k) Enhance the training of specialised personnel to manage water resources at all levels, additionally, promote in-service training.
- l) Review, improve, and enforce design and discharge standards of sewerage systems in Kenya.
- m) Evolve a national management plan for environmental sanitation and solid waste collection and disposal.
- n) Study and use low-input waste water management methods such as constructed wetlands.

#### 4.5.4 Management in the Lake Victoria Basin

Among the five basins, Lake Victoria is of special interest. Nearly half of the country's population live in this basin which is endowed with abundant water and other natural resources. It has immense potentials in terms of water resources, fisheries, biodiversity, agriculture and hydro-power, among others. While some of the resources have been exploited, many are still undeveloped. However, the lower reaches of the basin have serious environmental and health problems that affect development.

Development in agriculture, industry and urban centres has had adverse effects on

water resources in the basin. Consequently, the lake ecosystem has undergone significant changes, particularly during the last three decades.

##### 4.5.4.1 Land Use Impacts

About 40% of the Lake Victoria basin is under agriculture and the rest is under a mixture of unimproved pasture and natural vegetation. The human population has been expanding rapidly, resulting in increased agricultural and livestock activities. Some of these activities include clearing of forests in water catchment areas and overgrazing. The combined effect of these activities is increased soil erosion and pollution of the rivers and the lake.

Crop production is increasingly applying agro-chemicals, and substantial amounts of these agro-chemicals have found their way into watercourses. Besides, some cultivation methods lack soil conservation preventive measures; thus, they facilitate soil erosion, especially during the rainy season. Soil management is not helped by customs and traditions which favour large herds, irrespective of the land's carrying capacity. Overstocking of livestock has been increasing, resulting in overgrazing, which in turn leads to accelerated devegetation and soil erosion.

##### 4.5.4.2 Water Quality, Effluent Disposal and Flooding

Water quality has deteriorated due to increase in eutrophication, especially in the Winam Gulf of Lake Victoria. The rivers have been polluted by agricultural runoff and by effluents from industries. For example, phosphates and nitrates input into the Winam Gulf have been very high and are considered the greatest threat to the lake water quality.

In addition, effluents discharged from urban centres in the basin are major sources of pollution to the rivers and the lake. Although a few major towns have either sewage lagoons or conventional treatment facilities, the performance of these facilities are hampered by overloading and/or poor maintenance.

Most other towns discharge untreated or partially treated effluents directly into the lake or through the rivers draining into it.

Likewise, most agro-based industries in the basin lack waste water treatment facilities and like the towns discharge their effluents directly into the lake or into the rivers feeding the lake. Unfortunately for the inhabitants of the basin, these rivers are the principal sources of their drinking water.

Flooding is a recurring problem affecting the Lake Victoria basin. In particular, the Kano Plains on the eastern shores of Winam Gulf are susceptible to annual flooding from River Nyando. Flooding also affects the lakeshore areas where clearing of vegetation has occurred, especially in Busia District. Flood control is therefore a priority concern because of its frequency and the magnitude of the damage it causes.

#### 4.5.4.3 Water Weeds

Water weeds are gradually becoming a problem in Kenya's inland freshwater bodies. Among the weeds, water hyacinth (*Eichhornia crassipes*) has been spreading in Lake Victoria at a fast rate, with potential adverse effect on the productivity of the lake through destruction of fish breeding areas, blocking landing beaches and harbouring disease vectors. However, its management would be inadequate without the cooperation of neighbouring countries.

#### 4.5.4.4 Fisheries Resources

Since the 1970s total fish catches have increased by between four and five times due to the introduction of exotic species such as Nile Perch (*Mbuta*). However, catch per fishing effort has been dropping, indicating that the maximum sustainable yield is below the present level of exploitation.

Furthermore, introduction of exotic species of fish has altered the food web structure of Lake Victoria which has led to a dramatic decline in diversity of indigenous fish species. A number of the

original 300 species of fish are now extinct or facing depletion.

Other factors which have affected the status of lake and riverine fisheries in the Lake Victoria basin are: overfishing by use of small mesh nets and harvesting of brood stocks; destruction of fish habitats through river engineering; siltation due to deforestation, pollution, and water hyacinth infestation.

#### 4.5.4.5 Regional Cooperation

Since Lake Victoria is shared among Kenya, Tanzania and Uganda, regional cooperation is crucial to the management of Africa's largest fresh-water lake.

There is therefore need for regional cooperation in controlling water hyacinth and pollution; conservation of Lake Victoria fisheries; and afforestation and soil conservation programmes to protect the catchment areas.

#### 4.5.4.6 Recommendations

- a) Formulate an integrated water resources development plan for the Lake Victoria basin.
- b) Assess the full water resources potential of Lake Victoria basin.
- c) Initiate studies on water weeds control, fisheries management and biodiversity conservation.
- d) Make environmental impact assessment a pre-condition for approval of water related and fisheries projects.
- e) Identify, map, and protect water catchment areas.
- f) Develop plans and strategies for managing water pollution and sanitation for all urban centres in the Lake Victoria basin.
- g) Develop strategies for controlling and managing floods in the basin.
- h) Involve industries, local authorities and local communities in developing strategies to manage pollution and sanitation.

- i) Support cooperation with neighbouring countries in water quality studies, water hyacinth control and fisheries management.

#### 4.5.5 Coastal and Marine Water Management

##### 4.5.5.1 Current Status

The coastal and marine environment, which includes the land, shore, inter-tidal zone, exclusive economic zone (EEZ) and high seas, is endowed with abundant natural resources and a variety of ecosystems that are rich in biodiversity. These resources are of importance to Kenya's economy. In particular, they are a basis for the tourism industry which is Kenya's principal foreign exchange earner and one of the major employers. Their socio-economic importance include marine based industries, commerce, harbours and maritime activities. However, there are environmental and socio-economic problems that restrict the realisation of their full potential.

Currently, several organisations are involved in the management and use of coastal and marine resources. Such organisations include Ministry of Land Reclamation, Regional and Water Development (MLRRWD), National Water Conservation and Pipeline Corporation (NWCPC), Kenya Wildlife Service (KWS), Fisheries Department, Kenya Ports Authority (KPA), Local Government Authorities (municipalities, towns and counties), the Coast Development Authority (CDA) and NGOs. These institutions often have overlapping mandates, operations and at times, conflicting interests. These pose serious management problems.

##### 4.5.5.2 Issues

Shortage of freshwater supply is a critical problem affecting the coastal areas including urban centres and coastal islands. Fresh water is piped to Mombasa from the lower slopes of mount Kilimanjaro and Sabaki River with frequent breakdowns and repairs. Boreholes sunk too deep or too near the shore risk salt-water intrusion, which is usually irreversible and leads to further

deterioration of fresh water quality and quantity.

Threats to fresh water supplies, coastal and marine resources include domestic and industrial pollution from coastal towns, land-based pollution from the hinterland and oil pollution.

Coastal towns and tourist hotels generate domestic sewage which is discharged into the sea with little or no treatment. Solid waste, sludges and spent chemicals all find their way into the sea. The rivers emptying into the sea carry a heavy load of silt during the rainy season, and an increasing amount of agro-chemicals. Catastrophic pollution from an accidental oil spill is an ever present danger.

Reef fisheries of the inshore areas have been overexploited in many areas, with the exception of the marine national parks. The current fishing regime, which is poorly regulated, has resulted in the depletion of some fish stocks, particularly the popular species. The demand for and consequent harvest of lobsters, crabs and prawns has reduced the population of these aquatic resources considerably, especially lobsters. It may be necessary to consider serious regulatory measures in the exploitation of lobsters and crabs, and to have open and closed fishing seasons.

Over-harvesting of mangrove trees and conversion of mangrove forests to salt evaporation pans, industrial or tourist developments in parts of the coastal zone has destroyed the breeding sites and habitats of various marine life forms. Silt and sewage threaten the coral reefs, which stabilise the shores, nurtures biodiversity and provide an important tourist attraction.

##### 4.5.5.3 Recommendations

- a) Assess current and future freshwater demands, and explore alternative freshwater sources including possibilities for sea water desalination and rainwater harvesting; and develop a management plan for coastal water supply to alleviate the recurrent water shortages.

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- b) Conduct comprehensive studies to generate data which can be used to develop strategies for the sustainable exploitation of coastal and marine resources. The study and strategies should include development plans for urban centres and the hotel industry; management of harbours and ports; management of human settlements; management of manufacturing zones; and biodiversity conservation.
  - c) Review the roles and mandates of the various institutions empowered to manage the coastal and marine resources with a view to streamlining their responsibilities and operations as well as strengthening their capacities; and then enact a coastal and marine resources management act.
  - d) Draw up suitable plans for the provision of appropriate sewerage facilities and solid waste disposal systems for all coastal towns.
  - e) Assess the status and potential of coastal fresh water resources and associated watershed areas.
  - f) Strengthen the National Oil Spill Response Committee's capacity to cope with possible oil spill disasters.
  - g) Put into place mitigating measures in order to reduce the magnitude of land-based pollutants discharging into the coastal and marine environment.
  - h) Develop an integrated management plan for coastal and marine resources, including a review of policy and legal mechanisms on water resources, land tenure and land use, marine national parks and reserves, manufacturing and service industries, and fisheries.
  - i) Promote community participation in the management and conservation of water resources to ensure sustainable use.
  - j) Enhance awareness programmes to inform tourists and local residents on what they can do to conserve water and other natural resources, including biodiversity.
  - k) Review fisheries regulations and institute incentives and penalties to regulate lobster, crab, prawns and inshore fish harvests, including open and closed seasons.
- #### 4.6 ACTION PLANS
- ##### 4.6.1 Data/Information
- ##### 4.6.1.1 Selected Activities Requiring Funding
- a) Establish a national inventory of wetlands.
  - b) Assess the status and potential of coastal fresh water sources and their watershed areas.
  - c) Determine the full potential of water resources in Kenya
  - d) Assess the full water resources potential for Lake Victoria.
  - e) Assess underground water availability and quality, especially in ASAL areas.
  - f) Enhance water quality assessment throughout the country.
  - g) Identify, map and gazette water catchment areas.
  - h) Study aquifer and groundwater levels before undertaking major agricultural schemes.
- ##### 4.6.1.2 Some Long-Term Priorities
- a) Diagnose the relationship between climate factors and stream flow variability and evaluate quantitative indicators for climate change and its effects.
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**4.6.2 Policy**

**4.6.2.1 Actions Which Can Be Taken Immediately**

- a) Formulate a comprehensive national water policy, including water management in arid and semi-arid areas.
- b) Develop a comprehensive national policy on the management and safe disposal of liquid, solid and hazardous wastes.
- c) Formulate a national policy on management, use and conservation of coastal and marine resources.
- d) Establish a national policy on disaster management.
- e) Formulate a comprehensive national policy on the management, use and conservation of wetlands.
- f) Develop a regional policy on the management and conservation of wetlands shared by Kenya and her neighbours, in collaboration with the affected governments.
- g) Introduce incentives for recycling water in agriculture and industry.
- h) Take account of water availability, quality and flow when planning industrial sites.

**4.6.3 Legislation**

**4.6.3.1 Actions Which Can Be Taken Immediately**

- a) Review and harmonise the existing legislative statutes that affect water management with a view to making them more effective and responsive to water and environmental issues.
- b) Introduce within the Water Act provision for stop and desist orders for offenders polluting any given water source, and provide

for realistic penalties.

- c) Enact and/or review legislation to support policies on wetlands, coastal and marine resources, and on liquid, solid and hazardous wastes.
- d) Review land statutes that affect water resources to provide for effective and sustainable water resources and environmental conservation and management.

**4.6.4 Capacity Building**

**4.6.4.1 Actions Which Can Be Taken Immediately**

- a) Delineate institutional responsibilities and operational terms of reference and roles in the water sector.
- b) Formulate an employment policy for local authorities and water management agencies.
- c) Enhance participation of women and youth in water resources and environmental management.

**4.6.4.2 Selected Activities Requiring Funding**

- a) Increase human, technological and financial resources necessary for efficient operation and management of water resources.
- b) Train more wetland scientists and managers.

**4.6.5 Institutions**

**4.6.5.1 Actions Which Can Be Taken Immediately**

- a) Review the mandate and roles of the existing water and environment management institutions with a view to streamlining their responsibilities and operations as well as strengthening their capacities.
- b) Review the mandates and roles of

- b) Review the mandates and roles of the various institutions involved in management of coastal and marine resources with a view to streamlining their roles and responsibilities as well as strengthening their capacities.

#### 4.6.5.2 Selected Activities Requiring Funding

- a) Strengthen institutional capacities of the implementing agencies in water resources data acquisition, analysis, storage and dissemination.
- b) Establish an agency to coordinate and supervise the management and safe disposal of refuse and solid, liquid and hazardous wastes.
- c) Establish a national agency to coordinate management and conservation of wetlands.
- d) Strengthen existing institutions or establish new ones to:  
Carry out research on water resources; conduct environmental research and management; and coordinate environmental matters. For example, develop and implement a suitable plan on the establishment of institutions such as a Water Research Institute and an environmental Research Management Centre.

#### 4.6.6 Management

##### 4.6.6.1 Actions Which Can Be taken Immediately

- a) Review national drinking water standards and incorporate them into the Water Act.
- b) Develop effluent discharge standards for incorporation into the Water Act.
- c) Introduce an appropriate tariff on water usage and effluent discharge.

- d) Prioritise water allocation in quantity and quality according to domestic, commercial, industrial and agricultural needs, and ecological sustenance.

- e) Make Environmental Impact Assessment (EIA) a pre-condition for approval of water related projects; and require post-investment assessment.

- f) Involve local communities, women and youth groups in water and wetlands management at all levels.

- g) Take environmental considerations into account during inter-basin water transfer.

- h) Develop suitable environmental impact assessment and monitoring guidelines.

##### 4.6.6.2 Selected Activities Requiring Funding

- a) Evaluate and rehabilitate the existing water assessment and monitoring network.

- b) Prepare and implement sewerage plans for each urban area.

- c) Identify, map, and gazette water catchment areas for conservation.

- d) Develop suitable criteria for determining the optimum flow for downstream riparian use, ecological sustenance and waste dilution.

- e) Develop and implement a suitable national liquid and solid waste management programme.

- f) Develop and implement a national disaster management strategy for combating drought, floods and oil spills.

- g) Develop integrated management plans for multiple use and

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conservation of wetlands.

- h) Develop an integrated coastal and marine management plan to address biodiversity, water resources, tourism, pollution, human settlement, and industrial development.
- i) Develop a suitable national land use plan to harmonise development activities and environmental conservation.
- j) Collaborate with countries in the region in developing integrated water resources management and conservation plans for the Lake Victoria basin.
- k) Collaborate with other governments in the region to implement programmes on water quality studies, water weeds control and fisheries

management.

- l) Plan irrigation and hydro-power projects with careful assessment of geological, seasonal, biodiversity and socio-economic factors, and provide infrastructure to mitigate harmful impacts.

**4.6.6.3 Some Long Term Priorities**

- a) Provide water supply schemes with necessary water quality control and treatment facilities.
- b) Establish a water resources data base and coordinate its management.
- c) Rehabilitate all existing urban sewerage works with a view to making them fully operational.
- d) Study and adopt low-input waste water management methods such as constructed wetlands.

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CHAPTER FIVE

## SUSTAINABLE AGRICULTURE AND FOOD SECURITY

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### 5.1 OVERVIEW

Sustainable agriculture refers to utilisation of agricultural resources to meet the needs of the present generation without compromising those of the future; while food security is the access by each citizen to an adequate level of food for normal life.

Agriculture is the mainstay of the national economy, contributes about 30% of the gross domestic product (GDP), produces most of the national food requirements, generates 60% of the foreign exchange earnings and provides about 70% of Kenya's agro-based industrial raw materials and almost all employment opportunities in the rural areas. Realising the fast growth in Kenya's population, expected to reach 35 million by the year 2000, and given that less than 20% of the land area is arable, food insecurity, malnutrition and famine are the most serious threats facing the nation; consequently, the major national objectives are to achieve self-sufficiency in basic food and livestock products; provide food security for all; maintain strategic food reserves; and generate crop and livestock products to sustain a growing domestic agro-industries and for export. Since these needs must keep pace with the demands of a rapidly growing population, agricultural practices must be sustainable by not degrading basic resources such as soil, water and air. Increased agricultural production through expansion of land under agriculture is constrained by limited arable land. Thus, the most promising alternatives are agricultural intensification and diversification, to be facilitated by research, training and extension.

Tremendous development has been realised in the agricultural sector due to a number of factors i.e. expansion in area under cultivation albeit of more marginal quality and easily degraded land, sub-

division of large farms in high potential areas into more intensively cultivated small-scale farms and some government investment in research, training and extension services which have led to the adoption of high yielding crop varieties and animal breeds. However, a lot needs to be done to attain food self-sufficiency and food security.

A combination of factors have contributed to the failure to achieve these broad objectives, i.e., adverse weather conditions, rapid population growth, limited arable land and the lack of appropriate land-use policy; prevalence of pests and high incidence of diseases, and high prices of agricultural inputs which have made them less affordable by most farmers leading to low production. Public investment in agriculture in terms of roads, research, extension and other supportive infrastructure and services is inadequate and has even declined over the years. In addition, inappropriate technology for land preparation, weeding and harvesting, limited credit facilities, low agricultural prices together with inefficient agricultural markets, general environmental degradation, weak institutional linkages, and lack of community empowerment and participation are some of the contributory factors.

Wildlife has lately been destroying agricultural fields in many parts of the country. wildlife also has been in conflict with livestock. The conflict is a result of the direct competition with livestock for space and food. Wildlife is also regarded as a reservoir for livestock diseases. Besides, wildlife prey on livestock in addition to destroying crops. Consequently, there is risk that if this trend continues, wildlife could be confined to the protected areas only. However, most wildlife currently live outside protected areas. Besides, even if the absence of wildlife would increase land available to livestock, the presence

of wildlife is not necessarily acting against the broader and long-term interests of the livestock producer.

Environmental protection is a prerequisite to attaining sustainable agriculture and food security and yet agriculture is a major contributor to environmental degradation through pollution due to improper use of agrochemicals, and devegetation. Furthermore, degradation occurs as a result of inappropriate land use, poor land management practices, poor water management in irrigation facilities, and use of inappropriate tillage methods. The consequence is decline in soil fertility, siltation of flood plains and dams, unstable hydrological conditions and overall reduction in land productivity.

The negative impacts of environmental degradation have been recognised. However, where these have been identified, the present approach to environmental conservation has been directed towards the symptoms rather than the causes. Besides, land users are rarely consulted to determine the underlying causes. The result has been outright rejection or half-hearted adoption of recommended environmental conservation practices.

In order to achieve self-sufficiency in food production, food security, elimination of malnutrition, creation of employment and income-earning opportunities, earning of foreign exchange and import substitution, it is important to increase agricultural production through: intensification of crop and livestock production; the innovation and diffusion of technology to enhance yields; and efficient use of labour, appropriate machinery and agrochemicals. Also, there is need to develop a wildlife utilisation industry with a view to diversifying the income generation activities of communities and ranchers in areas of livestock-wildlife interaction. Besides, a conducive environment with regard to technologies, price policies, marketing and infrastructure, among others, plays a critical role. This will be achieved through appropriate government intervention in favour of improved

management of the basic natural and man made resources and sustainable agricultural development. Lastly, there is need to analyse the short-term implications of the on-going structural adjustment programmes with reference to sustainable agriculture and food security. The resources critical for sustainable agriculture and food security may be classified as follows: land, water, forests, livestock, fisheries, wildlife, human, financial, institutional and infrastructural facilities and services.

## **5.2 AGRICULTURAL RESOURCES**

### **5.2.1 Land**

#### **5.2.1.1 Current Status and issues**

Kenya covers an area of approximately 587,900 km<sup>2</sup>; 576,000 km<sup>2</sup> is land surface of which 461,400 km<sup>2</sup> (80%) is classified as arid and semi-arid lands (ASALs); the remaining 115,300 km<sup>2</sup> (20%) being of medium and high agricultural potential. These classifications are based mainly on average annual rainfall and evapotranspiration. The high and medium potential lands are devoted to crop and milk production, while much of the ASALs are largely used for extensive livestock production such as ranching and pastoralism as well as being the habitat for wildlife both in and outside the national parks and game reserves. The high and medium potential lands also contain important water catchments and certain habitats rich in biodiversity which are not included in the protected areas.

In order to optimise land use, it is necessary to practice proper land management and land-use planning techniques. As part of land management it will be necessary to: protect highly erodible soils from accelerated erosion; to adopt proper conservation methods in potentially productive soils; to rehabilitate eroded soils and prevent further degradation; to develop efficient water use strategies; and to increase crop and livestock production, especially in ASALs while protecting the quality of surface and ground water from pollution by sediments and chemicals.

The country has capabilities in resource survey techniques for use in rational sustainable exploitation and land use planning for both short-term and long-term benefits. Resource surveys provide factual data on the existing land use patterns, the potential demand for each of the major land use categories, and the underlying resource base. The trade-offs between the short and long-term socio-economic and environmental implications remain key challenges in an attempt to attain these goals.

The current land tenure system is aimed at privatising land which in certain cases has led to excessive subdivision often to uneconomical sizes. Additionally, there are no standards on optimal land-use practices in various agro-ecological zones. There is also increased migration of people from high potential areas to marginal areas where the migrants introduce inappropriate land use practices.

Although proper land management practices (soil and water conservation techniques, proper tillage, and principles of range management) are known, their application has not been widely adopted nationally. Likewise, land-use planning practices have been used to achieve short-term benefits hence land resource inventory, land use suitability mapping and evaluation are hardly exploited.

#### 5.2.1.2 Recommendations

- a) Promote a land tenure system that enhances agricultural production.
- b) Increase agricultural production in all parts of the country to achieve self sufficiency in basic food, and raw materials for local agro-based industries and for export. This does not necessarily mean bringing more land under cultivation.
- c) Provide advice on optimal land use practices in various agro-ecological zones.
- d) Promote research and adoption of appropriate land use systems and technology.
- e) Integrate environmental con-

siderations into sustainable land use and agricultural development.

- f) Develop, promote and apply land tillage methods that reduce soil erosion.
- g) Develop modalities to enable the youth to lease family land for their own use in agricultural production.
- h) Enhance extension, demonstrations and incentives to curb soil erosion.
- i) Introduce incentives to owners of underutilised or unutilised land to increase land productivity.
- j) Establish community-based conflict resolution mechanisms to curb banditry and insecurity and optimise land use.
- k) Use economic incentives and penalties to promote soil conservation.

#### 5.2.2 Irrigation and Drainage

##### 5.2.2.1 Current Status and Issues

The national irrigation potential is estimated at 540,000 ha and about 300,000 ha in drainage and valley bottom reclamation. Currently, the area under irrigation is only 52,000 ha. It is possible that the extraction of water for irrigation and the drainage of marshes and valley bottoms for arable farming causes degradation, and loss of biodiversity. Therefore, proper studies including consulting local communities should be carried out to determine the best option for each situation (i.e., agriculture, water catchment, production of wetland resources (such as weaving materials, dry season grazing and fish breeding grounds), or biodiversity conservation). If agriculture is the option, there is need to plan for proper management of environmental impacts.

The government has been committed to the development of irrigation schemes in the country. However, the schemes have faced both socio-economic and technical problems. In certain cases, irrigation schemes were initiated without proper feasibility studies resulting in serious

# AGRO-CLIMATIC ZONE MAP OF KENYA

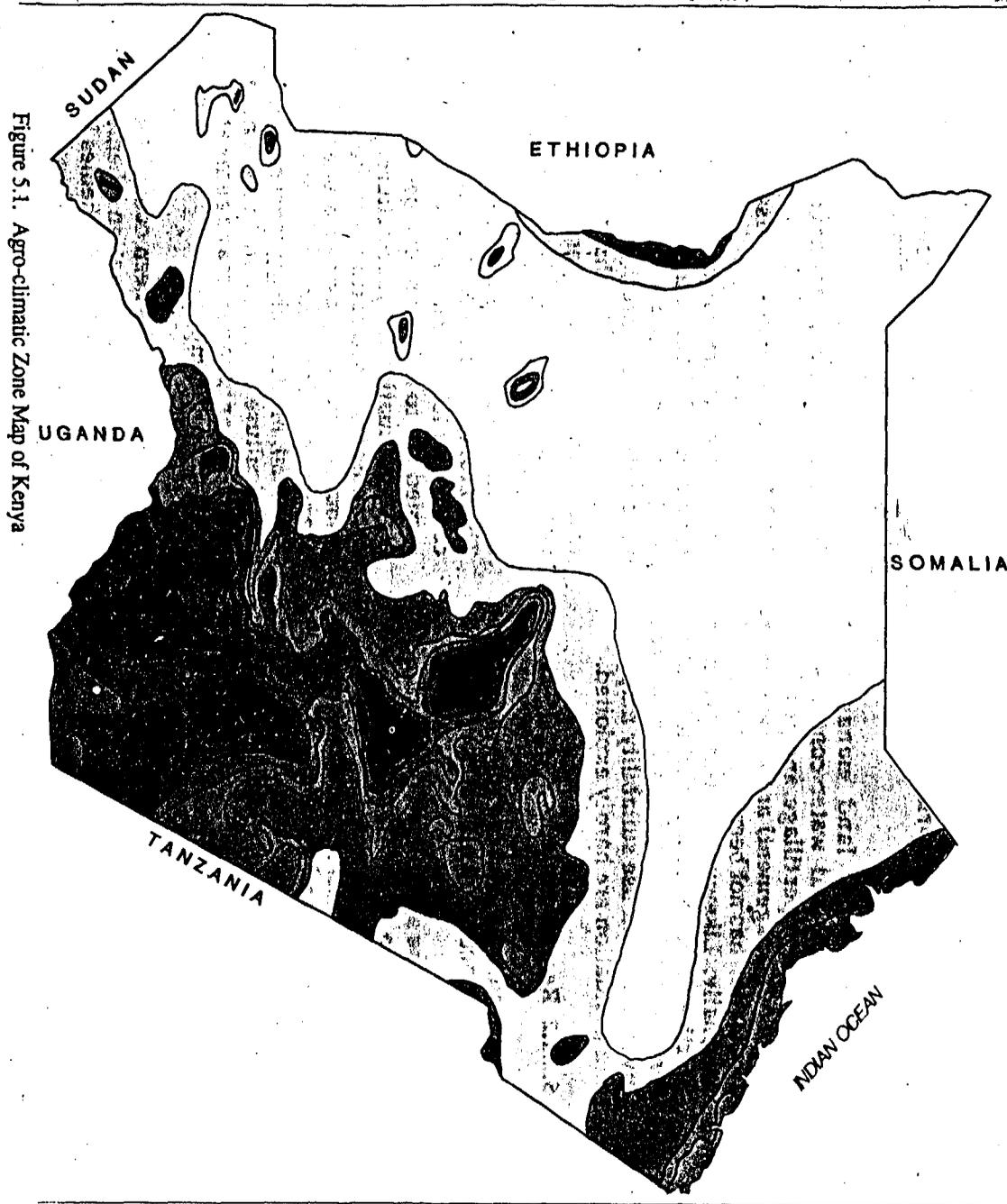


Figure 5.1. Agro-climatic Zone Map of Kenya

KEY Zone	Climatic designation	Agricultural potential
1	humid	high
2	sub-humid	high
3	semi-humid	high
4	semi-humid to semi-arid	medium
5	semi-arid	medium
6	arid	low
7	very arid	very low

## LEGEND EXPLANATION

Zone	r/Eo ratio	r/Eo ratio in %	Climatic designation
1	0.8	> 80	humid
2	0.65 - 0.80	65 - 80	sub-humid
3	0.50 - 0.65	50 - 65	semi-humid
4	0.40 - 0.50	40 - 50	semi-humid to semi-arid
5	0.25 - 0.40	25 - 40	semi-arid
6	0.15 - 0.25	15 - 25	arid
7	< 0.15	< 15	very arid

source: KARI

ecological consequences, e.g. salinity and sodicity, increase in water-borne diseases, soil compaction, reduction in water flow to downstream users, and change in water courses. Many of these problems could have been minimised or altogether avoided if the views of the local community were used to compliment technical guidelines. Consequently, irrigation and drainage should be carried out with due consideration of: the concerns of other water users; suitability of the soil and water; community participation; provision of infrastructure; treatment of water borne diseases; water storage; discharge and recharge; and the impacts of projects. In addition, it must be recognised that irrigation schemes are breeding grounds for vectors of certain diseases. It is therefore important to look into parasitic diseases that are prevalent in marshy areas for both humans and livestock. This is specifically diseases caused by trematodes like liver flukes.

#### 5.2.2.3 Recommendations

- a) Identify rehabilitation needs and viability of the existing irrigation and drainage schemes through identification of constraints and opportunities.
- b) Investigate the realistic potentials for irrigation and drainage development taking into account land, water, ecological impact, human and financial resources, organisation, management and technical capabilities, and the need to maintain wetlands ecosystems for their hydrological, ecological, economic, scientific and conservation functions.
- c) Collect data on performance of irrigation schemes including design, operation and maintenance, physical environment (soil fertility, water quality, drainage, irrigation efficiency, ecological impact, etc) crop and agronomic practices, cropping patterns and socio-economic environment through constraint analysis. Identify causes of poor performances and failures and recommend remedial

measures.

- d) Study the cost-effectiveness of various irrigation and drainage schemes (proposed or existing) in comparison with other relevant and viable forms of land use.
- e) Prepare a detailed applied irrigation and drainage research programme after identifying constraints limiting production in the schemes.
- f) Develop Kenyan human resources and research capability in irrigation and drainage functions, assessment, cost benefit analysis, and monitoring.
- g) Encourage and promote small-holder irrigation schemes with the full participation of the small scale farmer in the operation, maintenance and management of the schemes. The government input in the schemes will involve provision of support resources for capital investment, roads and storage facilities.
- h) Incorporate technical, economic and socio-cultural dimensions through community and private sector participation in irrigation programmes.

#### 5.2.3 Seeds

##### 5.2.3.1 Current Status And Issues

Most of the important economic crops are propagated through seeds. Farmers who start with high quality pure band of seeds which are appropriate for a given agro-ecological zone, and use an appropriate production practices are likely to get good harvests. It is because of the crucial role of seed in agriculture that the government places a lot of importance in various activities concerned with production of genetically superior seed through breeding. Having developed good seed suitable for specific agro-ecological zones and agricultural production system, there is close collaboration between KARI, Ministry of Agriculture, Livestock Development and

Marketing (MALDM) and various interested agencies to ensure the availability of high quality seeds of improved crops to the farmers. Quality control services are designed to ensure the preservation of genetic purity, identification of released superior cultivars. Activities of seed certification alone have been shown to increase crop production per unit area by 10%.

However, provision of high quality seed is constrained by several factors: lack of trained manpower in specific areas of seed technology; inadequate equipment for both field and laboratory testing; and use of unreliable seed multiplication agents and inappropriate packaging material for certified seed. Production of superior seeds does not ensure their utilisation. Similarly, loss of benefits of certified seed could occur through poor distribution network, seed adulteration by marketing agents, and the use of approved cultivars in wrong agro-ecological zones.

#### 5.2.3.2 Recommendations

- a) Provide facilities for seed testing and indexing.
- b) Use plant breeding to produce high yielding, low input cost and environmentally acceptable breeds.
- c) Develop human capacity in seed technology.
- d) Conduct surveys to assess the national seed situation and draw up policies that will enable the country to achieve a sound seed industry. This need is especially urgent as new private breeding institutions are coming into the industry.
- e) Integrate the crop improvement activities with those of cultivar maintenance, multiplication, processing, marketing and quality control so as to create one seed industry which looks at the problems and development of the seed industry as a whole.
- f) Ensure that seed multiplier agents

meet conditions that guarantee cultivar purity.

- g) Promote research in: appropriate packaging for certified seed; storage duration of seed under different ecological zones or storage conditions; and seed health standards of crops under certification scheme.
- h) Describe and document released maize, wheat and barley cultivars.
- i) Develop strong collaborative research programmes between all crop breeders.
- j) Evaluate horticultural crops (onions, cabbages, tomatoes, and carrots) for their suitability to Kenyan environment and then describe and document them for ease of reference and use. This should be carried out in collaboration with National Horticultural Research Centre (NHRC) in Thika.

#### 5.2.4 Fertilisers

##### 5.2.4.1 Current Status And Issues

Appropriate use of fertiliser contributes to increased output and is meant to maintain soil fertility. However, available information on fertiliser use is incomplete. Also, there is a limited selection of fertilisers in the Kenyan market. The common fertiliser, Diammonium Phosphate is known to increase acidity in certain Kenyan soils. Constraints that have affected the rate of utilisation of fertilisers in Kenya include high prices, import constraints, poor distribution, low quality, and poor rates of application.

Although it is important to use fertiliser in order to increase yield, their use should be regulated as they contribute to environmental pollution. Inappropriate use of fertiliser has polluted lakes and rivers and reduced the fertility of certain soils. Alternative sources of plant nutrients, for example, compost and manure, need to be studied, improved, developed, and used.

### 5.2.4.2 Recommendations

- a) Develop standards for fertiliser and ensure that farmers are supplied with quality fertiliser.
- b) Establish an efficient distribution network for fertiliser.
- c) Make fertiliser prices affordable to most farmers.
- d) Encourage the use of manure and compost as alternatives and/or additions to fertilisers.
- e) Assess the most suitable nutrients for the different soil types.
- f) Monitor the long term effects of the different nutrients on chemical and physical properties of the soil.
- g) Train farmers to use fertilisers as appropriate.
- h) Determine and formulate efficient fertiliser management techniques with regard to the time and method of application of various fertilizers.
- i) Establish a database for use in determining appropriate fertiliser requirements on the basis of soil and plant analysis.
- j) Develop collaboration linkages between researchers, extension workers and farmers on fertiliser use.
- k) Improve fertiliser use recommendations, for specific agro-ecological units.
- l) Minimise taxation on imported fertilizers and encourage farmer organisations to import the commodity directly.

horticultural. Similarly, the increase in food crop production in Kenya is partly due to increased use of pesticides. Meanwhile, crop losses, up to 30%, still occur in the field and during storage.

Acaricides have been used extensively to control tick borne diseases. However, farmers still experience livestock losses due to their efficacy and/or cost. In the past emphasis has been placed on the benefits derived from the use of pesticides without due regard to their safety and efficient use. A consequence of this has been ill-health on the part of the workers, the general public and in certain instances environmental degradation. Inappropriate use of pesticides has destroyed natural pest predators, affected other animal species and even caused human poisoning.

The international trend on pesticides has been moving from environmentally persistent/hazardous products to environmentally friendly products which include, carbamates, synthetic pyrethroids, natural products (pyrethrum) and biocides. To safeguard Kenya from some of the pesticides that have been banned or severely restricted elsewhere, the country participates in the UNEP/FAO prior informed consent (PIC) systems. PIC is a voluntary system and does not prevent exportation of dangerous chemicals. Recently, the European Union, a major market of Kenyan produce has established regulations that reject produce with heavy traces of pesticides. However, the trend should focus on integrated pest management (IPM) technique. This is a decision-making process that utilises regular monitoring to determine if and when treatments are needed and employs physical, cultural, biological and educational tactics to keep pest numbers low enough to prevent intolerable damage or annoyance. Least toxic chemical are used as a last resort.

### 5.2.5 Pesticides

#### 5.2.5.1 Current Status and Issues

The impact of pesticides in agricultural production has been most significant in the cash crops like coffee, tea and

#### 5.2.5.2 Recommendations

- a) Expand the capacity of the Pest Control Products Board to deal with the various aspects of regulating pesticide usage in the

country.

- b) Intensify the training and education of pesticides users, including extension staff and the general public, on safety and dangers of using pesticides with regard to toxic hazards to users and consumers as well as pollution of the environment.
- c) Promote on-farm research to develop non-chemical alternative pest management technologies.
- d) Develop an operational and interactive networks among farmers, researchers and extension services to promote integrated pest management.
- e) Formulate a national policy on disposal of pesticides and other wastes, and build the capability of disposal.
- f) Collect data and establish a database on the use of pesticides in Kenya and side effects on humans and environment.
- g) Train medical personnel to diagnose and treat cases of pesticide poisoning.
- h) Train extension workers, etc. to provide information and materials to farmers to enable them to practice integrated pest management (IPM).
- i) Explore the potential for natural pesticides such as Nim tree and Mexican Merigold.
- j) Provide economic incentives to farmers to use IPM.
- k) Enhance research on insect life histories and biological controls.

## **5.2.6 Herbicides**

### **5.2.6.1 Current Status and Issues**

Herbicides have been used in large-scale agriculture to control weeds. This is common in the grain (wheat, maize and

barley) producing areas. The use of herbicides however should be expanded and promoted. In particular women should be encouraged to use herbicides to control weeds so that they can have more time for other activities like marketing the produce.

There are problems associated with the use of herbicides and these include: inappropriate application methods, residual effects, health hazards to human and the environment and lastly they are costly.

### **5.2.6.2 Recommendations**

- a) Promote the use of herbicides in order to increase crop production.
- b) Intensify the training of extension workers and farmers on the safe and efficient use of herbicides.
- c) Sensitise the public on environmental pollution that could be a consequence of the use of herbicides.
- d) Ensure herbicides prices are affordable to farmers.

## **5.2.7 Farm Machinery Tools And Equipment**

### **5.2.7.1 Current Status And Issues**

Appropriate agricultural engineering technology is vital for increased agricultural production and environmental conservation. The current technologies have remained relevant to large scale agriculture yet farm holdings are increasingly becoming smaller in size. Therefore, there is a need to develop agricultural technologies relevant and environmentally friendly to smallholding agriculture. Timely land preparation, weeding and harvesting is essential in agriculture. Where these aspects are looked at, more often than not, little consideration is given to the tools and equipment and the associated power requirements.

### **5.2.7.2 Recommendations**

- a) Develop tools and machinery that

are appropriate for the physical, biological and socio-economic environment.

- b) Identify the engineering constraints to agricultural production through a multi-disciplinary approach, and alleviate these by emphasising accelerated development that is environmentally, socially, technically, and economically viable and acceptable.
- c) Encourage and promote medium horse-powered machinery.
- d) Develop and produce animal drawn farm implements.
- e) Develop and promote hand operated implements and equipment.
- f) Develop and promote technology appropriate for draught power.
- g) Design fiscal measures that encourage the adoption of environmentally friendly farming machinery, tools and equipment.

## 5.2.8 Financing Agriculture

### 5.2.8.1 Current Status And Issues

Agriculture is normally considered a low yielding profit venture by lending institutions. In fact, investment in agriculture is very risky due to factors beyond the farmers' control such as bad weather, pests and diseases, pricing and marketing problems. Nonetheless, agricultural credit stimulates production, increases farmers' income, accelerates the transfers of farm technology, and generates employment. Credit facilitates investments and thus increased supply of agricultural credit would enhance development of the sector given that other factors are availed at the right time and in sufficient quantities and quality. Financial incentives can be used to promote sustainable agriculture. Farmers could be offered financial assistance to cover some of the costs of conservation, tillage, protection of highly erosive lands with permanent cover crops

(of e.g. forage seedlings or trees), small water retention structures, seed to establish permanent cover on erosion prone areas could be provided at subsidised rates.

Agricultural financing in the country has experienced a number of constraints; these include the high cost of lending and servicing many small scale borrowers; lack of tangible collateral in most parts of the country and problems in realisation of the security in case of default; delayed payments for farms produce by marketing bodies especially in the cereals sector; and/or lack of awareness by farmers and complexity of credit management.

Agricultural lending past has been biased towards large-scale farmers, high-potential areas, cash crops and those with land title deeds. Over the last six years, the average agricultural credit outstanding from commercial banks has been 44.5 per cent for large scale farmers and only 17.8 per cent for small scale farmers (less than 50 hectares). The proportion of credit going to small scale farmers almost exclusively go to those with off-farm income(s). Thus, the bulk of the small scale farmers do not benefit from commercial credit. High potential areas comprise only 20 per cent of the total land surface. Thus, large areas of this country do not benefit from formal sources of agricultural credit. Only those with title deeds or other forms of acceptable securities get access to credit from financial institutions. Large areas of this country do not have registered individual titles and therefore do not get access to formal credit sources except from non-government organisation (NGOs) where they operate. Demand for collateral biases agricultural lending against women and youth.

The bulk of agricultural lending goes towards establishment and maintenance of high value cash crops such as coffee, tea, pyrethrum, etc. Very little credit goes towards food production with exception to commercial growing of wheat, maize, barley and horticultural crops. Among the livestock enterprises, the bulk of the credit goes towards dairy, poultry and to a limited extent to pig enterprise.

### 5.2.8.2 Recommendations

- a) Encourage commercial banks and other lending institutions to increase provision of medium and long-term credit facilities to agriculture sector.
- b) Establish agricultural credit guarantee schemes including crop and livestock insurance schemes.
- c) Correct the current situation where only those with title deeds or other forms of acceptable securities get access to credit from financial institutions.
- d) Improve agricultural credit policy coordination through establishment of an agricultural credit coordination council comprising key government ministries, private sector representatives and under the umbrella of the Central Bank. Such a body would be charged with the responsibilities of the overall agricultural credit policy, prioritising lending programmes, and resource mobilisation through research into the supply of agricultural credit.
- e) Promote specialised banks initiated by agriculturally sensitive interest groups such as the Kenya National Farmers Union (KNFU) and Kenya Planters Cooperative Union (KPCU). Such banks can mobilise savings and lending to the agricultural sector and improve access to credit as these would be required to serve their members.
- f) Enhance rural savings and credit by establishing more branches and mobile banking services by reducing license fees and other annual charges both by the Central Bank and local councils.

### 5.2.9 Human Resources In Agriculture

#### 5.2.9.1 Current Status And Issues

Human resources remain the most

important assets in any organisation. For the country to implement environment conservation programmes, trained manpower is a necessity. In the past, the government has developed training programmes for its scientists and support staff. This should be continued especially in the fields related to sustainable agriculture, food security and the environment, as their demand are increasing. Emphasis has also been placed on extension in order to promote transfer of production technology from research to land users. In this regard, the Ministry of Agriculture, Livestock Development and Marketing has an elaborate structure of agricultural staff who are fairly well trained.

The need for strengthening the planning capabilities of the various public and private institutions and agencies involved in rural development and the agricultural sector in particular is critical to attaining sustainable agriculture. The capabilities include social scientists, and economists specialising in rural development, agriculture, natural resources, environment and policy analysis. There is growing demand for these specialists to formulate, appraise and implement programmes/projects and subsequent monitor and evaluate their impact on the community's well being and on the environment. The policy analysts could formulate and subsequently assess the trade-off between the various policy options.

Training programmes have laid emphasis on natural scientists largely ignoring social scientists. Besides, each discipline has undertaken its duties with little or no cooperation with the other. Also their training, lack certain social considerations including the needs of farmers. The extension service has given minimal interest to integrating the activities of government and non-governmental agencies. At the national level, the input by policy analysts has been constrained by the lack of training facilities in the public sector. The situation has been exacerbated by the poor remuneration and general terms and conditions of services as compared to the private sector.

In order to strengthen the planning

capabilities of the various public, private and donor agencies involved in agricultural development there is need to: enhance the training capabilities of local universities for planners, environmentalists and policy analysts; and to review the terms of employment of the public sector employees to match those in the private sector.

#### 5.2.9.2 Recommendations

- a) Adopt a multi-disciplinary approach, integrating the services of various professions to optimise sustained agricultural production.
- b) Improve the quality of human resources by training extension officers, research scientists, and social scientists in sustainable agricultural practices.
- c) Develop collaborative extension programmes work for non-governmental organisations and government, especially the Ministry of Agriculture, Livestock and Marketing.
- d) Improve remuneration for policy analysts in order to retain them in the public sector and increase funding for extension services.
- e) Adopt participatory approaches to extension message formulation and packaging in order to reduce the gap between researchers and the users. This should include Participatory Rural appraisal (PRA) method. The method facilitates the adoption of catchment or conservation area approach, where the multi-disciplinary team of scientists, extensionists, planners and community leaders identify the problems rank them and then consider alternative solutions and finally prepare drawing an action plan that ensures sustainability of the intervention activities with full community participation.

#### 5.2.10 Linkages

##### 5.2.10.1 Current Status And Issues

There is need to establish and strengthen existing links for institutions involved in agricultural production. The priority will be in research-extension-farmer linkages, linkages between research institutions both local and international and the private sector. The linkages should be multi-disciplinary involving institutions working on crop production, agricultural research management, animal health and production, pest management fodder crops, etc. Linkages with international organisations will provide a major resource of scientific knowledge and improved technologies. The objective of the government is to ensure that international institutions with national and regional programmes based in Kenya contribute to the strengthening of the national agricultural research systems.

The importance of establishing and strengthening linkages with the private sector should not be overlooked. In the past there has been linkages between research institutions, e.g. KARI with East African Industries on oil crops research which has given good results.

##### 5.2.10.2 Recommendations

- a) Strengthen and increase support to public and private institutions involved in agricultural finance and marketing, monitoring and regulation.
- b) Strengthen institutional linkages between the various key actors in the agricultural sector, especially in production, marketing and processing.
- c) Increase food storage capacities at the national, regional, community and household levels as a measure towards food security.
- d) Involve rural communities in opening and maintaining secondary and rural access roads.

## **5.2.11 Community Participation**

### **5.2.11.1 Current Status And Issues**

Participation by communities in sustainable agriculture and food security is vital since their various activities can sustain or destroy the resource base. Their efforts need to be directed at rehabilitating degraded ecosystems, adopting technologies for increased production, and in promoting cultural norms which support food production and security.

The objectives of community participation are to: impart techniques of identifying and prioritising problems and opportunities; evaluate and implement strategies for effective natural resources management and food production; identify gender roles and needs; and intervene to address such needs as developing capacities of community groups and that of their leaders in sustainable resource management and organisational techniques.

Effective community participation will not only identify and prioritise peoples needs but also recognise and strengthen roles played by various actors: men, women, youth groups and extension officers. Women in Kenya and indeed in Africa are playing an important role in food production, soil and water conservation in addition to such roles as energy and water supply. Yet they are usually not part of decision making in agricultural development.

### **5.2.11.2 Recommendations**

- a) Develop initiatives in individuals and communities for participation in projects, programmes, and technologies.
- b) Promote public awareness on the role of people's participation and community organisations, especially women groups, and local based groups.
- c) Formulate a clear policy on systematising community participation in decision making.

- d) Promote sustainable use of natural resources, diversification in production and consumption through education and awareness.
- e) Enhance and integrate extension services with the community.
- f) Cultivate positive attitudes towards cultural values and indigenous technologies for sustainable agriculture.
- g) Streamline the harambee movement so that problems of accountability, sustainability and transparency are addressed.

## **5.2.12 Agricultural Markets**

### **5.2.12.1 Current Status And Issues**

Agricultural markets link production and consumption sectors. Its capacity to link domestic markets to the rest of the world makes it an important institution for generation of information necessary for decision making. However, it is susceptible to domestic and foreign macroeconomic environments.

Kenya's agricultural marketing system is a by-product of colonial monopolies. Commodity marketing boards have persisted over the years despite their inefficiencies. However, the current liberalisation efforts have created competitive marketing environments. Besides, there is an active private sector and cooperative organisations participation in agricultural marketing.

After the recent liberalisation of the grain market, the functions of the National Cereals and Produce Board (NCPB) have to change. The entry of the private sector into the grain market has increased the possibility of some operators buying large quantities of grains in times of shortage intended for speculation purposes. A consequence of this would be price instability. Development of on-farm storage facilities is therefore an essential component of on-farm food security. It is therefore necessary to formulate policies that would allow government intervention to stabilise the market.

### 5.2.12.2 Recommendations

- a) Stabilise food prices and ensure that food is available to vulnerable groups and at affordable prices.
- b) Ensure food distribution from surplus to deficit areas.
- c) Promote private sector participation.
- d) Develop infrastructure so that farm produce is marketed promptly to reduce losses and especially in the case of perishable produce and thus increase investible surplus.
- e) Develop standards and enforce them to meet domestic and export market requirements.
- f) Enhance food security through buffer-stock mechanism by the National Cereals and Produce Board (NCPB).
- g) Promote indigenous food crops and community-based food banks.
- h) Encourage utilisation of inputs through more liberalised markets and trade policies.

### 5.2.13 Women In Agriculture

#### 5.2.13.1 Current Status And Issues

The contribution of women to agricultural production is enormous. However, most agricultural policies discriminate against women. Consequently, such policies fail in the processes they aim to influence. It is however becoming inevitable that for agricultural policies to succeed in their set objectives, their impact on women specifically, the effects on the socio-economic environment of the farm household production must be identified. To maximise the participation of women in agricultural production the government needs to review current policy with a view to incorporating gender issues.

The gender issues in agricultural policy must include an understanding of the

possible effects on women, by determining the contribution of income generating activities at household levels, the allocation of time between men and women in farming activities, the control over resources between men and women and to determine the constraints facing farm women from achieving their goals.

### 5.2.13.2 Recommendations

- a) Encourage women and provide funding for programmes in which they have traditionally had economic control like in marketing and processing.
- b) Promote and encourage women to set up enterprises for the marketing of perishable farm produce in both urban and rural areas by availing short-term loan facilities.
- c) Ensure participation of women, in the management committees of cooperatives and other related organisations.
- d) Increase funding for informal credit systems for women.

## 5.3 AGRICULTURAL RESOURCE UTILISATION

In order to improve general welfare there is need to promote an efficient utilisation of agricultural resources. Besides, there is need to create conditions to motivate adoption of strategies that encourage farmers and other land users to practice conservation agriculture; promote catchment conservation; establish multi-disciplinary teams to identify and solve land use problems; and to ensure food security. There is need to diversify food sources to include traditional and indigenous animals and promote tree crops which have not received adequate recognition in terms of national resource allocations.

### 5.3.1 Crop Production

#### 5.3.1.1 Current Status And Issues

Considerable progress in the expansion

of food production in the past has been achieved through adoption of improved technology such as use of high yielding crop varieties, increase in the number of improved breeds of cattle, and an increase in small holdings following sub-division of large farms. The production of some crops such as sugar, rice, cotton and vegetable oils is less than demand. Besides, the rapid growth in population together with a shortage of arable land in the high potential areas is rapidly exceeding food production; the challenge therefore is to attain self-sufficiency in maize, beans, potatoes, vegetables, meat and milk, without taking more land. Increased agricultural production is dependent on adequate water availability. Plant yields are reduced by shortage or excess of soil moisture. Plant growth can be maximised and the soil potential can be well maintained by proper management of rain water, water run-off and soil moisture. However, there is generally inadequate data on arid and semi arid areas with reference to adequacy and reliability of water supplies.

To achieve this goal, research, extension and marketing of drought-tolerant tuber crops (cassava, yams and sweet potatoes, sorghum, millet) is required. In addition, there is need to study and conserve indigenous varieties of useful or potentially useful animals and plants.

In the case of cash crops, coffee, tea and horticultural products are the main foreign exchange earners. However, coffee production has dropped in the recent years due to low prices in the international markets and poor management while in the case of tea, the capacity for processing is lower than the production.

### 5.3.2 Recommendations

- a) Increase yields through: the use of certified seeds, increased intercropping, enhanced multiple cropping, integrated pest management; a judicious use of agro-chemicals, use of organic manures, and improved agronomic practices.
- b) Promote production of drought

resistant crops in ASALs, especially: sorghum, millet, sweet potatoes, pulses and oil seeds. Trees that are used when there is serious drought (e.g., *Balanites aegyptiaca*, *Acacia tortillis*, Doum palms) and those that have potential for cash generation especially gums, tannins and resins (e.g., *Acacia arabica*) should be promoted. Also adopt irrigation technology and consider increasing the land under irrigation.

- c) Ensure complete liberisation of the prices of agricultural produce by removing interference by the government in the marketing and pricing of various agricultural products.
- d) Minimise restrictive procedures and administration barriers of agricultural products.
- e) Supply and distribute on time the appropriate farm inputs such as quality seeds, agro-chemicals and farm machinery through government, private sector, cooperatives and farmers organisations.
- f) Increase provision of credit to farmers by both public and private financial institutions.
- g) Encourage private sector processors to support primary production through contract farming.
- h) Support initiatives by individuals and/or cooperatives to process, store, handle and market agricultural produce as a step towards liberalisation of marketing and pricing.
- i) Develop infrastructure and other support services to improve production, processing, storage and marketing of agricultural produce.
- j) Promote simple food processing

techniques like sun drying, smoking, fermentation and canning for food products like vegetables and root crops to prolong their storage life, enhance their availability long after their season is over.

- k) Develop on-farm storage facilities so as to reduce post harvest losses thus ensuring food reserves at household level.
- l) Develop an integrated pest management (IPM) programme to enhance production.
- m) Ensure that land in marginal areas is conserved through proper land use practices.
- n) Promote/rehabilitate cotton and sugar farming for self-sufficiency and export, intensification of rice production, promotion of oil crops (sun flower, coconut, sim sim, and castor oil seed) as well as pyrethrum production. Rehabilitate the coffee industry and improve the tea processing capacity.
- o) Diversify and improve marketing of horticultural produce in order to broaden the export base and minimise the risks of over-reliance on coffee and tea.
- p) Encourage and promote tree crops.

### 5.3.2 Livestock Production

#### 5.3.2.1 Current Status And Issues

Livestock raising is an economically important activity in Kenya. It is widely practised by small holders, commercial ranchers/farmers and nomadic herd-keepers. Small holders and pastoralists keep 93% of all livestock, while the rest is under large scale farms. Livestock production is especially important in the arid and semi-arid lands (ASALs) which support about 25% of the nation's human population and slightly over 50% of the livestock population. The rural labour force survey (RLFS) of 1990 estimated the livestock sector in the country offer about 2.5 million jobs. In the current era of

incipient balance between food supply and demand caused by the pressure of a rapidly increasing population on Kenya's limited area of high potential arable land, the livestock sector will continue to play an important role in sustainable agriculture and food security.

In 1991 beef cattle were estimated to be 8.0 million, but it is assumed to have been reduced by the 1992-1994 drought. Therefore, a deficit of beef products exist since the demand for beef currently stands at over 200,000 tonnes while the supply is about 180,000 tonnes, annually. The dairy herd is approximately three million with a milk output of over two billion litres/ annum which is adequate to satisfy the subsistence and commercial demands.

Sheep and goats have not been significantly improved to take care of shortfall in meat and milk supply, while the camel is grossly under-exploited. In the recent past, pig production has declined and the rabbit as a source of meat has been promoted. Bee-keeping (apiculture) is expanding to provide additional sources of food and income to the farmers.

Livestock activities have, therefore contributed to environmental degradation in Kenya. In arid and semi arid lands, overgrazing has resulted from increases in livestock numbers, changes in grazing patterns and provision of centralised services such as watering points, encroachment of dry grazing areas by cultivators and insecurity.

#### 5.3.2.2 Recommendations

- a) Improve animal health through provision of dips and crushes.
- b) Enhance veterinary services, ensure even distribution, and extend coverage of vaccination campaigns.
- c) Promote research into less expensive curative and pest control methods.
- d) Identify more fodder species, use ASAL-suited plant species (including trees) and establish proper fodder planting material

distribution.

- e) Promote quality fodder and feeds, artificial insemination and bull multiplication centres.
- f) Improve milk collection, cooling and marketing and liberalise milk supply and its marketing.
- g) Encourage zero-grazing and "cut and carry" green fodder production for dairy in humid and sub-humid areas.
- h) Improve livestock production through enhanced breeding, selection and proper husbandry.
- i) Encourage dryland crop residues - agro-industrial waste and low quality forage optimisation.
- j) Promote bee keeping in ASALs by providing credit and encouraging small refineries run on commercial lines under the control of bee keeper societies.
- k) Provide strategically placed water points to minimise overgrazing and over-use of available vegetation, especially in ASALs.
- l) Encourage regeneration measures such as rotational grazing, seeding, seeding desirable and adaptive forage reserves, and planting trees to promote re-establishment of cover in denuded areas.
- m) Encourage water and soil conservation measures including the establishment of drought forage stocks and drought grazing reserves/blocks.
- n) Provide improved marketing services to destock from drought affected areas.
- o) Promote spatial and temporal diversity of feed resources research.
- p) Encourage water-harvesting and where appropriate, irrigation for the production of forage, food and tree products in order to diversify

sources of livestock feed.

- q) Establish legal limits to cultivation in marginal lands which are ecologically better suited for grazing.
- r) Strengthen livestock extension support and promote environmental education through seminars for local leaders and extension staff.
- s) Utilise indigenous (traditional) management systems in research and extension.
- t) Undertake range rehabilitation and pasture improvements programme.
- u) Study and conserve indigenous livestock breeds for useful genetic traits, e.g., trypanotolerance.

### 5.3.3 Agroforestry

#### 5.3.3.1 Current Status And Issues

Agroforestry is a land use system which enables the production of trees, crops and livestock on a given unit of land either in spatial arrangement or over time to maximise productivity and sustainability of the land. Therefore, agroforestry practices should be promoted to diversify cash incomes and enable households to purchase food and enhance management. In the recent past, a lot of emphasis have been placed on agroforestry in collaboration with ICRAF but more still needs to be done.

#### 5.3.3.2 Recommendations

- a) Conserve forest resource in line with national aspirations through research, training and extension of agroforestry land use systems.
- b) Sustain supply of forest products and services.
- c) Sustain agriculture by soil and water conservation and agroforestry, and also by protecting the indigenous forest

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| <p>and other vegetation.</p> <p>d) Alleviate poverty by equitable forest based development.</p> <p>e) Contribute to international efforts to protect the environment.</p> <p>f) Promote agroforestry and rural afforestation programme within the small holder and large scale farming units.</p> <p>g) Undertake strong campaigns in tree planting on private and community lands as a means of maintaining a favourable balance between conservation and production functions of forests.</p> <p>h) Intensify forest research programmes especially on indigenous agroforestry systems and trees.</p> <p>i) Identify and promote the role of agroforestry practices and systems in soil erosion control and maintenance of soil fertility in different agro-ecological zones.</p> <p>j) Exploit the potential of agroforestry technologies in supporting the production of small ruminants including beekeeping and aquaculture with scientists providing information and guidelines to managers of these resources.</p> <p>k) Investigate lesser known products of plants including plant-based chemicals and oils and especially those with potential for import substitution with full community and government participation.</p> <p>l) Document biophysical data on different agro-ecological zones, parallel economic and sociological implications and also evaluate the practical application of agroforestry interventions.</p> | <p>expand cultivation destroys stable ecosystems. Settlements in catchment areas or construction of dams for power and irrigation affects water utilisation downstream. The riparian corridor utilisation has created conflicts between legal requirements and demand for agriculture. Farmers are advised to use agro-chemicals to improve soil fertility and protect crops and livestock in order to increase agricultural outputs. In the process, environmental quality changes. The health of workers involved in these activities is always in danger.</p> <p>Cultural differences among communities sharing a given resource may lead to environmental degradation. Population growth, limited infrastructure, lack of appropriate technologies and proper land use systems have lead to serious resource use conflicts. Wild animals compete with livestock for pastures. Fencing to keep off wild animals from predating on livestock affects their movement and breeding patterns. Insecurity, concentration of social amenities and centralisation of services lead to over-exploitation of resources around the centres.</p> <p>Development of the wildlife utilisation industry, will involve manipulation of wildlife population and at the same time there will be increased interaction between livestock and wildlife. Consequently, there is bound to be an increase in the frequency of disease transmission between wildlife and livestock with devastating effects as it is possible wildlife could be reservoirs of certain disease that are fatal to cattle and the reverse is possible. An example is bovine petechial fever, in which the bushback is a reservoir of the disease while cattle are highly susceptible. On the other hand wildlife could contract diseases such as tuberculosis, brucellosis and rabies from cattle. Such a situation will affect the efficiency of meat production.</p> <p>Wildlife is in constant conflict with agriculture as these animals invade agricultural land and destroy crops. The Kenya Wildlife Service (KWS), the government and the general public recognise this problem and as a result,</p> |
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#### 5.3.4 Resource Use Conflicts

Conflicts in resource utilisation in Kenya is evident. Clearing of woodlands to

KWS is fencing off the game reserves. While this will reduce wildlife-agriculture conflicts, the confinement of the wildlife may increase the incidence of diseases within the wildlife population.

There is an urgent need to minimise conflicts arising from resource utilisation through a harmonious management system.

## 5.4 ACTION PLANS

### 5.4.1 Actions Which Can Be Taken Immediately

- a) Intensify crop yields and reduce dependence on imports by encouraging integrated pest management, multiple cropping, agroforestry and organic compost and manures in agriculture. At the same time, train extension workers in these techniques.
- b) Train users of fertilisers, pesticides and herbicides including extension staff and the general public, on safety and dangers of chemicals.
- c) Encourage optimal livestock production, including high yielding breeds and zero-grazing in some areas and drought and disease resistant breeds in other areas.

### 5.4.2 Some Selected Priority Activities Requiring Funding

- a) Increase and diversify agricultural production by promoting the use of and improving the productivity of indigenous plant species and animal breeds. Provide incentives for farmers to maintain local crop varieties and animal breeds. b) Optimise production on existing land by promoting research into

and adoption of appropriate land use systems and technologies.

- c) Improve fish farming through research, extension and marketing.
- d) Conduct studies on wildlife-livestock disease relationships and multiple land use systems such as wildlife/livestock ranching.
- e) Investigate lesser known plant products, including plant based chemicals, oils, insecticides, fragrances and flavourings, with full community participation.
- f) Assess the viability, rehabilitation needs, environmental impacts and economic costs and benefits of existing and proposed irrigation and drainage schemes.
- g) Avail adequate budgetary resources for adaptive research, training, and extension.

### 5.4.3 Some Long-Term Priorities

- a) Collect and provide information on optimal land uses in various agro-ecological zones.
- b) Integrate environmental considerations and sustainable resource management into all aspects of agricultural development.
- c) Support programmes in which women have traditionally had economic control, including production, marketing and processing. Improve infrastructure facilities to support marketing.
- d) Keep some large farms intact to produce quality seeds, quarantine animals and for research.

## CHAPTER SIX

# DESERTIFICATION AND DROUGHT

### 6.1 CURRENT STATUS

Agenda 21 defines desertification as "land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities", while drought is defined as "the naturally occurring phenomenon that exists when precipitation has been significantly below normal recorded levels, causing serious hydrological imbalance that adversely affects land resource production systems."

The arid and semi-arid lands (ASALs) comprise about 80% of Kenya's total land area, while the remaining 20% are classified as high potential. The ASALs contain about 25% of Kenya's total human population and slightly more than half of the livestock population. About half of the country's districts are classified as ASALs. Most people living in the ASALs are pastoralists although the semi-pastoralists and farming communities are becoming increasingly important.

There is evidence that the ASALs are suffering from an increased rate of desertification and frequent drought. This situation is further exacerbated by the increasing needs of a rising population.

The following issues have been identified as being important in the management of desertification and drought, viz. assessment and mapping of desertification, drought monitoring and early warning systems, land tenure and property regimes, rangeland resource management, socio-economic characteristics and population dynamics, popular participation, research and development, and institutional capacities and coordination.

### 6.2 ASSESSMENT AND MAPPING OF DESERTIFICATION

#### 6.2.1 Issues

The main issues of concern are the methods, scientific and technological knowledge, capacity building, and monitoring. The methods used should take into account the risk, status, rate and hazard of desertification. In addition, appropriate parameters have to be identified and the problem of the scale of the affected area solved. The methodology used so far in Kenya has proved to be very expensive and time consuming.

Scientific and technological knowledge which can be used to assess and map desertification exists in the public domain. However, its applicability is constrained mainly by three factors: equipment, funds and skilled personnel. All these factors are inter-dependent.

Capacity building is a central issue. In the past, technologies used to assess and map desertification have relied only upon modern technical knowledge systems. However, efforts need to be made to integrate the indigenous/ traditional knowledge systems into the process. Local communities are able to identify degraded resources through environmental perception and cultural adaptation. However, these knowledge systems are known to a limited number in any community. Furthermore, most of these knowledge systems are yet to be documented. In fact, the capacity of major groups, particularly women and youth, have limited capacity to participate in combating and mitigating the effects of desertification and drought.

Assessment of desertification should

incorporate a monitoring programme. Appropriate methodology and equipment should be used to assess changes in land use, vegetation cover, water regimes as well as human settlement and demographic patterns. Surveys conducted should be multi-disciplinary, incorporating ground, aerial and space techniques. The aerial and space methodologies are rapid, cost-effective and provide timely data on areas where access on the ground is either difficult or impossible.

### 6.2.2 Recommendations

- a) Use remote sensing techniques because they are relatively cost effective, rapid and the information can be obtained on a periodic basis. The techniques can also be used for long term monitoring and assessment of desertification.
- b) Include socio-economic data in any assessment of desertification process since it is largely induced by human activities.
- c) Document indigenous knowledge systems and technologies used to manage desertification and drought.
- d) Develop a national monitoring programme with district components to assess trends.
- e) Collaborate with relevant international and regional institutions to facilitate the acquisition and development of appropriate technology in the assessment and mapping of desertification. These institutions include the United Nations Environment Programme (UNEP), the United Nations Development Programme (UNDP), the World Bank, the World Meteorological Organisation (WMO), and the Inter-Governmental Authority on Drought and Development (IGADD), to mention but a few.

## 6.3 DROUGHT MONITORING AND EARLY WARNING SYSTEMS

### 6.3.1 Current Status

Studies have shown that droughts are part of the history of this region, cyclical reality whose regularity is not clear. Droughts have thus through the centuries forced people into making essential decisions in order to survive. Thus, traditional pastoralist and farming systems accommodated these recurrent problems in highly adaptive ways.

Droughts generate food deficits, affect water resources, reduce incomes, increase incidence of poverty and sometimes cause human and livestock deaths. Droughts also accelerate the rate of land degradation.

### 6.3.2 Issues

While droughts are natural phenomena and can not be prevented, they can nevertheless be predicted, and mitigating measures put in place before disaster strikes. Recent experience shows that remote sensing techniques and district level monitoring can be used to predict the onset of drought at least several months in advance.

An effective drought management system should involve three phases which include preparatory, mitigatory, and recovery. The recovery stage has been started in Kenya. A fully developed system should rely on continuous long-term meteorological and remote sensing data. The current drought monitoring and early warning capability is constrained by limited professional skills, inadequate rapid appraisal techniques and inaccessibility of the technological packages to process satellite data.

### 6.3.3 Recommendations

- a) Formulate a drought preparedness policy.
- b) Strengthen human and institutional capacities in early

warning and monitoring systems and expand their services to all the ASAL areas.

- c) Strengthen current drought preparedness and recovery programmes and introduce them in areas where they do not exist.
- d) Create awareness of the impact of drought and adaptive and mitigating measures through training, outreach programmes, and seminars.
- e) Link meteorological knowledge to local experience on drought issues.
- f) Improve efficiency in agricultural and food production programmes in drought affected areas through research into higher yielding drought-tolerant varieties of known indigenous crops. Such programmes should incorporate alternatives to diversify diets of pastoral communities.
- g) Create a national drought relief fund.

## 6.4 LAND TENURE AND PROPERTY REGIMES

### 6.4.1 Current Status

The ownership of land is one of the most emotive issues in Kenya. Land tenure may or may not include rights in other properties such as trees, water, pasture and minerals. Complexities arise because tenure systems differ in different communities. It is therefore important that all aspects of land tenure and property rights in different resources, and the distinct proprietary attitudes that affect the productivity of these resources, be studied and understood.

Land in rangelands is predominantly communal. There are functioning membership criteria and communally defined guidelines for resource use. Land adjudication and settlement processes, however, have brought about privatisation of many resources in the ASALs. The shift from pastoralism to

ranching and arable agriculture have resulted in widespread environmental degradation due to reduced dispersal areas and blockage of the natural migration routes of both livestock and wildlife.

### 6.4.2 Issues

Pressing concerns are: access to and right of use of different land resources; land ownership, tenure and productivity; changing property rights; land disputes and legal procedures; and land tenure and gender issues.

Conflicts on land use arise from various production sectors such as agriculture, livestock, wildlife, urban settlement, settlement programmes, etc. Lack of a coordinated land use policy especially for the ASALs lead to competition for the resources within a single geographical area at the expense of environmental conservation. An example is in Chyulu Hills where conflicts arise between the water reservoir for Mombasa, a settlement scheme, water conservation measures, protection of wildlife and environmental protection each of which is administered by a different agency.

Privatisation has changed the traditional value of different properties through the commercialisation of the ASALs resources, bringing about socio-economic differentiations and creating a class of landless people. While privatisation improves access to some factors of production (e.g credit facilities) and incentives to invest on the land, it results in increased settlement, fences and permanent cultivation in and around the key production area (e.g water points, catchment areas and fertile pockets) within the ASALs. It also interferes with local production systems through increased disputes over resources and the creation of uneconomic parcels.

Land disputes have intensified in the last two decades, following increased sensitisation on the value of land. These disputes are a major cause of poor land use practices and have affected productivity through loss of land, and diversion of resources to cover the cost of litigation. Disputes affecting communal

lands include recruitment of new members, exclusion of legitimate members, land leasing and loss of land to community projects. Other disputes which also affect freehold systems include ownership disputes, boundaries, secret sale of family land, sub-division, etc. One cause of disputes that is assuming increased importance is discrepancies between customary, Islamic and national inheritance laws, which place women and children at a disadvantage. Women are not members of group ranches, while it takes a long time to update the register to include sons who have reached the age of maturity.

Regulations governing land use, such as sub-division of agricultural land, the carrying capacity of land, livestock production, cultivation of steep slopes, etc. exist, but are seldom enforced. Land tenure is also discussed in Chapters Two and Eleven.

#### 6.4.3 Recommendations

- a) Conduct a thorough study of the land tenure system in ASAL areas with a view to recommending a fair and workable system.
- b) Assess the impact of adjudication and settlement programmes on land productivity, access to resources by local communities and environmental degradation within ASALs. Get the opinion of local communities about the impact of different forms of land tenure on their livelihood, and the environment.
- c) Study land conflicts and recommend enactment/enforcement of laws that promote proper land use management (including settlement of disputes related to use, adjudication and settlement).
- d) Review inheritance legislation to take into consideration the needs of all community members, including women and children.
- e) Prepare a national land information system to meet the

requirements of all parties that may require land information.

- f) Penalise owners of idle land and/or improve land markets to facilitate leasing of idle land, through protection of property rights and incentives to conserve the environment.
- g) Discourage the attitude of viewing land ownership as the best form of social security.
- h) Establish environment monitoring units in all institutions whose activities lead to environmental degradation.

## 6.5 RANGELAND RESOURCE MANAGEMENT

### 6.5.1 Issues

The quest for more land has led to a shift from the predominantly communal land ownership in the ASALs to the freehold individual ownership system. In some areas increased fencing of privatised land has blocked the natural migration corridors for wildlife and livestock.

Proper range management practice advocates grazing in the appropriate season distributing the animals well over the rangelands; and reducing livestock numbers in rangelands suffering from desertification and periodic droughts. Despite the obvious occurrence of over-grazing, voluntary reduction of livestock numbers is rare; reductions occur through animal deaths in times of drought. Land degradation resulting from the removal of vegetation cover remains a common problem in rangelands.

From the pastoralists' point of view, the rangelands are threatened by agriculture, annexed by the state of development projects and misappropriated by a new type of livestock owner-investor. In addition, pastoral systems are losing their identity and are often misunderstood. An increasing number of pastoralists are becoming paid herders, hired by absentee owners, instead of the independent entrepreneurs and decision-makers they

used to be. as paid workers, they have little motivation to improve the management of the rangelands. This has led to larger herds which are less mobile and more concentrated around wells and principal towns and markets, leading to increased degradation of rangelands.

Experts often fail to appreciate the implications of cultivating fertile pastoral land, which are used by pastoralists during the dry season. Too often the outcome of the rangeland development programs has been the emergence of systems that are more prone to degradation, less efficient, less productive and less equitable than the ones they replaced.

Water for people and animals is crucial for the development of rangelands. Inadequate water supplies are a characteristic of the ASALs but this has been exacerbated by interruption of water systems through damming, direct abstraction of water, and degradation of water catchment areas. Water resources have also been constrained by sand harvesting which has resulted in the drying up of streams. The sand acts as a protective shield against evaporation thus conserving water that is used by the local communities for livestock and household needs. The removal of this sand for construction purposes mainly in urban areas, leaves a dry rocky river bed that cannot store water for the dry season, leading to a lower water table.

Insecurity in ASALs has created concentration of settlements, leaving extensive areas unexploited, while the settled ones are over-exploited.

#### 6.5.2 Recommendations

- a) Allow adequate flow downstream in basins where damming of the rivers has taken place.
- b) Provide sufficient water through harvesting technologies that are sustainable and environmentally friendly.
- c) Protect water catchments by maintaining the vegetation cover and curbing sand harvesting.

- d) Encourage conventional range improvement techniques such as range re-vegetation, managed bush fires, bush clearing and water development.
- e) Formulate development policies in the ASALs emphasising the participation of the local communities and the alleviation of poverty.
- f) Improve security in the ASALs so as to reduce pressure exerted on areas which are relatively secure.
- g) Promote integrated, multiple use of range resources.
- h) Strengthen cooperatives to provide technical advice.

## 6.6 SOCIO-ECONOMIC CHARACTERISTICS AND POPULATION DYNAMICS

### 6.6.1 Current Status

The arid and semi-arid districts of Kenya are characterised by a limited natural resource base and a low carrying capacity. Nevertheless, an estimated 25% of the country's population live in these districts. In addition, most of the country's livestock and wildlife are found in the ASAL districts. Wildlife is a significant tourist attraction, and tourism is a major source of foreign exchange for Kenya. Owing to the low carrying capacity of the ASALs, a relatively small increase in population has a marked effect; as such an increase can result in the over-exploitation of resources.

The population growth rate in ASALs is heavily influenced by migration. Due to high population densities in the high potential areas, more and more people are moving into the ASALs in search of farming land and employment opportunities. Other factors which affect population dynamics in the ASALs include temporary emigration of pastoralists in search of such primary services as water, education and health; displacement of pastoralists to allow for

agricultural expansion or urbanisation; and in recent times the influx of refugees from neighbouring countries.

#### 6.6.2 Issues

The immigrants into the ASALs from high potential areas bring with them the land use practices which they are familiar with. Most of these practices are inappropriate for the ASALs and lead to land degradation. The immigrants also disrupt the indigenous management systems which are based on appropriate and locally adapted technologies. Clearing land for cultivation, for example, increases evaporation from the soil surface.

The expansion of agriculture, urbanisation, and gazettement of land for conservation purpose have displaced pastoralists. The displaced population is forced to over-exploit the limited rangelands still available to them. The introduced activities often have a negative impact on the environment. The growth of urban centres within the ASALs, especially district headquarters has concentrated human and animal population in the vicinity of these centres. This has led to environmental degradation.

The movement of refugees are unplanned, and the affected people settle in camps which do not have adequate infrastructure. This leads to over-exploitation of available resources. Later, when people return to their traditional homes, they tend to settle near water points, leading to devegetation and soil erosion.

Desertification and drought have a direct bearing on household welfare; welfare levels in turn have a major influence on human attitude towards the environment. Poor households place a high priority on livelihood and survival strategies and not development or conservation measures. People are forced to fell trees for fuel, construction, charcoal burning for commercial/domestic purposes and may not have the incentive to conserve the environment.

#### 6.6.3 Recommendations

- a) Promote alternative means of livelihood to reduce the impact of cultivation and livestock activities on ASAL lands.
- b) Promote awareness on human impact on the environment, and technologies available to mitigate that impact.
- c) Provide incentives for individuals and groups for conserving biodiversity and water resources, and preventing soil erosion.
- d) Develop infrastructure for marketing of livestock, honey, and other ASAL products.
- e) Encourage the use of energy-saving technologies and determinative forms of energy, especially solar cookers and wind pumps.
- f) Promote industrial and trade skills as an alternative to agriculture in high potential areas.
- g) Take environmental costs into consideration in the management of refugee settlements.
- h) Develop physical and social infrastructure of ASALs.

#### 6.7 COMMUNITY PARTICIPATION

##### 6.7.1 Issues

Desertification and drought are environmental problems whose solutions call for concerted efforts at all levels of society.

Past and present desertification and drought projects are run either by the government or NGOs. Thus the people, who are the beneficiaries, are passive participants. Absence of community involvement in all stages of project development means that the project cannot be sustained after the government

or the NGO has withdrawn. Its sustainability is further weakened by the fact that since the community is not involved, the project fails to incorporate traditional values as well as socio-economic, political and environmental realities into the programme.

With regard to identification of programmes, a "top-down" approach has been used instead of popular participation. This is also true of research, design, implementation, and evaluation of projects.

It is important to identify priority target groups. In particular, there is need to involve such major groups as women and youth. Among users and managers of natural resources, women are usually in the frontline. For example, they are the majority among those who till the land, gather woodfuel and fetch water.

On the other hand, the youth are a threat to the environment through livelihood activities such as charcoal burning and timber harvesting. The situation is compounded by degradation of cultural practices that ensured sustainable resource management.

The process of desertification can be accelerated by imposition on local communities of inappropriate land use practices in ecologically fragile areas. Therefore, there is need to empower indigenous communities of such areas in the decision-making process.

To ensure that desertification and drought projects remain viable and sustainable, there is need to involve local people through encouragement and facilitation.

For more discussion of Community Participation, see Chapter 9, Public Participation.

#### 6.7.2 Recommendations

- a) Involve local communities in information collection and identification of problems that require research.
- b) Involve project beneficiaries fully

in the planning, implementation, monitoring and evaluation of the projects.

- c) Use culturally acceptable participatory methods at all stages of the development process to ensure that the interaction between local people and development agencies are not conflicting.
- d) Intensify public education and awareness on all projects, policies, and programmes, especially those that directly affect them.
- e) Promote participatory management of natural resources, including rangelands to meet both the needs of rural populations and conservation purposes based on innovative and indigenous knowledge and technologies.

## 6.8 INSTITUTIONAL ARRANGEMENTS

### 6.8.1 Issues

Kenya has numerous institutions addressing the issues of desertification and drought. They range from local grass roots institutions (churches, women and youth groups, and group ranches); local NGOs; government ministries; to international organisations. These institutions look at the problems from a narrow sectoral perspective depending on their specific area of interest.

There has been little coordination of activities among the institutions involved in desertification and drought. This has led to the inevitable duplication of efforts. Coordination and harmonisation is weak between government departments and almost absent among NGOs. It is therefore necessary to promote cooperation and exchange of information among these institutions, particularly through coordination and harmonisation of programme and project implementation.

Research and development work on desertification and drought have dealt

with symptoms and not root causes. In addition, research on desertification and drought has not been given priority.

#### **6.8.2 Recommendations**

- a) Strengthen the capacity of research institutions working on drought and desertification.
- b) Conduct all desertification and drought projects on sound scientific and technological basis. In addition, environment impact assessments based on socio-economic bias and hard data should be carried out before the commencement of these projects.
- c) Train extension staff in technologies that are environment-friendly and appropriate to the ASALs.
- d) Create or strengthen rural organisations in charge of village and pastoral land management.
- e) Co-ordinate all actors (government, NGOs, universities, research institutions, and the community) in all desertification and drought projects.

### **6.9 ACTION PLANS**

#### **6.9.1 Assessment and Mapping of Desertification**

##### **6.9.1.1 Actions Which Can Be Taken Immediately**

1. Identify and document indigenous knowledge used to assess desertification.
2. Encourage participation and build capacity of local communities through public awareness and education.

##### **6.9.1.2 Some Selected Priority Activities Requiring Funding**

1. Conduct inventories of natural resources (soil, water and vegetation) and their state of

degradation based primarily on the knowledge of the local population.

2. Build capacity and strengthen, harmonise and coordinate all institutions involved in assessing and monitoring desertification.
3. Develop simple technologies of assessing and monitoring desertification at local level and provide appropriate technical support.

#### **6.9.1.3 Some Long-Term Priorities**

1. Use remote sensing techniques which are cost effective, as well as socio-economic data and indigenous knowledge systems, for long-term assessment and monitoring of desertification.

#### **6.9.2 Drought Monitoring and Preparedness**

##### **6.9.2.1 Actions Which Can Be Taken Immediately**

1. Link meteorological knowledge to local experience related to drought occurrence, frequency and duration.
2. Evaluate, appraise and document the current capabilities of drought monitoring and early warning systems.
3. Increase public awareness on drought issues at the local level.

##### **6.9.2.2 Some Selected Priority Activities Requiring Funding**

1. Strengthen the government's ability to alleviate the effects of drought, such as the Drought Recovery Programme.
2. Provide community based and sustainable water supplies.
3. Strengthen environment monitoring systems through expansion of national meteorological and hydrological

networks and improve range resources monitoring systems.

4. Expand water conservation and rehabilitation measures backed by water monitoring using rapid appraisal techniques such as GIS and remote sensing.
5. Establish early warning and food information systems at district level and link them to those at national and sub-regional levels.
6. Create a national drought relief fund.

#### 6.9.2.3 Long Term Priorities

1. Develop appropriate guidelines for the formulation of national drought-preparedness.
2. Introduce appropriate water resource harvesting, conservation and development technologies.
3. Conduct pertinent research and development.
4. Use appropriate remote sensing and GIS technologies in monitoring drought in ASALs.

#### 6.9.3 Land Tenure and Property Regimes

##### 6.9.3.1 Actions Which Can Be Taken Immediately

1. Support multiple land use system in ASAL.
2. Penalise owners of idle land, for example through taxation, and improve land markets to facilitate leasing. Lease transactions should be properly documented to protect the leasee from laying claims to ownership rights on the same land later on.
3. Review land adjudication and settlement programmes and their impact on environment in terms

of: optimal acreage for each ecological zone; access to protected resources by the communities adjacent to them; and conflicts between different land uses that co-exist geographically.

4. Review laws and practices that govern land disputes and other land use practices.
5. Articulate desertification and drought control programmes with due regard to diverse tenure system.

##### 6.9.3.2 Some Selected Priority Activities Requiring Funding

1. Survey and document, in an easy retrieval system, land resource information vital to planners, decision makers and researchers.
2. Establish the impact of different forms of land tenure on livelihood and environmental protection.
3. Adopt planning procedures that conform with environmental conservation measures. Establish environmental monitoring units at all institutions whose activities lead to environmental degradation, especially in the ASALs.
4. Promote participatory management of natural resources, including rangelands, to meet both the needs of rural populations and conservation purposes, based on innovative and adapted indigenous technologies.

##### 6.9.3.3 Some Long Term Priorities

1. Alleviate poverty among communities in areas prone to desertification and drought through access to land resources.
2. Streamline the land use planning procedures to put into consideration sustainable land use

practices and technologies with the ASALs.

#### **6.9.4 Rangeland Resources Management**

##### **6.9.4.1 Actions Which May Be Taken Immediately**

1. Involve local communities in the planning and implementation of development projects.
2. Involve the local communities in decision-making especially in issues related to changes in use and improvement of pasture.
3. Provide adequate flow downstream to sustain ecological systems and agricultural activities of communities living downstream of a dammed river system.
4. Encourage local communities to support security measures that facilitate extensive use of range resources.
5. Take into account the environmental costs when planning refugee settlements.

##### **6.9.4.2 Some Selected Priority Activities Requiring Funding**

1. Strengthen capacity building in integrated water resources management.
2. Make use of both indigenous management systems and conventional range improvement techniques to maintain and restore rangeland productivity.
3. Improve socio-economic and physical infrastructure, including improved marketing for ASAL products.

##### **6.9.4.3 Some Long-Term Priorities**

Sensitise local communities on maintaining strategic herds according to changing environmental capacity, based

on early warning systems. Create an enabling environment for marketing of subsequent excess stocks in time and space. Plan for livestock breeding projects for herd replacement and restocking in times of improved vegetation and environment.

#### **6.9.5 Socio-Economic Characteristics and Population Dynamics**

##### **6.9.5.1 Actions Which Can Be Taken Immediately**

1. Promote alternative income generating activities, besides livestock and agriculture, in order to reduce pressure on pastures and natural vegetation.
2. Promote industrial trade in high potential areas to minimise migration to marginal areas by encouraging training in industrial and trade skills.
3. Intensify public education and awareness.

##### **6.9.5.2 Some Selected Priority Activities Requiring funding**

1. Promote the use of energy saving jikos such as solar cookers as alternatives to woodfuel; diffuse information regarding biogas technology; promote the use of wind energy in pumping water or to generate electricity.
2. Provide incentives for individuals conserving biodiversity, water resources and preventing soil erosion.
3. Develop physical and social infrastructure in ASAL areas. Put in place infrastructure to enable displaced pastoralists to initiate economic activities.
4. Enhance extension services in ASAL areas.
5. Support alternative livelihoods with improved transport and marketing.

**6.9.5.3 Some Long-Term Priorities**

Change current attitude of putting too much value on land ownership as a source of social security.

traditions which could otherwise hurt cultural norms.

2. Support marginalised groups to organise themselves to represent their interests.

**6.9.6 Popular Participation**

**6.9.6.1 Actions Which Can Be Taken Immediately.**

1. Use culturally acceptable participatory methods at all stages of the development process to ensure that the interaction between local people land development agencies is on a proper footing, and to reduce issues impinging on local

**6.9.6.2 Some selected Priority Activities Requiring Funding**

1. Involve local communities in information collection and identification of the problems that require research.
2. Intensify public education and awareness on all the projects, policies and programmes that affect them.

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## CHAPTER SEVEN

# ENVIRONMENTAL POLLUTION AND WASTE MANAGEMENT

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### 7.1 INTRODUCTION

Pollution is the presence in the environment (air, water and land) of contaminants in quantities, characteristics and duration such as to be injurious to human, plant or animal life or to property or which unreasonably interferes with the comfortable enjoyment of life and property.

Historically, people have assumed that the land, water and air around them would absorb all their wastes. Thus, they have viewed the earth, the oceans, the rivers, the lakes and the atmosphere as receptacles of infinite capacity. However, it is now quite clear that people may be exceeding nature's capacity to assimilate their waste.

Indiscriminate emission of gases and fumes into the atmosphere, improper storage, transportation and disposal of liquid and solid wastes, including hazardous wastes, have polluted the environment, particularly surface and underground water, air and soil. The pollutants have been generated by various human activities such as transport, industry, the use of chemicals in agriculture, public health, households and food production and preservation. Activities that pollute the environment should be identified in order to develop strategies to manage their impact on the environment. Continued pollution can have irreversible effects on the environment, some of which can be devastating to life. Some of the anticipated adverse effects on the environment include climate change, ozone depletion, acid rain, water pollution and soil degradation.

### 7.2 GASEOUS EMISSIONS

#### 7.2.1 Current Status

In the past two centuries, human activity

has greatly increased the release of gases into the atmosphere. Gaseous emissions are primarily generated by the industrial and transportation sectors, through the burning of fossil fuels such as fuel oil, petrol, diesel, coal, natural gas and liquified petroleum gases and the production and use of chemicals. Significant emissions from industry include oxides of nitrogen ( $\text{NO}_x$ ), carbon monoxide (CO), carbon dioxide ( $\text{CO}_2$ ), oxides of sulphur ( $\text{SO}_x$ ), unburnt hydrocarbons (3HC), and particulate matter.

Over the years, burning of fossil fuels, cutting of forests and ploughing of grasslands has released enormous amounts of carbon dioxide. Other sources of gaseous emissions include construction, quarrying and agricultural activities and natural sources such as volcanic eruptions.

#### 7.2.1.1 Climate Change

Solar radiation received at the Earth's surface provides the energy that fuels all life on Earth. Being a very hot star (6000 K), the sun produces shortwave radiation, most of which penetrates the Earth's atmosphere and reaches its surface but some of which is scattered or absorbed during passage through the atmosphere. The earth itself emits radiation but, being much cooler than the sun, does so at longer wavelengths. If the earth had no atmosphere, and was completely transparent to this outgoing longwave radiation, then its temperature would probably be only about  $-18^\circ\text{C}$  (about the same temperature as the planet Mars which has no atmosphere). Fortunately the earth's atmosphere contains a number of gases that tend to absorb, and thus block, part of the outgoing longwave radiation while allowing passage of much of the incoming shortwave radiation. This is enough to raise global surface temperatures by some  $33^\circ\text{C}$  to a much more comfortable average of  $15^\circ\text{C}$ . The

atmosphere thus acts as a warming envelope in much the same way as the glass of a greenhouse, and the "greenhouse gases" of the atmosphere (largely carbon dioxide, water vapour and other trace gases) are thus crucial to life on this planet.

This is called the greenhouse effect. The implications of the impending climate change, especially variation in rainy and dry seasons, are bound to greatly affect socio-economic activities. Agriculture, livestock, water resources, energy, fisheries, tourism and wildlife are some of the sectors especially vulnerable to climate change.

But increases in concentration of greenhouse gases can upset the earth's radiation balance, with more of the longwave radiation being absorbed in the lower atmosphere and some of this being re-emitted back to the earth's surface. This enhanced greenhouse effect could cause increases in the earth's surface temperature great enough to threaten many of its life forms.

Most CO<sub>2</sub> emissions are derived from industrial burning of coal, oil and other fuels. Currently, it is estimated that motor vehicles account for 15% of all CO<sub>2</sub> released into the atmosphere. Air traffic alone produces 2.6%.

Forests and undisturbed grasslands take up large amounts of carbon dioxide in the process of photosynthesis. Forests can thus act as "carbon sinks," absorbing some of the carbon dioxide emissions from industry and transport. In pasture, however, the carbon dioxide is released by the cattle.

#### 7.2.1.2 Health Impacts

Gaseous emissions are associated, among other things, with the problem of ozone layer depletion. A layer of ozone gas (a form of oxygen) high above the earth protects the earth from some of the sun's ultra-violet rays. However, chemicals produced by industrial processes, such as chlorofluorocarbons (CFCs), halons and methyl bromide, are damaging this ozone layer, thus allowing more ultra-violet rays to reach the earth, threatening

human health. Extra radiation is expected to increase incidences of cancer, and may also cause an increase in mutations.

CFCs are important in the manufacture of computers and air conditioning and refrigeration equipment. Therefore, if Kenya and other developing countries wish to industrialise, they should have access to recent manufacturing processes which do not use CFCs.

Carbon monoxide is produced mainly from incomplete burning of fuels in vehicles. In rural homes, it is produced when wood fuel is burned without enough oxygen. Carbon monoxide is a very toxic gas with adverse effects on human health. At high concentrations of 100 parts per million (ppm) and above, damage is caused to the central nervous system and with increased exposure death results from by asphyxiation. In pregnant mothers, it hampers mental and physical development of the foetus.

Most households in Kenya use wood fuel - firewood and charcoal - for cooking and heating. Burning wood fuel produces carbon dioxide, of course, but also particulate matter, hydrocarbons, and sometimes carbon monoxide. Exposure to these substances in the enclosed space of rural homes can cause respiratory ailments and other long-term problems.

Hydrocarbons are chemicals made of carbon and hydrogen. Major sources of emissions are the burning of petrol, diesel, ethanol, and coal, enteric fermentation in domestic ruminants and rice paddies. Their emission is increasing in Kenya through on-going industrialisation and the rapid increase in the transportation industry. Methane (CH<sub>4</sub>), which is also produced in nature, is one of the greenhouse gases.

Hydrocarbons may produce volatile organic compounds (VOCs) which when mixed with other chemicals (SO<sub>2</sub>, NO<sub>x</sub>) in sunlight, produce smog and particulate matter which are a hazard to human health. Some aromatic hydrocarbons such as benzene and toluene are carcinogenic. Others like ethylene and propylene help to form concentrations of ozone in the presence of sunlight. While the ozone

layer high in the atmosphere protects living things from ultra-violet rays, ozone concentrations at ground level is injurious to human health.

Particulate matter has two sources, biogenic and anthropogenic. Biogenic matter include wind blown dust, sea spray, pollen, forest fires and volcanic eruptions. Anthropogenic particulate matter are soot and dust from industries, fuel combustion and motor vehicle emissions. Industrial particulate matter may include toxic trace metals such as arsenic, lead, cadmium and mercury.

The most important source of lead emission in Kenya is the transportation industry where lead is added to petrol as tetra ethyl to enhance performance and increase fuel economy. Other important sources are industries such as metal smelting, battery manufacture, electrolysis, electroplating and paint industries. Minute quantities of lead are also a natural component of food and drink. This widespread use has resulted in undue exposure to lead among persons working with it as well as the general population.

Lead enters the body through either the gastro-intestinal or respiratory tract. Part of it is stored in bones, teeth and soft tissues, including those of the brain. Lead compounds are known to cause neurological disorders, brain injury, learning disabilities, damage to kidneys, liver, reproductive systems, and to impair blood formation.

Cadmium is a relatively rare metal, which is used in electro-plating and the manufacture of batteries. Cadmium is toxic to human beings, plants and animals. Inhalations of cadmium fumes can produce acute pneumonitis, and long-term exposure to high concentrations of cadmium damages the kidneys. Cadmium may be released into the environment when used batteries are thrown away.

Chlorine is used in pulp and paper making, and becomes a pollutant when released into the environment. Chlorine gas is highly poisonous, and also helps to deplete the ozone layer.

Nitrogen oxides, volatile organic compounds (VOCs) and sunlight form ozone and other oxidants which together with aerosols form photochemical smog, which causes respiratory ailments.

Smoking of cigarettes is another source of air pollution. The chemicals in tobacco in cigarettes have a carcinogenic effect on the smoker, and, to a certain extent, on those who breathe the smoke.

### **7.2.1.3 Environmental Pollution**

Noxious gases are produced by various industrial processes. Some of them affect the communities immediately surrounding the industry. Tall chimneys which take the gaseous emissions higher into the air only postpone the damage. The chemicals in the air mix with water vapour to form "acid rain", sometimes falling thousands of kilometres away from the source of pollution. Sulphur dioxide is produced by industry and by the burning of petrol and diesel containing sulphur (1% sulphur is allowed in petrol in Kenya). It is one of the chemicals that forms acid rain and also combines with other gases to form smog. Methyl bromide is used in agriculture as a fumigant for soil and structures. Bromine, the active part of methyl bromide, is a powerful ozone-layer depleting substance. Its use is now being phased out.

Emissions from burning fossil fuels in internal combustion engines such as vehicles cause heavy localised pollution in urban centres. As Kenya becomes more urbanised and industrialised, it will have to address a growing problem of air pollution. In Nairobi in particular, air pollution will soon become a major problem. The sight of matatus, mini buses, and lorries, as well as industrial chimneys, spewing black smoke are common. The city lies on a high plateau with a ridge of hills to the west. The industrial area is located to the east of the city, and the prevailing winds come from the east. Gaseous emissions from industries and vehicles are thus trapped against the western hills, and sometimes form a cloud of smog over the city.

Forest destruction, an activity which can

be controlled, results in the release of large volumes of carbon dioxide, which in turn is one of the causes of global warming, while undisturbed forests act as "carbon sinks," absorbing carbon dioxide.

### 7.2.1 Management Issues

The management of gaseous emissions is shared by a number of ministries who administer it from only their narrow sectoral concerns as defined within their legislative framework. For example, there are no agreed modalities for disposal of emitted gases. Therefore, there is need to review existing legislation in order to harmonise gaseous emissions management.

The problems of management are compounded by inadequate supply of suitable equipment and competent personnel to fully assess gaseous emissions, and institutional arrangements that are neither sufficiently developed nor equipped to fully manage gaseous emissions. The public also needs to be better informed on the dangers of gaseous emissions, and their management.

Kenya is one of the six countries to host Global Atmosphere Watch (GAW) stations and is a party to the Montreal Protocol on the consumption of CFCs and all ozone depleting substances. Total ozone measurements are carried out in Kenya. However, there is no inventory of sources of gaseous emission and there is inadequate information on the characteristics of the gases emitted. The impact of these gases on the environment, particularly with respect to human health, natural ecosystems and climate, is not well documented. Perhaps, the weakest link is the lack of a comprehensive policy and supporting legislation.

### 7.2.2 Recommendations

- a) Inventory the sources of gaseous emission; collect and document information on the characteristics of these gases, and establish a data base.
- b) Develop and initiate projects that

assess the impact of gaseous emissions on environment, and especially on human health, natural ecosystems, and climate.

- c) Formulate a comprehensive and well-articulated policy on control and management of gaseous emissions.
- d) Enact comprehensive legislation on control and management of gaseous emissions.
- e) Train personnel in gaseous emission control and assessment; and provide the trained personnel with equipment they require to effectively carry out their tasks.
- f) Use regulations, education and awareness to reduce exposure to cadmium and lead.
- g) Phase out use of CFCs and find alternative chemicals to use.
- h) Consider reducing duties on protective clothing and equipment used in controlling gaseous emissions.
- i) Provide incentives and penalties to industry to reduce gaseous emissions.
- j) Establish monitoring stations to record gaseous emissions.
- k) Take prevailing winds into consideration when siting industries.
- l) Create an institution to deal with environmental pollution management, with a specific department charged with management and control of gaseous emissions. It should be headed by an appropriately trained professional who should enjoy a large measure of autonomy.
- m) Educate the public and enlist the support of the mass media about international conventions and

protocols on the environment, and in creating awareness on the dangers of gaseous emissions.

- n) Intensify forest protection and reforestation to provide carbon dioxide sinks.
- o) Create green belts around all towns to act as carbon sinks.
- p) Co-operate with international initiatives to assess and monitor causes and effects of global warming and climate change. Assess available information on impacts of climate change on ecosystems and human development and formulate response strategies and options to mitigate or adapt to climate change.

### 7.3. LIQUID WASTES

#### 7.3.1 Current Status

The fast growing population has increased demand for expansion of urban, agricultural and industrial activities.

This has led to vast amounts of waste being generated and dumped into the environment untreated due to poorly operated treatment works. The unplanned development of small scale enterprises (Jua Kali) has increased discharge of pollutants including petroleum wastes into lakes, rivers and other water bodies. This has often led to pollution of the water systems upon which life depends. Water abstraction close to points of waste discharge as is the case in a number of areas in Kenya is a potential health hazard.

The continued indiscriminate disposal of effluents is likely to have a serious pollution effects on the environment. Examples of such effects include the contamination of streams resulting in limited utilisation of downstream waters, the destruction of fisheries and the elimination of agricultural activities in the vicinity of industries.

#### 7.3.2 Sources And Characteristics Of Effluents

Liquid wastes can be classified according to their sources and characteristics as industrial waste, urban (municipal) waste, and agricultural waste.

##### 7.3.2.1 Industrial Waste

Industrial effluents may be discharged from industries such as food industries, textile and paper industries, petroleum industries, chemical industries, and engineering works. Effluents from food industries such as canning, brewing, dairy, meat, sugar, coffee, tea, fruit, vegetable and miscellaneous food processing usually consist of biodegradable organic wastes with no toxic components.

Effluents from textile, leather and paper industries have the following common pollutants: alkali which causes pH to rise, suspended solids and toxic metals such as chromium. Effluents from petroleum refineries comprise of phenols, oil, grease and suspended solids. Effluents from chemical industries have various sources such as those producing basic chemicals, fertilisers, pharmaceuticals, preservatives, batteries, and dye-stuffs. Its pollutants include phenols, solvents (acetone, benzene and alcohols), acids, alkalis, ammonia, biodegradable wastes, chromium and other metals. Effluents from engineering works include electronics, metal finishing and transport systems. The pollutants consist of acids causing pH depression, suspended solids, cyanide, chromium and other metals.

##### 7.3.2.2 Municipal (Urban) Effluents

Municipal effluents originate from domestic activities, institutions such as schools and hospitals as well as runoff from pavements. Municipal waste waters have relatively small concentrations of suspended and dissolved organic and inorganic solids. They contain oil and grease from domestic wastes and ammonia from domestic sewage. Among the organic substances present in domestic effluents are carbohydrates,

lignin, fats, soaps, synthetic detergents and their products. Municipal effluents also contain a variety of inorganic substances from domestic and industrial sources. Some of these are potentially toxic such as arsenic, cadmium, chromium, copper, lead, mercury, and zinc.

### **7.3.2.3 Agricultural Effluents**

Agricultural effluents contain agrochemicals such as fungicides, insecticides, herbicides, acaricides, effluents from animal feed-lots and runoff containing fertiliser. All these have a polluting effect on the receiving waters. Modern intensive methods used in raising cattle, poultry and pigs produce significant effluents which when released to waterways have a number of adverse effects including depletion of dissolved oxygen and the increase of nitrogen contents. Runoff from fertilised land may contain a variety of chemical substances including nitrates and phosphates. Water drained from irrigated areas usually have a higher concentration of dissolved solids than from the normal stream.

### **7.3.3 Impacts Of Effluents On The Environment**

Indiscriminate disposal of effluents has had serious effects on many water systems, impairing the quality and usefulness of such waters. Some of such effects include: oxygen depletion, toxicity, and sources of disease vectors.

#### **7.3.3.1 Oxygen Depletion**

The principal causes of oxygen depletion in water are organic wastes from raw or partially treated sewage, wastes from agricultural operations such as animal feed-lots, and the processing of foods. As the organic matter decay in water they use up oxygen. As the oxygen dissolved in water decreases, aquatic life is affected and may eventually die. When all the dissolved oxygen is used up, anaerobic micro-organisms convert sulphur into hydrogen sulphide and the water takes an offensive foul-smelling characteristic rendering it useless for many productive or recreational purposes.

Effluents containing phosphates and nitrates cause excessive weed and algal growth which affect water movement and inhibit the dissolving of oxygen from the air. As the growths decay they consume oxygen and in its extreme form this process leads to eutrophication of lakes and slow moving water bodies.

#### **7.3.3.2 Toxic Materials**

The discharge of significant quantities of toxic materials into receiving waters make it unfit for water supply and recreational purposes. It has also a marked effect on the flora and fauna. Some of the toxic materials often discharged into water include: chromium from tanning or plating processes; cyanide from metal finishing; boron compounds from detergents which have deleterious effect on waters used for irrigation; pesticides and fertiliser from agricultural runoffs; acids and alkalis which are often lethal to plant and animal life; radioactive nuclides discharged from laboratories and hospitals; and wastes having significant heat content which can quickly change the temperature of the receiving waters and alter the biological balance.

#### **7.3.3.3 Public Health Impacts**

Raw or partially treated sewage when discharged into water bodies or soil may cause diseases such as cholera, typhoid and dysentery.

#### **7.3.4 Issues**

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 harmonised and thus they do not provide for efficient management. Penalties are usually too low to be effective deterrents. The statutes include the following: the Water Act; the Public Health Act; the Pest Control Product Act; the Radiation Protection Act; the Mining Act; and the Factories and Other Places of Work Act.

Constraints to effective waste management include: lack of discharge standards and methods for measuring

the quality and quantity of effluents and accordingly fining the polluter; lack of adequate sewerage networks and treatment facilities; and lack of incentives to adopt recycling technologies.

Waste water management is not widely adopted among industries in Kenya. This is because the costs involved are high and the direct benefits to the manufacturer are considered minimal. With appropriate research, development and incentives, however, some useful materials can be recovered from waste waters and re-used; or useful by-products can be produced, thus conserving resources.

A low-input method of treating liquid wastes which is gaining in popularity is called a constructed wetland. Raw sewage is mixed with bacteria and passed under vegetation and under the surface. Then it passes through a number of pools bordered with vegetation. The bacteria and plants remove the pollutants.

### 7.3.5 Recommendations

#### 7.3.5.1 Policy and Legislation

- a) Formulate a national policy based on the principle that no one has uncontrolled right to pollute the natural waters.
- b) Prepare strategies to control pollution by effluents, e.g, requiring that all polluting industries have liquid waste treatment facilities; and formulate incentives to encourage waste treatment and recycling.
- c) Review environmental regulations and enforcement under the ministries in charge of local government, health and water to improve their effectiveness in controlling and alleviating water pollution.
- d) Constantly review and update the water standards regulations as provided under the Public Health Act and/or Water Act, and keep enforcement officers informed of the amendments.

- e) Review penalties under the law with a view to making them more deterrent.
- f) Require environmental impact assessment before any industrial or other project is approved for implementation.

#### 7.3.5.2 Pollution Control

- a) Replace current initiatives on liquid waste management that focus on disposal options (i.e, end of the pipe solutions) with those that conserve resources, such as waste minimisation, avoidance and recycling.
- b) Improve industrial operations and use raw materials with a high rate of conversion to products in order to reduce the amount of waste.
- c) Reduce the quantity of waste for subsequent treatment by segregating strong wastes, which might allow the bulk of relatively unpolluted waste water to be discharged without treatment.
- d) Formulate and implement a method of charging for pollution that covers both the quality and quantity of effluents. Make the polluter pay for his/her load of pollutant, i.e., adopt the "polluter pays principle" option.
- e) Develop a culture where re-use of materials which can be recycled becomes routine.

#### 7.3.5.3 Waste Water Treatment and Disposal

- a) Treat all effluents to a level not exceeding the assimilation capacity of the receiving waters.
- b) Rehabilitate existing waste water treatment systems that are inefficient and/or inadequate.
- c) Provide funds for the sustainable maintenance and operation of treatment facilities.

- d) Locate water abstraction points away from effluent discharge points.
- e) Study and adopt innovative, low-input methods of waste water treatment, such as constructed wetlands.
- f) Encourage recycling of waste water.

#### 7.3.5.4 Human Resource Development, Research and Development and Environmental Education

- a) Establish proper mechanisms for the training of personnel to monitor water quality and enforce regulations.
- b) Assess human resource needs to identify the gaps and emerging challenges.
- c) Involve local communities, and particularly women and youth groups, in the management of waste water, waste avoidance and recycling.
- d) Plan and implement a national awareness programme on the management of waste waters from industry, local authorities and agricultural activities. This programme would inculcate appropriate attitudes and values and capabilities necessary for positive environmental action.
- e) Require research institutions to report annually on their activities regarding waste minimisation, waste avoidance, waste recycling, waste treatment and waste disposal.
- f) Promote more judicious use of agrochemicals and toxic industrial substances.

#### 7.3.5.5 Collaboration

- a) Harmonise standards and control regulations relating to waste waters with countries that share water sources/courses.

- b) Monitor water systems which cross political boundaries regionally to avoid environmental disasters and conflicts.

#### 7.3.5.6 Incentives to Industry

Assist industries to contribute to the management of the environment by extending incentives, e.g., tax-rebate on equipment, chemicals and technologies (patents, licences, consultancies etc) to be used in waste water management; and by involving industry in planning and management.

### 7.4 SOLID WASTES

#### 7.4.1 Current Status

Solid wastes include trade wastes, agricultural wastes, institutional wastes, domestic wastes, construction debris and waste from mining operations. Most local authorities give priority to water, giving little attention to solid waste management. Garbage is thrown on the roadsides, while at the disposal sites, it is dumped without due care. Currently these sites are breeding places for flies, mosquitoes and rodents; they are sources of smell nuisance due to decomposing organic matter; they block canals and drainage systems; they contaminate ground and surface waters; they cause deterioration of the environment and diarrhoeal diseases.

##### 7.4.1.1 Collection Of Solid Wastes

The frequency and thoroughness of solid waste collection is poor in Kenya. Frequency of collection is not based on storage capacity but on the availability of functioning vehicles; priority is given to central business districts and high income residential areas. Least effort is given to the low and middle income areas and slum settlements.

Most hospital, institutional and domestic wastes are mixed. This exposes both the workers and scavengers to risks

as they may not be aware of the dangers inherent in such wastes.

#### 7.4.1.2 Transportation Of Solid Wastes

The types of vehicles used for solid waste collection in Kenya are unsuitable for the task. The vehicles are either open trucks, highly automated trucks or tractors. The loading height of open trucks is not suitable for operators; such trucks also are not able to compact the refuse, thus they do not carry an optimum load at each run; they also spill refuse along the route since the refuse is normally loose. The highly automated trucks are designed for use in management systems which separate waste by composition, among other factors. The factors are different for Kenya and therefore make the use of such trucks highly inefficient. Tractors have the disadvantage of being slow, thus making fewer trips per day compared to fast trucks.

Waste collection has been deteriorating. For example, vehicles used for transportation and supervision of solid wastes in Nairobi between 1978 and 1988 dropped from 81 to 52. Besides, 162,439 tonnes of solid waste was collected in

1973 compared to 78,753 in 1988 (Tables 7.1 and 7.2). Most local authority vehicles are old, resulting in regular breakdowns and repairs; not all parts are readily available; and vehicles used are of different makes and models resulting in the need to have large number of spare parts which is costly and difficult to maintain. Therefore more solid wastes lie uncollected, causing hazards and nuisances.

#### 7.4.1.3 Disposal of Solid Wastes

Solid wastes in most urban areas of Kenya is disposed of in open dumps or crude sanitary landfills; burned; or composted. In low income areas collection service is very poor, the commonest mode of disposal being dumping along streets, play fields and between houses. This is done mainly by householders at night. The situation has occasionally gotten so bad that dumping is done during the day.

Burning is practiced in the estates. This sometimes involves separation of the combustion materials, usually plastics and paper, from other wastes. By so doing the residents usually increase the time taken for their bins to fill up. In most hospitals and

Table 7.1. Quantities of Solid Wastes Collected in Nairobi

Year	Collected (Tonnes)	Generated (Tonnes)	Collected (%)
1973	162,439	65,222	98.32
1974	173,785	173,979	99.89
1975	192,092	183,200	104.85
1976	186,524	193,437	96.43
1977	202,229	203,133	99.55
1978	197,619	213,899	92.39
1979	136,906	225,235	60.78
1980	187,595	238,274	78.73
1981	178,834	250,692	71.34
1982	178,136	264,480	67.35
1983	159,974	279,026	57.33
1984	116,895	295,179	39.60
1985	114,611	310,563	36.90
1986	115,112	327,644	35.13
1987	106,402	345,665	30.78
1988	78,753	365,675	21.54

Source: Mwangi 1990

Table 7.2. Quantities of Solid Wastes and Collection Efficiencies.

Year	Generated (Tones)	Collected (Tones)	Uncollected (Tones)	Vehicle Capacity (Tones)	Collected %	Efficiency Collection %
1978	213,899	197,619	16,280	221,555	92.39	89.20
1979	225,235	136,906	88,239	258,055	60.78	53.05
1980	238,274	187,595	50,679	226,188	78.73	82.94
1981	250,692	178,834	71,858	208,050	71.34	85.96
1982	264,489	178,136	86,344	209,875	67.35	84.88
1983	279,026	159,974	119,052	229,950	57.33	69.57
1984	295,179	116,895	178,284	176,046	39.60	66.40
1985	310,563	114,611	195,952	133,933	36.90	85.56
1986	327,644	115,112	212,532	135,050	35.13	85.24
1987	345,665	106,402	239,263	160,308	30.78	49.13

Source: Mwangi 1990

some research institutions, some of the solid wastes are burned, against current accepted practices. Composting is generally practiced in estates that have large compounds and within the rural areas. A pit is usually dug in the backyard and filled with vegetable wastes and garden trimmings, and then covered with a fine layer of soil.

The main solid waste disposal method used by most local authorities is crude sanitary landfilling. This technique approximates dumping and since the costs involved are nominal, it is the most popular and favoured technique by many local authorities. Inadequacy of disposal equipment has an adverse effect on disposal operations. Disposal operations are poorly supervised, thus allowing scavengers to chase waste vehicles whenever they arrive, creating dangerous conditions.

There is a scarcity of disposal sites in many municipalities which results in vehicles criss-crossing town centres to the few available disposal sites. Such vehicles carry mud and are vector transmitters especially when it rains. This is the result of lack of proper planning and zoning. Some local authorities do not have any designated disposal grounds and they rely on individuals requesting that the wastes be disposed of on their farms as manure-an unacceptable situation, especially in cases where toxic or hazardous wastes could find their way into the municipal water system.

Most disposal sites are open to the public and animals, creating a dangerous health

situation. Currently, private firms use disposal sites without a fee, while most local authorities allow refuse at most disposal sites without proper handling procedures.

#### 7.4.1.4 Mining and Mineral Processing

Mining disturbs the earth's surface, and pollutes it through disposal of waste. Open cast mining is physically destructive, producing various sizes of pits and heaps of waste. Quarrying is a very widespread open cast mining method in Kenya. Other minerals mined in this way include diatomite, fluorspar and some ruby.

Shaft mining goes deep into the earth's crust and is only noticeable on the surface due to waste product disposal heaps. The major impact on the environment is normally felt when these mines collapse, for example, the old gold mines of Migori.

Placer mines are associated with water movements. Sand harvesting in river beds/beaches and some gold in West Pokot are examples of place mining. Sand harvesting usually interferes with natural processes forming the river channels/beaches which can result in accelerated erosion.

During the extraction of common salt and soda ash from saline waters, solar energy is used for evaporation. Common salt is usually extracted along the Indian Ocean and soda ash at Lake Magadi. The evaporation ponds if not well controlled can be a source of soil salinisation.

Minerals and rocks in Kenya are processed into various products for domestic consumption, export and industrial use. The most widespread is the cutting of building stones which is both manual and mechanised. Dust from these stones can cause lung diseases and the byproduct stone chips usually render the land unproductive. Unrehabilitated quarries are wastelands, eyesores, and can become a danger when they fill with water.

#### **7.4.2 Issues**

##### **7.4.2.1 Management**

The rate of generation and characteristics of solid wastes is unknown, a limitation that makes planning difficult. There is shortage of storage facilities at both household and commercial/industrial levels and inadequate frequency of collection. Most solid waste disposal sites are poorly managed and some are located near water bodies, threatening water quality.

Solid wastes management includes incentives for those practicing environmentally friendly approaches. An appropriate management practice is to minimise the amount of wastes at various stages of production by recycling. Resource recovery is limited by lack of recycling industries and lack of government incentives to recycling industries. One problem is the general lack of information on recycling, for example, the most efficient ways, and their environmental and health impact, among others.

Solid waste management is vested in the Ministry of Health, the local authorities and the local communities. The Public Health Act, Cap. 242, and the various municipal by-laws are used to manage solid wastes. However, several problems have been identified, including the following: delays in prosecution and adjourning of cases; current fines which are too low to act as deterrents; human capacities to implement is sometimes lacking; and offenders sometime are not prosecuted because the councils fail to provide dustbins and the frequency of collection is insufficient and irregular.

##### **7.4.2.2 Labour and Funding**

Solid waste management is affected by shortage of labour and funding. High labour flight and turn over is due to unfavourable

working conditions, especially low salaries, lack of job security and satisfaction, lack of training and promotion.

Funds budgeted for waste management are usually far from adequate. Besides, revenue collected from refuse management fees does not cover the cost of its operation, and where it does, it is not ploughed back for improvement of the service. In most cases revenue generated from refuse collection is too low, covering only the plot and not the number of persons or families served. The actual cost is not commensurate with the expenditure incurred by the local authorities. Furthermore, revenue collected from refuse management is not elastic and does not respond to the growing costs of providing this service.

##### **7.4.2.3 Health Impacts**

Solid waste from industrial, domestic, commercial and institutional activities constitute an obvious threat to human health and the environment. Industrial solid wastes include scrap metal, paper and paper products, abandoned cars, tyres, bottles, cans, plastics, etc. Stinking refuse heaps of domestic solid waste dumped carelessly within residential areas, particularly in municipalities are not only a health hazard but also add to visual pollution.

Disposal of plastic products and polythene bags are of particular concern because they do not break down under normal conditions. There is no policy on recycling. Polythene bags are often burned, although studies have shown that the smoke is a hazard to health.

##### **7.4.2.4 Awareness and Public Participation**

There is inadequate appreciation of the importance of the cleansing sections within the local authorities. The position of the cleansing superintendent is far below that of the head of the department and this excludes the employment of professionals such as engineers, economists, and scientists. In the rural areas, there is lack of supervision by health personnel and lack of awareness by the general public.

The concept of community participation is widely acknowledged and practised but through organised clean-up operations only. Related problems include general lack of

environmental awareness on proper disposal of solid waste, and waste separation; and the huge gap between perceived need of proper disposal by the community and lack of urgency by the local authority. Other problems include poverty, lack of receptacles and individual participation. People who are economically well-off tend to be more conscious of solid wastes than the poor.

#### **7.4.2.5 Privatisation of Services**

Privatisation of solid waste management has been debated widely within the local authorities, especially Nairobi. Indeed, there are a few established private collectors who operate in the high income residential areas. Lack of a clear policy on who pays for privatisation is the main obstacle in its implementation.

#### **7.4.3 Recommendations**

##### **7.4.3.1 General**

- a) Conduct studies to establish rates of generation and characteristics of solid wastes in Kenya, to help plan the size of storage sites, frequency of collection, type of collection vehicles, type of disposal sites, and the potential for recycling.
- b) Provide adequate storage facilities, determine collection frequencies, review location of disposal sites and develop acceptable procedures for their management.
- c) Consider the role of the private sector in the storage and collection of solid wastes.
- d) Encourage recycling of solid waste, which can be a highly beneficial activity, and where necessary, introduce incentives for this.
- e) Upgrade the ranking of the cleansing section within the local authority system, thereby making it possible to employ professionals - scientists, engineers, economists; and allocate adequate funds and facilities for solid waste management.
- f) Involve the community in solid waste management.
- g) Encourage technology to produce alternatives to plastics.
- h) Develop an environmental policy for all local authorities, including the collection and disposal of solid wastes in an environmentally friendly manner and the development of solid waste data/information systems.
- i) Apply the "polluter pays principle" in Kenya.
- j) Provide adequate dustbins to all households and commercial enterprises with corresponding satisfactory frequency of collection.
- k) Provide prompt collection and disposal of carcasses and other objectionable materials from public places.
- l) Incorporate solid waste needs in all future developments.
- m) Encourage composting where practicable.
- n) Rehabilitate (with considerable scientific and engineering skills) disused mines and quarries as landfill sites.
- o) Plan for service lanes for collection of solid wastes.
- p) Streamline operations at disposal sites to avoid exposing workers to health risks; and fence disposal sites to exclude scavengers.
- q) Increase disposal sites to avoid long distances travelled by refuse vehicles in towns; and design and manage properly disposal sites to minimise environmental problems.
- r) Require mandatory environmental impact assessment (EIA) for all new disposal sites.
- s) Harmonise the mode of revenue collection for solid waste management, and cooperate with the private sector.
- t) Undertake centralised training and

research and development for local authorities in the field of solid waste management to cut down costs to individual municipalities.

- u) Invoke international maritime laws relating to waste disposal from shipping vessels within 12 nautical miles of Kenya's coast.

#### 7.4.3.2 Legislation, Incentives, and Institutional Arrangements

- a) Review relevant sections of the Public Health Act and the Local Government Act which relate to the management and disposal of solid wastes and develop the necessary amendments of the said laws or enactment of subsidiary legislation, to enhance management.
- b) Strengthen refuse collection sections in all local authorities through capacity building and the creation of separate solid waste departments.
- c) Use current service charges to improve solid waste management.
- d) Designate an appropriate central body to coordinate research and development in solid waste management.
- e) Persuade the business community that it is in their own interest to have an unpolluted environment, as this means a healthier work force and hence less loss of man hours.
- f) Change both consumer and producer behaviour by providing continuous incentives for pollution control.
- g) Encourage waste recycling and re-use by giving incentives.

## 7.5 CHEMICALS

### 7.5.1 Current Status

Chemical substances play a major role in agriculture and health; in industry and transport; in housing; and in the production of consumer goods. Demand for increased food production and advances in technology has provided new materials, new processes

and new industries resulting in increased production and use of chemicals. This industrial development, including production, storage, transport and trade, has significantly increased the number of people at risk to chemical hazards. Chemicals released into the environment may pollute the air we breathe, the water we drink and the food we eat with serious consequences. They may also have an adverse impact on the forests, the soils, and aquatic life.

Kenya in collaboration with the United Nations Environment Programme (UNEP) and other international organisations have recently compiled data profiles on chemicals. Chemicals can be classified into four major categories, namely: industrial, agricultural, household and body care, and pharmaceutical.

#### 7.5.1.1 Industrial Chemicals

Industrial chemicals are used in the manufacture of, among other things, rubber, plastics, synthetic fabrics, paints. In Kenya, most chemicals are imported; and they play a very important role as inputs in various industrial processes. Industrial chemicals include metals and their compounds, including mercury, lead, cadmium, zinc, copper, chromium, selenium and titanium. Organic compounds include polychlorinated biphenyls, polychlorinated terphenols, chlorinated chlorofluorocarbons, and pesticides. Other industrial chemicals are asbestos, arsenic, organic and inorganic solvents, gaseous compounds, nitrogenous compounds and radioactive materials such as those used in hospitals and research laboratories.

#### 7.5.1.2 Agrochemicals

Agrochemicals (agricultural chemicals) are used extensively in Kenya to improve agricultural production. Agrochemicals are categorised as pesticides or fertiliser. Pesticides include: insecticides, fungicides, herbicides, acaricides, nematocides, fumigants/soil sterilants, rodenticides, hormones and insect repellents and attractants. Fertilisers include: nitrogenous fertilisers, phosphatic fertilisers, potassic fertilisers, compound fertilisers, trace elements/foliar feeds, and soil improvers. As an agricultural country, Kenya uses large quantities of agrochemicals. Pesticides are

widely used to improve and protect agricultural products and to control plant, animal and human diseases. Pesticides introduced into the environment can cause serious environmental damage. Leaching and volatilisation of fertiliser residues can also impact negatively on the environment.

Most agrochemicals used in Kenya are imported. However, some agrochemicals are manufactured and/or formulated locally.

#### **7.5.1.3 Household and Body Care Chemicals**

Most household and body care chemicals are manufactured locally using some imported raw materials while some are imported. These chemicals can be broadly categorised as soaps, detergents, disinfectants and cosmetics and perfumes. Soap include laundry and toilet soap, while detergents include liquid and powdered detergents, cake or bar and pastes. Disinfectants are mainly of a liquid nature. Cosmetics and perfumes include skin care creams and lotions, hair tonics/gels, petroleum jellies and sheens, shampoos, talcum powders, lipsticks and nail polishes, antiperspirants and deodorants.

#### **7.5.1.4 Pharmaceutical Products**

Pharmaceuticals are consumed both in the medical and veterinary services. Most of these products are imported into the country either in their finished form or as active ingredients for local formulations. Some veterinary vaccines are produced locally. There are twenty five established pharmaceutical industries in Kenya. However, poor management practices have tended to contribute to overstocking and thus expired drugs and factory wastes needing disposal.

#### **7.5.2 Status of Policy and Legislation**

The policy on management of chemicals has recently been formulated but lacks the means and resources for implementation. Chemicals are currently managed by the users who include industry, public and government institutions.

Legislation on the use of chemicals are scattered over many acts. The main legal instrument for managing chemicals is the Food Drugs and Chemical Substances Act Cap. 254. The Public Health (Standards) Board Act, under Cap. 254, controls

potentially dangerous and harmful chemicals. However, the Act is not clear on the licensing and registration of foods, drugs and chemicals; and fails to identify the lead institution to coordinate chemical management.

The Pharmacy and Poisons Act, Cap 244 is used to manage pharmaceutical products; while the Pest Control Products Board has registered and monitored very few products since enactment in 1982 due to the large amount of work and the very limited funds, personnel and facilities to accomplish the work. A Chemical Controls Bill is expected to come before Parliament in 1994.

#### **7.5.3 Issues**

Toxic chemicals that, due to poor management, find their way into the environment are important contributors to environmental pollution. Many of the chemicals are harmful to the ecosystem, while a significant number do not break down easily into non-toxic substances. Instead they persist in the environment for many years, often causing irreversible damages to the environment.

In Kenya, there is general lack of awareness, lack of effective enforcement of law and inadequate technical information and know how on how to protect human health and the environment against dangers inherent in the use, handling, and disposal of chemicals. As a result, pharmaceutical manufacturing companies and other industries dispose of their chemical waste into sewers without due consideration of their impact. In rural areas, users apply agrochemicals (fertilisers and pesticides) without proper consideration of the quantities and time of application. Furthermore, direct application of chemicals on water courses for the control of disease vectors is often done without adequate consideration of other impacts.

There is need for guidelines on proper use, and use of designated sites, for the disposal of expired drugs or agrochemicals. Today, drugs are disposed of through dumping and as a result, they pollute the air and water.

The country is also faced with the emergence of non-biodegradable products such as plastics used as packaging materials; their disposal presents unique problems.

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

In the manufacturing sector, workers handling chemicals can be exposed to serious health risks. Users too can be exposed to risks. Problems arise due to lack of procedures on disposal of unwanted and expired chemicals; or to improper packaging, labelling and storage of chemicals. Transportation of dangerous chemicals by air, rail, road or sea also presents possibilities of hazards arising from accidents.

#### 7.5.4 Recommendations

- a) Develop and document procedures which protect workers and users from risks during production, handling and use of chemicals.
- b) Develop and document procedures governing proper disposal of expired or unwanted chemicals.
- c) Enact legislation governing packaging, labelling and proper storage of chemicals. Where legislation currently exists, it should be strengthened to ensure proper protection for all.
- d) Establish emergency procedures for the movement of all chemicals, and measures to be put in place in the event of an accident occurring during transportation.
- e) Provide incentives to industry for reducing production of dangerous chemicals, recycling their use and/or ensuring their safe disposal.
- f) Establish a central body to coordinate, formulate institutional procedures, undertake research, monitor safety of chemicals and establish a national information database on chemicals.
- g) Keep the public informed of the dangers of fumes from cooking fires, toxic chemicals, climate change and other effects of pollution on environment.

- h) Enact and/or enforce legislation on the management of chemicals, e.g. enact the Chemical Controls Bill of 1994.
- i) Train personnel and provide facilities, such as laboratory equipment, to manage chemicals.
- j) Assess and monitor the effects of small-scale gold mining on the environment and human health.

## 7.6 HAZARDOUS WASTES

### 7.6.1 Current Status

Hazardous wastes may be defined as all wastes that have hazardous properties which include being radio-active, toxic, explosive, corrosive, flammable, infectious or other characteristics causing or likely to cause danger to human health or the environment, whether alone or together with other wastes.

There are many ways of classifying hazardous wastes. One classification method has three categories of hazardous waste. Category I are wastes known to contain significant concentrations of highly toxic, mobile, persistent or bioaccumulate constituents.

Category II are wastes from common industrial processes like metal hydroxide sludge which contains toxic metals in a relatively insoluble physical form. These wastes include organic and inorganic solvents; toxic gases such as chlorine, sulphur and their compound; arsenic; asbestos; and nitrogen compounds.

Category III are primarily large volume low hazard waste including those which easily decompose for which the cut off point between a "hazardous" and a "non-hazardous" status is not clear. Among these wastes are aluminium metal, glass, wood, paper, plastics, and ceramics.

According to the Basel Convention sources of hazardous waste include, but are not limited to:

- a) Clinical waste from medical activities in hospitals, clinics, and dispensaries.

- b) Wastes from the production and preparation of pharmaceuticals products.
- c) Expired pharmaceuticals, drugs and medicines.
- d) Wastes from the production, formulations and use of biocides.
- e) Wastes from the production, formulation and use of organic solvents.
- f) Wastes from metal heat treatment and tempering operations containing cyanides.
- g) Waste mineral oils unfit for their originally intended use.
- h) Waste oils/water, hydrocarbons/water mixtures, emulsions.
- i) Wastes and articles containing or contaminated with polychlorinated biphenyls and or polychlorinated terphenyls, and or polybrominated biphenyls (PBBS).
- j) Waste tarry residues arising from refining, distillation and any pyrolytic treatment of petroleum products.
- k) Waste from production, formulation, and use of resins, latex plasticisers, glues and adhesives.
- l) Waste chemical substances arising from research and development activities which are not identified and/or are new and whose effects on man and/or the environment are not known.
- m) Waste from production, formulation and use of photographic chemicals.
- n) Waste resulting from surface treatment of metals.
- o) Waste residues arising from industrial waste disposal operations such as incineration.
- p) Waste from quarrying and stone dressing processes.

- q) Waste water from gold mining processes.
- r) Waste and waste water from coffee processing industry.

#### 7.6.2 International Regulations

The following international agreements govern the trans-boundary shipment of hazardous wastes:

- a) The Basel Convention on the control of transboundary movements of hazardous wastes and their disposal.
- b) The London dumping Convention (1972) on the prevention or limiting of deliberate disposal at sea of various types of waste materials produced on land.
- c) The Bamako Convention (1990) which bans imports of all forms of hazardous wastes to Africa and the control of transboundary movements of hazardous wastes generated in Africa.
- d) The resolution CM/Res 1153 (XLVIII) 1988 of the Council of Ministers of the Organisation of African Unity on dumping of nuclear and industrial wastes in Africa.

#### 7.6.3 Issues

Today there are about 10 million known hazardous compounds produced of which one million are produced for commercial purposes. Once these compounds have served their purpose, they are discharged as wastes. These hazardous wastes can be in the form of liquids, dusts, sludges, vapours or solids. Hazardous wastes have been disposed of into rivers, lakes and seas, in the air as well as public dump sites without due consideration of their adverse effects on the health of the populations that may come into contact with such wastes.

The potential effects of hazardous wastes on human health depend on the waste materials involved, their concentration, route of entry and the length of exposure. The health disorders associated with exposure to hazardous wastes include cancer, birth defects, sterility in humans, genetic mutations,

immunodeficiency, and failure of vital body organs.

Contamination of water sources by pesticides and fertilisers is a common occurrence, particularly in areas where agricultural activities are commercialised. Further, certain fertilisers are known to enhance chemical degradation of soils by generating excess acid when applied in neutral or already acidic soils.

Research and monitoring of hazardous wastes and related epidemiological data in Kenya has revealed many cases of human poisoning by hazardous wastes. It has also raised concern among the general public, especially in the most industrialised towns, and in intensively cultivated rural areas where such crops as coffee, sugar and rice are grown.

Several factors contribute to environmental contamination by hazardous wastes. First, there is insufficient policy and legislation for managing hazardous wastes. Second, the country lacks inventories of types, compositions and volumes of hazardous wastes. Third, Kenya currently does not have adequate trained manpower to enhance management of hazardous wastes. Fourth, facilities which can be used in management are generally lacking. Finally, public awareness and information campaigns on the dangers of hazardous wastes are almost non-existent.

#### 7.6.4 Recommendations

- a) Develop a comprehensive policy, supported by appropriate legislation, governing the management of hazardous waste. In addition, it is necessary to clearly define hazardous waste.
- b) Provide hazardous waste disposal facilities and/or sites, and train specialist staff.
- c) Develop comprehensive inventories of sources, types, volumes and composition of hazardous wastes.
- d) Work with the private sector to devise methods of handling and disposing of hazardous wastes.
- e) Support international agreements to control trans-boundary shipments of

hazardous wastes.

## 7.7 NOISE POLLUTION

### 7.7.1 Current Status

Noise is described as sound without musical qualities or as sound that bears no information and whose intensity varies randomly in time. The word noise is often used to mean sound that is unwanted or undesired. Urban noise is usually caused by a combination of some of the following: machinery in factories; juke-boxes and discotheques; loud speakers including those in passenger vehicles e.g. matatus; matatu touts shouting; motor traffic; aircraft; and quarrying and mining.

### 7.7.2 Issues

Noise pollution is associated with industrial and urban development. Kenya's pace of industrialisation and the increase in traffic volume has worsened the problem of noise. There is no policy or legislation on management and control of noise in industry, transport, commerce and even individual premises, and little public awareness on the dangers of noise pollution. However, there is increased concern about the problem.

The noise from industrial premises may cause a nuisance not merely from intensity level but because of its special features such as continuous volumes or hums or from irregular bangs and clanks. The attitude of both workers and management in industry has been to accept noise simply as part of the job because they are unaware of its dangers. For the general public, noise is regarded as a nuisance, irritating and annoying.

The daily barrage of noise which the ear sustains is transformed into shock waves of fluid inside the ear; the hearing mechanisms get damaged; and this damage results in impaired hearing ability.

Other harmful effects on health by noise include headaches, nausea, stress, sleeplessness and general fatigue. One of the difficulties inherent in any consideration of the effects of noise is the fact that in most instances, the effects only occur after relatively long period of exposure. A person exposed for several hours a day to noise levels above 120 DBA would have permanent ear damage in a few months, although some people may

even be permanently damaged by noise levels of 90-100 DBA, depending on their disposition.

### 7.7.3 Recommendations

- a) Develop a policy and enact supporting legislation on management of noise pollution.
- b) Educate the public on the dangers of noise pollution and their rights within the law. Also educate workers and managers to enhance their participation in the control of noise pollution.
- c) Consider reducing or waiving duty on imported hearing aids and equipment to protect people from noise hazards.

## 7.8 ACTION PLANS

### 7.8.1 Management of Gaseous Emissions

#### 7.8.1.1 Actions Which Can Be Taken Immediately

- a) Formulate policy on gaseous emissions.
- b) Enforce current laws.
- c) Phase out ozone depleting CFCs.
- d) Review existing legislation, and where appropriate enact new laws for proper management of gaseous emissions.
- e) Develop information campaigns to reduce exposure to cadmium and lead.
- f) Co-operate with international initiatives to assess and monitor causes and effects of global warming and climate change.

#### 7.8.1.2 Selected Activities Requiring Funding

- a) Build infrastructure for environmental conservation and management, including the expansion of monitoring systems

networks for recording gaseous emissions.

- b) Inventory and document gaseous emissions in Kenya.
- c) Find alternatives to ozone depleting CFCs for industrial use and to cadmium in batteries.
- d) Intensify reforestation to provide CO<sub>2</sub> sinks.
- e) Train personnel and avail equipment.
- f) Provide incentives (and penalties) to industry to reduce gaseous emissions.
- g) Inform the public and media about international conventions and protocols concerning the environment.
- h) Assess available information on impacts of climate change on ecosystems and human development.

#### 7.8.1.3 Some Long-Term Priorities

- a) Formulate response strategies and options to mitigate or adapt to climate change.

### 7.8.2 Liquid Waste Management

#### 7.8.2.1 Actions Which Can Be Taken Immediately

- a) Review and strengthen policy on the management of liquid wastes.
- b) Review and update water standards as provided for in the Public Health and Water Acts and ensure their enforcement.
- c) Provide incentives and dis-incentives to make the polluter pays for pollution, and encourage industries to treat their waste water.
- d) Review and enforce legislation to deter pollution and encourage recycling.
- e) Involve business and industry in reducing pollution and managing waste, including discharge and storage.

**7.8.2.2 Selected Activities Requiring Funding**

- a) Establish an organisation or department to initiate the setting of discharge standards and to implement the standards.
- b) Rehabilitate waste water treatment facilities and improve their efficiency.
- c) Create awareness on the dangers of careless disposal of liquid wastes and the benefits of proper management.
- d) Promote and support cleaner production technologies with economic incentives.
- e) Formulate and implement a method of charging for the quality and quantity of liquid waste in water.
- f) Provide funds to ensure sustainable maintenance and operation of sewage treatment facilities.
- g) Train personnel to assess, monitor and improve the quality of liquid wastes.
- h) Study and adopt innovating waste water treatment facilities such as constructed wetlands.

**7.8.2.3 Some Long Term Priorities**

- a) Facilitate and encourage research, and commercialisation of research results, on all aspects of minimising, avoiding, recycling, treating and disposing of liquid waste.
- b) Collaborate with neighbouring countries in the management and disposal of liquid wastes into common water bodies.

**7.8.3 Solid Waste Management**

**7.8.3.1 Actions Which Can Be Taken Immediately**

- a) Examine critically the issue of privatisation of solid waste

management and the impediments facing this option, with a view to formulating a policy.

- b) Create departments of solid waste management in local authorities.
- c) Encourage solid waste minimisation, particularly the composting of organic matter.
- d) Encourage community participation in solid waste management.

**7.8.3.2 Selected Activities Requiring Funding**

- a) Promote clean-up exercises, especially where there are no established refuse collection facilities.
- b) Promote waste reduction, re-use and recycling through education and incentives for both producers and consumers.
- c) Increase budget allocation for solid waste management in the local authorities and improve revenue collection for improved efficiency. Revenue collected from solid wastes should be used in the improvement of the sector.
- d) Rehabilitate used mines and quarries for possible use as disposal sites.
- e) Provide adequate storage facilities, determine collection frequencies, review location of disposal sites and develop acceptable procedures for their management.

**7.8.3.3 Some Long Term Priorities**

- a) Encourage community participation by teaching the public to act in a more environmental friendly manner.
- b) Promote training and research and development at all levels of solid wastes management and cleaner production technologies.
- c) Encourage technology to produce alternatives to plastics.

#### **7.8.4 Chemicals Management**

##### **7.8.4.1 Actions Which Can Be Taken Immediately**

- a) Enact and/or enforce legislation on the management of chemicals.
- b) Set priorities in product development to avoid adverse effects on health and environment.
- c) Devise procedures for proper management of chemicals at all levels, including manufacture, transport, handling, packing, labelling, use and disposal.
- d) Require mandatory environmental impact assessment for all new industrial chemical projects.

##### **7.8.4.2 Selected Activities Which Require Funding**

- a) Create awareness among the public, farmers, industrialists and policy makers on the danger of poor management of chemicals by organising workshops, seminars and barazas throughout the country.
- b) Establish or strengthen a central coordinating body to create awareness on better management of pesticides, fertilisers and chemicals and to promote their safe use; formulate safety procedures; undertake research and conduct surveys; and monitor the state of chemical disposal and suggest appropriate solutions.
- c) Train personnel and provide facilities (e.g. laboratory equipment) for management of chemicals.
- d) Assess and monitor the effects of mercury used in small-scale gold mining on people and the environment.

#### **7.8.4.3 Some Long Term Priorities**

- a) Encourage collaboration with international organisations and donor agencies in training personnel for effective management of chemicals.
- b) Promote research and development in chemical management.
- c) Implement risk reduction programmes in the development or use of chemicals by effective product labelling, restrictions on marketing and phasing out of specific chemicals.
- d) Encourage recycling of chemicals or products if it is safe to do so.

#### **7.8.5 Hazardous Waste Management**

##### **7.8.5.1 Actions Which Can Be Taken Immediately**

- a) Formulate a comprehensive policy on the management of hazardous waste.
- b) Enact legislation for use in enforcing proper management of hazardous waste.
- c) Support international agreements to control trans-boundary shipments of hazardous wastes.

##### **7.8.6.2 Selected Activities Requiring Funding**

- a) Enhance the development of technology for treatment and disposal of hazardous wastes.
- b) Identify and/or train local manpower with skills and expertise in hazardous waste management.
- c) Establish, in co-operation with local authorities, facilities to treat and dispose of hazardous wastes.
- d) Establish an awareness programme

among the public, industrialists, the media, and policy makers on the dangers of poor hazardous waste management.

them by giving incentives for hazardous waste management and minimisation.

#### **7.8.5.3 Some Long Term Priorities**

- a) Establish long-term programmes, including targets where appropriate, for reducing the amount of hazardous wastes produced per unit of manufacture.
- b) Work closely with industry and local authorities to identify programmes and projects; assist them to access funding; and where possible motivate

#### **7.8.6 Management of Noise Pollution**

- a) Develop noise emission standards.
- b) Develop comprehensive legislation on noise pollution.
- c) Create awareness of the dangers on noise pollution among industrialist, workers and the general public.
- d) Provide incentives and dis-incentives to reduce noise pollution.

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## CHAPTER EIGHT

# HUMAN SETTLEMENTS AND URBANISATION

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### 8.1 INTRODUCTION

Human settlements are the physical articulation of the social, economic, political and environmental interaction of people living in communities. The communities can be either urban or rural. The development of these communities involves changing the environment from its natural state to a built one. The activities that bring about change include provision of housing, places of work, recreation facilities, water, transport facilities, energy and sanitation.

Human settlements are significant agents of environmental change and economic development. For example, settlements influence the location of investments, which provide employment, generate revenue for the government, and create demand for materials and services. The services include supply of water, waste disposal, sanitation, and provision of shelter and transport. The extraction, supply and use of materials in developing the settlements have significant impacts on the environment, some of which are detrimental to health and quality of life.

Human settlement policies, laws and regulations are designed to protect human health and the environment from pollutants. In this connection, the planning and management of human settlements should consider, not only the provision of infrastructure and services necessary for commercial services and industrial expansion, but also the control of their harmful impacts on human health and the environment. Sustainable development issues in human settlements and urbanisation will be considered further by the HABITAT II preparatory process and conference under the following two related themes: "Sustainable Human Settlements in an Urbanising World" and "Adequate Shelter for All."

### 8.2 POPULATION AND ENVIRONMENT

#### 8.2.1 Current Status

The population of Kenya has been increasing rapidly in the last three decades. It increased from 7.8 million in 1963 to about 23 million in 1992. This high growth rate, which is higher than the economic growth rate (which had been declining, especially since late 1970s) has had an adverse effect on the sustainable use of available natural resources, and existing infrastructure. Perhaps the most noticeable impact is the overall fall in living standards. As a result, many rural and urban dwellers live in poverty and unhealthy surroundings. The demands of the resulting large number of people now far outstrip the capacity for provision of water, sanitation, waste removal, transport and health facilities.

#### 8.2.2 Issues

About 80% of Kenya's population live in the high potential lands which cover about 20% of the country's land area (Annex 4). The densities in these high potential areas are high and the use of resources in these areas intense. The resulting environmental impacts include soil erosion; conversion to agriculture of land under natural forests that constitute water catchments; migration into fragile arid and semi-arid lands (ASALs) and to urban centres; inappropriate land use practices in ASALs leading to soil erosion and land degradation; and expansion of urban areas.

#### 8.2.3 Recommendations

- a) Broaden the economic opportunities in both urban and rural areas.
- b) Intensify family life education.
- c) Develop a national human settlements policy that will aim at

achieving balanced development between urban and rural areas.

- c) Develop suitable education programmes to create awareness and develop public attitudes that are favourable to sustainable use of natural resources.
- d) Educate Kenyans to value other security e.g professionalism and business rather than only land.

### 8.3 LAND USE

#### 8.3.1 Current Status

Land is considered the most valuable resource and therefore the most sought for asset in Kenya. About 80% of the total land area is however, arid and semi-arid; and this supports only up to 20% of the country's total population. The remaining about 20% is arable land, which has to support about 80% of the country's total population. The demands on the available land for various uses are many, and often create tremendous pressures and conflicts. Sustainable land use planning becomes crucial as it enables the available land to be used in such a way that it brings optimal benefits to the users while having minimal negative impacts on the environment.

#### 8.3.2 Issues

The absence of a comprehensive land use policy in Kenya has often led to the destruction of vital water catchments and wetlands. This problem is exacerbated by the continuing demand on land and a rapid increase of unplanned settlements.

The current land use practices in both rural and urban areas are often inappropriate. Land parcels continue to be fragmented/subdivided to the extent that some have become uneconomical. In addition, inappropriate exotic land use practices are often introduced by immigrants, especially in the arid and semi-arid lands (ASALs) without due consideration of their impact on the environment.

The growth in unplanned settlements is often induced by current weaknesses in land

allocation procedures. Some of these weaknesses include delays in land registration and the long process needed to obtain approval for development.

Often, potential developers opt to purchase land parcels at the urban fringes, in order to avoid such delays and the costs that go with them. Here, the development of the plots is done with very little environmental consideration. When town boundary extensions are made to incorporate these unplanned developments, the local authorities face the enormous task of improving the environments of these developments.

There is limited community participation in the planning, implementation, monitoring and evaluation of land use plans. This often results in non-adherence to approved land-use plans. This problem is made worse by the limited physical planning personnel and weak legal enforcement of development control measures.

Though land-use planning issues are backed by various legislations, there is need to review the existing land-use policy, laws and regulations with a view to making them more coordinated and enabling.

There is an increasing number of land-use conflicts. These include: urban expansion into prime agricultural zones and encroachment by human activities on environmentally fragile lands such as mountain catchment forests, riverine zones and other wetlands; wildlife protection vis-a-vis pressure for land and access to resources by local communities; introduction of arable agricultural practices in marginal zones; and the allocation of land, especially open spaces, for other users through change of user approvals.

#### 8.3.3 Recommendations

- a) Formulate a national policy on land use planning that takes into consideration agro-ecological zones, traditional tenure systems, inevitable urban growth, and environmental management.
- b) Prepare procedures for managing minimum land parcels.

- c) Incorporate environment impact assessment in both rural and urban land use plans.
- d) Review land use approvals with a view to developing a rapid method without compromising on use of environment impact assessment.
- e) Review land-use legislation and regulations with a view to harmonising them and making them more enabling.
- f) Educate and involve local communities in land-use planning, management, and environmental impact assessment.
- g) Review expansion of urban areas with a view to limiting their growth into high potential land.
- h) Enhance the utilisation of participatory modes of wildlife conservation and management.
- i) Protect water catchment areas from further encroachment and enhance rehabilitation of the already destroyed catchments.
- j) Provide incentives to industry to relocate away from both major urban centres and agricultural areas.
- k) Improve access to land, and educate Kenyans to understand that part of the population will remain landless.

## 8.4 RURAL SETTLEMENT

### 8.4.1 Current Status

Although urbanisation has grown rapidly, Kenya is still largely a rural society. By 1989, about 80% of Kenya's population lived in dispersed rural settlements. These settlements have continued to receive minimal attention, yet most of the country's population resides there. Several reasons explain this apparent neglect. First, rural people have always provided their own forms of shelter using locally available materials. Second, some low density rural settlements have been seen to cause little damage to the environment. Third, funds and professionals

that can be used to manage the expansive rural areas are extremely inadequate. In contrast, urban centres are comparatively well-planned with more attractive facilities and employment opportunities. This encourages rural-urban migration, with subsequent congestion and slum development.

### 8.4.2 Issues

Most rural areas are faced with a serious shortage of water, especially in the ASALs. Therefore, settlements are usually located near the few water points. Livestock and wildlife also tend to congregate most of the time around water points. The effects of settlement activities and trampling by animals causes serious environmental degradation.

Rural settlements obtain most of their energy needs from woody vegetation. As a result they leave the land bare and so accelerate soil erosion. Rural people lead subsistence livelihoods based on crop cultivation or livestock keeping often employing practices which degrade the environment. They may keep large herds of livestock which remove most vegetative cover, thereby facilitating soil erosion. The demand for and removal of woody vegetation for timber and wood fuel has reduced vegetation cover, especially in woodlands.

Some rural areas, especially the Coast and North Eastern Provinces, have received an influx of refugees from neighbouring countries. The demands of these refugees have had adverse environmental impacts such as indiscriminate destruction of vegetation, yet there is no comprehensive resettlement mechanisms to cater for displaced persons. Other problems include inadequate transport network, educational, health and recreational facilities.

### 8.4.3 Recommendations

- a) Develop a comprehensive human settlements policy and implement strategies to facilitate balanced and environmentally sustainable development of both rural and urban settlements.
- b) Formulate clearly defined human settlements strategies, incentives and sanctions at district level that

emphasise harmonious relationships with the environment.

- c) Implement environmentally sound infrastructure programmes and projects to facilitate accessibility to rural settlements and promote linkages among small, intermediate and large urban centres and their hinterlands.
- d) Develop alternative energy sources.
- e) Encourage and enforce the establishment of projects that are environmentally friendly (based on EIA) and that promote community participation.
- f) Develop a comprehensive national resettlement mechanism to cater for displaced persons and refugees.
- g) Design and implement environmental education programmes on management of resources, especially in the fragile ASAL ecosystems.
- h) Expand rural electrification programme to unserved areas to promote development of light industries.
- i) Incorporate traditional and societal cultural values in planning human settlements; and study, respect and adapt for use, indigenous resource management systems.

## 8.5 URBANISATION AND URBAN SETTLEMENTS

### 8.5.1 Current Status

The environment of most urban centres in Kenya is unsatisfactory, and the magnitude of poverty is growing. The majority of the population live in poor sanitary conditions with inadequate or sub-standard shelter. Environmental degradation has been exacerbated by the rapid population growth in urban centres since independence (Fig. 8.2). The proportion of total urban population rose from 15% in 1979 to 19% in 1989; and it is projected to increase to 25% by the year 2000.

The growth has mainly been due to rural-urban migration, natural population growth, influx of refugees, boundary extensions for a number of municipalities and the creation of new urban centres. A large proportion of new residents have ended up in the three primary centres of Nairobi, Mombasa and Kisumu. In 1979, these three accounted for between 60% and 70% of the total urban population, with Nairobi alone accounting for 36%. However, the Government recognises that urbanisation is irreversible and needs to be well-planned and managed by the relevant local authorities.

### 8.5.2 Issues

The rapid urbanisation has placed pressure on available housing, infrastructure and services. The mismatch between the rate of urbanisation and economic development (provision of social infrastructure, industrial growth, commerce and employment) has exacerbated urban poverty, unemployment, under-employment, crime, drug abuse and the incidence of street children and beach operators. It also exhibits itself in the proliferation of slums and squatter settlements with inadequate water, sanitation, waste disposal, health facilities, roads, etc.

The unsanitary conditions of these settlements have significant impacts on the quality of the urban environment and that of surrounding rural areas. Assorted wastes and their leachates find their way into river courses polluting the water and the land, which affects human health and the environment.

### 8.5.3 Recommendations

- a) Develop a national human settlements policy that will aim at achieving balanced growth between urban and rural areas; and among small, intermediate and large urban centres.
- b) Improve the planning and management capacities of local authorities.
- c) Provide incentives and opportunities to small and medium scale entrepreneurs that generate employment to alleviate poverty and reduce pressure on environmental resources.

- d) Increase the supply of affordable and progressively developed housing through slum upgrading and provision of serviced land.
- e) Review the process used in upgrading urban centres.
- f) Implement revised building by-laws and planning regulations.
- g) Develop and implement guidelines for informal settlements improvement programmes.
- h) Provide sewerage facilities for all municipalities and urban centres.
- i) Improve sanitation and environmental management in all municipalities and urban centres.
- j) Explore cooperation with the private sector to provide infrastructure.

supplies, social and public amenities such as playgrounds, parks, social halls, health, education, postal and telephone services.

Industrial development brings obvious benefits, but it frequently entails damage to the environment and to the human health. Work premises are generally planned, laid out and built to meet the technical requirements of the work carried out in them. However, when projects are drafted, it is sometimes forgotten that in addition to the machinery they are to contain, human beings spend many years of their lives here and often in conditions involving hazards or nervous strain. The health standards require the premises where work is to be done to have favourable environmental conditions in particular natural lighting, ventilation, maintenance of suitable temperature and sound proofing. Noise and vibration are often sources of considerable irritation to the workers and the factory management should ensure that noise and vibration intensity and characteristics do not exceed tolerable limits.

## 8.6 MANAGEMENT OF HUMAN SETTLEMENTS

### 8.6.1 Current Status

Institutions charged with the management of human settlements play a crucial role in economic and social development as well as in facilitating interaction between the built and the natural environment. The quality of the living environment in settlements, i.e. villages, towns and major cities, depends considerably on the planning and management capacity of respective institutions.

In Kenya it is mainly the responsibility of the central government and local authorities to enforce environmental regulations aimed at protecting the human environment from pollutants or pathogens arising from domestic, commercial, social and industrial activities. The institutions managing human settlements include municipal councils, town councils and urban councils for urban settlements; and county councils and the provincial administration (districts, divisions, locations and sub-locations) for rural areas. It is the responsibility of the central government and the local authorities to ensure the removal of liquid and solid wastes; provide roads, pavements, drains, energy

It is the duty of factories inspectors to make sure that the working environment is safe with sufficient ventilation to purify the air and eliminate pollutants without creating draughts or making the workers uncomfortable. The temperature and humidity should be conducive to work without involving discomfort or hazards to health. Since it is difficult, costly and sometimes impossible to correct the builders mistakes after the building has been completed, it is during the initial approval of plans that the builder should be advised or be required to change the design to meet the necessary basic health standards.

The factories and other places of Work Act Cap. 514, places duties on both the employer and the worker in respect of safety appliances.

### 8.6.2 Issues

The problems of human settlements management are many and varied; The serious problems that require attention include limited institutional capacity in both the central government ministries and local authorities, largely due to inadequate finance, manpower, research and information/data for effective planning and management. In some cases, there is also inadequate coordination of the actors in the development

of human settlement activities, often leading to sectoral development and duplication of efforts. This calls for an integrated development approach. A related concern is the need to share public sector funds and coordinate programme implementation between national and local authorities. Coordination of efforts in planning and implementation of development projects, especially housing and infrastructure for the poor, requires a clear definition of roles.

The organisational structures for both elected and technical officers are not conducive to effective community participation in the planning, programming and implementation of settlement projects. This calls for the restructuring of national and local authorities to accommodate community participation. Human settlements are further hampered by inadequate data and information upon which they can base their plans for proper environmental management.

Uncontrolled industrial practices have led to unacceptable high level of harmful or toxic substances in the air, pollution of rivers, lakes, coastal waters and soil, destruction of forests and accumulation of carbon dioxide and other greenhouse gases which threaten to cause climate changes, including a global warming of the atmosphere. In the workplace, protection needs to be provided against particular noxious substances such as dust, gases, fumes and vapours.

Industrial accidents, especially accidents involving chemicals, pose a great danger to workers and the public as a whole. The need to prevent accidents to workers is obvious, but it is emphasised when we consider the cost of accidents from several points of view: cost to the worker, the employer, and the country as a whole.

### 8.6.3 Recommendations

- a) Strengthen the local authorities revenue base and financial management.
- b) Strengthen data and information gathering programmes e.g the city data programme to cover all towns in the country for effective management of urban settlements.
- c) Undertake regular reviews of the

terms and conditions of service for public and local authority staff with a view to motivating them to develop and implement programmes effectively.

- d) Review and amend the Local Government Act with a view to strengthening enforcement of regulations governing proper planning and management of the environment.
- e) Plan and coordinate allocation of public sector investment funds between central and local authorities in order to minimise regional imbalances with particular focus on arid and semi-arid lands.
- f) Give priority to community participation in the re-organisation of local authorities in order to promote individual and collective responsibility in urban and rural settlement development programmes and projects.
- g) Explore cooperation with the private sector in human settlements management.
- h) Establish a long-term training programme for workers on health and safety in industries.
- i) Create awareness of industrial health and safety among workers and employers by organising workshops and seminars in factories and technical colleges.
- j) Strengthen the enforcing arm of government to ensure health and safety standards are maintained in work places.

## 8.7 HOUSING

### 8.7.1 Current Status

Housing is basic human need. The demand for housing and related infrastructure and services is ever increasing due to increasing population, rural-urban migration, the high cost of land and building materials, and the short-term negative impacts of economic

changes arising from the implementation of the structural adjustment programme (SAP).

In urban areas, the housing demand increased from 7600 units annually in 1967 to 60,000 units in 1983 and 65,800 units in 1989. Of the 60,000 units required in 1983, only 40,000 units were realised through new and upgraded housing, creating a shortfall of 20,000 units. This demand is expected to rise to an estimated 112,000 units by the year 2000. The shortfall in housing is met through over-crowding, development of slums and informal settlements lacking basic infrastructure and services. The deficit in urban housing is most acute among the low income group who constitute about 70% of households.

In rural areas, families construct their own houses. In 1980 it was estimated that 254,000 additional units were required. Most rural housing is sub-standard due to widespread poverty. For instance, in 1992 about 62% of households had incomes below national average. Thus, the magnitude and the urgency of the problem is enormous, requiring immediate attention. It is therefore unrealistic to plan for long-term environmental sustainability without developing short-term solutions and mitigating measures for the day-to-day survival of most of the people. Poverty alleviation measures are usually supportive of long-term environmental management.

#### 8.7.2 Issues

There is no coherent up-to-date housing policy to guide development plans and programmes. Inadequate supply of housing has led to over-crowding, development of slums, and informal settlements. Often such settlements are located on fragile or unhealthy environments such as steep slopes or around swamps. These settlements lack water, sanitation services and sewerage facilities, making the living environment unsanitary.

#### 8.7.3 Recommendations

- a) Formulate and implement a housing policy that is responsive to the current challenges of providing for an environmentally sustainable housing sector into the next century.
- b) Strengthen poverty alleviation

measures.

- c) Undertake slum upgrading programmes in liaison with local communities.
- d) Promote research and development, and training programmes, that incorporate environmental concerns into human settlements developments.

## 8.8 BUILDING MATERIALS AND CONSTRUCTION INDUSTRY

### 8.8.1 Current Status

Building materials constitute the single largest input in construction and account for about 70% of the cost of housing. In Kenya, the building and construction industry relies on various types of mineral and organic materials. Minerals include earth, building stone, sand, gypsum and limestone while organic building materials include wood, bamboo and grass. Their continued use has a major impact on the environment. Other materials such as galvanised corrugated iron (GCI) sheets, steel reinforcements and asbestos-based products, are mainly imported or rely on expensive imported inputs and expertise.

As the population increases, demand for building materials increases, creating a shortfall between demand and supply, while imported materials are expensive and in turn reduce affordability of housing.

### 8.8.2 Issues

The construction industry is a major consumer of natural resources and a potential polluter of the environment. The quarrying of stone, gravel, sand, and limestone leaves behind unrehabilitated quarry scars that accelerate soil erosion and constitute sites for ponds in which disease vectors breed. Removal of sand from river beds in ASAL areas has the effect of lowering the water table and thus drying up river courses. In addition, air pollution is caused by dust from blasting of rocks and processing of cement, lime, etc.

The production of bricks, tiles and lime further relies on local biomass fuels for the firing process, adding pressure on

wood fuel supplies and loss of biodiversity. It is estimated that an average of 1000 m<sup>3</sup> to 1200 m<sup>3</sup> of wood fuel is required to fire 10,000 to 14,000 bricks of standard size.

### 8.8.3 Recommendations

- a) Minimise environmental degradation through application of environment impact assessment (EIA) on all quarrying projects and enforce rehabilitation of quarries.
- b) Expand research and development efforts and training programmes in appropriate technologies through joint ventures with the communities and the private sector.
- c) Research into energy sources for the making of bricks, tiles and lime other than wood fuel and other plant material.
- d) Extend the Mining Act to cover extraction of building materials, such as sand, to ensure sustainable quarrying.
- e) Promote utilisation of industrial by-products in construction to reduce pollution and dependence on natural resources.
- f) Provide economic incentives and sanctions in order to promote the use of new energy-efficient, low-polluting building materials and technologies, particularly in the wood processing industry.
- g) Consider reducing duty on appropriate building materials.

## 8.9 ENERGY

### 8.9.1 Current Status

Energy is an essential input in all forms of human activities including domestic, commercial, and industrial. Currently, Kenya depends largely on three main sources of energy, namely, wood fuel, electricity and imported petroleum. About 63% of the country's energy needs are met from wood

fuel, 24% by petroleum products, 10% by electricity and 3% by imported coal.

Over 60% of the country's foreign exchange earnings is spent on petroleum imports while most of the rural population and urban poor rely on wood fuel. Other sources of energy are wind, solar, biogas, coal, geothermal and ethanol. As population increases, the demand for energy is expected to grow at the rate of 4% annually placing high demand on forests. On the other hand, the new and renewable sources of energy, although clean, have not been adopted due to high initial cost of imported components. However, the long-term goal of energy development in the country is to formulate and implement policies that encourage use of renewable sources of energy, employing environmentally sound production techniques.

### 8.9.2 Issues

The rapid increase in the demand for wood fuel (firewood and charcoal) is expected to continue and is seen as a major threat to forest resources and biodiversity. The main constraints to sustainable wood fuel supply include inadequate replenishment and inefficient utilisation technologies. The inefficient utilisation is wasteful and causes indoor air pollution, especially in overcrowded and poorly ventilated housing.

Petroleum and coal are imported to meet the country's commercial energy requirements. Petroleum is the main source of energy used in transport, industry, commerce and agriculture. The demand for crude oil in 1992 was 2.4 million tonnes. Petroleum is a significant polluter of air, land and water resources through emissions of exhaust fumes, oil spills and inappropriate handling of oil residues.

Most electricity supply in Kenya is generated by hydro-electric stations, followed by geothermal stations. Electricity is a major source of energy for the middle and high income groups, thus reducing pressure on wood fuel. Hydro-electric power is clean but the silting of the dams and control of downstream flow has significant ecological and socio-economic impacts. Dams are also subject to siltation. Production of geothermal energy is accompanied by carbon dioxide and hydrogen sulphide discharge into the

atmosphere, both of which pollute the environment.

### 8.9.3 Recommendations

- a) Strengthen reforestation programmes and projects with greater involvement of the community, especially women and youth groups, and the private sector.
- b) Provide economic incentives and strengthen energy conservation awareness programmes to achieve efficient use of available energy through use of new energy - efficient technologies.
- c) Provide incentives for research into possible uses of oil wastes, and environmentally sound disposal mechanisms for oil wastes.
- d) Set and enforce emission standards.
- e) Promote use of the oil pipeline to reduce oil spills from accidents on roads.
- f) Reduce dependence on wood fuel by intensifying rural electrification programmes, promoting energy conservation, and promoting alternative energy sources.
- g) Promote research and development and commercialisation of appropriate technologies for new and renewable sources of energy, especially for solar, wind and biogas, and promote the use of alternative, clean and renewable sources of energy, including mini hydro power stations, solar power, biogas and wind energy.
- h) Provide economic incentives to home owners to install solar hot-water heaters; including reducing duty on solar equipment.

## 8.10 INFRASTRUCTURE AND SERVICES

Infrastructure includes water supply, sanitation, solid waste management, drainage, ventilation, and lighting. Infrastructure is a major component in the development of human settlements, yet it

usually receives little attention. Any settlement that lacks any or all the infrastructural facilities suffers a loss in the quality of life of its residents. The management of these facilities also has significant impact on the quality of the environment.

### 8.10.1 Environmental Health

#### 8.10.1.1 Issues

Environmental health in human settlements is mainly concerned with the living and working environment of the people. The major health problems arise from inadequate or lack of housing; inadequate lighting and ventilation; lack of clean water; poor sanitary surroundings including inadequate excreta disposal; and poor surface water drainage and solid waste management. These environmental health factors lead to prevalent transmission of diseases such as malaria, acute respiratory infections, and diarrhoeal diseases. These diseases can be prevented largely by better management of the living and working environment.

#### 8.10.1.2 Recommendations

- a) Develop sustainable water and sanitation projects which are easy to maintain and are affordable to the target community.
- b) Promote environmental sanitation through awareness programmes.
- c) Develop effective storm water drainage systems to take care of rain water runoff and to avoid water stagnation that act as breeding grounds for disease vectors.
- d) Promote improved house designs that emphasise proper ventilation, lighting and outlets for smoke.
- e) Involve local communities and youth groups in managing human surroundings to minimise disease-causing conditions.

### 8.10.2 Water

#### 8.10.2.1 Current Status

Access to safe water is a major government

concern; in fact the government has committed itself to providing clean water to the entire population within the next several years. However, in 1991 an estimated 17 million Kenyans were without reasonable access to clean water. It is also estimated that only 35% of the rural population and 75% in urban areas has access to clean water within reasonable distance. The major challenge in the water sector is to improve access to safe drinking water, and to establish an institutional arrangement to monitor and prevent water pollution. Research on suitable or adaptable technology in water supply is a major concern.

#### **8.10.2.2 Issues**

Currently, the major problems affecting water supply are lack of a comprehensive water policy; shortage of fresh water; degraded water quality; continued destruction of water catchments; diminishing dam sites; pollution of surface and ground water; and lack of coordination among water supply organisations. Other problems are those which have been introduced by the urbanisation process, namely; inadequate water, sanitation, liquid and solid waste disposal, etc.

#### **8.10.2.3 Recommendations**

- a) Formulate a comprehensive policy on water supply and management.
- b) Strengthen water management funding and capacities in urban areas and local authorities.
- c) Strengthen coordination in water supply and disposal.
- d) Review legislation on water supply to incorporate conservation of water and enforce them.
- e) Enforce regulations protecting water quality.
- f) Provide incentives and penalties to reduce the unnecessary use and wastage of water.

### **8.10.3 Sanitation**

#### **8.10.3.1 Current Status**

Good sanitation is aesthetically desirable and has important environmental health implications. Many common diseases such as diarrhoea, dysentery and enteric fever can be transmitted through various unsanitary conditions, such as mismanagement of human excreta. The enforcement of regulations promoting aesthetically desirable sanitation and environment is necessary for a healthy population.

#### **8.10.3.2 Issues**

The current sanitation arrangements are limited in coverage; use unsafe procedures in disposing of toxic wastes; are characterised by poor surface water drainage which often leads to contamination of other water resources. Limited community participation in the provision and management of sanitation has resulted in the exclusion of socio-cultural factors. Consequently, the implementation and management of sanitary facilities such as pit latrines lack the critical social support for effective implementation.

#### **8.10.3.3 Recommendations**

- a) Aim at creating a balance in funding between curative and preventive measures in water and sanitation, programmes.
- b) Encourage active participation of communities in planning projects and programmes, including proper use and maintenance of sanitation facilities; and incorporate socio-cultural values in their design and management.
- c) Review and implement appropriate standards for safe disposal of hazardous wastes.
- d) Provide sanitation services throughout the Republic, with emphasis on areas with high population densities.

### 8.10.4 Solid Wastes

#### 8.10.4.1 Current Status

Poor management of solid wastes poses environmental pollution problems, particularly in urban areas. A significant portion of this waste is generated by domestic, commercial, industrial and other institutional human settlement activities.

Solid wastes in rural areas, including trading centres, is composed mainly of vegetable matter; some of it has the potential for recycling, reuse or composting to enrich the soil.

#### 8.10.4.2 Issues

Inadequate disposal of solid wastes has adverse environmental effects. Poorly managed solid wastes or those not disposed of pollute the land, water and air. Increased amount of plastic materials among solid wastes has resulted in frequent blockage of drains, causing floods in urban areas, among other dangers. Poor enforcement of the Public Health Act and related local authorities' by-laws, and lack of a specific department within local authorities to manage the environment, contributes to poor solid waste management.

Other handicaps include lack of or inadequate facilities for recycling of solid wastes, especially in urban areas, and inadequate precautions in the re-use of recycled containers that may have contained harmful substances. There is also limited community participation in the management of solid wastes.

#### 8.10.4.3 Recommendations

- a) Select appropriate technology for each area from available options which include: composting, incineration, refuse pits, and controlled tipping.
- b) Minimise the generation of solid wastes.
- c) Explore and promote the recycling and reuse of solid wastes.
- d) Review relevant laws, by-laws and penalties so as to keep pace with changing trends.
- e) Encourage privatisation of refuse

collection and recycling where necessary.

- f) Establish a department, with appropriate institutional framework, within the local authorities whose responsibility will be environmental health and solid waste management.
- g) Promote full community participation in solid waste management through continuous creation of awareness. Refuse management should also be included in school curriculum so as to encourage and involve the youth in protecting the environment.
- h) Promote the separation of domestic and commercial wastes for easier collection and reuse.

### 8.11 TRANSPORT

Transportation is the single most important facilitator of economic and social development. Kenya is served by a network of roads, railway lines, water-ways and harbours, airports, airstrips, and footpaths (Fig. 8.2). The use of these modes of transport often causes negative impacts on the environment.

#### 8.11.1 Current Status

Road transport accounts for 80% to 90% of passenger and freight movement in the country. The road network consisted of 62462 km of classified roads as at the end of 1992; there were 386,058 registered vehicles giving the country a motorisation rate of 15 vehicles per 1,000 people.

Most people in urban centres use road transport either by public vehicles, private vehicles, cycling or walking. However, in recent years the road network has deteriorated significantly, partly accounting for the increase in road accidents. It is estimated that only 24% of the total road network in Nairobi, Mombasa and Kisumu is in good condition.

Most municipalities, towns and urban centres do not have a public transport system. Where it exists, like in Nairobi and Mombasa, it is inadequate. As a result, many people who own vehicles drive to work.

Railway transport serves the largest urban

centres and some high potential central parts of the country. The railway line has had a significant impact on the pattern of human settlements, particularly urbanisation in Kenya (Annex 4). However, the current operations of the railway transport pose some environmental problems.

The main waterways and harbours are located along the Indian Ocean and Lake Victoria. Spills from oil tankers pose the most significant environmental threat related to water transport. The National Oil Spill Response Committee (NOSRC) has prepared a plan that can handle spills of over 10,000 tonnes of oil but it needs a legal framework and financial support to respond effectively to larger spills.

In recognition of the need for international collaboration, Kenya had by 1992 ratified the following relevant international conventions and protocols:

- a) Civil Liabilities on Oil Pollution Convention, 1969;
- b) Oil Pollution Fund Convention, 1971;
- c) Maritime Pollution Conventions, (MARPOL) 1973, 1978.

However, the concerns raised in these conventions and protocols have not been fully incorporated into the Kenyan legislation.

Kenya has two main airports in Nairobi and Mombasa; and several airstrips in other main towns. As a result, the negative impacts of air transport are only significant at major airports.

The environmental problems associated with airports include excessive noise by aircraft engines, air pollution from exhaust fumes and water pollution from fuel and oil spills. Birds can be struck by aircraft or sucked into jet engines, causing damage and sometimes accidents. Kenya is particularly vulnerable to bird strikes.

#### **8.11.2 Issues**

The environmental impacts of the use of motor vehicles include emission of toxic fumes causing air pollution and a health hazard to human beings, animals and plants. Gravel extracted from various sites for road construction often leaves quarries unrehabilitated. Another issue is the inappropriate handling of waste oils at service

stations. Petroleum tankers occasionally spill oil, polluting surface and ground water.

Within national parks and game reserves, tour operators have established numerous tracks while searching for different animals. This behaviour is continually destroying the natural habitats and modifying the behaviour of wildlife animals.

Owing to concentration of vehicles in urban centres, traffic jams are common at peak hours in the morning, lunch time and in the evening. This congestion causes air pollution from exhaust fumes. Urban centres also have many service stations at which petroleum products and residues are not handled appropriately. Most of the roads have inadequate footpaths and provisions for the disabled and non-motorised transport.

The Kenya Railways Corporation has a fleet of over 200 locomotives each of which carries 30 to 45 litres of lubricating oil. In the course of draining oil wastes from locomotives, some spillage inevitably occurs. While there exist drainage channels to a separator for spilt oil, the channels are often clogged with weeds, grass and other substances causing overflow of oils that pollute the soil and water courses. The quantity of oil drained from locomotives is substantial. For instance, in Mombasa, a minimum of 50,000 litres of oil is drained annually.

Other spillage occur accidentally due to derailment of wagons, at fuelling stations, etc. Even where spillage is minimal, pollution occurs from inappropriate dumping of oil residues. The situation worsens during wet seasons when oil is spread far afield by water runoff.

Kenya Railways Corporation is a major user of stone ballast in the maintenance of its 2,085 kilometres of running line. The environmental impacts of ballast quarrying include noise, air pollution, dust and quarry scars.

The Port of Mombasa serves a large hinterland extending to Zaire, southern Sudan, Uganda and Rwanda. Apart from the regular cargo, the port handles relief supplies to neighbouring countries. The amount of cargo handled by the port translates into higher frequency of ships calling in; and in turn to higher risks of pollution through deliberate

dumping of wastes, discharge of oil by ships at sea, and oil spills from oil tanker ships and storage facilities. Kenya lies on an oil tanker route from the Persian Gulf to the south. Thus oil spillage along the coast and at sea affects the biodiversity of fauna and flora e.g mangroves, corals, sea organisms and marine parks. This situation can adversely affect the tourism industry.

For inland waterways, the Kenya Railways Corporation is mandated by law to survey, licence and regulate operations from Kisumu, on lakes including Victoria and Turkana. Oil spills are a problem on the lakes but the effectiveness of surveillance is hampered by distances from Kisumu headquarters. Birds strike at airports have caused a number of minor accidents. It is urgent to remove attractions to birds from airports in order to minimise the danger of a major accident.

#### 8.11.2 Recommendations

- a) Conduct research on leaded petrol and fuel economy to reduce pollution hazards.
- b) Enhance environmental concerns and safety in road design, construction and maintenance.
- c) Enforce vehicle emission control.
- d) Promote, facilitate and increase availability of public transport.
- e) Promote non-motorised transport, and pathways for cyclists, pedestrians and the disabled.
- f) Clear drainage channels at railway stations and rehabilitate dilapidated facilities to minimise pollution.
- g) Enhance recycling of drained lubricating oils and plan for effective management of waste oils.
- h) Enhance the National Oil Spill Response Committee's capacity to mitigate major oil spills.
- i) Determine environment-friendly quarrying processes and enforce quarry rehabilitation.
- j) Research into stone-crushing

processes that minimise noise and dust pollution.

- k) Develop procedures for transportation of hazardous and toxic substances, taking appropriate measures to ensure that handling, transportation, storage and disposal of such wastes conform to set international standards and restrictions.
- l) Incorporate the provisions of the maritime conventions and protocols into the country's laws.
- m) Institute vessel traffic control surveillance operations to safeguard Kenya's territorial waters against pollution and dumping of toxic and hazardous wastes.
- n) Rehabilitate sites especially along the coast, that have been damaged by dumping and enforce control measures.
- o) Bring all inland water transport activities under the jurisdiction of the Merchant Shipping Act.
- p) Locate airports and airstrips far from dump sites, water points, slaughterhouses, fishmarkets and other sites attractive to birds to minimise bird strikes to aircraft.

## 8.12 DISASTERS

### 8.12.1 Current Status

Natural and man-made disasters cause loss of life, damage to the environment, infrastructure and property. The major disasters in Kenya that contribute to environmental damage include earthquakes, fires, lightning, drought, desertification, pest invasion and industrial accidents.

Various government ministries and agencies have within their portfolios responsibilities to take precautionary and remedial measures against impacts of disasters. For instance, on drought and desertification, the measures include long-range forecasting, plan of action to combat desertification and the sub-regional

programmes undertaken by the Intergovernmental Authority on Drought and Development (IGADD). For floods, the measures include construction of dams, dykes and levees along flood-prone rivers. As for earthquakes, two seismological stations have been established to record the intensity of earth tremors and quakes.

In 1994, the government established the Department of Relief and Rehabilitation to manage famine relief operations and the drought recovery programme through the Relief and Rehabilitation Committees at provincial, district, divisional, locational and sub-locational levels.

#### **8.12.2 Issues**

In spite of the above efforts, a number of environmental issues arising from disasters still persist. Floods are common in urban centres due to extensive impermeable surfaces and blocked storm-water drains. Urban and rural floods cause soil erosion, block drainage system and create pools suitable for breeding by disease vectors that cause epidemics, while deposited soils have caused the silting of rivers and dams. While floods and droughts can be predicted, there has been inadequate preparation for their cyclic occurrences. Therefore, there is need to formulate a comprehensive policy on disaster preparedness and response.

Transport hazards arise mainly from accidents, e.g. of railway wagons, tankers, other motor vehicles, aircraft and sea vessels. Some of these accidents cause oil spills and thereby pollute the soil and water, and destroy plant life. The accidents also destroy human and animal life.

Another critical environmental and health problem involves exposure to chemical hazards. Exposure arises from inappropriate disposal of chemical wastes, expired chemicals, and use of chemical containers by households without adequate cleaning. This can cause poisoning.

Although suitable regulations exist on strengthening of high-rise buildings to withstand earthquakes, they have not been adequately enforced.

#### **8.12.3 Recommendations**

- a) Formulate a comprehensive national

policy and legislation on disaster management.

- b) Promote environmental awareness and disaster preparedness to assist communities develop and adopt practices that can mitigate impacts of disasters.
- c) Maintain storm water drains to reduce the impacts of floods, especially in urban centres.
- d) Develop strategies for managing minor and major oil spills arising from transport hazards.
- e) Enforce building regulations to strengthen skyscrapers to withstand earthquakes.
- f) Enforce safety regulations to prevent industrial accidents.
- g) Use lessons learnt from past disaster audits, early warning systems and indigenous knowledge to take preventive measures that minimise the impacts of disasters.
- h) Strengthen the coordination mechanism for disaster management at all levels.
- i) Establish a national fund for disasters to be administered by a coordinating agency.

#### **8.13 RESOURCES (CAPACITIES)**

In order to carry out the tasks of sustainable human settlements development and management, it is necessary for the implementing agencies to have adequate and appropriate monetary and human resources and supporting institutional capacities.

##### **8.13.1 Human Resources**

###### **8.13.1.1 Current Status**

The main actors in the human settlement sector include the central government, local authorities, the formal and non-formal private sector, non-governmental organisations (NGOs), community-based organisations (CBOs) and individuals. However, the

development and management of human settlements require relevant trained personnel both for the central government and local authorities. Currently, the management requires to develop an appreciation of environmental considerations in development, and to incorporate community participation in planning, implementation, maintenance and monitoring programmes.

#### 8.13.1.2 Issues

Most rural and urban local authorities have limited institutional capacities; thus they are ill-prepared to cope with the growing demand for services. Furthermore, the training, research and development institutions have limited financial and material resources to undertake medium and long-term research, and development, training programmes and demonstration projects in the human settlements sector. The environmental education programme has not been fully developed for implementation at all levels of formal and non-formal education systems.

The NGOs, CBOs, youth groups, women groups and the private sector have not been fully utilised and integrated into the information dissemination campaigns on sustainable human settlements.

#### 8.13.1.3 Recommendations

- a) Provide financial, material, and technical assistance to training, research and development institutions.
- b) Promote joint venture projects between central government and local authorities in consultation with the private sector.
- c) Review and evaluate regularly the performance and the terms of service for employees of local authorities and central government and recommend ways of improving performance.
- d) Incorporate environmental education programmes in all levels of education, in in-service training and public awareness.
- e) Undertake an annual coordinated information campaign as a joint action programme of community/private

and public sectors to highlight the environmental issues facing the public.

### 8.13.2 Financial Resources

#### 8.13.2.1 Current Status

The development of human settlements to satisfy demand would require large sums of money annually. However, the amount of public funds allocated by the government for the development of public shelter has drastically declined from 3.4% in 1984/85 to 1% of the total development vote in the 1989/90 fiscal year. This amount is grossly inadequate to meet the demand for shelter in urban and rural areas. This in turn has negative effects on the human settlement environment, including prevalence of poor sanitary conditions and housing. Ways and means need to be found to improve shelter affordability.

#### 8.13.2.2 Issues

The human settlement sector has not commanded high priority in resource allocation both at central government and at the local authority levels. Another critical issue is the absence of an effective coordination among institutions managing and developing human settlements, and particularly in mobilising funds. The shortage of trained manpower further reduces the capacity of local authorities to plan, implement, and evaluate their projects/programmes.

At the individual level, most poor residents in both rural and urban areas have limited access to credit; while mortgage finance is too expensive. These factors reduce the affordability of shelter.

#### 8.13.2.3 Financial Resource

- a) Recognise and mobilise resources from all actors to supplement government efforts in promoting sustainable human settlements.
- b) Introduce innovative financing mechanisms to enable the poor improve their shelter.
- c) Consider the use of other sources of funds, e.g, pensions funds in

providing shelter.

- d) Strengthen the local authorities' capability to collect rents, rates, fees, etc that are due to them.

## 8.14 ACTION PLAN

### 8.14.1 Population and Environment

#### 8.14.1.1 Actions Which Can Be Taken Immediately

- a) Intensify family life education.
- b) Formulate national human settlements strategies for achieving balanced, sustainable development between urban and rural areas.
- c) Formulate education programmes to increase awareness and change attitudes in support of sustainable use of natural resources.
- d) Educate Kenyans to value other security, e.g professionalism and business, rather than only land as security.

#### 8.14.1.2 Some Long-Term Priorities

- a) Strengthen agencies undertaking the monitoring and evaluation of the demographics and family planning; and its impacts on the environment.
- b) Intensify women literacy and family life education and the negative impacts of high population on the environment.
- c) Broaden economic opportunities in rural and urban areas by diversifying and promoting export-oriented industries; and support marketing and distribution infrastructure.

### 8.14.2 Land Use

#### 8.14.2.1 Actions Which can Be taken Immediately

- a) Formulate a comprehensive land use policy that provides a system of enabling laws, rules, regulations and practices that govern the rights and

obligations of land owners, with appropriate guidelines towards optimal utilisation of available land in both rural and urban areas.

- b) Develop appropriate strategies for effective protection and sustainable utilisation of fragile ecosystems such as forests and wetlands.

#### 8.14.2.2 Selected Activities Requiring Funding

- a) Streamline registration, allocations and planning permissions through improved titling and registration systems which support efficient land transactions and reduce unplanned settlements.
- b) Enhance the capacities of local authorities and Physical Planning Department, through training and provision of equipment, for appropriate land-use planning and management.
- c) Implement education programmes that increase awareness and change attitudes in support of sustainable use of natural resources; and study and respect indigenous resource management systems.

#### 8.14.2.3 Some Long-Term Priorities

- a) Improve access to land and educate Kenyans to understand that part of the population will remain landless.
- b) Involve the local communities in land-use planning and management matters; and require an environmental impact assessment (EIA) for most cases of land allocation and change of user approvals.
- c) Redirect urban expansion and housing developments away from high potential agricultural land, and improve the physical planning for low potential areas.
- d) Develop a participatory mode of wildlife conservation and management, and increase research in ASALs in order to find appropriate land use systems and suitable

technologies for such areas.

### 8.14.3 Rural Settlements

#### 8.14.3.1 Actions Which Can Be Taken Immediately

- a) Formulate a comprehensive human settlements and urbanisation policy; and incorporate traditional and societal cultural values in planning human settlements.
- b) Strengthen national resettlement mechanisms to cater for displaced persons and refugees in order to reduce their impacts on the environment.
- c) Intensify application of environmental impact assessment (EIA) procedures by District Environment Management Committees, with the participation of the communities.
- d) Strengthen environmental awareness programmes at district level to achieve sound environmental management.

#### 8.14.3.2 Selected Activities Requiring Funding

- a) Strengthen programmes aimed at improving rural-urban linkages, international linkages as a way of reducing to sustainable levels migrations into urban settlements.
- b) Promote industrial investments in rural areas with suitable social and infrastructural services.
- c) Intensify anti-desertification measures to restore and increase the carrying capacity of ASALs.
- d) Reduce pressure on wood fuel by strengthening rural electrification programmes in unserved areas, and encouraging the use of alternative energy sources such as biogas, solar and wind power.
- e) Develop and promote low-input, small scale water supply, waste management, and energy systems.

- f) Support research and development of above by economic incentives.

### 8.14.4 Urbanisation And Urban Settlements

#### 8.14.4.1 Actions Which Can Be Taken Immediately

- a) Provide incentives and opportunities for small and medium scale entrepreneurship to generate employment and alleviate poverty.
- b) Increase the supply of affordable, progressively developed housing through slum upgrading and provision of serviced land.
- c) Review and implement mechanisms of upgrading urban centres based on environmental impact assessment (EIA).

#### 8.14.4.2 Selected Priority Activities Requiring Funding

- a) Improve the planning and management capacities of local authorities.
- b) Develop and implement guidelines for informal settlements improvement programmes.

#### 8.14.4.3 Some Long-Term Priorities

- a) Provide and maintain sewerage facilities within all municipalities and urban centres.
- b) Improve sanitation and environmental management in all municipalities and urban centres.

### 8.14.5 Management of Human Settlements

#### 8.14.5.1 Actions Which Can Be Taken Immediately

- a) Institute planning procedures to minimise regional imbalances with emphasis on proper utilisation of fragile arid and semi-arid lands, particularly by the poor.
- b) Broaden the finance base for local authorities and enforce collection and

mobilisation of taxes, rates, rents, for effective management of their local environments.

- c) Promote industrial safety and health through law enforcement, awareness and training.
- d) Explore cooperation with the private sector in providing infrastructure.

#### **8.14.5.2 Selected Activities Requiring Funding**

- a) Review conditions and terms of service of local authorities and national civil servants in order to improve performance.
- b) Restructure national and local authorities to accommodate enhanced community participation and improve efficiency in implementation and management of environmentally friendly human settlements programmes.
- c) Upgrade or develop infrastructure, in particular water and sanitation.

#### **8.14.5.3 Some Long-Term Priorities**

- a) Strengthen programmes such as the City Data Programme to cover all towns and areas in order to collect and analyse data for effective settlements management.
- b) Expand current research and development and training programmes to develop, promote and commercialise appropriate and environmentally friendly housing, building materials, construction and infrastructural technologies, in co-operation with communities and the private sector.

#### **8.14.6 Housing**

##### **8.14.6.1 Actions Which Can Be Taken Immediately**

- a) Revise and implement the national housing policy.
- b) Encourage local authorities to

implement the revised Building By-laws and Planning Regulations (1993)

##### **8.14.6.2 Selected Activities Requiring Funding**

- a) Promote environmentally sustainable construction of affordable housing for the low income group
- b) Strengthen the implementation of poverty alleviation measures including generation of employment opportunities in the housing and building sector.
- c) Undertake environmentally sound slum upgrading programmes with the involvement of the community.

##### **8.14.6.3 Some Long-Term Priorities**

- a) Support research, development and training programmes in housing.
- b) Strengthen implementation of poverty alleviation measures.

#### **8.14.7 Building Materials And The Construction Industry**

##### **8.14.7.1 Actions Which Can Be Taken Immediately**

- a) Enforce rehabilitation of quarries and application of EIA on quarrying activities.
- b) Promote use of industrial by-products as fuel and as raw materials in the building industry.
- c) Consider reducing duty and taxes on appropriate building materials to enhance affordability.
- d) Extend the Mining Act to cover extraction of building materials such as sand to ensure sustainable quarrying.

##### **8.14.7.2 Selected Activities Requiring Funding**

- a) Research and disseminate information on standardised local

building materials and encourage production on small scale, on a sustainable basis, in cooperation with the private sector.

- b) Promote and strengthen use of environmentally friendly production for existing local building materials, e.g tiles, bricks and lime.

#### 8.14.7.3 Some Long Term Priorities

- a) Strengthen and fund research into environmentally friendly building materials technologies.
- b) Encourage the construction industry to adopt new energy-efficient, low polluting and material conserving technologies, particularly in the wood processing industry.

#### 8.14.8 Energy

##### 8.14.8.1 Actions Which Can Be Taken Immediately

- a) Strengthen reforestation programmes through greater involvement of communities and the private sector.
- b) Promote the use of alternative, clean and renewable sources of energy by households, industry, commerce, transport, and the construction industry, including mini hydro power stations, solar power, biogas and wind energy.
- c) Provide economic incentives and awareness programmes to promote energy conservation.

##### 8.14.8.2 Selected Activities Requiring Funding

- a) Research into possible uses and appropriate disposal mechanisms of waste oils.
- b) Strengthen awareness programmes on efficient use of energy to minimise pollution.
- c) Provide economic incentives such as reducing duty and taxes on solar hot-water heaters and other equipment to promote use of renewable energy sources.

- d) Strengthen the capacity of the National Oil Spill Response Committee to mitigate oil spills at sea.

#### 8.14.8.3 Some Long Term Priorities

- a) Extend the oil pipeline to major towns to reduce oil spillage.
- b) Intensify rural electrification programmes and the use of alternative energy sources to reduce dependence on wood fuel.
- c) Promote research and development and commercialisation of appropriate technologies for new and renewable sources of energy such as solar, wind and biogas.
- d) Assess available woody vegetation and monitor changes due to utilisation in order to monitor the effects of wood fuel harvest on the environment.

#### 8.14.9 Infrastructure

##### 8.14.9.1 Actions Which Can Be Taken Immediately

- a) Formulate a comprehensive policy on water resources management.
- b) Review the existing data collection network for adequacy and improvement to cater for the needs of environmental management of water resources.
- c) Update and enforce the current laws and regulations on sanitation and pollution.
- d) Formulate appropriate standards to handle safe disposal of toxic wastes.
- e) Promote improved house designs that emphasise proper ventilation, lighting; and strengthen awareness programmes on adequate ventilation and lighting, technologies that reduce smoke in houses, hygienic use and maintenance of public toilets.
- f) Enforce pre-treatments of sewage before discharge into water courses.
- g) Enhance coordination in water supply

and disposal.

#### 8.14.8.2 Selected Activities Requiring Funding

- a) Provide effective storm water drainage system to take care of rain water runoff and avoid water stagnation that acts as breeding grounds for disease vectors, such as mosquitoes.
- b) Implement the planned storage reservoir dam schemes as proposed in the National Water Master Plan.
- c) Promote rainwater harvesting and develop and maintain small scale community water projects.
- d) Develop sustainable sanitation projects that are easy to maintain and afford through community participation.
- e) Intensify manpower training and development in sanitation programmes.
- f) Establish and implement solid waste management measures to ensure effective storage, collection, transportation and disposal of solid wastes. Select appropriate technology from available options, including composting, incineration, refuse pits, and controlled tipping.
- g) Reduce the bulk of solid waste through reuse and recycling as potential ways of minimising wastes and generating employment. Educate the public to separate rubbish for easier collection, disposal and recycling.
- h) Establish a department in all town, municipal and city councils to be responsible environmental health and waste management.
- i) Explore cooperation with the private sector in the provision of infrastructure.

#### 8.14.9.3 Some Long-Term Priorities

- a) Review relevant laws and by-laws from time to time especially as regards to penalties for waste disposal.
- b) Strengthen water management capacities in urban areas and enforce regulations that protect water quality.
- c) Include waste management in school curricula and involve youth and community groups in environment management efforts.
- d) Research into appropriate technologies for managing waste.
- e) Provide a balance in funds budgeted for curative and preventive measures in water and sanitation programmes.

#### 8.14.10 Transport

##### 8.14.10.1 Actions Which Can Be Taken Immediately

- a) Establish clean air standards and enforce vehicle emission control.
- b) Develop strategies to strengthen management of oil spills.
- c) Monitor transportation of hazardous materials and wastes.
- d) Incorporate appropriate maritime legislation into Kenyan laws.
- e) Impose appropriate sanctions against polluters.
- f) Bring all inland water transport activities under the jurisdiction of the Merchant Shipping Act in order to manage the marine environment.

##### 8.14.10.2 Selected Activities Requiring Funding

- a) Promote non-motorised road transport and develop pathways for non-motorised transport, pedestrians and the disabled.

- b) Undertake research on impacts of leaded petrol on the environment.
- c) Research into uses of drained oils, and provide economic incentives to promote recycling.
- d) Rehabilitate sites damaged by dumping countrywide, and especially along the coast.
- e) Keep sites attractive to birds (such as dumps and fish markets) away from airports and air strips.

#### 8.14.10.3 Some Long Term Priorities

- a) Establish and implement vessel traffic control surveillance.
- b) Develop measures to reduce impacts of noise including noise at airports, public transport (matatus), industry, informal sector, etc.
- c) Enhance optimum operational standards for all existing oil separators at railway stations; and design more effective separating systems.

#### 8.14.11 Disasters

##### 8.14.11.1 Actions Which Can Be Taken Immediately

- a) Formulate and implement a national policy and legislation on disaster management that includes establishment of a national fund for disasters to be administered by a coordinating agency.
- b) Enforce building specifications and regulations to strengthen skyscrapers to withstand earthquakes.
- c) Enforce safety regulations to prevent industrial accidents.
- d) Disseminate early warning information and data on disasters to local users.

#### 8.14.11.2 Selected Activities Requiring Funding

- a) Promote a maintenance culture to reduce impacts of disasters, e.g flooding, fires.
- b) Develop community preparedness on disasters through awareness programmes.

#### 8.14.11.3 Some Long Term Priorities

- a) Strengthen disaster relief committee at all levels.
- b) Establish a data bank and information system on disasters and develop appropriate dissemination channels.

#### 8.14.12 Resources (Capacities)

##### 8.14.12.1 Actions Which Can Be Taken Immediately

- a) Strike an appropriate balance between the roles of the public sector, the private sector and the community, and promote partnerships in human settlement development and management.
- b) Promote environmental awareness for the public jointly with private and community sectors.
- c) Enforce effective measures in collection of current and overdue rates in local authorities.
- d) Seek or find ways of optimising municipal assets such as land in joint public/private development ventures.
- e) Provide an enabling environment for all actors to participate in human settlement finance, e.g, recognise and accommodate activities of street hawkers within planned periodic markets in Central Business Districts (CBD) and other parts of towns.

f) Identify innovative community-based financing mechanisms to increase affordability of shelter and reduce overcrowding and unplanned settlements.

g) Identify other sources of funding shelter programmes such as pension funds, cooperatives, etc.

**8.14.12.2 Selected Activities Requiring Funding**

a) Review the terms of service for central government and local authorities staff in order to retain them and enhance

management.

b) Support research, and development in human settlements.

c) Expand environmental education at all levels, including managers and decision-makers.

d) Intensify manpower training and development for effective human settlement planning and management.

e) Promote a maintenance culture for infrastructure and services.

## CHAPTER NINE

## PUBLIC PARTICIPATION AND ENVIRONMENTAL EDUCATION

### 9.1 COMMUNITY INVOLVEMENT

Broad public participation in decision-making is needed to achieve sustainable development. Individuals, groups and organisations must actively participate in the planning and management processes, particularly those which affect the way they live and work. Participation can be aided by unhindered access to knowledge and skills held by national authorities. At the same time, planners and decision-makers should utilise indigenous knowledge and traditional management systems developed by the affected communities.

The objective of community participation in environmental planning and management is to sustain a productive local environment, including sustainably managed soils, water and biological diversity, for the benefit of the community and the nation. It calls for people's involvement in the identification of their felt needs, mobilisation of resources, and in deciding on direction and execution of programmes and projects. Community participation can take place at three different levels, namely:

- a) At all levels of planning and management, including training, problem identification, prioritisation, implementation, monitoring, and evaluation;
- b) At specific levels e.g. provision of labour; and
- c) As beneficiaries.

*Additional information can be found as follows in this document:*

*Indigenous Knowledge and Community Participation in Biodiversity Conservation - Chapter three; Community Participation in Sustainable Agriculture and Food Security Chapter Five; Community Participation in ASAL Areas, in Drought and Desertification - Chapter six.*

#### 9.1.1 Current Status

Community participation in development activities has long been a common approach to development in Kenya. In fact, self-help and harambee groups are widespread and active down to the smallest administrative regions of Kenya. The foundations for building a more participatory planning approach has already been started and formalised by the Government at the district level. The District Focus Strategy for Rural Development (DFRD) has decentralised decision-making from the central government level to the district level. Within the district, the decision-making process must be initiated at the sub-location level, by the community. To strengthen this process, the Government has deployed more public servants and allocated more funds to the districts. In the area of environment capacity building, initiatives include the posting of District Environmental Officers (DEOs) and District Environment Protection Officers (DEPOs) in order to provide technical advice and support for the District Development Committees and community projects.

Community participation is quite pronounced in the development of our education system, for example, Parent-Teacher Associations (PTAs) are in charge of developing infrastructure in schools. Within the Ministry of Culture and Social Services the departments of culture, social services, adult education, and sports devote most effort in supporting and encouraging the growth and development of self-help groups, sports associations, adult education and cultural groups. Extension services are also offered by the ministries dealing with agriculture, commerce, health, water, environment and natural resources.

Non-government organisations (NGOs) have continued to play an important role in complementing government efforts in

the involvement of communities in environmental programmes and projects. However, NGOs involved in development work at the community level have tended to work independently and in isolation. There has been little collaboration between NGOs, government and other agencies working in the same locality and sector.

However, a positive change towards co-ordination is taking place. For example, NGOs have formed an NGO Council to represent their interests, while the Government has established an NGO Co-ordination Board to co-ordinate NGO activities.

### **9.1.2 Process and Methodologies of Community Participation**

There are five stages of community participation, namely: diagnosis/needs assessment, organisation, empowerment, implementation, and monitoring and evaluation.

Participatory methodologies are important tools in environmental planning and management. There are several participatory methodologies, e.g. Participatory Rural Appraisal (PRA), Farming Systems Approach (FSA), Participatory Action Research (PAR) and Rapid Rural Appraisal (RRA).

PRA has been widely used in Kenya since 1988 and has the following important attributes: The community identifies its felt needs and ranks them in its own way; relies on local leadership to take initiatives; uses community institutions to implement most project activities; and seeks advice from professionals and facilitates training and provision of materials not available locally.

### **9.1.3 Issues**

The Government and development agencies have continued to involve communities in all aspects of development including environment matters. For example, the Government has actively sought community support in afforestation, water and sanitation projects. However, these good efforts have suffered from several constraints.

With regard to communities, certain factors hinder their effective participation. These include conflicting cultural practices, inappropriate technologies and limited leadership skills. Frequently, the community fails to interpret the project objectives which are often initiated without their involvement.

Other constraints are due to conditions set by government and aid agencies. For example, most projects supported by donors must be completed within certain periods, often before communities can develop their participation. Consequently, many projects are left incomplete. Inadequate budget provisions and institutional support have also contributed to the failure of projects. Conflicting political interests may affect the success of projects in terms of project sites, provision of materials and human resources. Furthermore, some implementors may not be fully committed to the success of community projects.

Experience indicates that the provision of incentives are often a major contributing factor to effective community participation.

At the donor level, knowledge of local environmental conditions are a prerequisite to successful project implementation. Flexibility in administering the funds and time scheduling together with cooperation and trust contribute to greater community participation at all levels. Collaboration between project implementors and benefitting communities is necessary. There is also need for donor agencies to recognise and appreciate the indigenous knowledge and management systems of local communities.

Other constraints include man-made or natural calamities, and local and global economic change.

### **9.1.4 Recommendations**

- a) Involve communities in all stages of environmental planning and management.
- b) Enhance community capacity to

- |    |  |    |  |
|----|--|----|--|
|    | participate through training, educational programmes, etc.   | k) | Strive for gender balance in community representations.  |
| c) | Incorporate incentives to sustain community participation in environmental projects and programmes.  | l) | Strengthen and utilise existing community groups and networks as avenues of achieving sustainable development.   |
| d) | Integrate income generating activities into environmental projects and programmes to achieve sustainability.   | m) | Train development agents (government, NGOs) in participatory methodologies, especially on how to involve communities in planning and implementation of environmental projects. |
| e) | Recognise and promote the use of indigenous knowledge and skills whenever appropriate in environmental management.   | n) | Develop appropriate methods of motivating community resource persons and extension workers involved in environmental management.   |
| f) | Examine and strengthen existing policies and strategies such as district focus for rural development (DFRD), harambee and self help movements that promote community participation   | o) | Develop special programmes to train local staff and community leaders on how to inform, involve and mobilise target groups when preparing and implementing projects.           |
| g) | Promote and enhance collaboration and coordination at all levels of environmental planning and management.   | p) | Increase funds for community development initiatives in environmental planning and management.   |
| h) | Support efforts by the NGO Council to develop a comprehensive code of conduct/ethics for its members as a self-regulatory mechanism. Also avoid duplication of efforts, which result in a waste of scarce resources among NGOs.              | q) | Review the credibility of some international organisations involved in community projects.   |
| i) | Encourage international organisations to honour the priorities locally identified; to support sustainable programmes; and to coordinate their activities with those of the local communities to minimise duplication and waste of resources. | r) | Communicate information on disasters and calamities affecting peoples' lives accurately and in time for a state of preparedness.   |
| j) | Encourage international organisations to utilise local expertise and resources as much as possible, and sensitise donors/international organisations to appreciate local conditions.   | s) | Review and strengthen the activities of district development committees and decentralise some of their functions to divisional and locational levels.                          |
|    |  | t) | Help communities adjacent to protected areas to reap direct benefits from such areas in order to appreciate the value of conserving and protecting resources.                  |

- u) Require audits of the accounts of harambee and self-help initiatives.
- v) Use economic incentives to reward industrialists and communities that take a leading role in environmental conservation.
- w) Initiate a monitoring and evaluation system of projects in various communities to check on accountability and transparency.
- x) Involve communities in environment impact assessment (EIA) before, during and after implementation.
- d) Develop a flexible and adaptable work force of various ages to solve increasing environmental problems, and changes arising from the transition to sustainable development.
- e) Strengthen national capacities, particularly in scientific education and training.
- f) Facilitate the transfer and assimilation of new, environmentally and socially acceptable and appropriate technology/know-how, including use of indigenous knowledge.

## 9.2 ENVIRONMENTAL EDUCATION

### 9.2.1 Introduction

Environmental education is both formal and non-formal in Kenya. Formal education has course/courses contents, a time limit and it is institutionalised. Formal education is used for capacity building. On the other hand, non-formal education is usually a continuous process, and most of it is not institutionalised. It also varies from region to region.

### 9.2.2 Goals of environmental education

- a) Provide every person with an opportunity to acquire knowledge, and develop values, attitudes, commitments and skills needed to manage dynamism of the environment.
- b) Create new behaviour patterns of individuals, groups and communities towards the environment.
- c) Promote integration of environment and development concepts, and enhance awareness of, and concern for, economic, social, political and ecological interdependence.

- g) Enhance capabilities of professionals to solve specific environmental issues.
- h) Integrate environmental considerations at all managerial levels and in all functional management areas such as marketing, production, and finance.

### 9.2.3 Current Status

#### 9.2.3.1 Formal Environmental Education and Training

##### a) Policy

The 1989-1993 National Development Plan says development should not be at the expense of natural resources. This is re-emphasised in the 1994-1996 National Development Plan, while Sessional Paper No. 6 of 1988 on 'Education and Manpower Training for the Next Decade and Beyond' says "environmental studies be part and parcel of the education and training curricula and be taught at all levels of education".

##### b) General

Formal environmental education in Kenya is used to increase awareness, improve extension services, sensitise people on environmental issues, and strengthen institutional capabilities.

Some efforts have been made to integrate environmental aspects in the curricula of most training institutions. The training institutions include teacher training colleges, national polytechnics, technical training institutes, medical training institutions, the Forestry Training College, agricultural training institutions, the Wildlife and Fisheries Training Institute, and the universities. Religious institutions and other NGOs carry out environmental training in their specialised areas. Some private institutions and organisations have also included environmental aspects in their curricula.

Generally, environmental education is not very well developed in the pre-primary schools. At the primary school level environmental education is infused in subjects like geography, agriculture, science and home science. Similarly, in secondary schools there are sectoral subjects which include biology, geography, chemistry, physics, etc. The course contents are usually prepared by the Ministry of Education in conjunction with the Kenya Institute of Education (KIE).

Universities and teacher training colleges are continuously producing graduates in various subjects such as geography, biology, etc.

#### c) Technical Training

Many school leavers enter Teacher Training Colleges, Polytechnics, Institutes of Technology, National Youth Service, etc. Environment training is offered at the Kenya Polytechnic and some of the teacher training colleges. In most of these institutions, environmental training is for a greater part sectoral including: Architecture, Agriculture, Agricultural Engineering, etc. There is need for institutions that do not offer environmental training to have an introductory environmental course for all students.

#### d) Training in Specialised Fields

Specialised training is offered by institutions owned by the government, NGOs and individuals. The training may

cover some of the environmental sectors like Health (MTC), Water (Water Training Institute), Forestry (Londiani Forest College), Agriculture (Egerton and Jomo Kenyatta University Colleges) etc. Other sectors of the economy like secretarial, computer technicians, defence, police, etc. are also covered. Each of the institutions should have a general "Environmental Course" in order to create environmental awareness in Kenya at all sectors of the economy.

#### e) Special Schools

Special schools have been developed by the Ministry of Education and the Ministry of Culture and Social Services and various NGOs to cater for both academic and training of the handicapped people. Like all the other institutions an introductory course on environment is desired.

#### 9.2.3.2 Issues

Despite its inclusion in the curricula, environmental education is not adequately supervised and is not tested in the terminal examinations. So far, no evaluation has been undertaken to assess the impact of formal environmental education in our schools. A monitoring and evaluation programme is needed in order to propose improvements.

Training programmes are fairly specific, focusing on solutions to problems in a localised situation, and trainees are equipped with the necessary skills to tackle the problems pertaining to their subject of training. Technical and vocational training programmes such as masonry, carpentry, leather works, etc. do not have an environmental syllabus. Moreover, there is limited use of indigenous knowledge in developing training programmes and little consideration is paid to socio-cultural aspects and interests of target groups. Industries have continued to benefit from environmentally trained personnel, while their contribution to training is minimal.

Although the school curricula has incorporated essential aspects of environmental education, not all institutions have the capacity to teach it

effectively. The major constraints include shortage of funding, basic teaching and learning resources, and facilities such as text books, audio visual materials, and laboratories. In addition, teachers trained in environmental education are few, while pre-service and in-servicing in environmental education is slowly being implemented. Teachers are currently exposed to varied approaches in environmental education. Furthermore, there are few trained school inspectors to supervise and evaluate the subject at all levels.

Graduates of institutions dealing with formal education are employed in almost all government ministries, governmental organisations (River Basin Authorities, Museums, etc.) and non-governmental organisations (KENGO, Uvumbuzi, ACTS, etc.). However, motivation for environmental workers in the public sector is low since there is no clear career ladder, unlike in other professions which have stipulated schemes of service for advancement. This discourages students from studying environmentally related subjects; consequently, capabilities in environmental agencies are limited.

#### **9.2.3.3 Recommendations**

- a) Formulate a national environmental education strategy.
- b) Encourage universities and other institutions to intensify study and evaluation of the quality of environmental education and avail results to implementing organisations.
- c) Increase in-service environmental education for trainers and supervisors/evaluators.
- d) Incorporate environmental education in the formal syllabi as an examinable subject at all levels of education
- e) Develop an environmental course for institutions and university faculties that are not training environmentalists.
- f) Monitor and regularly evaluate

sustainability of the environmental education programmes.

- g) Upgrade and strengthen existing institutions to meet the needs of formal and non formal environmental education.
- h) Introduce environmental education departments in all pre-service training institutions. In addition, provide these institutions with the necessary equipment and other facilities for the purpose.
- i) Introduce training levies and require industries benefiting from personnel trained in environmental matter to pay.
- j) Review the scheme of service for environmental scientists in the public sector.
- k) Collect, study, store analyse and disseminate the indigenous knowledge of Kenyan communities.

#### **9.2.4 Non-formal Environmental Education**

##### **9.2.4.1 Current Status**

Non-formal environmental education/training has a long history as regards the protection and conservation of sites of interest by the different cultural groups. These include, for example, Kaya forests by the Miji-Kenda at the coast, salt licks by the Maasai and Kikuyu, "circumcision forests" by the Kalenjin, "circumcision wetlands" by the Bukusu, etc.

Non-formal environmental education is intended to benefit people outside the formal education system. This is important for Kenya where only 45 per cent of pupils from primary school enter secondary school.

Non-formal environmental education is conducted by different ministries and departments of Government in form of extension services, for instance forests, agriculture, Kenya Wildlife Services, etc.

Extension work can be in form of village/ community barazas or mass media.

There are many public, private, non-governmental and international organisations involved in non-formal environmental education. In the public sector, the ministries /departments dealing with tourism, wildlife, energy, agriculture, environment, forests, and the Kenya Wildlife Service (KWS), National Museums of Kenya (NMK), Tana and Athi Rivers Development Authority (TARDA) and Coast Forest Conservation Unit have educational programmes. The Ministry of Culture and Social Services also offers non-formal environmental education as part of its adult education programme. Environmental education has been incorporated into adult education programmes and projects carried out by NGOs, women and youth groups.

NGOs have played a significant role in supplementing government efforts to promote environmental education programmes. Amongst national NGOs are Kenya Energy Non-Governmental Organisation (KENGO), Wildlife Clubs of Kenya, East African Wildlife Society (EAWLS), Uvumbuzi Club, and Climate Network Africa. International organisations involved in environmental education include Co-operative CARE International, The World Conservation Union (IUCN), Worldwide Fund for Nature (WWF), African Wildlife Foundation (AWF), Environment Liaison Centre International (ELCI), Africa Water Network and Bellerive Foundation.

Women and youth groups are also very important in promoting non-formal environmental education. These include Maendeleo ya Wanawake, National Council of Women of Kenya (NCWK), Young Women's Christian Association (YWCA), Kenya Scouts and Girl Guides Associations, and Kenya Association of Youth Organisations (KAYO).

The private sector has not been left out in the efforts to promote non-formal environmental education. Examples in the sector include Bamburi Portland Cement Company, Pan African Paper Mills (Pan Paper), and oil companies.

The target groups and methods used vary with the organisation. Some of the methods used by these groups include posters, slides, films, video shows, magazines, drama, newsletters, exchange visits, extension services, etc. Popular concepts include afforestation, soil conservation, food security, range management, community participation and clean-ups.

#### **9.2.4.2 Issues**

There are no available measurements of the progress and impacts made in the area of non-formal education. Drawbacks include unco-ordinated planning for environmental activities, inadequate community involvement in deciding where and what programmes should be undertaken and where; and limited use of indigenous knowledge and local expertise.

Since most of the environmental information is published in the official languages of English and Swahili, environmental education does not always reach the target group. Furthermore, there is no organised non-formal environmental training programmes for communities.

#### **9.2.4.3 Recommendations**

- a) Extend environmental education and awareness to leaders and decision makers in government, NGOs, the private sector and donor agencies.
- b) Involve more youth in environmental issues. This can be done through organisations like Young Farmers Clubs, Wildlife Clubs of Kenya, Girl Guides, Boy Scouts, etc.
- c) Publish environmental messages in various languages besides English and Swahili.
- d) Prepare and update training manuals and resource guides for environment and sustainable development education.

- e) Attach trained environmental extension officers to District Environment Offices.
- f) Recognise and respect moral and socio-cultural aspects and interests of target groups in training programmes.
- g) Equip more target groups with specific environmental education and training packages.
- h) Tap indigenous knowledge on the environment.
- i) Establish training committees at the national, district, divisional and locational levels to prioritise, organise and conduct non-formal training at all levels with the full participation of communities.

### 9.3 PUBLIC AWARENESS

#### 9.3.1 Overview

Sustainable development can better be achieved with the support and co-operation of an informed public. Often, wrong actions have been taken because of lack of awareness.

Information can be made available to society through formal and non-formal education so that society can internalise values that support sustainable environmental management. It will then be possible to evolve ethics for sustainable living, and a dynamic re-examination of values and behaviour.

#### 9.3.2 Current Status

The Provincial Administration and natural resources extension workers often convene local meetings or use other fora to discuss sustainable development issues, sometimes using audio visual techniques. There are many NGOs and other public and private organisations that inform the public and promote awareness about environmental issues at all levels. World Environment Day, Tree Planting Day, and Water Day are usually

commemorated by activities such as tree planting, clean up campaigns, and building of gabions.

#### 9.3.3 Issues

More trained personnel are needed to carry out environmental programmes throughout the country, while the use of audio visual materials requires substantial financial resources. At present, the mass media has limited access to factual information about the environment, and most journalists have not been trained to report on environmental issues.

Sometimes, although the public may be aware, the need to survive today and to conserve for tomorrow are conflicting.

#### 9.3.4 Recommendations

- a) Intensify the use of mass media to sensitise the public to environmental issues.
- b) Improve access to environmental information by the media, individuals and communities.
- c) Use professionally researched materials in the public awareness campaigns.
- d) Prepare information packages in local languages for local communities.
- e) Develop specific environmental programmes for the mass media and strengthen the production of documentary films, videos, slides, posters, etc. on environmental issues and activities.
- f) Avail human and financial resources to develop an awareness.
- g) Encourage networking among organisations and environmental institutions.
- h) Organise competitions for environmental conservation

among schools, villages, locations, sub-locations, divisions, districts and at national level.

- i) Recognise and affirm the role of culture and indigenous knowledge in environment and development.

#### 9.4 PLAN OF ACTION

##### 9.4.1 Actions Which Can Be Taken Immediately

- a) Review the education policy with a view to strengthening environmental education in the formal curriculum and in the national examinations.
- b) Redefine and reformulate existing strategies such as District Focus for Rural Development, harambee, extension packages, etc. to incorporate more flexible locally based participatory approaches to environmental planning and management.
- c) Develop a strategy that enhances community participation in resource management and promotes equitable distribution of benefits.
- d) Involve the mass media in providing environmental information.

##### 9.4.2 Important Activities Requiring Funding

- a) Formulate a national environmental education strategy.
- b) Orientate policy and decision-makers and train project managers, extension and field staff in participatory methodologies.
- c) Improve the exchange of information, skills and technology

among communities through training, networking, incentives and other relevant programmes.

- d) Develop specific environmental education curricula for all levels of education.
- e) Collect, study, store, analyse and disseminate indigenous knowledge.
- f) Organise workshops and seminars to prepare training packages for use by the institutions already implementing environmental education curricula.

##### 9.4.3 Long Term Priorities

- a) Train communities in leadership skills and environmental planning and management.
- b) Strengthen the process of involving communities in decision making.
- c) Empower communities through financial, training and appropriate technological support.
- d) Enhance the capacities of local governments to involve communities in environmental activities.
- e) Monitor and evaluate environmental education and awareness.
- f) Develop an appropriate communication strategy that includes radio, TV, documentary films, newspapers, magazines, and posters to disseminate information emanating from environmental activities.
- g) Produce newsletters and magazines to promote networking on environmental education and training.

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## CHAPTER TEN

# ENVIRONMENTAL INFORMATION SYSTEMS

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### 10.1 INTRODUCTION

Information is a fundamental resource upon which organisations, countries and individuals depend on in managing their affairs. In the decision-making process information is required to define objectives, set targets and guide in the implementation process in order to bring about effective and harmonious implementation of programmes. A decision is generally no better than the information on which it is based.

Nowadays with what is termed "literature explosion", it becomes difficult for an individual to keep pace with even a small fraction of it, and the common problem is that of ensuring that those who need information can obtain it with minimum cost and without being overwhelmed by large amounts of irrelevant matter. The concern about organised and processed information has made many organisations in the world improve management of their information systems and affairs.

So much information is currently generated so that without proper organisation it would hardly be of any use to those requiring it for some specific use. Information should be disaggregated to correspond with the personal, community, institutional, project, district and national needs. In this regard specialised information centres are essential if various groups working to solve various problems are to get the information they need as fast as they need it.

#### 10.1.1 Environmental Information (EI)

Environmental information refers to forms of knowledge which relate to the environment in one way or another; it includes all forms of knowledge needed to understand or manage the environment. The forms of knowledge

(commonly referred to as information/ data) are complex and include, but is not restricted to industry, pollution, biodiversity, water, climate, health, soils, geology, the atmosphere, cultivation, cropping, animal husbandry, management, infrastructure, settlements, human activities, and rural development.

In a nutshell, environmental information is extremely broad and multi-disciplinary in scope. It embraces scientific information as well as newer subject disciplines such as the modern management sciences, systems analysis, operational research, bio-technology, comparative-risk assessment and decision theory.

#### 10.1.2 Information Systems (IS)

For ease of retrieval and use, environmental information must be collected, stored, analysed, displayed and disseminated in a systematic manner which is easy to understand and access. The system used to store, analyse, display and disseminate information is referred to as the information system (IS). Environmental information system (EIS) is therefore the system used to collect, store, analyse, display and disseminate environmental information.

The need for an environment information system (EIS) is acute when consideration is given to the fact that recent and current economic, social and technological activities have and continue to contribute to rapid and potentially stressful changes in our environment.

Kenya lacks a national information policy and a national information system. However, any information system can only be relevant if it is perceived to be useful. Consequently, Kenya's EIS must be based on user or client demand. It must also be both self-sustaining, effective, and economically feasible.

## 10.2 STATUS OF ENVIRONMENTAL INFORMATION IN KENYA

The government, parastatals, private companies, research institutes and centres, educational institutions, NGOs, and other institutions have progressively established departments to generate data required to manage particular resources. However, most of the data/information collected remain unanalysed; consequently, they are of limited use.

### 10.2.1 Wildlife

#### 10.2.1.1 Current Status and Issues

A major gap in wildlife information is little or lack of data on population dynamics especially sex ratios and population growth potential. Equally, data collection suffers from infrequent surveys and lack of timing. The above factors could be mitigated by strengthening the available human resources and technology.

The areas that have impeded information development and dissemination in the wildlife sector are outdated policies/legislation, weak institutional framework, inadequate finances storage, networking, marketing, and public relations.

#### 10.2.1.2 Recommendations

- a) Make collection of wildlife data/information be as comprehensive as possible with special emphasis on population dynamics including sex ratios and recruitment potential.
- b) Make wildlife surveys frequent and periodic.
- c) Provide funds, and appropriate technology in addition to enhancing human resource capacity in information/data management.
- d) Enhance institutional capacity by providing human resource, technology and funds, and by reforming legislation and administrative structure to favour

better information management.

- e) Develop and sustain an aggressive national and international public relations and marketing exercise. Any successful public relations and marketing programme must be supported by an active information database and network which must in turn be adequately funded and managed by competent and competitively remunerated personnel.
- f) Strengthen information system management in the wildlife sector.

### 10.2.2 Tourism

#### 10.2.2.1 Current Status and Issues

Tourism is a rapidly expanding economic industry in Kenya. As an industry, tourism is based mainly on wildlife and its natural habitat in addition to the natural attractions like beaches and landscapes. The growth of tourism will depend on good public relations, marketing efforts, political stability and world economy and politics. As the sector grows there will be increased negative impacts on the environment which must be contained. The expansion of the tourism industry will partly depend on the efficiency of the national environment information system. It must be able to respond to issues as they arise and be able to develop and sustain an efficient ecotourism based on current data and projected trends. So far, information on cultural changes and their responses to tourism have not been adequately documented.

An equally serious constraint to the tourism industry is the financial base on which the information programmes must be sustained. In particular, public budget provision is severely inadequate.

#### 10.2.2.2 Recommendations

- a) Collect comprehensive information on the impact of tourism on the environment.
- b) Develop a comprehensive tourism information system and provide

- sufficient funds for its development and maintenance.
  - c) Formulate an outreach programme emphasising active dissemination, networking and marketing. Concurrently, there is need to aggressively publicise socio-cultural aspects, particularly as they affect the environment, e.g., diseases, degradation, etc.
  - d) Develop human resources and provide appropriate technology at all levels to support (c) above.
  - e) Review policy guidelines periodically to respond to the dynamism in the industry. In this regard, frequent and periodic studies need to be conducted.
- d) Coordinate the forestry information collection and management in order to reduce or eliminate duplication of effort and consequent waste of funds.
  - d) Develop a systematic mode of information dissemination both nationally and internationally. This will lead to a profitable networking, marketing and bio-diversity conservation.

### 10.2.3 Forestry

#### 10.2.3.1 Current Status and Issues

Forests occupy about 3% of total land surface in Kenya, but its contribution to the national economy is considerable. Information pertaining to its characteristics, biodiversity, dynamism and economic value is required for its efficient management and conservation.

The recently completed Kenya Forestry Master Plan has contributed immensely to the forestry database which was previously lacking. Besides, the DRSRS line information and related statistics are also invaluable supplementary contributions. Periodic updates of these records and other complementary studies would further improve the situation. However, management of the information should be improved with a view to achieving better utilisation of the forestry resource.

#### 10.2.3.2 Recommendations

- a) Collect forestry data periodically for use in preparing management strategies and for monitoring purposes.
- b) Update frequently the forest database.

### 10.2.4 Livestock

#### 1.2.4.1 Current Status and Issues

Livestock is an essential component of Kenya's subsistence and cash economy. Any change in this sector can have significant effects on the economy, human welfare and the environment. For example, the rapid changes which have occurred in the last 30 years on land utilisation caused by the rapid increase in human population has had negative impact on livestock population and consequently the environment.

In view of the afore-mentioned, it is important to assess the impact of all these factors on the environment. However, an authoritative assessment must be based on a good database. In Kenya, information relating to livestock is far from adequate, particularly on population dynamics, biodiversity, policy/legislation, human resources/technology, networking/marketing, quantity and socio-cultural aspects.

#### 10.2.4.2 Recommendations

- a) Develop comprehensive information collection programme on livestock.
- b) Make the collection of information a continuous process with emphasis on consistency and reliability.
- c) Establish a responsive public relations programme that promotes the potentiality of the sector.

- d) Restructure the existing institutional framework to incorporate an information system.

#### 10.2.5 Marine and Fisheries Resources

##### 10.2.5.1 Current Status and Issues

The prices of traditional sources of protein (e.g. meat), have been rising rapidly. As a result, the demand for fisheries and marine resources have been growing. However, its growth and potential can best be assessed using an efficient comprehensive information base.

In Kenya, information on the fisheries industry is generally difficult to get or altogether lacking. Besides, there is general inconsistency and lack of periodicity in data collection. Such an information system cannot therefore be expected to be of much use to both a dissemination service and an active public relations programme. The main contributing factor to the constraints is inadequate funding for human resource capacity building, and for purchase of equipment, and for surveys, analyses, and storage.

##### 10.2.5.2 Recommendations

- a) Provide adequate funds for capacity building, to facilitate data collection, analysis, storage and dissemination.
- b) Develop information collection and management strategies and implement them.
- c) Review existing institutional structures to provide for an information management system on marine and fisheries resources.

#### 10.2.6 Soils

##### 10.2.6.1 Current Status and Issues

Information on soils is currently being gathered by the Kenya Soil Survey, a soils inventory programme within the Kenya Agricultural Research Institute. Other bodies which collect the information are the public universities (University of

Nairobi, Moi University, Egerton University and Kenyatta University), government ministries, non-governmental organisations, etc. Other information is contained in scientific journals, proceedings and reports of seminars and workshops. The forms in which the information is stored varies in form from hard copy reports to digital maps and databases.

Soil surveys are expensive to carry out due to intensive and demanding field checks. This has resulted to having only limited areas (30% of the country) covered to a scale of 1:100,000 in a span of 20 years. The only soil map covering the whole country is at a scale of 1:1,000,000 which is low in resolution and inappropriate for project implementation. Inadequate funds has been a major constraint to these efforts.

Most soil survey reports are written in a vocabulary which is mainly understood by soil specialists. Besides, such reports lack appropriate illustrations for the general public, particularly maps on the distribution of soil erosion hazards and soil loss amounts. In addition, publishers of soil survey reports have not developed an appropriate feedback system.

##### 10.2.6.2 Recommendations

- a) Increase funds for collecting information on soils in all parts of the country at appropriate levels and scales.
- b) Increase funds for training on soil type characteristics, identification, and evaluation through simple land/soil degradation surveys.
- c) Collect data/information on soil pollution and environmental degradation.
- d) Write soil survey reports using vocabulary appropriate for the target readers. Besides, publish more reports for general readership.
- e) Store soil information preferably in a digital database such as the

GIS to enable integration with other databases.

#### 10.2.7 Water Resources

##### 10.2.7.1 Current Status and Issues

The Ministry of Land Reclamation, Regional and Water Development recently completed the National Water Master Plan (NWMP) in collaboration with Japan International Cooperation Agency (JICA). The NWMP comprise interrelated databases including the following: socio-economic conditions; potential water resources; potential water demand; development plan for domestic and industrial water supply; development plan for livestock water supply; wildlife and fisheries; development plan for agriculture; hydropower development; and flood protection and drainage.

The NWMP also contains a total of 151 various thematic maps and other illustrations on vegetation and land use, land forms, hydrology, ground water quality, surface water, water resources, and project location. The information has been digitized.

There are also other government ministries such as health, agriculture, local government in addition to universities, research centres, parastatals, NGOs, development authorities, etc. that collect, analyse and store information on water. Water and waste water samples are also analysed by other government and private laboratories and should therefore be consulted when data on water is required. Furthermore, public and private universities and researchers have data in the form of research reports.

The NWMP has identified key areas where information on aquatic environment is missing and also gives recommendations on studies to be carried out. The recommendations included studies to: determine the location and extent of aquifers in different areas and their potential; determine the cause of declining water levels in Rift Valley lakes; understand the effect of pesticides, heavy

metals and other substances on water quality.

##### 10.2.7.2. Recommendations

- a) Strengthen the coordination of water management information.
- b) Improve inter-ministerial and inter-sectoral coordination on aquatic information and analysis.
- c) Collect comprehensive information on water resources and develop an efficient data management system.
- d) Analyse all data as soon as it is collected.
- e) Develop an efficient information dissemination system.

#### 10.2.8 Geology and Mining

##### 10.2.8.1 Current Status and Issues

The geological survey and research programmes have mainly been mapping new areas and revising outdated maps and reports. The information collected can be used to assess and locate ground water resources, rock formations, hydrocarbons, geological hazards, and mineral potential.

The existing databases are available in forms of: geological reports and maps; well information which includes well logs and cores; geochemical and petrophysical samples; and geophysical data and accompanying reports. However, these data are for only a part of the country; the other parts have not been geologically mapped.

Existing databases are being digitized by the National Oil Corporation of Kenya (NOCK), whereas the data at the Mines and Geological Department are still in the form of reports and maps.

There is enormous information in the Mines and Geological Department, MLRRWD, Ministry of Research Technical Training and Technology, universities (Departments of Geology) and related NGOs.

### 10.2.8.2. Recommendations

- a) Avail all geological and mining information to a central environment coordinating body.
- b) Improve the coordination and management of geological and mining information.
- c) Develop and introduce geological and mining sciences in primary and secondary school level of education.
- d) Restructure existing institutional framework and establish information units in all organisations dealing with the management of geological resources.

### 10.2.9 Energy

#### 10.2.9.1 Current Status and Issues

Kenya currently depends on four main sources of energy: wood fuel, fossil fuel, hydro and geothermal electricity.

Wood fuel is the main energy source in the country. The immediate objective for wood energy is to ensure adequate supplies through sustained yields while at the same time mitigating against the environmental effects resulting from increased wood removal. Fossil fuels are the second main source of energy and is mainly used in industrial and other sectors.

Information is available but is scattered in different institutions such as National Oil Corporation of Kenya (NOCK), Ministry of Energy (MOE), Ministry of Public Works (MOPW), and private and non-governmental organisations.

#### 10.2.9.2 Recommendations

- i) Collect all data on energy and put them in a central place for ease of access.
- ) Improve management of data/information on energy to facilitate easy retrieval and provide for data management

units within existing institutions dealing with energy.

- c) Intensify information acquisition and research on alternative renewable sources of energy.
- d) Enhance human capacity in information management.
- e) Increase funds for collection, analyses, and management of information/data.

### 10.2.10 Meteorology

#### 10.2.10.1 Current Status and Issues

Meteorological data is observed at 28 ground surface stations, 15 agrometeorological stations, 3 radiosonde stations, 18 pilot balloon stations and about 2000 rainfall stations in Kenya. The Kenya Meteorological Department (KMD), is charged with collecting and disseminating meteorological data in the country. In performing these tasks, use is made of organisations such as schools, hospitals, government offices, farmers and interested individuals for observation of rainfall data. These organisations are provided with the raingauges, while KMD maintains them regularly.

However, there is an insufficient network of observing stations due to inadequate funding. Besides, the maintenance of existing stations is inadequate, especially for the stations manned by non-meteorological staff (viz. most rainfall stations).

The type of data collected include: rainfall, clouds, wind, temperature, visibility, pressure, evaporation, sunshine, radiation, etc. Some of the data date back to 1890. These data can be obtained from KMD. Most of these data are kept on magnetic tapes but there is still an amount on observation registers. Processed data are microfilmed and stored. However, some data are still on observation registers.

There are other constraints affecting the quality of data provided by KMD. For example, radiation measurements are

imprecise, particularly in terms of type and intensity, and this denies the scientist the chance of involvement in research of ozone depletion and global warming. This is compounded by a comprehensive programme on global warming monitoring. Equally, air pollution monitoring has not been emphasized either within the meteorological sector or elsewhere.

Meteorological reports use vocabularies which cannot easily be understood by most literate members of the public. Consequently, their usefulness is very limited. Besides, they can easily be misinterpreted.

Finally, the public sector meteorological institutions suffer from a high turnover of staff.

#### 10.2.10.2 Recommendations

- a) Open more observatories and establish more automatic stations in remote areas.
- b) Develop wide area network (WAN) system for digital transfers, for example by using electronic mail (E-mail).
- c) Develop further and strengthen public education on weather and climatic implications.
- d) Establish air pollution recording and monitoring stations.
- e) Train meteorological staff to translate their findings into everyday language, or employ public relations staff to do so.
- f) Improve measurement of radiation data.
- g) Develop and motivate human resources.

#### 10.2.11. Agriculture

##### 10.2.11.1 Current Status and Issues

Information relating to agricultural activities and services are at the moment held by various organisations and

government departments. The information is stored in various forms ranging from monographs to digital information. Attempts are currently being made by the individual organisations to organise the information in a manner appropriate to their own requirements and use. The Ministry of Agriculture, Livestock Development and Marketing (MOALDM) publishes bulletins on agriculture and related services. The ministry also has several information systems ranging from a library service to a documentation unit and computerised databases. Related information is maintained by parastatals, universities and research institutions especially KARI.

The need for precise information and data for food production cannot be over-emphasised. The ministry's extension service need timely information in order to offer appropriate advice to the farmers on the recommended practices given the unpredictable weather changes being experienced. A need to link the extension service with the researcher has been expressed in several instances. Setting a databank and information service in the agricultural research institutions has proved inadequate since supportive data may need to be obtained from other sources.

Current agricultural information services are managed by uncoordinated institutions. Besides, these institutions lack clear, consistent guidelines for data collection, standardisation and reporting. On the other hand, the public lack information on the availability and dissemination of information in the sector.

These problems are compounded by inadequate funds to support information acquisition and management; there is also an absence of adequately trained personnel to undertake the tasks of information management and dissemination.

Information collection, management and dissemination has not been accorded appropriate priority and funding for instance in the Public Investment Programmes (PIP). Consequently, the

presentation of some information from agricultural research is sometimes difficult for the end users to understand.

#### 10.2.11.2 Recommendations

- a) Present information about agricultural technologies from research bodies in a manner which is easily understood by the end users.
- b) Build local capacity when establishing local projects on information.
- c) The Ministry of Agriculture, Livestock Development & Marketing should coordinate and maintain information related to agriculture emanating from other organisations to enable it serve the sector more effectively.
- d) Make disciplined use of institutional resources to enhance information gathering and management.
- e) Prioritise resource allocation and ensure a well balanced distribution of the same to facilitate agricultural information collection and management.
- f) Encourage and strengthen the use of appropriate and existing technologies by reviewing existing technologies before implementing new agricultural projects.

#### 10.2.12 Land-Use

##### 10.2.12.1 Current Status and Issues

A land use policy provides guidelines for land use and information generation. However, Kenya lacks such a policy. Land use information in Kenya is held by various organisations including government and non-governmental organisations. Since there is no policy on land use, the available information is of varying types, formats and scale.

Land use information collection, analysis and management can be very expensive as it is multi-sectoral in nature requiring

the participation of various institutions. Besides, funding has been inadequate, while technologies used have been largely inappropriate.

#### 10.2.12.2 Recommendations

- a) Coordinate and integrate all natural resource data collection with a view to developing appropriate land use policies and plans for the different agro-ecological zones.
- b) Develop information management units within all organisations dealing with land use.
- c) Generate information on the potential use of all areas, especially low rainfall areas, especially the impact of increasing agricultural activities on the environment.
- d) Develop capacities in land use information collection and management.

#### 10.2.13 Commerce and Industry

##### 10.2.13.1 Current Status and Issues

The current information pertaining to commerce and industry sector are maintained by individual industries, CBS and Ministry of Commerce and Industry. CBS has data on the following as pertains to commerce and industry: chemical pollution, solid waste, liquid waste, gaseous pollutants, sewerage effluence and noise pollution.

CBS administers an annual questionnaire for the main cities and towns to facilitate the publication of the annual Economic Survey. The information collected and published include the following: solid waste generation by type and geographic location; volume of waste disposed and method of disposal; recurrent expenditure on solid waste disposal by type and geographical region; garbage related to health hazards and measures taken to abate waste accumulation by type and local authority; handicaps experienced by various authorities during generation, accumulation and disposal of waste; recycling centres; and land

degradation (quarries and rehabilitation slums, refusal disposal & treatment, recreational facilities, location of polluting sources).

In spite of the efforts expended in generating data, the amount collected is still far short of that produced. The information collected is also poorly managed. Besides, there is lack of public awareness on the dangers of environmental pollutants and their management.

#### 10.2.13.2 Recommendations

- a) Develop a checklist of potential polluters of the environment for ease of monitoring.
- b) Build human and technological capacities on environmental protection, with emphasis on data collection and management.
- c) Establish an industrial database on environmental management with efficient linkages with all relevant institutions. Introduce an industrial or green levy for servicing database development, management and capacity building.

#### 10.2.14 Health

##### 10.2.14.1 Current Status and Issues

Environmental health problems in Kenya like in most other developing countries are tied up with socio-economic problems. Much of the population, both rural and urban, is unable to afford the full economic cost, of even the most basic essential services such as food, water supply, sanitation, and shelter. Hence, provision of relevant information linked to the conditions of the environment is of paramount importance in planning health for all.

The Central Bureau of Statistics has the following information: number of health facilities by type, ownership and geographic location; distribution and attendance of MOH/FP clinics; health personnel by occupational category and

geographical locations; and number of beds and bed/patient ratio by geographic location.

In addition, the Ministry of Health has information on: drugs and their distribution; disease incidence and distribution; health facilities and distribution; doctor/nurse patient ratios and MCH/FP records. Other institutions maintain health records, among them municipal authorities, AMREF, religious organisations, FPAK, and other NGOs.

Most of the information held by Ministry of Health is in report form and registers maintained at dispensaries, hospitals and the Ministry of Health headquarters.

The amount of information generated by all these institutions is enormous. Unfortunately, the organisations generating these information lack a coordinating mechanism. Besides, there is no standard format for collecting and maintaining the records. In brief, management of health information is almost totally lacking.

##### 10.2.14.2 Recommendations

- a) Urgently computerise the massive raw health data to ease storage, analysis and retrieval.
- b) Appoint a central agency to coordinate the collection, analyses, and management of health information.
- c) Develop standards for collection and management of health information.
- d) Review current institutional structures with a view to providing for information management units within each institution.
- e) Develop a health information database under a central management agency.
- f) Strengthen public education programmes, e.g., by eliciting public participation in solving environmental and health problems.

## **10.2.15 Population and Demographic Statistics**

### **10.2.15.1 Current Status and Issues**

Population and demographic statistics permeate almost all the sectors of the economy. Most population and demographic statistics is collected, maintained and published by CBS. The information produced and disseminated include the following: population size, composition and distribution by age, sex and geographic locations; population growth rate at national and districts levels; number of children by age and sex; maternal mortality rates; teenage pregnancy; mortality data; proportion of death of children under 5, caused by malnutrition; proportion of deaths of children under 5 caused by HIV/AIDS; data on marital status; family planning statistics; fertility; migration; etc.

There is an increasing concern among data users on the timeliness and uncertainty in the production of CBS publications. Many data users of such statistics have had to seek needed statistics from other sources. For example, although a lot of data on gender is collected, it is apparent that their analysis is inadequate. In addition, users of environmental statistics have continuously expressed concern over accuracy and reliability of statistics emanating from statistical units in the various ministries and districts.

In spite of the above concerns, there is evidence that many government ministries, NGOs and agencies involved in environmental data collection have enormous amounts of raw data which have not been analysed, nor are there plans to analyse such data in the foreseeable future.

With the decentralisation of planning to lower administrative levels, most planning agencies feel that the current dissemination of environmental data is highly aggregated and therefore not very useful for fast decision making and specific planning. Besides, many users and producers of environmental data are unaware about the range of statistical

information either produced or processed by CBS and other producers/custodians of environmental information. This magnitude of ignorance is an indication of the degree of lack of collaboration among producers and also between the producers and users of information.

It is also known that the needs of users far exceed available data. This is due to inadequate funding for data collection, analysis and dissemination.

### **10.2.15.2 Recommendations**

- a) Update frequently and periodically the needs of users from which producers can base their collection strategies and data development efforts.
- b) Collect data regularly and disseminate analysed products periodically preferably with little elapse of time between collection and dissemination.
- c) Data producers should endeavour to maintain high standard of accuracy of their statistical outputs.
- d) Statistical units in line ministries and districts should be strengthened and/or restructured so as to improve professionalism, and management skills and supported by adequate funding and equipment.
- e) CBS in collaboration with other relevant bodies should be assisted to urgently undertake analysis, processing and dissemination of the existing large volume of unanalysed data.
- f) Producers of environmental statistics should maintain a systematic and comprehensive directory of all statistics under their custody. The directory should indicate the format, storage and mode of accessibility.
- g) All data gathered, processed and disseminated should be gender disaggregated.

## 10.2.16 Society and Culture i Environmental Management

### 10.2.16.1 Current Status and Issues

Various ministries, governmental organisations, NGOs have data on community groups involved in environmental matters. However, there is need for a directory of the different groups at the divisional, district and national levels. An assessment of the success of these social groups and the way they accept new innovations on the environment would be of importance. Traditional indigenous knowledge needs to be identified and documented in order to understand the key elements of the traditional system, particularly how the community was, how they are, and what assistance they require in environmental management.

Currently, there is lack of appreciation and integration of indigenous knowledge in environmental management. Furthermore, there is no directory on the different socio-cultural groups dealing with environmental management.

### 10.2.16.2 Recommendations

- a) Develop a directory of the different social cultural groups dealing with the environment.
- b) Document and integrate indigenous knowledge systems in environment management programmes.

## 10.3: INFORMATION MANAGEMENT

### 10.3.1 Current Status

Information is stored in a variety of media and forms. These include analogue (bibliographies, reports, journals, etc.), digital (GIS, remote sensing and information held in computer databases), microfiche, audiovisual (exhibitions, demonstrations, films, photographs, television, visual aids). Oral information i.e., indigenous knowledge is also a key media and form of information.

The display, storage and access to such information is facilitated in various ways

by the individual organisations through libraries, documentation centres, archives, and the print and electronic media.

The information types, contents and format also vary depending on discipline, source and origin. The use to which the information is put similarly varies and depends on specific objectives for use, the hierarchical level for which the information is sought (i.e for national, regional or individual use) and the capacity of the recipient to analyse and interpret the information/data.

However, there are limitations, which hinder optimal use of all environmental information generated in the country. Some of the reasons include: fragmentation of the information in various institutions and organisations, undefined confidentiality for some information generated, differing storage media and analytical tools between different organisations, limited number of 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, absence of consultations, coordination and linkages between the relevant information producers and users, absence of an information management structure and infrastructure in addition to the fact that environmental information is expensive to collect and store.

Kenya has a number of libraries and documentation centres, most of which exist as isolated information services. These libraries and stores can be categorised as university, school, public, research centre, governmental, and also archives and herbaria.

In addition, computerised databases including GIS have been developed over the last several years by a number of government departments, companies, NGOs, research institutes, international organisations, etc.

Some national institutions having GIS

Table 10.1. Some types of environmental information by type and source

Information type	Source
<b>(a) Biological Information</b>	
(i) Cattle census data	DRSRS, ILRAD, IGADD, ILCA, MALDM
(ii) Animal diseases vectors and pests	ICIPE, ILRAD, UNEP-GRID, ILCA, KARI, MALDM, KETRI, Wellcome, KSPCA., NMK, UNEP-GRID FAO/UNDPRAF, DLCOEA
(iii) Livestock	FAO, DRSRS, KWS, MALDM, KARI, ASK, ILCA
(iv) Wildlife	DRSRS, KWS, NMK, Wildlife clubs, EAWLS
(v) Marine & Fisheries	KMFRI, MENR, KWS, UON, KU, NMK, Fish Dept., Moi University.
<b>(b) Physical Information</b>	
(i) Hydrology	MRRWD, LBDA, KVDA, TARDA, KPLC, Geology & Mines Department, Public Universities
(ii) NOAA data on climate	DRSRS, KMD., DEPT., RCSSMRS, FAO, MRRWD, LBDA, TARDA
(iii) Soils	KARI, Min. of MALDMS, public Universities, PPCSCA
(iv) Pollution & Pollutants	Government chemist, MRRWD, CBS-Partly, various universities, Min. of Transport, NES
(v) Topography (i.e. roadnet-works, physical features, etc)	Survey of Kenya, Tourist information centres, KWS, RCSSMRS, Public Universities, etc.
(vi) Geology & Minerals	Geology & Mines Dept, Min. of Energy, various Universities, Oil companies, Mining companies, NOCK
(vii) Infrastructural facilities	CBS, DRSRS, KARI, KPTC, KPLC, Min. of Transport, Physical Planning Dept., local authorities
(viii) Energy	Ministry of Energy, Oil Companies, Power Companies, Regional Authorities, NOCK
(ix) Satellite imagery	RCSSMRS, DRSRS, Private companies (FEWS, ASK)
<b>(c) Agriculture and Land use Information</b>	
(i) Agriculture and forestry	MALDM, KARI, Egerton Univ., Univ. of Nairobi, DRSRS
(ii) Vegetation & land use	DRSRS, KARI, NES, Forest Master Plan, MALDM, KWS, NMK
<b>(d) Socio-economic and Cultural Information</b>	
(i) Human population & demography	CBS, FAO, UoN, NCPD, AMREF
(ii) Health & human diseases	MOH, KEMRI, ICIPE, NGOS, UNICEF, WHO, AMREF, NES
(iii) Environmental education	Moi University, UON, KU, JKUCAT, Schools, Kenya Polytechnic, NMK, WCK, CARE KIE, Bellerive.
(iv) Tourism	Min. of Tourism, KWS, Tour companies, KTDC, KATO
(v) Commerce and industry	CBS, National Chamber of Commerce, Banks, Financial Institutions,
(vi) Policies & legislation	NES, AGs Chambers, Libraries
(vii) Socio-economic data	CBS, LBDA, KARI, various NGOS, CBS, Ministry of Culture and social Services, MPND, AIS

are: the Department of Resource Surveys and Remote Sensing; the Kenya Wildlife Service (KWS); the Lake Basin Development Authority (LBDA); the Kenya Agricultural Research Institute (KARI); the Ministry of Land Reclamation, Regional, and Water Development (MLRRWD); the National Museums of Kenya (NMK); the Forest Department and the National Environment Secretariat (NES).

Some international bodies based in Kenya with GIS facilities include: United Nations Environment Programme (UNEP); International Centre for Insect Physiology and Ecology (ICIPE); International Laboratory for Research on Animal Diseases (ILRAD); Wildlife Conservation International (WCI); the International Centre for Research in Agroforestry (ICRAF); and the Regional Centre for Services in Surveying, Mapping and Remote Sensing (RCSSMRS).

### 10.3.2 Issues

Most of these databases are still in their early development stages and therefore access to them is still restricted. Furthermore, they suffer from serious handicaps including inadequate or lack of trained personnel, inadequate back-up service, lack of funds to upgrade the hardware and software.

Most local organisations having GIS lack appropriately trained personnel and back-up services to allow maximum use of the facilities. Information exchange between and amongst these institutions is also minimal.

Institutions without GIS facilities have other computerised 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 organisations, making accessibility by most Kenyans difficult. Lack of awareness of the existence of the information or documentation services in most of these institutions is also an additional hinderance to information access, exchange, and transfer.

There are frequent complaints that it is difficult to have access to information from many national organisations because of problems of confidentiality and organisation. Besides, up to 70 per cent of collected data is inaccessible because they remain unanalysed for long periods and therefore uninterpreted. This situation reduces considerably the value of collected information. Consequently, the investment made in collecting the data is wasted.

This condition is reflected by infrequent publication of research and survey reports. Similarly, periodic reviews such as annual reports and ecological reviews are published irregularly. The problem of irregularity is compounded by the very limited numbers of those printed, which are in turn disseminated to very few people. Published research and survey reports are written in terminologies and expressions which render them inaccessible to most members of the public.

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. This unfortunate situation is usually explained by unavailability of funds, a situation which renders staff and equipment idle a lot of the time.

Other constraints that affect access to information are as follows: fragmentation of the information in various institutions and organisations; undefined confidentiality; differing storage media; lack of a central reference system; limited trained human capacity to collect, analyse, retrieve, and disseminate the information; technological limitations; limited funds for developing an information system; lack of awareness on what is available, where available and in what format; absence of co-ordination and linkages between information producers and users; absence of an information management structure and infrastructure; and environmental information is expensive to collect and store.

### 10.3.3 Recommendations

- a) Establish a national environment information service to network, coordinate and document the various sources and forms in the country. 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 and more specifically the following:
- i) Collect periodically all environmental information from the producers and store them in the most appropriate manner and using the most efficient and yet cost effective technologies.
  - ii) Allow the public access to its information at economic rates in addition to assisting them obtain information/data from source also at an economic fee.
  - iii) Provide an abstracting and bibliographic service.
  - iv) Publish a directory of local capacities on environmental matters.
  - v) Promote and encourage data compatibility and efficient exchange of information.
  - vi) Maintain a modern reference library and conference facilities.
  - vii) Serve as a hub in a network of environmental databases by cooperating and collaborating with existing libraries, archives, documentation centres, herbaria, and automated databases in the collection and exchange of environmental information/data.
  - viii) Develop formal effective cooperation with research centres, government institutions, NGOs and other agencies (including private sector) collecting environmental and related data. The collaboration should include licensing agreements in which NEIS will sell information at a fee and remit a commission to the sources of information.
- ix) Develop and maintain a user-query response service to ensure that user demands are met.
  - x) Serve as a national focal point for exchange of environmental datasets with neighbouring countries and other international databases.
  - xi) Publicise NEIS activities especially contents of its databank to all cadres of people from policy makers to ordinary members of the society.
  - b) Digitize environmental information and develop computerised databanks including the geographic information system to ease integration and retrieval.
  - c) Analyse information as soon as it is collected.
  - d) Make analysed information available to users in order to generate feedback.
  - e) Write reports using vocabularies which can easily be understood by users and the general public.
  - f) Publish reports of all researches and surveys and make the same available to the public.
  - g) Publish regular bulletins on biodiversity, forestry, crop cultivation, soils, geology, minerals, chemicals, animal husbandry, pollution, waste, human settlement, climate, etc.
  - h) Publish an annual environmental review.
  - i) Modernise the management of registries in government ministries, parastatals, and in the private sector.
  - j) Review laws and regulations governing confidentiality with a view to putting into public domain a lot of useful environmental information.

- k) Develop and sustain an aggressive national information policy. Such a policy should include the development of an active information bank and network which must in turn be adequately funded and managed by competent and competitively remunerated personnel.
- l) Increase funds for collecting data/information to allow for regular and increased interval of collection. Currently most institutions are unable to plan data collection because of insufficient funds.
- m) Increase funds for analysing collected data/information.
- n) Store environmental information in standardised media and formats.
- o) Promote compatible technology used in storage, analysis, retrieval, dissemination, and networking.

#### 10.34 The International Environment Information System (INFOTERRA): Kenya National Focal Point.

##### 10.3.4.1 Current Status

INFOTERRA was established in 1975 as a decentralised information system operating through a worldwide network of national environmental institutions designated by their governments as national focal points (NFPs) and coordinated by a Programme Activity Centre (PAC) at UNEP headquarters in Nairobi.

Kenya through the National Environment Secretariat (NES) was registered as an INFOTERRA national focal point in 1977. Since then it has played an active role in promoting INFOTERRA by registering, as information sources, more than 60 government institutions, NGOs and experts in Kenya, in addition to providing substantive information to users within and outside Kenya.

The registered information sources have access to information on soil conservation, freshwater ecology, rural environment, human settlements, nature

conservation, pollution control air quality, air pollution, environmental education and training, biodiversity etc. Typical queries handled by the NFP recently include pesticides control, management of mangroves in coastal areas, waste disposal, environmental legislation, environmental health, and management of wetlands. The NFP uses micro CDS/ISIS software which was supplied by the INFOTERRA (PAC).

In 1989 the Kenya NFP was designated as a Regional Service Centre, (RSC) serving east, central and southern Africa. The RSC acts as a service centre for INFOTERRA NFPs and users within a region or sub-region. In 1991 the INFOTERRA PAC split this region into two: Eastern and Central African Region. The Kenyan NFP was requested by INFOTERRA PAC to continue serving the East African sub-region as its RSC. Countries involved in the sub-region are Somalia, Ethiopia, Uganda, Djibouti, Sudan, Seychelles and Mauritius.

##### 10.3.4.2 Issues

The NFP/RSC has faced various constraints including the lack of trained staff due to a high turn over, out-of-date equipment/facilities and lack of adequate office accommodation.

Although the INFOTERRA system has handled a variety of queries and it has the potential of being utilised more by decision-makers and environmentally conscious members of the public, there is need for promotional campaigns on its use and existence. It should expand its activities to the district by networking with documentation centres.

##### 10.3.4.3 Recommendation

- a) Strengthen the national capacity of the NFP/RSC by facilitating the referral and exchange of internationally and nationally available information on environment issues through provision of training.
- b) Conduct needs assessment survey on environmental information within the country

- c) Institute a mechanism for dissemination of environmental information within the country
- d) Carry out a continuous inventory on national environmental information.
- e) Identify and develop dissemination mechanism. These include publications such as registers, catalogues, articles in journals, publish newsletter, electronic bulletin boards, etc.

and maintenance of facilities and equipment. Teachers and others responsible for EIS education and training would need exhaustive training.

Students at schools, colleges, polytechnics, and universities should receive training on information management to the extent that they can fully appreciate and even perform some of the basic functions pertaining to EIS; while the general public should be trained mainly to appreciate the functions and importance of EIS.

## 10.4 CAPACITY BUILDING

### 10.4.1 Current Status

An efficient environment system must be based on a clear career structure that can attract dedicated and highly motivated staff at all levels.

#### 10.4.1.1 Categories of People Requiring Training

The following categories of human resources are needed to set up an EIS: policy makers, administrators, scientists, technicians and teachers. EIS Policy-makers and planners, including politicians and senior officials, need training in general awareness including practical and policy implications. In addition, individuals especially leading scientists and directors of environmental programmes, whose decisions affect EIS, would need similar training.

Directors of government institutions and agencies and also managers of private enterprises need sufficient technical training to coordinate activities pertaining to EIS development and applications. Likewise, professionals conducting research including surveys need detailed instructions on information services use, particularly computerised database access interpretation of satellite data, and aerial photographs, including digital analysis.

Similar training should be given to para-professionals and other technical support staff who are responsible for operations

#### 10.4.1.2 Training

In Kenya training in information management including computerised ones are offered by some of the local universities, polytechnics, and colleges. Training opportunities at certificate level are given by other colleges. Moi University and the Kenya Polytechnic offer degree and diploma courses in information management, including documentation, librarianship, publishing and informatics. The University of Nairobi and other institutions also offer some courses in information management. A common approach is on-the-job training.

Information science, publishing and informatics trainings are available in many universities and colleges in other African countries, Europe, Asia and America.

Training courses have to be tailored to suit the different categories of information managers and users. For example, short (five days) courses/seminars/workshops are recommended for senior managers. Currently, this type of training is offered by ITC, FAO, ECA, etc. The same category of managers together with professional managers need two to four weeks introductory EIS courses. However, it is also recommended that professionals and technicians attend courses ranging from two to four months; alternatively they should be trained for periods ranging from six to twelve months. Undergraduate courses should last up to three years, while post-graduate courses should last a minimum of two years.

#### 10.4.2 Issues

The country lacks an information policy. Consequently, the implementation of information development programmes lacks guidelines. Primarily, a policy should state the importance to which the country places on information development and management.

Currently, it is not easy to obtain the following information relating to environmental education: types of institutions involved, the course contents, the student enrolment and the availability of trainers/teachers. The teaching institutions fall into the following four categories; pre-primary (nursery schools), primary schools, secondary schools and universities.

Kenya urgently requires a large number of trained information workers at various levels. This is required to satisfy the growing demands of rapidly growing library and information services.

Training abroad is expensive; uses the very limited foreign exchange or international fellowships provided by international organisations or by bilateral arrangements. In some instances, training abroad may be inappropriate; and there is also the risk of "brain drain."

The emerging information technologies should be used optimally to modernise and improve the services and management of the information services in the country. Computers are now extensively used for library and bibliographic services. However, the requirements of a computerised system can be fairly expensive initially. Besides, decisions regarding hardware and software are difficult, and more so on a national level. Compatibility of systems to facilitate information exchange have its demanding requirements. Furthermore, human capabilities can be a decisive operational factor.

#### 10.4.3 Recommendations

- a) Motivate staff working in registries, libraries, archives, documentation centres, herbaria and computerised databases in order to increase

efficiency.

- b) Promote training in appropriate technologies for better management of natural resources.
- c) Popularise the importance of information in the decision-making process through demonstrations, workshops, seminars, published materials, mass media, and popular media.
- b) Coordinate all the sectoral environmental training (Geography, Geology, Biology, etc) in all the schools, universities and training institutions.
- e) Incorporate environment information management in all environment training courses.
- f) Develop compulsory environmental courses for the institutions and university faculties which are not currently training environmentalists.
- g) Strengthen the School of Environmental Sciences, Moi University and the Faculty of Environmental Studies, Kenyatta University and the Department of Survey and Photogrammetry at the University of Nairobi
- h) Develop an inventory of student enrolment in environmental sciences.
- i) Encourage community participation in non formal training programmes.
- j) Harness, develop and document indigenous knowledge on environment.

### 10.5: PLAN OF ACTION

#### 10.5.1: Short-Term

- a) Enact legislation to establish a national environment information service as an autonomous, statutory institution free from external influence in order for it to efficiently

facilitate information collection, storage, analysis, retrieval, dissemination and updating.

- b) Review policies and legislation on information with a view to developing appropriate ones which respond to the rapid and dynamic changes affecting management, exchange, institutional linkages, copyright rules, and patent rights.
- c) Establish a multi-sectoral environment information steering committee to oversee the implementation of the national environment information system. The committee will be drawn from the government, non-governmental organisations, and individuals concerned with the environment.
- d) Promote sustainability by appropriately costing, marketing, and pricing information.
- e) Establish linkage mechanisms such as E-mail amongst the EI producers.

#### **10.5.2: Medium-Term**

- a) Strengthen human resource capacity by training personnel in information management, GIS, remote sensing, and related disciplines.
- b) Purchase and upgrade hardware/software to cope with the expanded task.
- c) Prepare and implement programmes.
- d) Develop network mechanism to coordinate sectors, including establishing a national coordinating and exchange centre.

#### **10.5.3: Long-Term**

- a) Monitor and evaluate implementation of EIS programmes, especially as they respond to planning needs at the project, district, and national levels.
- b) Desegregate the information centres to the divisional level.

## CHAPTER ELEVEN

# LEGAL INSTRUMENTS, LAND USE, EIA AND INSTITUTIONAL FRAMEWORK

### 11.1 INTRODUCTION

#### 11.1.1 Current Status

Since independence in 1963, Kenya's economy has been expanding rapidly. This, coupled with high population growth, has placed great demand on available resources, while past economic and social development programmes often disregarded environmental factors and sustainability. As a result, there has been considerable environmental damage.

The Government has recognised these negative impacts and is constantly devising improved guidelines and programmes to promote sustainable environmental management. Government efforts in this direction are illustrated by policy statements contained in various documents, presidential directives and pronouncements, and legal provisions. The government has also established institutions to handle environmental issues and to promote sustainable environmental management, including supporting many non-governmental organisations with similar objectives.

#### 11.1.2 Issues

A framework of national laws and regulations, policy guidelines, and implementing and/or coordinating institutions are needed to:

- a) Integrate environmental conservation in economic development to provide sustainable development for Kenya's people now and in the future. This includes integration of environmental considerations in sectoral structural and socio-economic planning at national, provincial, district and community levels; promotion of environmentally sound use of both renewable and non-renewable resources in the process of national development.
- b) Develop procedures for encouraging optimal use of land and water resources.
- c) Institute and implement an environmental quality control programme by requiring prior environmental impact assessments of new investments, and monitoring existing developments.
- d) Establish an institutional framework for monitoring, coordinating and enforcing environmental regulations and standards.
- e) Maintain ecosystems and ecological processes essential for the functioning of the biosphere; conserve unique, fragile and threatened ecosystems; maintain biological diversity; and protect humans, animals, plants and ecosystems against harmful impacts and destructive practices.
- f) Control pollution and improve waste management. Develop and/or review national environmental quality standards; enact legislation on management of noise pollution; manage the manufacture, export, import, marketing and use of toxic chemicals and chemicals that are banned or severely restricted in Kenya or in other countries; and manage hazardous wastes, including trans-boundary movement of wastes.
- g) Help in developing and maintaining professional cadre within the country to supervise, coordinate, implement and enforce procedures and legislation essential for safeguarding the environment and maintenance of sound ecological systems.
- h) Establish an environment information system which can be used by all concerned.

- i) Promote and support research programmes aimed at better understanding of the different ecozones and the factors affecting them, as well as health-related environmental problems, and the development of appropriate technologies for environmentally sound management and use of local resources, including renewable energy systems.
- j) Create awareness among all sections of the community about the environment and its relationship to socio-economic development.
- k) Manage agricultural and human settlements in a sustainable relationship with the environment.
- l) Manage natural and human-induced disasters, with preventive, mitigative and managerial measures, including establishment of a National Fund for Disasters (NFD); and plan developments that minimise pollution and land degradation, and promote conservation of biodiversity and water resources.
- m) Implement international treaties and agreements.

## 11.2 LEGAL FRAMEWORK

### 11.2.1 Current Status

There are about 77 statutes relating to the management and conservation of the environment (Annex 3).

### 11.2.2 Issues

These laws have not been adequately enforced by the relevant authorised institutions, owing to a number of reasons such as: poor or weak administrative structures; absence of provisions to specify standards of performance; inadequate deterrents and inadequate incentives; generally low levels of active/participative awareness among a majority of the population; preference for short-term gains at the expense of more sustainable alternatives in policy making and planning; gaps and overlaps in the

institutional responsibilities making enforcement difficult; and poverty, which promotes unsustainable use of resources. However, there is a Task Force on Reform of Penal Laws with a Committee on Environmental Crimes.

Technological advances such as developments in energy generation and biotechnology require frequent updating of legislation.

### 11.2.3 Recommendations

- a) Review all provisions of law relating to environment in various statutes, with a view to harmonising, updating and strengthening the statutes.
- b) Review or examine laws relevant to land use in order to: incorporate standards of performance, remove obsolete provisions, enhance deterrents, ensure effective implementation of provisions, provide incentives, and repeal sections that directly promote environmental destruction.
- c) Review and update fines and penalties for environmental crimes, in order to make them more effective deterrents to environmental abuse.
- d) Formulate regulations to protect the public and the environment against hazardous biotechnological innovations.
- e) Provide a legal framework for the National Oil Spill Response Committee in order to enhance its ability to marshal resources to contain and clean up oil spills.
- f) Develop human resources in environmental law, evaluation and enforcement.
- g) Monitor and review laws to respond to the dynamism in environment management.
- h) Liaise with the Task Force on Reform of Penal Laws (Committee on Environmental Crimes).

### 11.3 LAND LAW, LAND USE AND THE ENVIRONMENT

#### 11.3.1 Legal instruments and legal base

##### 11.3.1.1 Current Status

Kenya does not have a consolidated environmental legislation; however, there are ample legal provisions for the protection and proper use of land. These provisions are scattered in numerous statutes. These statutes include the following:

Government Lands Act Cap. 280  
Land Titles Act Cap. 282  
Registration of Titles Act Cap. 281  
Land (Group Representatives) Act Cap. 287  
Trust Land Act Cap. 288  
Mazrui Land Trust Act Cap. 291  
Registered Land Act Cap. 300

Government land is land owned by the Government of Kenya under the Government Lands Act, Cap. 280 of the Laws of Kenya.

##### 11.3.1.2 Issues

Trust land is land held and administered by various local government authorities as trustees under the constitution of Kenya and the Trust Land Act, Cap. 288 of the Laws of Kenya. Private Land is land owned by private individuals under the Registered Land Act, Cap. 300 of the Laws of Kenya.

Freehold implies absolute ownership of land. Leasehold refers to all interest which subsists in land for a definite period of time and which is subject to certain conditions being fulfilled by the lessee for the benefit of the lessor.

##### 11.3.1.2 Recommendations

Review relevant laws in order to: incorporate standards of performance, remove obsolete provisions, enhance deterrents, ensure effective implementation of provisions, provide incentives, and repeal sections that directly promote environmental destruction. Also, provide for the creation of an authoritative national body to oversee implementation of various statutes (see section 11.5).

#### 11.3.2 Land Tenure Legislation

##### 11.3.2.1 Current Status

Land ownership and land use in the country are regulated by a large number of Acts of Parliament. There are well over fifty (50) statutes that directly deal with land and many others that make constant reference to land.

The government has endeavoured to make land laws that are acceptable to the majority of its citizens and that relate to the multiplicity of cultures, life styles and other historical conditions obtaining in different communities in different regions. For example, the Registered Land Act is mainly applied in the upcountry regions of the country. The Registration of Titles Act is mainly applicable in the coastal regions of the country. The Mazrui Land Trust Act applies to the ownership of land by members of the Mazrui family, while the Trust Land Act only deals with land under the jurisdiction of local authorities. Below are some of the statutes that enable persons to acquire land, including those statutes that make specific provisions regarding use of land. Other statutes exercise overriding powers over any person's rights to land.

##### a) The Constitution

This is the basic law of the land and it provides that: "...Every person in Kenya is entitled to the protection of the privacy of his home and other property and from deprivation of property without lawful compensation." (Sec. 70). The constitution guarantees security of property but provides that such property may be "acquired if it is necessary in the interest of defense, public security, public morality". Absolute ownership is not so absolute after all. Among the statutes that give ownership of land to persons are the following:

##### b) The Government Lands Act (Cap. 280)

Under this Act the President, through the Commissioner of Lands, allocates any unalienated land to any person he so wishes. Such land once allocated is held as a grant from the government on payment of such rents to the government as the government

announces. The government retains the powers to call back the land at any time for its own use. Among land allocated in this manner is agricultural land, mainly in settlement schemes, and also town plots within local authorities which are allocated on application by interested persons. Town plots are allocated for a maximum period of a hundred years, subject to renewal. Such allocations have often disregarded social and environmental imperatives, leading to degradation, inequity and other undesirable impacts.

**c) The Registered Land Act (Cap. 300)**

Under the Registered Land Act any person may acquire absolute ownership to any land once he has been registered as the absolute owner. On registration such a person acquires freehold interests on the land. A subsequent buyer of the same land acquires the same rights as enjoyed by the previous owner.

**d) The Trust Land Act (Cap. 285)**

The constitution vests all land which is not registered under any act of Parliament under the ownership of local authorities as Trust Land. In these Trust Lands a person may acquire leasehold interest for a specific number of years subject to renewals. The local authorities retain the powers to repossess such land for their own use should the need arise.

**11.3.2.2 Issues**

Land is a crucial national resource that is basic to the livelihood and well being of Kenyans; however, there is not enough land for everyone to own a viable unit.

Freehold land ownership is a traditional aspiration of most Kenyans. With the high population growth rate, now at 3.34% per annum, the demand for land continues to rise steeply. All high and medium potential land has been densely settled and there is a gradual movement into marginal zones through the adjudication and registration process in trust lands as well as through the alienation of government land. Increased landlessness will result from the extension and subdivision of group ranches, the inability of those outside the groups to join, and the cultural barrier to

the incorporation of women as members and owners.

It is important to improve access to land by most Kenyans, and especially women. A system to enable poor, landless people to lease undeveloped land is one option. The laws, customs, and economic regulations that limit women's ability to own, buy, inherit and transfer land should also be discouraged or reviewed.

Decision making on land boards requires attention. There should be sufficient women representation at all levels from sub-locations upwards. Culturally appropriate participatory methods should be used at all stages of the development process (concerning land matters) to ensure that interaction between local people and development agencies is sustained.

The kinds of land reforms most appropriate for specific areas and situations have to be agreed on locally in consultation with all actors ensuring that women, mobile pastoral groups and any marginalised groups are included in the process. Land tenure policies should take into account the rights of access to grazing and water customarily exercised by livestock producers, which should be documented and officially recommended. In regions where customary communal tenure systems are still in existence, there is need to recognise, through legislation, the relevant customary land rights and land tenure.

**11.3.2.3 Recommendations**

- a) Improve access to land by most people.
- b) Educate Kenyans to understand that large numbers of the population will remain landless.
- c) Review laws, customs and economic regulations that affect women's ability to own, lease, buy, inherit or transfer land.
- d) Amend legislation to provide for the leasing of land by poor or landless people or welfare groups, while protecting ownership rights.

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### 11.3.3 Land Use and Other Legislation

#### 11.3.3.1 Current Status

##### a) Agriculture Act (Cap. 318)

The Agriculture Act defines agricultural land as "all land that is not within a township". In effect this means that all land is agricultural land unless otherwise declared. The Act gives the minister extensive powers to make rules for purposes of conservation of the soil, etc.

##### b) Crop Production And Livestock Act (Cap. 321)

The purpose of the crop production and livestock Act is to regulate the quantity of land that can be utilised for food crops or livestock production; what types of crops to be grown in which areas; etc.

##### c) Forest Act (Cap. 385)

The Forest Act gives the minister wide powers to declare any unalienated land to be a forest area; to declare the boundaries of forests and to alter those boundaries; to declare a nature reserve; and to declare that a forest area shall cease to be a forest area. All that the minister is required to do to exercise his powers is to give a 28 days notice to the public via a Gazette Notice. The same Act gives the minister power to issue licences for the use of forest produce.

##### d) Water Act (Cap. 376)

The water law mandates the minister to ensure that certain water catchment areas are protected and to declare such areas as water catchment areas. The minister through his water undertakers, is to ensure that owners/occupiers of land do not pollute water that is used for domestic purposes. Currently, many industries and factories are polluting domestic water sources.

##### e) Lakes and Rivers Act (Cap. 409)

The Lakes and Rivers Act was enacted to control dredging of rivers and lakes.

##### f) River Authorities Act (Cap. 443)

The Rivers Authority Act empowers all the existing river authorities to, inter alia:

"construct any works necessary for the protection and utilisation of the waters and soils of the area."

##### g) Maritime Zones Act (Cap. 371)

Enacted in 1989, the Maritime Zones Act provides that Kenya's Exclusive Economic Zone extends to 12 nautical miles. It gives the minister power to explore and exploit the zone for the production of energy from tides, currents and winds; and the regulation, control and preservation of the marine environment.

##### h) Mining Act (Cap. 306)

The Mining Act gives the minister powers to prospect for minerals and to mine in any land. Where damage is caused to land, etc., the prospector must pay damages to the owner/occupier of the land. However, there is no provision for rectifying any damage caused to the environment. This is an important omission which should be rectified.

##### i) Grass Fires Act (Cap. 327)

The Grass Fires Act prohibits the setting of fires without authority.

##### j) Land Planning Act, Cap. 303

The Land Planning Act contains land planning regulations on all interim areas and any other area that the President may specify. Where these regulations apply, "... no person shall carry out any development except with the consent of the local authority." Although these regulations have been in place since pre-independence days, they appear to have no enforcement authority. There also exist town planning regulations which appear to have overshadowed these regulations.

##### k) Public Health Act, Cap. 242

The Public Health Act empowers local authorities to take measures to maintain their districts in clean conditions and to remedy conditions injurious to health. Local authorities are to provide unpolluted drinking water to their residents, and to ensure that factories and trade premises within their jurisdiction do not emit offensive vapours, liquids, gases, dust or other substances dangerous to health.

**l) Factories Act, Cap. 374**

The Factories Act provides that precautions shall be taken to ensure that explosives and inflammable dusts or gases are well contained so as not to escape and be ignited and explode. There are however no provisions in this Act for action to be taken to prevent harmful emissions from being released into the atmosphere and contaminate the environment.

**m) Wildlife (Conservation and Management) Act, Cap. 376**

The Wildlife (Conservation and Management) Act is used to conserve and manage wildlife. To achieve this the minister has powers to declare any land to be a national park, nature reserve, local sanctuary; and to prohibit removal of minerals from the declared areas, and hunting in prohibited areas except with a licence. This law has not adequately provided for participatory management of these vast areas where local communities have often been seen as intruders rather than joint owners of the land.

**n) Land Control Act, Cap. 302**

The Land Control Act was enacted to regulate the sale and subdivision of agricultural land. The constitution gives powers to the officers of the Land Control Board to refuse to grant consent for transfers or subdivisions of agricultural land into uneconomic units. However, the practice on the ground is hindered by lack of standards to guide the Land Control Boards.

**o) The Land Acquisition Act, Cap. 295**

The Land Acquisition Act reinforces the provisions of the constitution on compulsory acquisition, and consequently gives powers to the government to acquire any person's land for public utilities such as roads, hospitals, schools, dispensaries, etc. The only requirement by both the constitution and this act is that once such land is acquired, prompt and full compensation be paid to the owner. However, the Act does not provide for the involvement of the land owners in determining the level and mode of compensation.

**p) The Kenya Posts and Telecommunications Act, Cap. 411 and The Kenya Power and Lighting Company, Companies Act, Cap 48**

These Acts give powers to the corporations to enter any land and install telephone and electricity lines as long as notice has been given to the occupiers and owners. No compensation can be requested from the corporations.

**11.3.3.2 Conflicts and Other Issues**

Present land use practices in Kenya often disregarded actual potentials, carrying capacities and limitations. Thus, as the country becomes urbanised and developed, requiring more housing estates, industries, roads, railways, schools and other institutions to be built, often the lands sacrificed are the highly productive agricultural zones, with cool climate and attractive weather patterns.

In addition, human settlements and the expansion of arable agriculture have eaten into the important forested zones, thus reducing the area necessary for water catchments, production of wood and non-wood materials, wildlife sanctuaries and biodiversity maintenance. The expansion of arable agriculture into arid and semi-arid lands (ASALs) has led to accelerated desertification.

**a) Agriculture vs Housing, Physical Infrastructure, Urban and Industrial Expansion**

Urban centres are fast expanding into the highly productive agricultural zones. The results are the increased destruction of prime coffee, tea and horticultural farms around the towns. The process is being accelerated by the extremely high property prices in these areas.

There is need to re-direct urban expansion away from these prime farmlands and towards less productive areas. At the same time, facilities for developers whose housing developments are focused on rich farmlands should be reduced; or a sufficiently high cost premium should be attached to serve as a deterrent. The powers of the Commissioner

of Lands should be limited by accommodating more open dialogue with interested parties, and by making EIA a condition for all proposed change of user.

**b) Environment vs Settlement and Agricultural Expansion**

Human settlement and the expansion of arable agriculture have also eaten into important forested zones, thus reducing the area necessary for water catchments, production of wood and non-wood materials, wildlife sanctuaries and biodiversity maintenance, as well as general environment protection. The water catchment function of forested areas is especially important in Kenya today.

The powers to degazette forests seem to have been used liberally without due regard to the critical role of forests in maintaining environmental stability. Thus, its use has resulted in the depletion of many forests, which in turn has endangered the national water supplies, besides other far-reaching negative impacts. Action should be taken urgently to repeal the section of the Forest Act which gives the minister these powers. Under the same Act the minister has powers to issue licences to persons to use forest produce. The result in some cases has been indiscriminate felling of trees to the detriment of environmental conservation. There is need to review this law and develop sustainable ways of utilising forest produce, especially in important catchment areas.

Reclamation and drainage of wetlands for agriculture also causes destruction of water reservoirs and fragile ecosystems, loss of biological diversity, erosion, and disruption of the hydrological cycle.

Management of rural water schemes is largely a community affair, except for roof catchments and individual family wells. Government and NGOs have continued to assist in the provision of water in parts of the country. But the critical determinant remains the extent to which the water catchments are preserved and enhanced. Protection of water sources is therefore extremely important. Costs and benefits must be carefully assessed before draining any wetland. A strong and extensive water development programme is also required to enhance the national water supplies.

**c) Wildlife vs Pressure for Land and Access by Local People**

Large numbers of wildlife live outside the gazetted national parks in areas where pastoralism is the main economic activity of the local people. Some of these areas were demarcated into special ranches in the 1960s and 1970s, but the general movement towards individualised property ownership has led to increased subdivision of the ranches, often into small units which are not viable economically or from an environmental point of view. The sub-divisions have also led to fencing which has become barriers across wildlife migratory routes, thus creating increasing population pressures inside the designated national parks. The future of wildlife in these areas, the role of the local people in conservation and the incentives for cooperation should be defined urgently.

**d) Arable Agriculture vs Livestock and Pastoral Production**

The rapid increase in the human population has led to out-migration from the high potential zones into low rainfall areas that are mostly suited to extensive livestock production. The resultant expansion of arable agriculture into marginal zones has led to destruction of natural vegetation and loss of biodiversity; erosion, degradation and accelerated desertification; creation of famine prone zones with constant crop failures; reduction of the natural potential to support sufficient populations (human, livestock and wildlife); and increased poverty.

**11.3.3.3 Recommendations**

- a) Redirect urban expansion and housing away from high potential agricultural land and improve physical planning for low potential areas.
- b) Protect water catchment areas from further encroachment.
- c) Restrict cultivation of slopes and river courses and enforce other regulations necessary to protect the environment.
- d) Require an Environmental Impact Assessment (EIA) before a forest reserve or nature reserve can be degazetted.

- e) Use forest produce in a sustainable manner, promote private forestry, and involve large consumers in wood production.
- f) Assess costs and benefits of draining or reclaiming any wetland before the project commences.
- g) Develop a participatory mode of wildlife conservation and management.
- h) Initiate projects to improve the carrying capacity of the land, especially arid and semi-arid lands.
- i) Promote the retention of ranches in ASALs and discourage sub-division of land to uneconomical units.
- j) Increase use of research results in ASALs and improve land use systems, including adoption of suitable technologies, such as water harvesting.
- k) Intensify agricultural production in high potential areas.
- l) Provide industrial and other job opportunities.

### **11.3.4 Land use planning**

#### **11.3.4.1 Issues**

##### **a) Policies**

Land use planning policies are well articulated and are backed by various legislation. Problems arise, however, owing to weaknesses in implementation of the provisions.

Very often, policies in other sectors have adverse impacts on the environment. These conflicts should be removed in order to discontinue policies that favour unsustainable use of biological and land resources for short term economic gains. One method of doing this would be to modify the national income accounts to reflect the full costs of resources depletion and environment degradation.

The sanctions provided in Kenya's environmental legislation are often ineffective

because they are not stringent enough to be taken seriously: competing economic realities such as industrial development or the need for jobs may seem more important than pollution control to those who want to make economic gains or merely to survive. Effective deterrents are therefore necessary.

As a model, the National Biodiversity Committee has designed a matrix correlating policies at the micro-economic, socio-legal and research/training levels with categories based on ecosystem classifications or forms of land use.

##### **b) Zoning**

Short term development plans and zoning maps indicating land use zones and development standards applicable to each zone. The standards include densities, plot sizes and ratios as well as site coverage. Plans for some urban centres have been prepared and are in various stages of implementation. The optimum agricultural plot size is unique for each ecological zone in terms of moisture availability and reliability, soil fertility, texture and other production variables. Thus, each zone has to be assessed individually. Zoning for industrial, commercial and public utilities have special effects on the environment in terms of solid waste disposal, interference with catchment areas, land degradation and pollution, interference with ecological balances, etc.

##### **c) Planning and Registration Process**

Planning procedures are lengthy, involving a lot of consultation and approvals before plans are finally available for use. Community participation in the planning process is very poor; consequently, their activities to a large extent take place in total ignorance of such plans. Besides, such community or individual activities not subject to planning regulations may be in conflict with environmental conservation principles, hence resulting to land degradation.

There is no clear legislation to govern and empower planners to carry out their functions, especially in ensuring conformity to plans by developers. The anticipated amendment of the Physical Planning Act is hoped to alleviate the situation.

**d) Maintenance of Large Scale Farms**

The creation of high density settlement schemes has led to drastic reductions in large farms. Future policy is geared to competitive (private sector) seed production and marketing, and the Seventh National Development Plan envisages a sizable expansion in the area under seed production. The plan has proposed to achieve this expansion by hiring of private land and through use of irrigation schemes. It is important to ensure that key large farms are retained by the government for research, seed production and livestock breeding, in the national interest. There is need to have new legislation that will allow retention of large farms and also promote leasing of large farms by private owners to those able to use them while protecting the ownership rights.

**e) Reservation of Land for Public Utilities**

There has been concern over the security of tenure of land reserved for public utilities, especially schools, dispensaries, leisure parks, playgrounds, national antiquities and open spaces in urban centres. Often such land has been converted to other uses through allocation to individuals. To protect such areas, the Seventh National Development Plan stipulates that such land will be planned, surveyed, reserved and titles issued to the relevant institutions in order to secure them for the intended purposes. Loopholes in the registration and other regulations will thus have to be identified and ironed out. The power of change of user under the Commissioner of Lands needs to be reviewed or the intended changes be subjected to EIAs.

**f) Protection of Areas of Special Environmental Importance**

Environmental resources are fundamental to the well-being of Kenyans in many ways. Valuable ecosystems are found all over the country, and include mountain areas, riverine areas, lakes, swamps, coastal and marine ecosystems and indigenous forests containing cultural shrines. They provide critical biological resources which are diverse at many levels and include genetic variability, species richness and overall ecosystem characteristics.

Strategies for protecting areas of special environmental importance should include

respect for and incorporation of indigenous Kenyan values, knowledge and priorities; involvement of local people in the management and use of environmental resources; control or reversal of environmental degradation; and treating environmental conservation and economic advancement as integral aspects of the same process of sustainable development.

The role of local communities in planning and management of wildlife areas should be enhanced in order to give the people greater access to resources and means of livelihood. However, it is important to safeguard national (public) resources against the general movement towards individualised property ownership.

**g) Tourism**

Although tourism does not necessarily harvest natural resources, its infrastructure such as hotels, transport, road networks in sensitive areas, and sheer numbers of visitors, can have major impacts on the environment.

**11.3.4.2 Recommendations**

- a) Formulate policies that coordinate land use legislation and make use of environment impact assessment.
- b) Modify national income accounts to measure the true value of natural resources, and to reflect the full costs of resource depletion and environmental degradation.
- c) Make land allocation and change of user decisions more open and participatory.
- d) Require Environmental Impact Assessment for development projects and programmes. Where changes of user is proposed the Commissioner of Lands should first seek to have an Environment Impact Assessment conducted by the authorised institution before a decision is made.
- e) Provide for leasing of large farms, and retain large government research farms.
- f) Improve zoning implementation.

- g) Strengthen land planning and registration capacity, and involve local communities in decision-making, including land boards.
- h) Discourage sub-division of high potential agricultural land into uneconomic units, by providing standards for Land Control Boards.
- i) Develop suitable strategies for the protection and/or sustainable utilisation of significant and fragile ecosystems such as coastal and mountain forests and certain wetlands.
- j) Set aside areas of cultural, religious and ceremonial importance, and areas of relaxation and recreation in and around urban centres.
- k) Require Environmental Impact Assessments for tourist developments and environmental audits for companies. Planning for tourism should be integrated with other land uses, especially protected areas.
- l) Enhance the participation of local communities in the tourist industry so as to derive economic benefits. Also, people likely to be affected by tourism should be involved in decisions on developments and be able to modify proposals and to block those they see as unsuitable to their life-styles and environment.
- m) Educate tourists and tour operators on their responsibilities towards the environment.

## 11.4 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

### 11.4.1 Overview

Environmental Impact Assessment (EIA) is a method used to identify a project's probable impacts on the environment. As a national policy instrument, EIA is carried out early in the project cycle at the pre-feasibility stage for proposed activities, policies, programmes and development projects which are shown by preliminary screening as likely to have significant adverse environmental impacts.

Monitoring is carried out during and after implementation. Exemption from EIA does not exclude project monitoring in line with the conditions of approval.

Participation by District Development Committees and Environmental Committees at the district level, and a broad cross-section of community groups, NGOs and other interested parties, are important. So is a review of cultural impacts. A formal procedure for EIA is to be developed for projects and activities at national, provincial and district levels. The procedures and terms of reference for the EIA process are included in Annex 2.

Any activity that alters the environment is likely to have wide repercussions. One of the greatest benefits of EIA is its capacity to bring together a wide range of environmental, social and economic considerations of a project before investments are committed. It is therefore an essential step in development planning.

### 11.4.2 Current Status

Reference to EIA as part of government environmental conservation and management policy in the 1979-83 Development Plan states "... a system of Environmental Impact Reports will be introduced. All major projects will be modified to ensure observance of environmental standards." A more comprehensive commitment is contained in the 1988 - 93 Development Plan: "The Government is desirous to ensure that development does not take place at the expense of the natural environment. Government will carry out Environmental Assessments (EIA) and resource surveys for all districts and identify both the productive potential and possible negative environmental consequences of economic activities. In making decisions regarding programmes and projects, principle of socio-economic cost-benefit analysis will be employed, a list of possible consequences of starting projects and programmes will be made and their potential impacts analysed."

However, environment and development have not yet been effectively integrated at the planning and management levels. The absence of legislation regarding EIA has meant that these policy statements could not be implemented to any significant extent.

EIA has been occasionally used when required by donor agencies.

The Public Investment Programme (PIP) 1993/94-1995/96, sets out the following criteria for project appraisal: Economic Viability Assessment; Financial Structural Analysis; Social Impact Analysis; Institutional Requirements Analysis; Environmental Impact Assessment (EIA). But few EIA studies are ever undertaken for public sector projects.

#### 11.4.3 Summary Procedure

It is proposed that development projects and programmes in the private and public sector will be subject to EIA.

##### a) National Projects

Investors of projects and programmes of a national nature will submit their proposals through the Investment Promotion Centre (IPC). The institution charged with overseeing the EIA process will review the investment in accordance with procedures established, which shall include public consultation.

A decision can include any of the following:

- i) Exemption from full EIA, but subject to monitoring of the conditions of approval;
- ii) Acceptance of the proposal;
- iii) Advice for revisions;
- iv) Rejection.

In the case of projects recommended for revision, the review may result in a decision to allow the proposal to proceed or alternatively may reject the proposal.

All projects allowed to proceed will be subject to monitoring.

The expansion of existing industries and major agricultural projects will also be subjected to EIA before they are approved. Existing and new industries will be subjected to regular environmental accounting and auditing.

##### b) District Projects

District projects will be subjected to a similar process by district committees. Procedures for district projects will be established and

strictly adhered to under the supervision of the institution charged with overseeing the EIA process in consultation with DDCs and DECAs.

Detailed procedures on EIA are given in Annex 2.

## 11.5 INSTITUTIONAL FRAMEWORK

### 11.5.1 Current Status

The government has, over the years, set up primary institutions on environmental matters, notably the National Environment Secretariat established in 1974, the Inter-Ministerial Committee on Environment (1981), and the Permanent Presidential Commission on Soil Conservation and Afforestation (1981). In recent years, institutional forms and programmes which are capable of cutting across administrative jurisdiction were established. These include the District Focus Strategy for Rural Development, and regional authorities such as the Tana and Athi Rivers Development Authority (TARDA).

District Environment Officers were posted to the districts in 1989; and in 1993 the Ministry of Environment and Natural Resources also sent District Environment Protection Officers to most districts.

### 11.5.2 Issues

At the moment, coordination of environmental conservation and protection for sustainable utilisation of natural resources is weak, with the different institutions generally working in isolation and often creating conflicting policies and programmes. The implementing bodies (line ministries and parastatals) lack the authority to coordinate others which are on the same functional level. For example, the National Environment Secretariat (NES) is a department within a line ministry lacking a legal base; and it therefore lacks the authority to coordinate across ministerial lines. The Permanent Presidential Commission on Soil Conservation and Afforestation (PPCSCA), under the Office of the President, has a limited coordinating capacity owing to its narrow mandate, lack of a legal base and poor operating resources. The Inter-Ministerial Committee on Environment (IMCE), chaired

by the Permanent Secretary, Ministry of Environment and Natural Resources, is a body whose mandate and authority are unclear. The District Development Committees also lack focus in environmental matters, and the sub-committees on environment have low status in most districts. In some cases, the District Focus Strategy for Rural Development has itself tended to promote unsustainable utilisation of resources by giving preference to local short-term demands, while ignoring long-term public interests.

There is need for a single institution with the legal authority to coordinate the management of environmental resources. This new organisation should be strong and preferably autonomous and able to query, audit and coordinate other institutions. It should have strong representation at the district level and be able to work closely with local communities and collaborate effectively with the public and private sectors, local authorities and non governmental organisations (NGOs)

The new organisation would oversee and enforce the environmental impact assessment process (see section 11.5 of this chapter).

The institution could be established through an Act of Parliament as a constitutional office in order to enhance efficient coordination. Alternatively, it could be placed directly under the Office of the President in the Cabinet Office. A third alternative would be to place it within the Ministry of Environment and Natural Resources.

One possibility is to form the new organisation from a merger of existing ones such as the National Environment Secretariat (NES), and the Permanent Presidential Commission on Soil Conservation and Afforestation (PPCSCA). Such a merger would involve little additional budgetary provisions, and may in fact reduce administrative costs, leaving extra funds for delivery of services. Other benefits of a merger include readily available expertise which would only need a new organisational and administrative structure to serve new mandates and strategies.

At the same time, the sectoral ministries need to be strengthened in the areas of funding

and personnel in order to increase their effectiveness. Existing coordinating institutions dealing with environmental matters should be accorded the necessary legal and administrative support in order to enhance their performance.

Public participation in environmental management should be enlisted through appropriate incentives and involvement in the decision making process.

An Environmental Tribunal, as a forum for settlement and redress of environmental disputes, should also be established. Statutes on environmental matters should be reviewed in order to enhance environmental management and protection, and the mechanisms of enforcing the various laws should be reviewed.

### 11.5.3 Recommendations

- a) Enact legislation to establish a new institutional framework to coordinate, enable, and where necessary enforce, environmental policy and legislation. The new institution will also coordinate and enable the continuation of the National Environment Action Plan Process and its investment programme; and initiate the establishment of the national environmental information system, and an Environment Tribunal. It will initiate and oversee environmental monitoring and evaluation, including environmental impact assessment (See Annex 1 and 2).
- b) Establish the national environment agency, including a national environment information system and an Environment Tribunal (See Annex 1).
- c) Provide human and financial resources to support the environment and development coordinating agency and EIA institution.
- d) Study and monitor the institutional framework with a view to recommending improvements or better management system(s).

**11.6 PLAN OF ACTION**

**11.6.1 Legal Framework**

**11.6.1.1 Actions Which can Be Taken Immediately**

- a) Review all provisions of law relating to environment in various statutes, with a view to harmonising, updating and strengthening the statutes.
- b) Provide a legal framework for the national oil spill response committee in order to enhance its ability to marshal resources to contain and clean up oil spills.

**11.6.1.2 Selected Activities Requiring Funding**

- a) Develop human resources in environmental law, evaluation and enforcement.

**11.6.1.3 Some Long-Term Priorities**

- a) Monitor and review laws to respond to the dynamism in environment management.

**11.6.2 Land Issues**

**11.6.2.1 Actions Which Can Be Taken Immediately**

- a) Review or examine laws relevant to land use in order to: incorporate standards of performance, remove obsolete provisions, enhance deterrents, ensure effective implementation of provisions, provide incentives, and repeal sections that directly promote environmental destruction.
- b) Review, discourage or repeal laws, customs and economic regulations that restrict women from owning, leasing, buying, inheriting or transferring land.
- c) Amend legislation to provide for leasing of land by poor or landless people or welfare groups without compromising on ownership rights.

- d) Require an EIA before a forest reserve or nature reserve can be degazetted.
- e) Formulate policies that promote coordination of land use legislation and make use of EIA.
- f) Make change of user approvals subject to EIA.
- g) Require an EIA and environmental audits for tourist developments, companies, development programmes and projects.

**11.6.2.2 Selected Activities Requiring Funding**

- a) Develop and implement projects to improve the carrying capacity of the land, especially in ASALs.
- b) Make available research results on ASALs for use in improving land use systems, especially adoption or development of technologies such as water harvesting.
- c) Modify national income accounts to measure the true value of natural resources, and to reflect the full costs of resource depletion and environmental degradation.
- d) Strengthen land planning and registration capacity, and involve local communities in decision-making, including Land Boards.
- e) Educate tourists and tour operators on their responsibilities towards the environment.
- f) Develop a participatory mode of wildlife conservation and management.
- g) Redirect urban expansion and housing away from high potential agricultural land and improve physical planning for low potential areas.
- h) Protect water catchment areas from further encroachment and degradation including restricting

cultivation of slopes and river courses.

- i) Use forest produce sustainably, promote private forestry, and involve consumers in wood production.
- j) Assess costs and benefits of draining or reclaiming any wetland before project implementation.
- k) Develop suitable strategies for protection and/or sustainable use of significant and fragile ecosystems such as coastal and mountain forests and certain wetlands.
- l) Enhance participation of local communities in the tourist industry.

#### **11.6.2.3 Some Long Term Priorities**

- a) Educate the public that large numbers of them will remain landless.
- b) Intensify agricultural production in high potential areas.
- c) Discourage sub-division of high potential agricultural land into uneconomic units by providing standards for Land Control Boards.

#### **11.6.3 Environment Impact Assessment**

##### **11.6.3.1 Actions Which Can Be Taken Immediately**

- a) Require an independent environmental impact assessment and monitoring for all new development projects and programmes (with exemptions for certain cases).
- b) Establish procedures for enforcement of Environment Impact Assessment (EIA).

##### **11.6.3.2 Selected Priority Activities Requiring Funding**

- a) Involve a broad cross-section of

community groups, NGOs, private sector and other interested parties in the EIA process.

##### **11.6.3.3 Some Long-Term Priorities**

- a) Review and evaluate the EIA process regularly.

#### **11.6.4 Institutional Framework**

##### **11.6.4.1 Actions Which Can be Taken Immediately**

- a) Enact legislation to establish a new institutional framework to coordinate, enable, and where necessary enforce, environmental policy and legislation. The new institution will also coordinate and enable the continuation of the national environment action plan process and its investment programme; and initiate the establishment of an information system, and an Environmental Tribunal. It will initiate and oversee environmental monitoring and evaluation, including environmental impact assessment (See Annex 1 and 2).

##### **11.6.4.2 Selected Activities Requiring Funding**

- a) Establish the national environment agency, including a national environment information system and an environment tribunal.
- b) Provide human and financial resources to support the environment and development coordinating agency and EIA institution.

##### **11.6.4.3 Some Long-Term Priorities**

- a) Study and monitor the institutional framework with a view to recommending improvements or better management system(s).

## ANNEX 1. PROPOSED INSTITUTIONAL FRAMEWORK

### A 1: CO-ORDINATING INSTITUTION

A new institution to co-ordinate, enable, and where necessary, enforce environmental policy, legislation and activities is proposed.

#### A1.1 Functions

- a) Co-ordinating and enforcing environmental policy and legislation.
- b) Co-ordinating and enabling the continuation of the National Environment Action Plan process and its investment programme.
- c) Facilitating the establishment of the national environment information system (NEIS).
- d) Initiating, monitoring and enforcing environmental monitoring and evaluation, including environmental impact assessment (EIA).
- e) Initiating and facilitating the establishment of an Environmental Tribunal to settle environmental disputes.
- f) Facilitating transparency, accountability and access to information by regularly publishing State of the Environment reports.
- g) Initiating the establishment of specialist committees with a wide professional representation to provide:
  - Advice on management of biotechnology and biosafety.
  - Studies and recommendations on management of pollution, chemicals and hazardous wastes.
  - Advice on land use planning.
  - Advice on the management of water resources.
  - Monitoring of the status of

- biodiversity and recommending protection in situ or ex situ where necessary.
- Advice on human settlements.
- Studies and advice on management systems for areas of environmental and cultural importance, including gazetted areas such as game reserves, forest reserves and national monuments, and presently ungazetted areas such as recreational parks, ungazetted forests, water catchments, and sacred sites. Management systems can include parastatals operating as economically viable entities, community-run sites, and areas where the local people are the managers of their environment.
- Advice on environmental research.
- Studies on the impacts of commerce, industry and services, including tourism, on the environment.
- Advice on management of environment at the district level, supported by enhanced district infrastructure, safety enforcement and co-operation with district planning units.

#### A1.2 Establishment

The proposed institution will be established by an Act of Parliament. In order to carry out its duties effectively, the institution requires independence and authority. It is therefore proposed that it be established as an independent constitutional office, and headed by a chief executive and governing council with security of tenure. Alternatively, the institution may be placed in the Cabinet Office, Office of the President, or the Ministry in charge of environment, and the chief executive appointed by the President.

### A1.3 Structure

- a) It is important that the proposed institution be well represented at the district level. It is therefore proposed that the structure of the institution at the national level will be reflected at the district level. The Government may consider the harmonisation of the duties, responsibilities and reporting mechanisms of DEOs and DEPOs.
- b) Three versions of the proposed institutional structure are appended. (Charts 1, 2 and 3).
- c) In establishing and staffing the institution, present environmental institutions and committees should be considered in order to minimise costs and enhance co-operation.

### A1.4 Name

The following names for the institution have been proposed:

- Kenya Environment Agency (KEA)
- Kenya Environment Protection Authority (KEPA)
- Environment and Development Authority (EDA)
- National Environment Agency (NEA)
- National Environment Management Agency (NEMA)

## A2. ENVIRONMENT TRIBUNAL

### A2.1 Establishment

Having noted the increased concerns on the management of the environment, and particularly the widespread serious conflicts that have arisen over the past years, it is recommended that an Environmental Tribunal be established.

### A2.2 Authority

The Tribunal should be headed by a Judge. Interest or background in environmental law would be an advantage. Members of the Tribunal should also enjoy security of tenure

of office. The decisions of the Tribunal should have the power of law.

### A2.3 Operations

Since the conflicts occur countrywide and involve all levels of society, it is recommended that the Tribunal ease the burden of members of the public by conducting business in various parts of the country. The Tribunal will settle disputes raised by individuals, organisations, government, industries, etc. including disputes regarding EIA.

## A3. NATIONAL ENVIRONMENT INFORMATION SERVICE (NEIS)

### A3.1 Establishment

Having realised that there is enormous data and information in Kenya cutting across all sectors, it is recommended that a national environment information service (NEIS) be established to network, coordinate and document the various sources and forms of information in the country. The service will be operated on a sound economic basis. Its long term objectives include the establishment and maintenance of a reliable and up-to-date and yet responsive information service on natural resources.

### A3.2 Management

A multi-sectoral environment information steering committee will manage NEIS. The committee will be drawn from the government, non-governmental organisations, and individuals devoted to the environment. The system will be sustainably managed through appropriate costing, marketing, and pricing of information.

NEIS will promote compatible technology used in storage, analysis, retrieval, dissemination, and networking of information.

## A4. ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

Development projects in the private and public sector will be subject to EIA.

#### **A4.1 National Projects**

Investors of projects and programmes of a national nature will submit their proposals through the Investment Promotion Centre (IPC). The institution charged with overseeing the EIA process will review the investment in accordance with procedures established, which shall include public consultation.

A decision can include any of the following:

- a) Exemption from full EIA, but subject to monitoring of the conditions of approval.
- b) Acceptance of the proposal.
- c) Advice for revisions.
- d) Rejection.

In the case of projects recommended for revision, the review may result in a decision to allow the proposal to proceed or

alternatively may reject the proposal.

All projects allowed to proceed will be subject to monitoring.

The expansion of existing industries and major agricultural projects will also be subjected to EIA before they are approved. Existing and new industries will be subjected to regular environmental accounting and auditing.

#### **A4.2 District Projects**

District projects will be subjected to a similar process by the District Environmental Committees (DECs). Procedures for district projects will be established and strictly adhered to under the supervision of the institution charged with overseeing the EIA process in consultation with DDCs and DECs. Detailed procedures on EIA are available from the NEAP Secretariat.

CHART 1

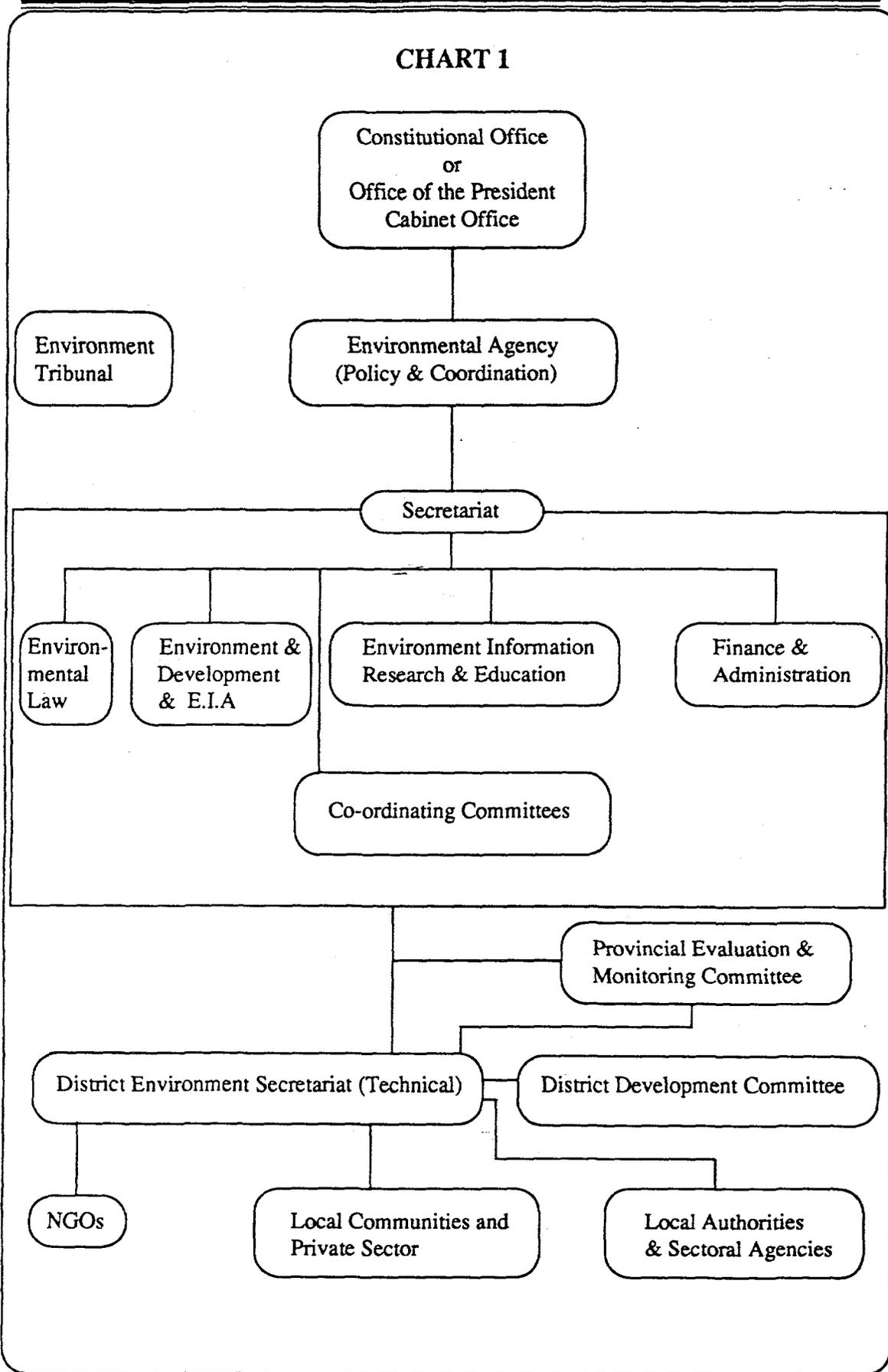


CHART 2

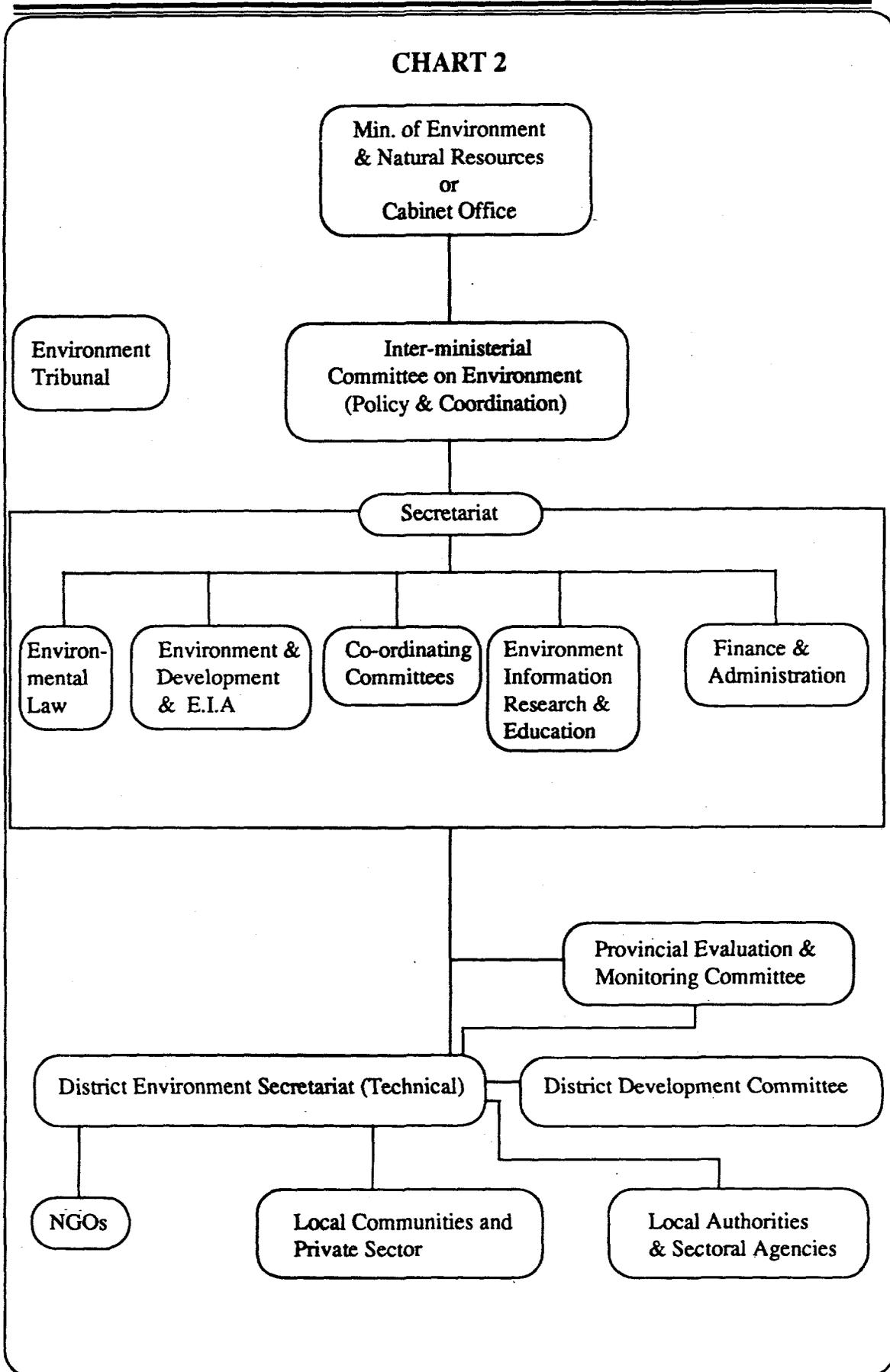
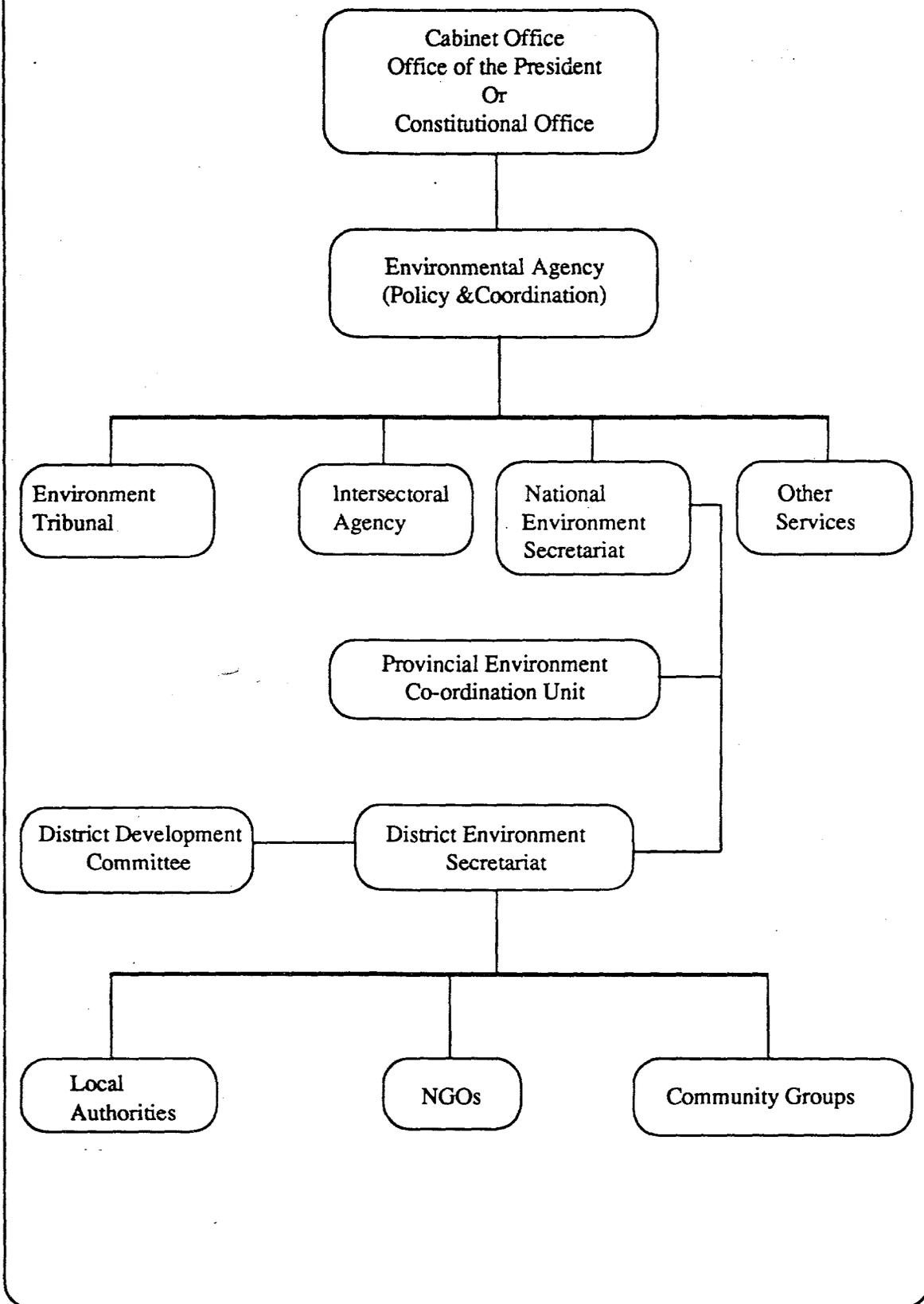
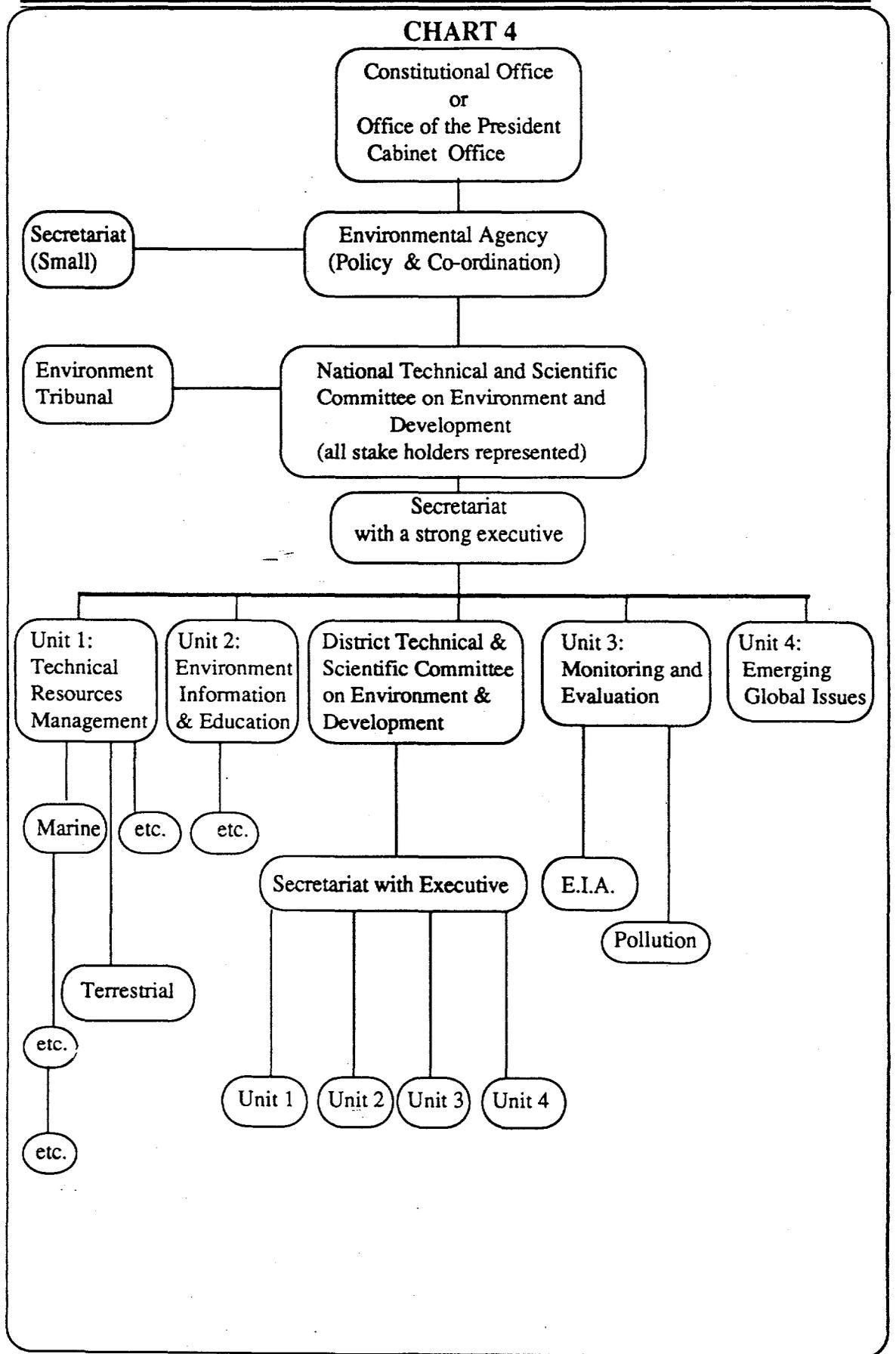


CHART 3





## ANNEX 2. ENVIRONMENTAL IMPACT ASSESSMENT

### B1. OVERVIEW

Environmental Impact Assessment (EIA) is a formal study whereby information on likely environmental impacts, possible alternatives and mitigating measures of a given activity or project are determined. EIA concentrates on problems, conflicts or natural resource constraints that could affect the suitability and/or viability of development projects, programmes, activities or policies. A full EIA should also examine how the development might affect people and their culture, their livelihood or other nearby developments. The EIA should then attempt to identify measures to minimise the problems and outline ways to improve the project suitability for the proposed environment. In certain cases, the project may be rejected. EIA should be carried out at all stages in the project's planning and design stages, starting with pre-feasibility, and proceeding through the total project cycle.

### B2. THE SCOPE OF EIA

- Environmental Impact Assessment (EIA) studies shall be applied to all development projects, activities, programmes and policies shown by preliminary screening as likely to have significant environmental, social or economic impacts. Exemption from EIA shall not exclude monitoring of the project in line with conditions of approval.
- The expansion of existing industries and major agricultural projects will also be subjected to EIA before they are approved.
- Existing industries will be subjected to environmental accounting and auditing.
- Physical impacts as well as social and economic benefits of a development project will be considered.
- EIA of development projects shall be undertaken at all stages in the project planning cycle beginning at the pre-feasibility stage.

- There shall be full public participation involving all groups that might be affected. (Guidelines for ensuring public participation will be developed)
- EIA shall be applied to new technologies, proposed policies and laws that are likely to have significant impacts on the environment.
- EIA shall, after assessing and mitigating the impacts of projects, also assess alternatives, including that of not proceeding with the project.
- All EIAs shall be subject to environmental standards to be developed by the Government.
- All EIAs shall be subject to review by a national EIA unit to be set up under the environmental coordinating institution.
- A checklist of all possible impacts will be developed by the national EIA unit to define the scope and Terms of Reference (TOR) for the EIA study.
- Development sites for projects that do not require full EIA study shall first be subjected to environmental audit to determine the accumulated impact of existing developments in the particular location.

### B3. PROPOSED EIA PROCEDURE FOR DISTRICT-BASED PROJECTS

Environmental Impact Assessment (EIA) procedure for district-based projects has been produced to assist investors and developers wishing to submit proposals to the District Development Committee (DDC). The procedure explains the steps to be followed in the review and approval of proposals for development within the district, in order to achieve the following goals: Provision of better information on which decisions are taken; accountability for decisions taken; due consideration of alternative options; and the

mitigation of negative impacts and enhancement of positive attributes.

The EIA procedure follows a number of steps which are illustrated in the accompanying EIA Chart. Each stage of the procedure is explained below.

### B3.1 Proposal Concept

The interested party (hereafter referred to as the applicant) will contact the District Commissioner as the Chairman of the DDC in writing to obtain a copy of all relevant plans and guidelines prepared by the district, such as the District Development Plan and the District Environmental Action Plan and any relevant maps or zoning plans. The District Commissioner will provide the applicant with copies of these documents at normal official prices.

The applicant will review the plans and guidelines, and, if interested in pursuing the development, he will develop a project concept, not exceeding three pages in narrative text. He will then request a meeting to present the project to the DDC, or he will send it to the National EIA Unit (a checklist will be provided in the Screening Guidelines, detailing those developments to be referred to the National EIA Unit). The project concept should outline the need for, and desirability of, the proposed development.

### B3.2 Classification

The District Environment Secretariat (DES) of the environmental coordinating institution will meet with the applicant to determine if the project concept is in compliance with the district plans and what the likely impacts of the proposed development will be. The proposal will then be classified as follows:

- A proposal that follows policy guidelines and is not expected to lead to significant negative impacts or lost positive opportunities may be allowed to proceed. (It may then require Conditions of Approval.)
- A proposal that does not meet policy guidelines, fails to mitigate negative impacts, or does not enhance positive attributes in a satisfactory manner, may be rejected. The developer may then revise the concept; accept the decision

(and shelve the proposal); or appeal (Tribunal will be established, and an appeals procedure will be developed).

- A proposal that requires more information must go to the Proposal Development stage, for further consideration.

A record of the decision will be provided to the developer in writing. For those developments that proceed to the Proposal Development stage, a scrutiny fee will be payable up front. This fee covers both the cost of developing the policy guidelines relative to the proposal, and the scrutiny of the proposal-specific application.

The correlation of the proposal development and the fee payment will be done in such a way that there is a fair "user-pays" approach to charging the developer for costs incurred by district officials in participating in the EIA. (The scrutiny fee is normally a percentage of the value of the development. The value of the development should be ascertained by the District technical departments within the DDC and DES).

### B3.3 Proposal Development

A preliminary proposal for the development will be prepared by the applicant. If the development is site-specific, the applicant will be responsible for all costs associated with evaluating up to three sites within the zones(s) approved for the proposed development. The proposal will address all significant elements included in the Site Selection Criteria (A list of criteria to consider will be developed) for each of the proposed sites and will not exceed ten narrative pages in total. The proposal should identify the Applicant's preferred site.

The applicant will submit the preliminary proposal to the DDC for review. The DES will analyse the preliminary proposal and prepare a site-suitability analysis with a formal recommendation of the preferred site for approval by the DDC. If none of the sites selected are acceptable to the DES, the Applicant will be responsible for selecting additional sites and submitting a revised proposal for consideration. When a site is approved, the DDC records the decision to the Applicant in writing as a letter of offer.

### **B3.4 EIA Terms of Reference**

When the Applicant receives the letter of offer, Terms of Reference (TOR) will be established by the Applicant and/or the Applicant's consultant in consultation with DES and other interested and affected parties. For site specific developments, the Applicant will also refine the preliminary proposal according to the site allocated. The TOR will include:

- the identification of interested and affected parties;
- the alternatives to be addressed;
- the issues to be addressed for each alternative;
- the designated responsibilities;
- the procedure to be followed;
- the timing of the assessment; and
- possible confidentiality considerations;

### **B3.5 Impact Assessment**

An impact assessment of the proposal will be undertaken subject to the Terms of Reference. The impact assessment should be undertaken in conjunction with the development of the proposal, as far as is possible. A feedback loop allows for the impact assessment to send the proposal back for further development. The scale of the EIA can vary from an issue-specific impact, such as ways in which to mitigate noise, to a major assessment, such as alternative options for sewerage facilities in a residential area.)

The team responsible for the Impact Assessment will be appointed by the Applicant (in collaboration with those setting the Terms of Reference), and paid for by the Applicant. The DDC may choose to co-opt a district based technical officer, a representative from any ministry or department, or an independent consultant as a review member of the impact assessment team. This will be at the district's expense (covered by the scrutiny fee). This is desirable, as it facilitates the constant revision of the proposal in line with expected impacts.

During the development of the impact assessment, a public consultation will take place on the proposed site. This will take the form of a public meeting or baraza, and will enable local residents and community leaders to comment on the proposed activity, and to

recommend changes and mitigating measures.

### **B3.6 Final Proposal and Environmental Impact Statement**

The final proposal will be the product of several rounds of development and revision, and adverse environmental impacts should have been mitigated in the design stage. The final proposal must be in a form that allows the DDC to readily understand the merits of the proposal in comparison to the alternatives required in the Terms of Reference. (Guidelines for the preparation of environmental impact statements are to be prepared to further assist developers, their consultants and DDCs).

### **B3.7 Review**

The final proposal and environmental impact statement will be submitted for review. The review may be conducted by a number of groups, the DES, or the national EIA Unit; a specialist or group of specialists, and possibly interested and affected parties. Guidelines on the composition of the Review Team are to be developed, and will be included in the Terms of Reference. The DDC retains the right to second whoever it determines appropriate to undertake the review. The decision-making should not result in a conflict of interests. Where this occurs, an independent review by a specialist consultant may be sought.

### **B3.8 Record of Decision**

The review may result in a decision to allow the proposal to proceed, or alternatively may reject the proposal. If the proposal is rejected, the developer may revise the proposal, drop the proposal, or appeal against the review decision. (An appeal procedure will be established). A Record of Decision will be given, in writing, by the DDC. This serves to ensure that there is a accountability for decisions taken.

### **B3.9 Conditions of Approval**

There will always be Conditions of Approval for projects that are allowed to proceed (if only to ensure that they do what they say they are going to do). In addition to the standard terms of a lease agreement, these

Conditions of Approval may require that the developer produces a Management Plan for the implementation, monitoring and eventual decommissioning of the proposal. They may further define an Environmental Contract whereby penalties are defined for non-compliance with the Conditions of Approval.

### **B3.10 Project Implementation**

The developer implements the proposal, following the Conditions of Approval.

### **B3.11 Monitoring**

Implemented proposals will be monitored by the DDC sector representatives and DES usually through site visits undertaken by district-based technical officers. If a site visit determines non-conformance with the Conditions of Approval, a decision may be taken to halt all development activities immediately until the situation is rectified.

There should be clear guidelines for the issues, responsibilities, procedure and timing relating to Monitoring. Contingency aspects should be allowed for, the responsibility of which should be provided for in the Environmental Contract.

### **B3.12 Auditing**

A re-evaluation, or Audit, of the development is a possible step following Project Implementation. This should be determined during negotiations prior to the Review/ Conditions of Approval of the proposal. The audit will be carried out by DES in collaboration with district sector representatives from the DDC.

## **B4. PROPOSED EIA PROCEDURE FOR INTER-DISTRICT, REGIONAL AND NATIONAL PROJECTS**

The Environmental Impact Assessment procedure for Province based projects follows the same steps recommended for district based projects, as described above.

The interested party (hereafter referred to as the Applicant) will contact the Provincial Commissioner as the Chairman of the Provincial Monitoring and Evaluation Committee (PMEC) in writing to obtain a copy of all relevant plans and guidelines

prepared for the Province, and the District Environmental Action Plan and any relevant maps and zoning plans. For national or regional projects the Applicant will contact the Investment Promotion Centre (IPC).

The Applicant will review the plans and guidelines and if interested in pursuing the development, the Applicant will develop a project concept, not exceeding 3 pages in narrative text. The Applicant will request a meeting to present the project concept to the PMEC or he will send it to the National EIA Unit.

A check list will be provided in the screening guidelines, detailing those developments to be referred to the national EIA unit). The project concept should outline the need or desirability of the proposed development. The rest of the procedure is as outlined for the District-Based projects up to Auditing.

## **B5. PROPOSED EIA PROCEDURE FOR NATIONAL PROJECTS**

The EIA procedure for national projects has been produced to assist investors and developers wishing to submit proposals of a national scale. The procedure explains the steps to be followed in the review and approval of proposals for development, in order to achieve the following goals:

- the provision of better information on which decisions are taken;
- accountability for decisions taken;
- due consideration of alternative options; and
- the mitigation of negative impacts and enhancement of positive attributes.

The EIA procedure follows a number of steps which are illustrated in the accompanying diagram. Each stage of the procedure is explained below.

### **B5.1 Proposal Concept**

If the interested party (hereafter referred to as the Applicant) is a private investor, he will contact the Investment Promotion Centre (IPC) in writing to obtain a copy of all relevant plans and guidelines regarding

environmental conservation in Kenya, such as the National Development Plan and the National Environmental Action Plan, EIA guidelines and procedures and any relevant maps or zoning plans for the area where the proposed development will take place. IPC will request the national environment coordinating and EIA agency (this authority is to be established) to provide the Applicant with copies of these documents. If the IP is a Government Department or the application must be channelled through the Ministry of Planning and National Development (MPND), to the EIA agency.

### **B5.2 Screening of the Proposal Concept and Classification**

EIA agency will meet with the Applicant to determine if the project concept is in compliance with the National Plans and what the likely impacts of the proposed development will be. The proposal will then be classified as follow;

- A proposal that follows policy guidelines and is not expected to lead to significant negative impacts or lost positive opportunities may be allowed to proceed. (It may then require Conditions of Approval).
- A proposal that does not meet policy guidelines, fails to mitigate negative impacts, or does not enhance positive attributes in a satisfactory manner, may be rejected. The Applicant may then revise the concept; accept the decision (and shelve the proposal), or appeal (an Appeals Tribunal will be established, and an appeal procedure will be developed).
- A proposal that requires more information must go to the Proposal Development stage, for further consideration. Screening guidelines to determine proposals which require more information will be developed.

A record of the decision will be provided to the developer in writing. For those developments that proceed to the Proposal Development stage, a scrutiny fee will be payable up front. This fee covers both the cost of developing the policy guidelines relative to the proposal, and the scrutiny of the proposal-specific application.

The correlation for the proposal development and the fee payment will be done in such a way that there is a fair "user-pays" approach to charging the developer for costs incurred by government officials in participating in the EIA. The scrutiny fee is normally a percentage of the value of the development. The value of the development should be ascertained by the EIA agency, in collaboration with MPND or IPC.)

### **B5.3 Proposal Development**

A preliminary proposal for the development will be prepared by the Applicant. The Applicant will be responsible for all costs associated with evaluating up to three sites. The proposal will address all significant elements included in the Site Selection Criteria (a list of criteria to consider will be developed) for each of the proposed sites.

If none of the sites selected are acceptable, the Applicant will be responsible for selecting additional sites and submitting a revised proposal for consideration. When a site is approved, the EIA agency records the decision to the Applicant in writing as a letter of offer.

### **B5.4 EIA Terms of Reference**

When the Applicant receives the letter of offer, Terms of Reference for the EIA of the proposed development will be established by the Applicant and/or the Applicant's consultant in consultation with the EIA agency and other possible interested and affected parties. The EIA agency will retain the final say on the definition of the Terms of Reference. The Terms of Reference will include:

- The identification of interested and affected parties. This will include both national authorities, local authorities, the general public and any other organisations which will be affected.
- The alternatives to be addressed. This will include both site-specific considerations as well as alternative designs or procedures.
- The issues to be addressed for each alternative.
- The designated responsibilities of the Applicant and his representatives on the one hand and the government and

local representatives on the other hand.

- The procedure to be followed for the development of the EIAs. This may involve several reviews, assessing a draft proposal, a final proposal, the development/implementation schedule and the commissioning of the project.
- The timing of the assessment
- Possible confidentiality considerations

### **B5.5 Impact Assessment**

An impact assessment of the proposal will be undertaken subject to the Terms of Reference. The impact assessment should be undertaken in conjunction with the development of the proposal, as far as is possible. Feedback loops allow for the impact assessment team to send the proposal back for further development. The scale of the EIA can vary from an issue-specific impact, such as ways in which to mitigate noise, to a major assessment, such as alternative options for sewage facilities in a residential area.)

The team responsible for the impact assessment will be appointed by the Applicant (in collaboration with those setting the Terms of Reference), and paid for by the Applicant. The EIA agency may choose to co-opt a district-based technical officer, a representative from any ministry or department, or an independent consultant as a review member of the impact assessment team. This will be at Government's expense (covered by the scrutiny fee). This is desirable, as it will facilitate the constant revision of the proposal in line with expected impacts.

During the development of the impact assessment, public consultations will take place on the proposed site. This will take the form of public meetings or barazas, and will enable local residents and community leaders to comment on the proposed activity, and to recommend changes and mitigating measures.

### **B5.6 Final Proposal and Environmental Impact Statement**

The Final Proposal will be the product of constant development and revision, and

adverse environmental impacts should have been mitigated in the design stage. The Final Proposal and environmental impact statement must be a form that allows the EIA agency to readily understand the merits of the proposal in comparison to the alternatives required in the Terms of Reference. (Guidelines for the preparation of environmental impact statements are to be prepared).

### **B5.7 Review**

The final proposal and environmental impact statement will be submitted for review. The review may be conducted by a number of groups: the EIA agency; a specialist or group of specialists, and possibly interested and affected parties. Guidelines on the composition of the review team are to be developed, and will be included in the terms of reference. The EIA Unit retains the right to second whoever it determines appropriate to undertake the review. The decision making should not result in a conflict of interests. Where this may occur, the independent review of a specialist consultant may be sought. The EIA agency retains final decision-making responsibility.

### **B5.8 Record of Decision**

The Review may result in a decision to allow the proposal to proceed, or alternatively may reject the proposal. If the proposal is rejected, the developer may revise the proposal, stop the proposal, or appeal against the review decision. (An appeal procedure will be established).

A Record of Decision will be given, in writing, by the EIA agency. This serves to ensure that there is accountability for the decision taken. This decision will be copied to the IPC, and the relevant DDCs. If the project is approved, the EIA agency will issue an environmental permit which the Applicant will take to IPC or MPND to get clearance for development.

### **B5.9 Conditions of Approval**

As under District Procedures

### **B5.10 Project Implementation**

The developer then implements the proposal, following the Conditions of Approval.

### **B5.11 Monitoring**

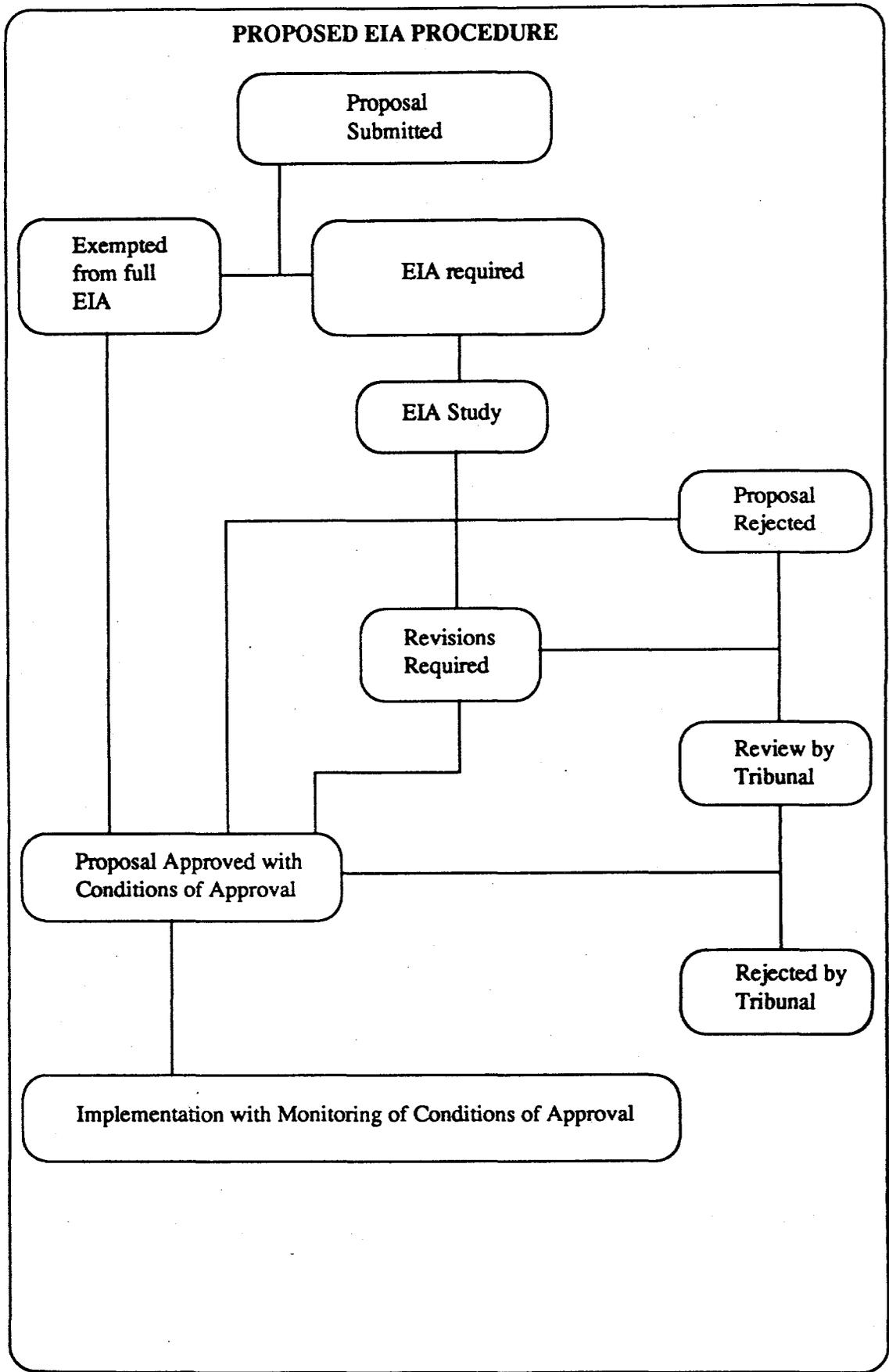
Implemented proposals will be monitored by the relevant DDCs and DES, usually through site visits undertaken by district-based technical officers. If a site visit determines non-conformance with the Conditions of Approval, the EIA agency will be informed and a decision may be taken to halt all development activities immediately until the situation is rectified.

There should be clear guidelines for the issues, responsibilities, procedure and timing relating to Monitoring. Contingency aspects

should be allowed for, the responsibility of which should be provided for in the Environmental Contract described under District Procedure.

### **B5.12 Auditing**

A re-evaluation, or Audit, of the development is a possible step following Project Implementation. This should be determined during negotiations prior to the Review/ Conditions of Approval of the proposal. The audit will be carried out by the EIA agency in collaboration with representatives from the affected DDCs.



## ANNEX 3: STATUTES RELATING TO THE ENVIRONMENT

1. THE CONSTITUTION
2. THE PENAL CODE CAP. 63
3. THE CHIEF'S AUTHORITY ACT, CAP. 128
4. THE PUBLIC HEALTH ACT, CAP. 242
5. THE RADIATION PROTECTION ACT CAP. 243
6. THE LOCAL GOVERNMENT ACT CAP. 265
7. THE TRUST LAND ACT, CAP. 288
8. THE LAND PLANNING ACT, CAP. 303
9. THE MINING ACT, CAP. 306
10. THE PETROLEUM (EXPLORATION AND PRODUCTION) ACT, CAP. 308
11. THE AGRICULTURE ACT, CAP. 318
12. THE WATER ACT, CAP. 372
13. THE WILDLIFE (CONSERVATION AND MANAGEMENT) ACT, CAP. 376
14. THE TOURIST INDUSTRY ACT, CAP. 385
15. THE FORESTS ACT, CAP. 385
16. THE MERCHANT SHIPPING ACT, CAP. 389
17. THE TRAFFIC ACT, CAP. 403
18. THE TOURIST DEVELOPMENT CORPORATION ACT, CAP. 382
19. THE LAKE BASIN DEVELOPMENT AUTHORITY ACT, CAP. 442
20. THE KERIO VALLEY DEVELOPMENT AUTHORITY CAP. 441
21. THE TANA AND ATHI RIVERS DEVELOPMENT AUTHORITY ACT, CAP. 443
22. THE FACTORIES ACT CAP. 514
23. THE COAST DEVELOPMENT AUTHORITY ACT, NO. 20 OF 1990
24. THE FISHERIES ACT, NO. 5 OF 1989
25. THE MARTIME ZONES ACT, CAP. 371
26. THE NATIONAL WATER CONSERVATION PIPELINE CORPORATION ACT L/No. 270/  
1988
27. CARRIAGE OF GOODS BY SEA ACT, CAP. 392
28. THE TIMBER ACT, CAP. 386
29. THE GOVERNMENT LANDS ACT, CAP. 280
30. THE REGISTRATION OF TITLES ACT, CAP. 281
31. THE LAND TITLES ACT, CAP. 282
32. THE LAND CONSOLIDATION ACT, CAP. 283
33. THE LAND ADJUDICATION ACT CAP. 244
34. REGISTRATION OF DOCUMENTS ACT, CAP. 285
35. LAND (GROUP REPRESENTATIVES) ACT, CAP. 287
36. MAZRUI LAND TRUSTS ACT, CAP. 288
37. EQUITABLE MORTGAGES ACT, CAP. 291
38. WAY LEAVES ACT, CAP. 292
39. DISTRESS FOR RENT ACT, CAP. 293
40. LAND ACQUISITION ACT, CAP. 295
41. RENT RESTRICTION ACT, CAP. 296
42. SURVEY ACT, CAP. 299
43. REGISTERED LAND ACT, CAP. 300
44. LANDLORD AND TENANT ACT, CAP. 301
45. LAND CONTROL ACT, CAP. 302
46. MORTGAGES (SPECIAL) ACT, CAP. 304
47. LAKES AND RIVERS ACT, CAP. 409
48. GRASSFIRES ACT, CAP. 327
49. CROP PRODUCTION AND LIVESTOCK DEVELOPMENT ACT, CAP. 321
50. LOCAL AUTHORITIES (RECOVERY OF POSSESSION OF PROPERTY)
51. ANTIGUITIES AND MONUMENTS ACT, CAP. 215

52. OCCUPIERS LIABILITY ACT, CAP. 34
53. PLANT PROTECTION ACT, CAP. 324
54. SEEDS AND PLANT VARIETIES ACT CAP. 326
55. FERTILIZERS AND ANIMAL FOODSTUFFS ACT, CAP. 345
56. TOWN PLANNING ACT, CAP. 134 (1948)
57. FIRE INQUIRY ACT, CAP. 103
58. WAKF COMMISSIONERS ACT, CAP. 109
59. EXPLOSIVES ACT, CAP. 115
60. PETROLEUM ACT CAP. 116
61. HOUSING ACT, CAP. 117
62. METHYLATED SPIRIT ACT, CAP. 120
63. MALARIA PREVENTION ACT, CAP. 246
64. USE OF POISONOUS SUBSTANCES ACT, CAP. 247
65. FOOD, DRUGS AND CHEMICAL SUBSTANCES ACT, CAP. 254
66. LOCAL AUTHORITIES SERVICES CHARGE ACT, CAP. 274
67. CONTINENTAL SHELF ACT, CAP. 312
68. SUPPRESSION OF NOXIOUS WEEDS ACT, CAP. 325
69. COCONUT PRESERVATION ACT, CAP. 332
70. PESTS CONTROL PRODUCTS ACT, CAP. 346
71. MINERAL OIL ACT, CAP. 307
72. IRRIGATION ACT, CAP. 347
73. TERRITORIAL WATERS ACT, CAP. 371
74. EWASO NG'IRO SOUTH RIVER BASIN DEVELOPMENT AUTHORITY ACT CAP. 447
75. EWASO NG'IRO NORTH RIVER BASIN DEVELOPMENT AUTHORITY ACT CAP. 448
76. THE SCIENCE AND TECHNOLOGY ACT, CAP. 250
77. THE NATIONAL MUSEUMS ACT, CAP. 216

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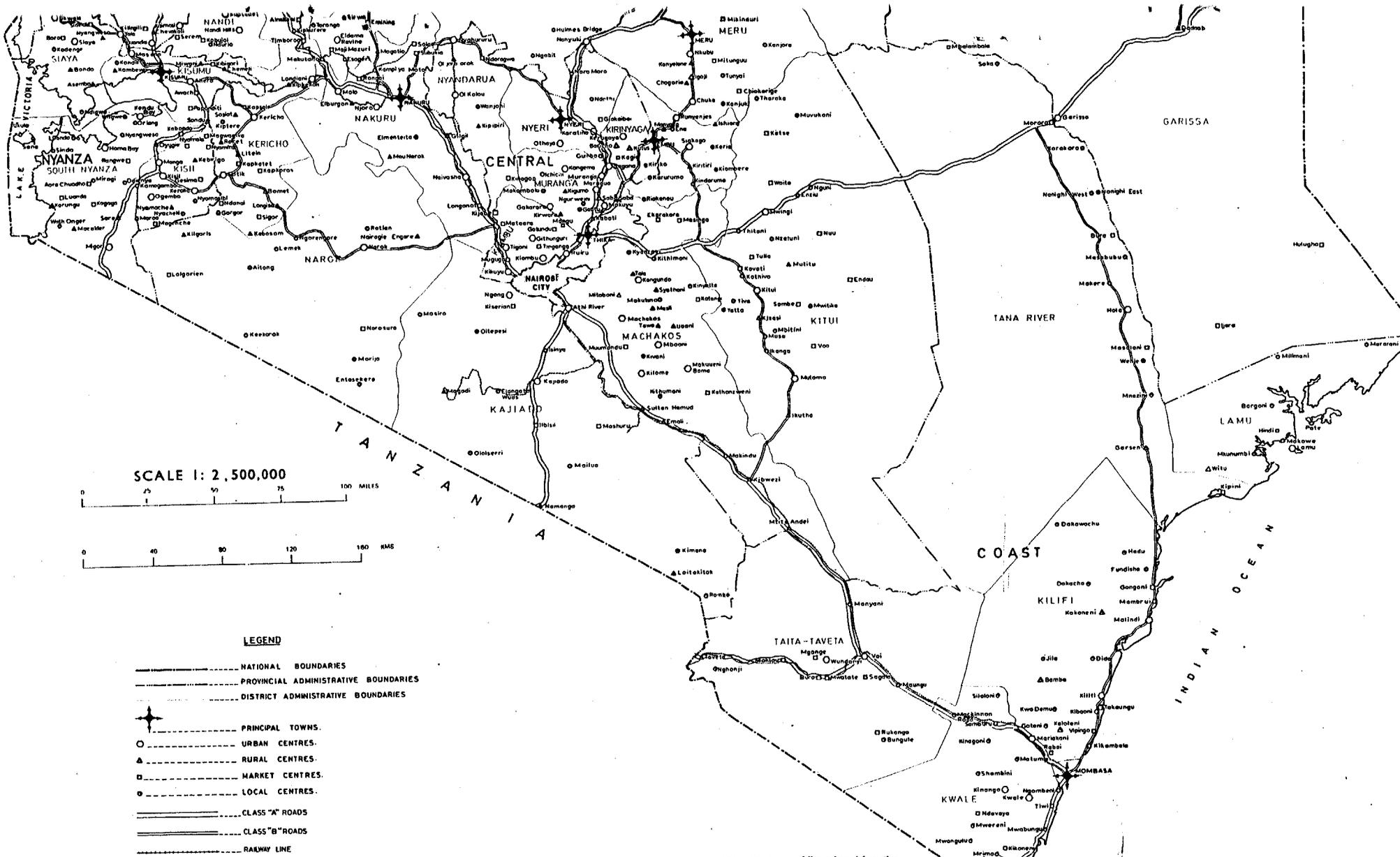
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