STATE OF THE ENVIRONMENT REPORT FOR LIBERIA 2006

FIRST STATE OF THE ENVIRONMENT REPORT FOR LIBERIA - 2006

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FOREWORD

The purpose of this State of the Environment (SOE) Report is to provide early warning and analysis of potential problems for the environment; to allow the public to monitor progress towards the achievement of the objectives of the Environmental Protection Agency Act and the Environment Protection and Management Law, consistent with the National Environmental Policy of Liberia. We believe these actions can set the drive towards achievement of the Millennium Development Goals and the National Biodiversity Strategy and Action Plan.

The Report provides important information, which we hope will help the Liberian Government make the right decisions about the environment in order to build a sustainable economy and conserve a healthy environment. Basically, the Report has attempted to answer the following questions:

- ✓ What is happening to the environment?
- ✓ Why is it happening?
- ✓ Why is such happening significant?
- ✓ What are we doing or do we intend to do about it?

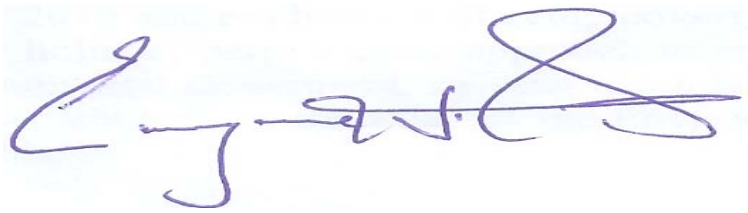
In an attempt to answer these questions, the report has developed indicators to demonstrate whether changes are either positive or negative. Some of the outputs include collection of baseline information on water, climate, land, population wildlife, forest and other natural resources, agriculture production, social, cultural and economic factors, historical background, waste management, marine and coastal biodiversity. It is in our opinion that dealing with the above information parameters, it is anticipated that as a result of the report, public perception about the need to conserve the Liberian environment will improve, there will be increased level of environmental management, improved food security and a reverse in the trend of forest and wildlife loss, improved water supply and sanitation, improved sensitization about energy needs and adaptation to climate change and full and effective participation of the public in the design, planning and implementation of environmental programmes. This report is therefore compiled to be circulated within and outside Liberia.

Liberia subscribes to the World Summit on Sustainable Development and its Johannesburg Plan of Implementation, which calls for significant reduction in the rate of biodiversity loss by 2010 and eradication of acute poverty by 2015. But this can only be realized through holistic, participatory approach to environmental impact assessment, strategic environmental assessment, striving towards achievement of the Millennium Development Goals. We believe the State of the Environment Report is one of the vital steps to achieving this.

Liberia is a party to several Multilateral Environmental Agreements (MEAs), with the realization that obligations under these instruments are sufficient to address environmental conservation and sustainable use of its components. As a further reaffirmation of how much we recognize the value of environmental sustainability, and the importance it holds for sustenance of all life support systems, the Government of Liberia create the Environmental Protection Agency (EPA) in 2003, which has now been fully institutionalized and given the mandate to supervise, coordinate and consultant on all environmental activities in the country.

The achievement of environmental management must be fully participatory. And therefore, we call on everyone, including all citizens of Liberia, the United Nations System and other development partners and the private sector to work in concert with UNDP and UNEP to support the Liberian Government to safe the environment. Let us bear in mind that the rate at which we achieve this will depend on the conduct of human activities towards the environment, by ensuring that our actions are environmentally friendly and sustainable.

We have no doubt that with the full and effective participation of all stakeholders, Liberia will follow the good examples of other environmentally friendly nations, and that we will not be found relenting on this course. Let us all be reminded that this is the time to act.



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&
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ACKNOWLEDGEMENT

Preparation of the State of the Environment (SOE) Report for Liberia is actually a continuing initiative. The first attempt was made in 2001 with UNDP funding under the project, "Strengthening the National Environmental Commission of Liberia" (NECOLIB), the predecessor of the Environment Protection Agency of Liberia. With the termination of that project, the activity could not continue. However, we recognize the efforts of all the national and international actors who conceived the idea and set the stage for the product we have today.

The need to complete the State of the Environment Report was rekindled at the Seminar on the Environment in Liberia held in July 2004, and organized by UNDP, UNEP and UNMIL. UNDP therefore took the lead by allocating funding to complete the process after the issue was brought up at meetings of the Task Force on the Liberian Environment, chaired by the Ministry of Planning and Economic Affairs (MPEA) and co-chaired by UNDP. We wish to extend many thanks to the chairman and members of the Task Force for demanding a state of the environment report.

Through the joint efforts of the Environmental Protection Agency of Liberia (EPA) and UNDP, a working group on Liberia's SOE Report was constituted, comprising staff members nominated by their respective institutions from agencies and ministries of Government, national and international NGOs, UN Agencies and the private sector. UNDP is very thankful to the working group for all the effort put into organizing the work and structuring the report after the initial drafting by the UNDP programme consultant and other local consultants. Without the work of the working group and initial draft of the local consultants, we would not have had a material to work with.

We also acknowledge the work of the special review committee, which participated in a three-day retreat to review the initial draft and re-structure the report. Special thanks to Dr. Aiah Lebbie of the Environmental Foundation for Africa, Mr. Clarence Momo of Liberia Water and Sewer Corporation and Ms. Hiroko Mosko of the United Nations Mission in Liberia (UNMIL) for the leadership skills during the retreat.

The first draft report after the retreat was presented at a stakeholder validation workshop in Monrovia. We wish to thank all the over one hundred participants who worked from morning to evening for three days to further improve the report. Many thanks also to Abdoulaye Sene, an international consultant from Senegal, who attended the workshop and assisted in producing the next draft of the report. A revalidation workshop became necessary when it was apparent that some situations changed since the last draft of the SoE report was completed. We wish to extend our thanks and appreciation to all those who participated in this workshop.

After the validation workshop the report was sent out for voluntary peer review. We wish to recognize special contributions from Joseph Opio-Odongo of the Regional Service Centre, UNDP Nairobi, Linda Ghanime of UNDP HQ, Shigeki Komatsubara of UNDP HQ and Cleophas Toriri of UNDP-Liberia. Ms. Elizabeth Gowa, a Ugandan working in Nairobi, Kenya is credited for performing final edit of this document after consolidating comments from voluntary peer review. We extend many thanks to Fauna and Flora International - FFI (Liberia), Farmers Associated to Conserve the Environment (FACE), Center for Sustainable Energy Technology (CEST) and others for providing photographs contained in this document.

For those institutions and individuals we did not mention in this acknowledgement, you are not less important in the production of this report. You all worked to bring this work to reality. Many thanks for your invaluable services.

Executive Summary

This is the first state of the environment (SOE) report for Liberia. As required by the Environmental Protection and Management Law, the report should be produced after every five years. The state of the environment report is a guide for development planning and decision-making and is an important reference for environmental education and awareness. It is expected to serve as a monitoring tool for measuring progress against stated development goals. . Within the environmental domain, there are serious data gaps related to Liberia's biodiversity, mountains, solid waste management, and greenhouse gas emissions, among others. This needs to be urgently addressed so as to improve subsequent editions of the SOE.

This report is divided into four parts: 1) environment and economic development, 2) the state and trend of the natural resources, 3) the human environment, and 4) environmental governance. These are designed to reflect the inter-linkages between environment, development, security and good governance in Liberia and are the broad areas that Liberians will have to think about and act on during the process of reconstructing their country.

Part one provides a general overview of the country and discusses the link between environment and development as key to sustainability. The country is richly endowed with water, forests and mineral resources, and has a climate favourable for agriculture. Timber and rubber are the main products. Contrastingly Liberia is a poor country. GDP is less than US$500 million, and total debt of US$3.7 billion by 2005. Unemployment rate is 85 per cent and 1.4 million people are living on less than US$0.50 per day. The economy is largely dependent on humanitarian aid, but it has a vibrant informal sector with potential for growth. Past economic considerations did not take into account the need for environmental sustainability and some of the physical signs of this are still evident
As Liberians undertake the task of rebuilding the country, environmental issues will be one of the major challenges facing the country. The urgent need for economic growth will have to be balanced against the potential impacts on the environment.

Part two provides information on the state and trends of the major natural resources of land, water and biodiversity. Land is critical for human survival and development; it supports agriculture, forestry, tourism, human settlement, wildlife and industrial development. Land resources are affected by land degradation from activities such as mining, poor agricultural practices, lack of land-use planning and the current land tenure system.
Habitat degradation and loss, over-exploitation of resources through excessive harvesting or hunting, introduction of exotic species and ineffective institutional arrangements are threatening the rich biodiversity. To address the issue of biodiversity loss, 10 national forest reserves and two fully protected areas have been gazetted. The fully protected areas are Sapo National Park and East Nimba Nature Reserve
Water resources management is weak. There is no integrated water resources management, the laws are fragmented across several agencies and there are no proper enforcement mechanisms. There is no policy governing water resources management.

Part three discusses the state of the human resource and its relevance for the environment.
The population of Liberia was estimated to be 2.9 million in 2004. Annual population growth rate is 3 percent and fertility rate is 6.7 percent. The population is young. In 1984, it was estimated that 44 percent of the population was below 15 years. Rural-to-urban migration is on the increase and population displacement has been a factor due to the war. Less than 2 percent of the population has access to pipe borne water. The major diseases are malaria,

anaemia, respiratory infections, diarrhoea and malnutrition. The HIV/AIDS prevalence rate was approximated as 12 percent in 2002 and only 30 percent of this group reside in communities in which the nearest health facility is less than one-hour away on foot.

One of the biggest problems facing Liberia is that of poor waste management and sanitation. Only 11 percent have access to flush toilets and 25 percent access to latrines. The majority use the bushes and water bodies to dispose of their waste. Poor waste management contributes to environmental conditions that may threaten human health and well-being. This issue represents a heavy burden for the authorities and communities concerned. Although waste collection and disposal systems used to exist in some municipalities, these are currently not functioning. The most common solid waste disposal method in Liberia is open dumping at disposal sites generally located at various sites around communities, most of which are not suitably located. Other problems include inadequate legislation, weak enforcement, lack of substantial financial and human resources, lack of appropriate technologies and effective mechanisms to coordinate stakeholders.

Trade and industry are vital to the development of the country. Mining is the major activity in the sector with the remainder being predominantly trade and service related activities. The main minerals are gold, diamond and iron-ore. With proven reserves of 3 billion tons, the revival of this industry could contribute to economic growth. But mining has environmental implications. Artisan mining of diamond and gold has resulted in clearing and excavation of large tracts of forests and riverbeds, and pollution of land and water. This sector had severe setbacks because of the war, poor management and shortage of inputs. With peace and a new government in place there are opportunities for improvement. .

Transport and energy are important factors in development as they facilitate trade, education, tourism, mobility and cultural exchange. . Liberia has significant potential primary energy resources. The major ones are biomass, hydro-electricity, petroleum and other renewable sources. The country has been without central electricity for more than a decade. Wood is the major source of fuel for 99.5 percent of the people. The fuelwood and charcoal market is thus a lucrative one. Charcoal production in 1999 accounted for 9 per cent of GDP. Although charcoal production generates employment and income, it has become one of the major causes of deforestation. Improvements in the energy sector will play a crucial role in development.

In part four, the document highlights the governance framework that has been put in place to manage these environmental resources. Liberia is putting in place strategies to promote sustainable development and sound environment management. Three instruments provide the legal framework for environment management in the country. These are the Environment Protection and Management Law, the National Environmental Policy and the Act creating the Environment Protection Agency. The Environment Protection Agency is the government authority mandated by law to monitor, coordinate and supervise environmental issues in the country. A National Environment Policy Council and a Board of Directors oversee the implementation of the National Environmental Policy and the functions of the EPA.. There are also other stakeholders involved in the sector. The private sector, civil society, men and women are all actively engaged in and encouraged to participate in environmental management and decision-making. Ensuring proper environmental governance is essential for economic development and sustainable environmental management

PART 1
ENVIRONMENT AND ECONOMIC DEVELOPMENT

1 OVERVIEW OF LIBERIA'S ENVIRONMENT

Introduction

There are clear inter-linkages between environment, development, security and good governance in Liberia. Poor environmental management, overexploitation of natural resources and poverty are some of the issues that have fuelled conflict in the past. After years of instability, war and destruction, Liberians with the support of Government and the international community have begun the process of transformation, recovery and reconstruction. This is a major challenge. Areas to be addressed include the provision of basic services, security and public sector reform, governance and the rule of law, decentralization and community revitalization, and economic recovery. Within the framework of the Governance and Economic Management Assistance Programme (GEMAP), environmental issues appear as key challenges facing the country in the process of sustainable development.

As part of the government's strategy to ensure sustainable development, Liberia formulated its Environment Protection and Management Law in 2003. This law in Section 103 calls for the production of a State of the Environment (SOE) Report every five years. It also calls for the establishment of a monitoring system in Section 34.

This SOE report has therefore been produced in accordance with the requirements of the law. It will serve to provide information for effective and evidence-based policy and also provide early warning and analysis of potential environmental problems. Some of the issues it addresses include, but are not limited to, land degradation, pollution, deforestation, waste management and the need for better environmental management across the sectors. An analysis of the problems will allow the public and government to monitor progress towards the achievement of national environmental objectives as well as towards international targets such as the Millennium Development Goals.

There is a growing recognition that Liberia's development plans and environmental policies have a better chance of being implemented effectively when supported by an informed, educated and involved public. Already several local and international non-governmental organizations (NGOs) have put in place programmes and projects to address environmental sustainability through public education and awareness. This SOE will build on those efforts through a coordinated nation-wide approach. It will provide environmental information to support decision-making and enhance public participation with the aim of building a sustainable economic and healthy environment.

Key Aspects of Liberia's Environment

Liberia is a country with a relatively high elevation. It has highlands and rolling hills covered with rain forest. The equatorial position and the distribution of high and low pressure belts

over the African continent and the Atlantic Ocean influence the climate of Liberia. There are two seasons – a rainy and dry – with a transitional period.

Location, Size and Characteristics

Liberia is situated on the southwest corner of the West Coast of Africa. It lies between the longitudes of 7°30' and 11°30' west and latitudes 4°18' and 8°30' north. It covers a surface area of about 111,370 km^2 (about 43,506 square miles). The dry land extent is 96,160 km^2 or 37,570 sq. miles. Liberia is bordered on the west by Sierra Leone, on the north by Guinea, on the east by Côte d'Ivoire and on the south by the Atlantic Ocean. The perimeter is 1,585 km (990 miles), excluding the Atlantic Ocean. The border with Guinea is 563 km (352 miles), Cote d'Ivoire 716 km (446 miles), and Sierra Leone 306 km (191 miles).

There are four topographical regions at different altitudes, each with distinct physical features. Along the sea coast is the coastal plain of 350 miles (560 km), an almost unbroken sand strip, which starts from the lowest elevation up to 30 meters above sea level. Next to the coastal plain is the belt of inundated plateaux followed by the belt of high lands and rolling hills in the north and northwest. The lowest point is the Atlantic Ocean at zero meters and highest elevation is the northern highlands, which includes Mount Wutivi (1380 meters), the highest point in Liberia.

The Urban Environment

Urbanization is a necessary part of development and is a good thing as long as it is planned, well managed and controlled. In Liberia, urban development is largely uncontrolled. There is a lack of long-term planning, management and monitoring of inputs that would nurture sustainable development. One reason is possibly the lack of coordination between the institutions involved in urban management.

Unplanned urbanisation has negative impacts on both the environment and human well-being. For example, the inadequacy of basic urban services such as water supply, electricity, housing and sanitation creates environmental problems that manifest in diseases caused by drinking unsafe water or from air pollution caused by burning waste or poor ventilation. Issues regarding urban management are also discussed in *Chapter 6: Population and social development*.

Figure 1.1 Location of Liberia

Physiography

Mountains

Most mountains are located in the northern part of Liberia. They include the Bong, Nimba, Mano, Putu, Bomi and Wologizi ranges. Mount Wutivi (1380 meters at Yekepa) is the highest peak and Wologizi the second highest. Mount Putu is located in the southeast of the country. The major rivers in Liberia derive their sources from the mountains. They are also important for mineral deposits. Diamonds are found along the banks of the rivers that flow from the mountains. Mountains have not been surveyed systematically, but four of them (Nimba, Bong, Bomi and Mano) contain ore deposits and have been exploited for the resource. The Nimba massive is the most important, shared by Cote d'Ivoire, Guinea and Liberia. It has been recommended for world heritage site status. Information on the biodiversity and minerals found in mountain areas is provided in *Chapter 5: Biodiversity resources and use*, and *Chapter 9: Trade and industry*, respectively.

Coastline

Liberia has a beautiful coastline that is a tourist attraction. The coast is pounded by powerful surf, which has produced a relatively straight coastline with many lagoons. The coastline is 560 km long (350 miles), characterized by an unbroken sand strip. The width of the coastal plain varies from 16-40 km and most of its land mass has an elevation of 9-30m. Most rivers meander slowly over the plain and then widen near their estuaries. The territorial water is about 159,200 km^2 (70,000 sq. miles), larger than the land area of the country.

Rivers

The geomorphologic structures and relief determines the drainage patterns of the watersheds or river systems. The major river basins drain the territory in a general northeast to southwest direction to the Atlantic Ocean. Major exceptions to the pattern is the middle reaches of the Cavalla and Dugbe in eastern Liberia, which flow parallel to the coast in their lower reaches before entering the Atlantic Ocean.

There are six major rivers, which drain 66 percent of the country. These are Rivers Mano, St. Paul, Lofa, St. John, Cestos and Cavalla. The short coastal watercourses drain about 3 percent of the country and include the Po, Du, Timbo, Farmington, and Sinoe rivers. The largest and longest is the Cavalla River. These rivers are not navigable and therefore do not support water transport and industrial fishing.

Du River in Margibi County

Courtesy of UNDP Energy and Environment Programme

Lakes
There are only two major lakes in Liberia – Lake Shepherd in Maryland County and Lake Piso in Grand Cape Mount County. Lake Piso is the larger of the two. Both of them are along the Atlantic Ocean. Lake Piso is characterized by a vast expanse of wetlands and lowland forest vegetation. They are one of six proposed protected areas of Liberia. There are other large ponds, which people refer to as lakes. The most popularly known in this category is the Blue Lake in Tubmanburg, Bomi county. This large pond was created from iron ore mining that left a large unclaimed land. It is now a tourist attraction.

Climate
The equatorial position and the distribution of low and high-pressure belts along the African continent and Atlantic Ocean determines the climate of Liberia and more generally, West Africa. Because of this position and the moderating influence of the ocean, a fairly warm temperature throughout the year with very high humidity is common.

Sunshine and Temperature
The sun is overhead at noon throughout the year, giving rise to intense insolation in all parts of the country. This results in high temperatures with little monthly variations. Temperatures would have been much higher had it not been for the effect of the degree of cloud cover, air, humidity and rainfall, which are influenced by the vegetation cover of the country. Daily sunshine hours are at a minimum during July, August and September. The days with longest hours of sunshine, fall between December and March, averaging more than six hours per day (MPEA 1983).

The Atlantic Ocean also has an additional ameliorating effect on the temperature along the coast with maximum annual and daily variations. As a whole, the temperature over the country ranges from 27-32^{0}C during the day and from 21-24^{0}C at night. High altitude explains a pleasant climate near the Guinean border in the north. Along the coast, the average annual temperature ranges from 24-30^{0}C (75-85^{0}F). In the interior it is between 27-32^{o}C (80-90^{0}F) (MPEA 1983). The highest temperature occurs between January and March and the lowest is between August and September. The low temperatures are mainly caused by the amount of cloud cover.

Rainfall
The country has two seasons: rainy and dry seasons. The rainy season is from May to October, and the dry season runs from November to April. Average annual rainfall along the coastal belt is over 4000 mm and declines to 1300 mm at the forest-savannah boundary in the north (Bongers and others 1999). The months of heaviest rainfall vary from one part of the country to another, but are normally June, July and September

Rainfall is caused by the South Atlantic sub-tropical high wind called the southwest Monsoon of the Maritime Tropical Air between April and October. For the rest of the year, the Inter-Tropical Front moves south, and most of West Africa comes under the influence of the low pressure from the Sahara Desert. At this time low humidity prevails usually from the end of December to January, and sometimes till February. This dry wind sweeps across the continent and reaches Liberia between December and February bringing considerable amounts of fog and dust with low cool temperatures during the night.

Since the soils in Liberia have low moisture storage capacity, the amount and frequency of rain during the dry season becomes a limiting factor for crop cultivation. Despite the heavy

torrential rainfall, it does not rain continuously during the rainy season. It is common to have sunny days even during months when rain is heaviest.

Observations concerning the diurnal distribution of rainfall prove that two-thirds of the rain along the coast, particularly in Monrovia and its environs, falls during the night between 18.00 and 07.00 hours. Most of the rest of the rain usually falls during the morning while only a minimum of rain is recorded between mid-day and early afternoon. This is one of the reasons why the rainy season in Liberia is not as inconvenient and disturbing as in other parts of West Africa.

Data on Liberia's isokeraunic (thunderstorm) condition is not available, but 150 thunderstorms days per annum have been recorded at Roberts International Airport (Schulze 1975).

Humidity

Relative humidity is generally high throughout the country. Along the coastal belt it does not drop below 80 per cent and on average is above 90 per cent. There is a wider variation in the interior, where it may fall to below 20 per cent during the harmattan period. A relative air humidity of 90-100 per cent is common during the rainy season.

In Monrovia, the relative humidity shows a relationship with the existing air temperature and its variation depends on the prevailing season and the hour of the day. During the dry season it decreases to 80-85 per cent. In March and February the driest period of the year, relative air humidity may be as low as 65 per cent. Regardless of the season, the relative humidity at night and in the early morning is usually in the range of 90-100 per cent. Data from other weather stations such as Bomi Hills, Harbel and Greenville show similar results. Only the zone, north of the Inter-Tropical Front, where the continental air masses prevail from mid-December to end of January show arid conditions. At times due to the extreme dryness of the harmattan, the humidity may drop to below 50 per cent (Schulze, W. 1975).

Wind and Ocean Currents

Data on wind is incomplete. However, total wind speed is greatest in the rainy season and lowest in the dry season. The maximum wind speed is greatest between July and September and lowest in December and January. There are local variations, with the coastal area having much more wind than the interior of the country. The low wind speed in the interior can be attributed to the vegetation cover. High vegetation cover serves as a windbreak. Average wind speeds of 6.8 mph have been recorded at Harbel (Firestone). The highest wind speed (45 miles/hour) was recorded in Buchanan in April and May 1988. The average annual wind speed was 19.5 mph.

The coastline runs approximately from southeast to northwest and at right angles to the prevailing southwesterly rain-bearing winds. As the maritime air reaches the coast, it is forced to rise, cool and subsequently heavy conventional rain falls. The relatively marked seasons result from the movement of the Inter-Tropical Convergence Zone (ITCZ) from the northern hemisphere over the Sahara desert near the Tropic of Cancer while at the same time cool air mass over the south Atlantic ocean in the southern hemisphere is overhead south of the equator. As a result of these pressure shifts, the dry continental air mass and the moist south-equatorial maritime air mass replace each other at six-month intervals.

In the intermediate vicinity of the coast, there is another circulation of air. This is the daily change of sea and land breezes. On sunny days, the air over the land warms up rapidly, expands, rises and flows at high altitude towards the sea where it is displaced by the sea breeze. A circular flow of air in the opposite direction sets in and a land breeze, which has considerable cooling, provides good atmospheric conditions for recreation, work and agriculture.

Vegetation

There are three main vegetation zones in Liberia. They include the coastal vegetation (savannah woodland), northern savannah and the tropical rainforest (GTZ/MPEA1983). The savannah vegetation is influenced by human activities and has developed as a result of clearing the rain forest for agriculture. The coastal vegetation consists of mangrove swamps, savannah woodland and patches of forest scattered in fields of grassland. The northern savannah is found in Lofa and Nimba Counties. The area is densely covered with elephant grass, which grows up to about 10 feet in height. There are also scattered trees and patches of forest in this savannah zone. This vegetation type is encroaching into the rainforest zone as it steadily moves southward

Forests

Liberia is the only country in West Africa that once was covered entirely with rain forest. The forest of Liberia is being reduced at the rate of 1-2 per cent per annum (WRI 2003, FAO/FDA/IDA 1985). More than 50 per cent of the forests have been destroyed over the years. The two remaining dense forest areas are now found in the northwest and southeast of the country separated and isolated from each other by a corridor extending from Monrovia to Nimba County. These two forest blocks are further fragmented and dissected by the advances of shifting cultivation along existing roads and by the construction of logging roads. Issues regarding forest management and use are discussed in *Chapter 5: Biodiversity resources and use*.

Wetlands and Swamps

Wetlands are transitional zones between terrestrial systems and open water systems and are highly productive and rich in flora and fauna. Their economic and ecological functions attract human activities that eventually impact on biodiversity. Liberia has a few wetlands that provide both subsistence and economic benefits to its many inhabitants. Like wetlands all over the world, they have become stressed by human induced activities. There are four wetland types: Inland riverine, inland swamp, coastal and coastal lacustrine. Presently, five of the eight wetlands of conservation status identified have been gazetted by the RAMSAR Secretariat (table 5.2 on page 50 reflects the eight wetlands of conservation status).

Swamps are traditionally important in the rural areas for two main reasons. They serve as a source of herbs and are used to augment rice production. Cultivation in swamps is only done on a small-scale basis. For more information on swamps and wetlands, see *Chapter 5: Biodiversity resources and use*.

Wetlands with Water hyacinth along Benson River near Buchanan city

Courtesy of EPA 2004

Mangroves

Mangroves characterize the wetlands of Liberia and cover a small area along the coast, from Cape Mesurado to Cape Palmas, at the edges of lagoons, riverbanks, and river estuaries and in widespread areas of swamps. Mangroves are estimated to cover 0.5 per cent of the land surface of Liberia, which is equivalent to a 500 km-wide belt extending along the total length of the coastline (Gatter 1988). Mangroves are being degraded due to urban expansion, collection of firewood and construction of makeshift structures. The mangroves are a vital coastal ecosystem. They provide habitat for fish, invertebrates and epiphytic plants, and are considered more efficient photosynthesizers than most plants. A detailed discussion on mangroves is provided in *Chapter 5: Biodiversity resources and use*.

Commercial Plantations

The development of large commercial plantations poses a threat to biodiversity and the environment. For example the establishment of rubber plantations involves clearing and excavation of large tracts of natural vegetation. During the process many species are destroyed to make way for a monoculture. There are also issues of soil erosion and waste management. This is discussed in greater detail in *Chapter 3: Land resources and use* and *Chapter 7: Waste management and sanitation*.

Mangroves of the Mesurado wetlands near Monrovia

Courtesy of EPA 2004

Conclusions and Recommendations

Liberia has rich and varied environmental resources that if managed well could provide for its people now and in the years to come. Key recommendations to ensure that these are managed are listed below.

1. Conduct a study on the value of mangroves and wetlands to tap their economic, tourist and other potentials,
2. Put in place a mechanism for government to declare the Liberian portion of Mount Nimba as a World Heritage site,
3. Encourage proper city planning and the enforcement of zoning regulations to enhance a sound urban environment,
4. Institute a government ban to prevent people from destroying mangroves for construction and promote the re-establishment of mangroves, and
5. Ensure that those establishing rubber plantations do not clear forests and other vegetation on high elevations within their leased land.

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2 ENVIRONMENT AND ECONOMIC DEVELOPMENT

Introduction

Liberia is rich in natural resources, and in a quest to develop its economy and meet the needs of its growing population, wants to make maximum use of its abundant biological and environmental wealth. The link between environment and development is one that needs to be understood if Liberia is to achieve sustainable development. Economic growth affects the environment through the increased use of natural resources. In the same way, environmental change can affect the economy, especially those sectors that are based on natural resources for example agriculture and forestry. Economic growth provides the resources needed for investment in the productive capacity of the economy. Such resources are necessary for poverty alleviation and can also be used to mitigate environmental problems.

Although economic growth may generate resources needed for investment, improving human well-being and for addressing environmental problems, it may not be sustainable. In recognition of this, the Liberian government formulated the National Environmental Policy in 2003. The overall policy goal is to promote sustainable development and conservation of the environment on a long-term basis for the betterment of present generations without compromising the ability of future generations to meet their needs.

In pursuing economic growth, there are certain minimum requirements that Liberia will have to meet to ensure both environmental sustainability and economic growth. These are indicated in box 2.1.

History of Liberia's Economy

The Liberian economy was and still is largely dependent on extractive industries mainly timber, rubber, minerals and agriculture. Past growth performance was fuelled principally by the buoyant world market prices of the country's principal exports of iron ore, rubber, timber, cocoa and coffee. There was also significant production of food crops. Liberia has an "open door" policy to external investment, which resulted in considerable success in attracting foreign investment, although mainly in the sectors of mineral and rubber production. The change in fortune in Liberia's economic growth is a story of the rise and fall of private, foreign investment-based production of raw materials for export.

Box 2.1: Minimum requirements for environmental sustainability

1. Eradication of extreme poverty (poverty alleviation),
2. Equitable distribution of benefits arising out of the use of natural resources,
3. Capacity building and reduction in illiteracy rate,
4. Good governance and a decentralized economic and governance structure,
5. Stabilization of HIV/AIDs prevalence,
6. Gender sensitivity and participatory government, especially the involvement of local communities in environmental planning and decision making, and
7. Trade liberalization, including increased production for local consumption, and a better understanding of ecosystem functions, with the adoption of local solutions to environmental problems.

Source: EPA/GEF/UNDP 2004

Trend analysis of Liberia's income distribution clearly indicates a prolonged period of inequitable income distribution. Inequality in growth and development led to a decline in livelihood opportunities for an increasing proportion of the population. This was one of two underlying reasons for the eruption of the civil war in late 1989. The second reason was poor governance.

Fourteen years of civil war aggravated the policy and structural deficiencies of the economy, and accelerated social and economic decline. Foreign trade, which historically served as the main impetus for growth, was disrupted. The productive sectors, particularly production of iron ore, rubber and cash crops became virtually dormant. Economic activities, employment, savings and social services were very severely affected. Physical infrastructure in general, and those supporting basic social services in particular, were largely destroyed or left in a state of serious disrepair. The financial system was also disrupted, and the number of commercial banks dropped sharply from 14 to 4 (CBL 2002).

Apart from the economy, the war destroyed much of Liberia's infrastructure. Continued international sanctions on diamonds and timber exports limit growth prospects for the foreseeable future. Many businessmen have fled the country, taking capital and expertise with them. Some have returned, but many may not.

The Current State of the Economy

Liberia is richly endowed with water, forests and mineral resources, and has a climate favourable for agriculture. This has made Liberia a producer and exporter of basic products – primarily raw timber and rubber. Local manufacturing, mainly foreign owned, has always been small in scope.

Currently, the country survives largely on humanitarian aid and a vibrant informal sector. It operates at about one-third of the pre-war level, with a GDP of less than US$500 million compared to over US$1,000 million in 1988. Unemployment stands at 85 per cent, with 1.4 million people living in abject poverty (US$0.50 per person per day). Total debt recorded during the second quarter of 2005 was US$3,600 million, total domestic debt of US$377.2 million (MOF 2005).

The agriculture sector is primarily dominated by traditional farming practices and requires some modernization. The sector was largely developed as a dual system. It consists of large commercial plantations and subsistence producers. The civil crisis disrupted the sector, resulting in low productivity of agricultural systems, disruption of production due to population displacements and a bad security environment. The country therefore remains among the most food insecure countries in Africa, with less than 10 per cent of the arable land being cultivated. According to a Joint FAO/WFP Crop and Food Assessment Mission carried out in January 2006, 80 per cent of farming activities are carried out upland, while 20 per cent of farming is done in lowland swamps. With an estimated 250,000 farm families, 40 per cent are active. This is due to low yield of food crops mainly rice and cassava. Less than 30 per cent of baseline production levels were recorded in 2005. This was attributed to rodent attacks on cassava farms.

Traditional versus Modern Economy

The uneven development of Liberia's natural resources and the urban-biased nature of the development process have contributed to the emergence of a dual economic and social

structure, consisting of a traditional, low productivity, subsistence sector and a modern "enclave" sector.

The traditional subsistence sector is predominantly agricultural and rural, and historically has been the source of livelihood for about 75 per cent of the population. However, low levels of productivity characterize agriculture. This is reflected in the subsistence sector's relatively low contribution to Gross Domestic Product (GDP). In the modern sector, the major activities have been the production and export of rubber, timber products, iron ore, cocoa, coffee, oil palm, diamonds and gold, a limited range of import substituting and export-oriented manufacturing activities, construction and a wide range of services. Box 2.2 gives a summary of the recent economic performance of Liberia.

In aggregate terms, agriculture accounts for the largest share of the GDP, followed by industry and services. In its narrower definition, which encompasses only manufacturing, the industrial sector is small, accounting for barely 5 per cent of the GDP. On the expenditure side of GDP, public and private consumption registered decreases over a long period.

In terms of the relative importance of individual sub-sectors, iron ore mining was the largest economic activity during much of the pre-civil war years. In fact, for several years prior to 1979, Liberia was the second largest producer of iron ore in Africa. It had proven reserves of 800 million tons with an iron ore content of between 35-67 per cent.

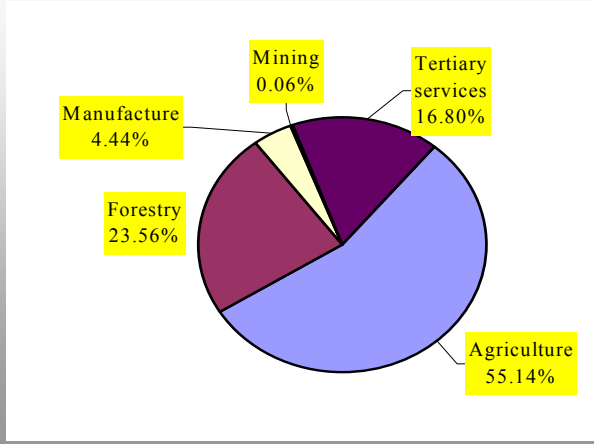
Rubber production was the second single largest economic activity in the modern sector. Foreign concessions accounted for nearly one and a half million acres of land usable for rubber production, while Liberians owned less than 100,000 acres of rubber farm (CBL, (2002). Liberia has the world's largest single industrial rubber plantation. This used to be owned by the US Firestone Company, but is now owned by the Japanese Bridgestone Company, although it continues to be managed by Firestone. In 1989, total rubber production was 118,000 tons and accounted on average for about 16 per cent of GDP over the decade preceding the war. Rubber production was adversely affected by the civil war, but has potential for making a substantial contribution to Liberia's post-war recovery.

Box 2.2: Summary of recent economic performance

The economy of Liberia is weak. GDP per capita was US$166.5 in 1998, US$169 in 1999, US$199 in 2000 and US$163 in 2001. On top of that, Liberia has a per capita debt burden of more than US$1,000. This economic situation is affecting the lives of many people. In 1999, Liberia ranked 174 out of 175 countries on the UNDP Human Development Index. It is estimated that over 76 per cent of the population lives below the poverty line.

Macroeconomic indicators (2004 estimates)
Unemployment rate (formal sector) ---85%
GDP per capita (US$ and PPP$) ---158.06
External debt (US$) as percent of GDP ---707.8%

Sector contributions to GDP



Source: UNDP 2004a

Forestry and cash crop production are two other important economic activities. Together they accounted for 6.7 per cent of GDP during the decade before the war. Liberia has large forest reserves with a huge extractive potential (estimated at 80,000,000 cubic meters in 1967), with total land extent of about 24 million acres. Offshore fishing is another potentially important activity, but output data for this sector is scanty.

Analysis of the country's trade statistics shows that the major imports have been minerals, fuels and lubricants, transport equipment, foodstuff (mainly rice), manufactured goods and chemicals. These items averaged about 83 per cent of total imports during the decade before the war. Liberia's exports have either reduced drastically or have been non-existent due to dormancy/closure of industries, resulting from the civil war. But imports continue to increase.

The Informal Sector

Informal sector activities are defined as economic activities with no regular stream of income or return, for example salaries and wages. The informal sector in Liberia is mainly a subsistence enterprising sector. It comprises mainly micro-enterprises, such as cook shops, petty trading in dry goods, used-clothing, and domestically consumed agricultural products such as bitter balls, okra, beans, sugar cane, old palm and vegetables. The income generated in this sector is used mainly for food 59.2 per cent, education 12.2 per cent, transport 13.4 per cent, and health care 7.6 per cent (UNDP 2001: Poverty Profile of Liberia). With the poverty level at 76.2 per cent nationwide and a dependency ratio of 90-150 per cent, the informal sector has become the main source of livelihood for the urban poor.

The informal sector was relatively small before the war. The near collapse of the formal sector and the influx of displaced people into Monrovia and other urban centers during the period of the civil war provided the impetus for the growth of the informal sector. It is estimated that the population of Monrovia swelled from 450,000 in 1989 to 1.2 million in 1991. Although by 2000, it had dropped to 700,000, this was still about 156 per cent of its pre-war level. Currently, the sector is the only source of livelihood for the majority of the urban poor. It especially appeals to women because about 76 per cent of them are illiterate, and many lack the collateral to access formal banking sector credit (MEPA 2001). Women are estimated to carry out about 83 per cent of activities in the informal sector (MPEA 2001).

The Informal Sector Credit System

The informal sector entrepreneurs have organized themselves to meet the acute shortage of credit. Different schemes include the rotational susu, yearly susu or savings club, the daily susu club and the Lebanese and Fula merchants. Other more formal micro-credit schemes are also emerging such as those supported by UNDP. These are described below.

- *Rotational susu*: Businessmen and women organize themselves into a Susu club, and agree to pay a certain amount each month. This is given to a member of the club. This process continues until all members of the club get paid. For example, a Susu club of 10 women may agree to pay LD$250.00 per month each. The total of LD$ 2500.00 will be given to a member at the end of the month until everyone receives.
- *Yearly susu/Savings club:* Group of business people and other interested persons organize themselves to contribute and save money monthly. The sum is then given out as loans to members and non-members. Where formal commercial banks exist, these monies are saved with the bank. At every meeting of the saving club, payments are received and loans are given out. Every member of the saving club is expected to borrow certain amount and/or carry a potential borrower. The interest on the loan runs up to 20 per cent for members, and 25 per cent for non-members.

- *Daily susu club:* This is normally a "one man" scheme. Usually, a well-known business person may organize a daily susu. The process begins with the broker printing cards with details of the personal cardholder and daily amount of savings. Every business day, the daily susu broker collects the customers' daily savings. The saver decides on how much to save daily. For example, a saver who saves LD$25.00 daily, will get LD$625.00. The balance LD$25.00 goes to the Susu banker as compensation. These small savings can become large amounts, up to LD$50-100,000. The sad effect is that in some instances, the broker would run away with the money, and claim burglary or accident. The savers become the losers.
- *Lebanese and Fula merchants*: Lebanese and Fula merchants assist the petty traders with goods on credit. They also serve as bankers for some of the petty traders.
- *UNDP micro-grant and micro-credit schemes*: As part of its strategy for poverty reduction, UNDP launched two schemes – the micro-grant and micro-credit schemes. Under the micro-grant scheme, beneficiaries were given US$100 each in two instalments to undertake micro-businesses in the informal sector. With the micro-credit scheme, an initial amount of LD$3,000-4,000 is given to each beneficiary as a loan. An interest of 16 per cent is charged for a 16-week period. The beneficiaries are expected to stay in business and to save 10 per cent of their earning during that 16 weeks period. The principal, interest and savings are required for a follow-up loan, which is equivalent to the initial principal plus the savings of a beneficiary.

Foreign Trade

Foreign trade has played a major role in the growth of the economy and has been a major contributor to GDP. Before the war, the country had a trade to GDP ratio of over 60 per cent (Ministry of Commerce Annual Report, 2000). However, with heavy reliance on a few primary exports, the economy was vulnerable to the volatility of commodity markets.

Exports and imports accounted for 64 per cent of the GDP in 2000 and 44 per cent in 2001, which are approximately 73 per cent of the pre-war level. The growth in export earnings, estimated at 14 per cent in 2000/2001 was attributed to increases in exports of rubber and logs of 9 and 46 per cent, respectively. The trade deficit has increased by 21 per cent from US$69.2 million in 2000 to US$83.7 million in 2001. This sluggish performance of the foreign trade sub-sector is attributed to the overall poor macroeconomic policy and structural weaknesses in the economy. These weaknesses hinge on governance concerns, in respect of creating the enabling environment for private direct investment and entrepreneurs financing. In 2005 imports averaged US$240 million against export earnings of mere US$14 million. This high rate in the balance of trade is mainly attributed to very narrow export base and low receipts from existing exports.

Table 2.1 Sectoral origin of GDP at current prices (US$ million)

Sector	2001	2002	2003	2004	2005
Agriculture	240.8	275.3	236.2	267.5	298.5
Rubber	54	59.12	43.9	71	89.6
Coffee	0.1	0.2	0	n/a	0.1
Cocoa	1	0.4	0.9	3	3.8
Rice	66.8	73.3	53.6	85	85.7
Cassava	39.6	48.3	49.9	32.3	33.3
Others	79.3	93.3	87.9	84.3	86
Forestry, hunting, gathering & fishing	152.3	154.2	95	101.5	105.8
Logs & timber	108	106.7	59.7	61.1	64
Charcoal & wood	39.2	40.7	31.2	34.4	35.5
Mining & quarrying	8.5	0.3	0.3	0.3	0.3
Iron ore	n/a	n/a	n/a	n/a	n/a
Gold	0.3	0.3	0.3	0.3	0.3
Diamond	0.1	n/a	n/a	n/a	n/a
Manufacturing	24.8	26.5	15.2	26	32.9
Cement	9.3	9.9	5.7	15	20.7
Beverages	15.5	16.5	9.5	11	12.2
Others					
Tertiary	106.6	107.6	88.7	126.1	143.2
Transport & telecommunication	28.4	30.1	28.1	33.2	39
Trade, hotels, etc	20.1	21.4	20.7	22.9	29.2
Construction	9	11	8.4	17	18.8
Financial institutions	15.4	11.6	9	11	13.4
Energy (water, electricity, etc.)	2	2.1	2	3.9	4.5
Government services	19.8	21.2	13	24.4	24.3
Other services	11.9	12.3	7.5	13.7	14
Discrepancy	3	3.2	2.8	2.9	3.1
GDP at current prices	521.9	560.7	432.6	493.5	543.4
Per capita	200.7	207.7	153	170.1	181.1
Real GDP % change	4.8	7.8	-23.5	14.6	10.1
Population (projected)	2.6	2.7	2.8	2.9	3

Source: MPEA/IMF 2005

Inflation

In terms of prices of goods and services, the economy benefited from a period of relatively low inflationary pressure between 1997 and 2001. Inflation for the period 2001/2002 was estimated at 4-7 per cent. Between January and May 2002, this rose to over 20 per cent (CBL 2002) and by 2005 stood at 15.8 per cent (CBL 2002). This increase was attributed to the poor pricing policies adopted by the government.

Too much emphasis is placed on the US dollar at the expense of the Liberian dollar. Almost all imported commodities are priced in US dollars, and the tax levy for almost all foreign currency-related transactions is in US dollars. For instance, petroleum products and other imported items, taxes on wholesale commodities, passport and airport fees, vehicle and land registration, among others, are levied in US dollars. The high demand for the US dollar has weakened and contributed to the depreciation of the Liberian dollar. The depreciation of the Liberian dollar was estimated at 50 per cent between January and May 2002 (CBL 2002). The increase in the prices of petroleum and other imported commodities is having a domino effect on prices of other commodities, including domestically produced food products. The high prices have depressed consumption, production, and consequently the welfare and standard of living of the population.

Fiscal Performance
On the fiscal front, national revenue performance improved from 22 per cent in 1999 to 26 per cent in 2000/01. The actual revenue in 2000/01 fell by 9 per cent against projection of US$90.7 million. Recurrent expenditure accounted for 68 per cent of actual revenue of US$82.8 million. About 49 per cent of recurrent expenditure was on salary and personnel services, and about 48 per cent on goods and services (CBL 2002). Expenditure on social services like health, education, water and sanitation has not exceeded 10 per cent of actual annual revenue since 1997. UN agencies and other donors have funded about 85 per cent of this expenditure. By May 2002, government had not paid public sector workers for seven months. This reduced the purchasing power of many people who are already living below the poverty line. GDP purchasing power parity is $3,350 million and GDP per capita purchasing parity is US$1,100. Although there was a cash base of US$80 million between 2004 and 2005, more than 10 per cent is unaccounted for (CBL 2002). Additionally, many traditional sources of fiscal revenues (such as export fees, charcoal and pit-sawing levies are not accounted for in the national budget).

However, since the inception of the current administration in 2006, the Government of Liberia operates on a cash-based budget of US$129 million **(**of which 9 million is based on contingency**)** for the Fiscal Period (July 1, 2006 to June 30, 2007). Total revenue collected during the first and second quarters (July 1, 2006-December 31, 2006) amounted to **US$** 60,760 million against a projection of US$54,821 million. This shows an 11% (US$ 5,939M**)** surplus over the projected revenue for the period; while total expenditure amounted to US$ 40,208 million**,** showing a variance of 34% (US$20,552M) surplus in the first and second quarters performance of the 2006/07 Fiscal Budget (Source: MOF 1st & 2nd quarters 2006 Fiscal Report).

By December 2005, Liberia's external and domestic debt obligations totaled US$3.7 billion (sources: MOF/MPEA/IMF 2005 Reports).

Foreign Aid
Foreign aid has played a very important role in Liberia's development effort. Following the end of the war in 1997, the focus of development assistance has been on health, education, agriculture, relief, governance and economic management. It is estimated that from 1996 to 2001, multilateral assistance including UN agencies amounted to US$220 million in the above-mentioned sectors. Bilateral donors contributed US$212 million during the period 1996-1999. The estimated amount for national reconstruction and development over the next five years is about US$460 million.

Other areas that foreign aid has facilitated are support to national and sub-regional peace efforts, respect for human rights and the rule of law, as well as the pursuit of prudent macroeconomic policies.

Debt Burden
Liberia has a heavy debt burden. The accumulation of this external public debt by Liberia goes as far back as the 1980s. During the 1960s and 1970s, Liberia benefited enormously from gains in increased export earnings as a result of the increase in world commodity prices and in terms of trade. With the advent of the 1989 civil conflict, the country's debt service payments were halted and by 31 December 2000, total debt (domestic and external) stood at about US$2,840 million. By December 2005, this figure was US$3,700 million (MPEA/IMF 2005).

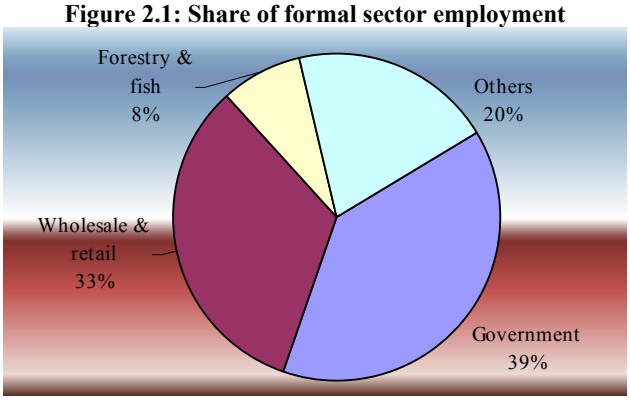
Social and Economic Issues

Poverty and Employment

Poverty is a big problem in Liberia and this is likely to hamper efforts towards development. In 2000, about 76.2 per cent of the population was estimated to be living on less than US$1.00 a day, and 52 per cent on less than US$0.50 per day (extreme poverty) (UNDP 2004b). Approximately 86.4 per cent of the rural population falls below the poverty line. Almost all sections of the society are inflicted by poverty, including professional groups such as craftsmen, school teachers and mine workers. In terms of age groups, about 60 per cent of the most productive age group (25-44) falls below the poverty line. Most of these people depend on environmental goods and services for livelihood. Poverty has been identified as one of the factors contributing to unsustainable use of biological resources.

Employment opportunities are limited. According to the Ministry of Planning and Economic Affairs, only 55 per cent of males and 40.6 per cent of females are currently economically active (MPEA 2005). Overall, about 80 per cent are estimated to be unemployed, and there is even more hidden unemployment. However, one needs to consider that current unemployment trends are based on a depressed economy that is recovering from 14 years of war. Formal sector employment has been estimated at only 15 per cent, compared to 50 per cent pre-war era. Figure 2.1 shows the share of formal sector employment in the country. The contraction of the formal sector employment is due to the destruction of mines, private enterprises, as well as the continuous instability in the country.

Figure 2.1: Share of formal sector employment



Source: MOL 2005

The informal sector accounts for about 30 per cent of the entire labor force. The Ministry of Labor puts the figure of informal sector employment at 30,000 out of an estimated total labor force of 980,000 people (MOL 2006). According to UNDP, 52 per cent of the unemployed were in fact self-employed in the informal sector (UNDP 1998). In 2001, the informal sector accounted for 300,000 or 30 per cent of total employment. The sector is however constrained by domestic structural limitations and poor policies that should be reformed, especially high tax levies.

Food Security

Rice is the main staple food in Liberia, followed by cassava, accounting for 62 per cent and 23 per cent, respectively. Meat and fish also form part of the food basket for some households.

To date, food production has reached 80 per cent of its pre-war level. Extreme hunger has been the most critical manifestation of poverty in Liberia. Hunger causes malnutrition, illness and death. It robs the people's potential to work, learn and to make a decent living.

According to the Liberia Demography and Health Survey (MHSW 1999), the main sources of food for Liberian households are market (51 per cent) and the farm or garden (48 per cent). The food supply situation in rural areas, however, is slightly more stable than urban areas. About 70 per cent of rural households rely on food from their own farms or gardens, with only 28 per cent of households relying on the market. In urban areas, 95 per cent of households depend on food from the market, with less than 5 per cent relying on food from their own farms.

According to a recent FAO report, the labor force participation ratio is 55 per cent for male and 44 per cent for female. The dependency ratio is 150 per cent in urban areas and 94 per cent for the rural areas. In the urban areas, the major source of food is the market, and for the rural areas, it is the farm or gathering of edible fruits and other edible stuff. The main sources of funding for foodstuff in the urban areas are salary and wages. People in the rural areas are most likely to be engaged in subsistence agriculture to produce food for their own consumption and to raise domestic animals for the use of the household.

The main sources of funding for foodstuff in the urban areas are salary and wages. The non-payment of wages to about 57,000 public sector workers in recent times, made the food security situation very precarious. Mass displacements of people also contribute to food insecurity. For example, the displacement of the people from Northern Lofa by the war disrupted food production; and caused over 50,000 people to turn to relief assistance for their survival (FAO, 2005). Other causes include the reluctance of people to return to their original places due to insecurity, land degradation influenced by mass movement of people during displacement and the destruction of biodiversity. Box 2.3 outlines the challenges facing the attainment of food security.

Box 2.3: Major challenges for attainment of food security in Liberia

1. The absence of sustained peace and security, which impedes repatriation and resettlement,
2. Post harvest losses and poor storage facilities, especially for locally produced commodities,
3. Limited adoption of improved production technology beyond seasonal periods,
4. Strong desire to honor and preserve cultural norms that hamper effective farming activities,
5. Absence of a comprehensive policy on land acquisition (land tenure arrangements) for agricultural production,
6. Bad and impassable farm-market roads and inadequate transport and market infrastructures, and
7. Absence of a national strategy on food security.

Source: UNDP 2004b

Conclusions and Recommendations

The potential of Liberia's resources to contribute to the socio-economic well being of the people is immense. Over the years, activities of the population have negatively impacted and altered the environment. The destruction of the ecosystem, decimation of animal and plant species, along with the loss of genetic wealth has begun to deprive the population of natural sustainable livelihoods. Though a number of policy decisions have been made, including the creation of the Environmental Protection Agency (EPA) to regulate environmental sector, there is room for further legislative and institutional improvement to ensure sustainability.

The Liberian economy has a potential to grow, attract foreign direct investment, and create jobs provided the requisite development challenges are addressed. These include weak institutions of governance, human rights and the rule of law, destroyed capital and socio-

infrastructure, national security and macroeconomic reforms. These challenges are not insurmountable, but require concerted commitment on the part of the government and the international community to remedy them. The following are recommended:

1. Revive or re-open the Agriculture Cooperative Development Bank in order to re-introduce the agriculture loan scheme
2. Enhance good farming practices by empowering local farmers;
3. Review or revise, where appropriate, fiscal policies of Liberia;
4. There should be a massive public education and awareness about the need for people to change their consumption patterns and preferences so as to reduce over dependence on rice and cassava; and
5. Fully operationalize the EPA constituting the Policy Council and Board of Directors and appointing an Executive Director and Deputy.

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PART 2
ENVIRONMENTAL RESOURCES: STATE AND TRENDS

3 LAND RESOURCES AND USE

Introduction
Land resources provide a variety of functions and services that can be used in support of ecosystem processes, livelihoods and food security. Some of the activities supported by land resources include agriculture, forestry, tourism, human settlement, wildlife, mining and industrial development. It is thus a principal asset for survival and development.

However, a combination of interlinked factors is presenting a threat to the sustainability of land resources. Some of these include unregulated mining, high impact logging, inappropriate agricultural practices, unplanned human settlements and industrial expansion. In view of the opportunities that are provided by land resources, this chapter cites a need for an appropriate framework to guide sustainable land-use and development in Liberia.

Land Resources Issues
A number of issues affect the management of land resources in Liberia. These include land degradation from activities such as mining or poor agricultural practices, a lack of land-use planning and the current land tenure system.

Lack of Land-Use Planning
Land-use planning is an integrated approach to land management. It links up various sectoral land-use strategies and also considers issues such as land tenure and property rights. Some of these land-uses could include urban, industrial, commercial, agricultural and watershed protection. It aims to ensure the sustainable use of land and prescribes management practices to that end. For example on agricultural land, it would bring together multiple objectives – profit, restoration and functional. Land-use planning also employs other tools like environmental impact assessment and Geographical Information Systems to aid in decision-making.

In Liberia land-use planning and zoning regulations are virtually non-existent. Consequently, land is not classified based on productivity. The lack of a land-use planning means that land is not being used to its best advantage and this may ultimately affect its sustainability.

Land Degradation
Unregulated mining, uncontrolled forestry practices and soil erosion are some of the reasons for land degradation in Liberia. Land degradation can be defined as the reduction in the productivity of land by any biological, chemical or physical process. The intensity of degradation depends on the type and kind of land-use practices. The

Box 3.1: Impacts of mining and forestry on land

- An increase in shifting cultivation,
- Uncontrolled fuel wood collection,
- Unplanned influx of people to mining areas,
- Hunting and poaching,
- Abandoned open-cast pits left after mining,
- Pollution of water bodies and habitats by sediment and wastes from mining processes,
- Loss of valuable timber species
- Fragmentation of forests by the unregulated creation of road networks in logging areas.

Source: EPA/GEF/UNDP 2004

presence of minerals and other resources such as forests provides opportunities for development, but their unregulated use can lead to degradation. This is an area of concern for the government. Box 3.1 highlights some impacts of mining and forestry activities on land.

Soil erosion is another major cause of land degradation. Traditional agricultural practices such as shifting cultivation or slash and burn techniques result in land degradation. In the rural areas, shifting cultivation is widely practiced. It involves clearing large tracts of vegetation usually using slash and burn techniques. Seeds, tubers or cuttings are then planted using either a crude hoe or simply making holes in the ground with a digging stick. This clearing of vegetation and grass cover can lead to erosion by wind. Torrential rain also results in the removal of fertile top soil through sheet erosion, or the formation of deep gullies in the land.

Unplanned Human Settlements and Industrial Expansion

Unplanned human settlements, inadequate zoning regulations and uncontrolled industrial expansion are all contributing to land degradation. In many cases, the establishment of villages and other settlements are not coordinated. This results in the haphazard establishment of settlements with no control over how the land is used. One impact of war is that settlement camps set up for displaced people often results in land degradation. This can increase human vulnerability limiting options and exposing the people to health risks. Insecurity and displacement also renders huge tracts of land and large populations of people unproductive, affecting their livelihoods and ultimately the national economy. Other impacts could be the establishment of settlements in locations that could negatively impact mangroves, other ecosystems and biodiversity. The lack of land-use planning and ineffective zoning regulations means that industries can be set up without an environment impact assessment in places that are not appropriate.

Zoning has been used in Liberia as the means by which citizens can guide the growth of their communities. Zoning and planning are tools that can guard against the problems created by unplanned growth. A comprehensive zoning plan may be the first step towards effective planning and land-use regulations. This process has, in the past, been used by cities in Liberia. For example, a zoning act was created for Monrovia in 1957. The purpose of the Act was to regulate the location and use of buildings and structures, the nature and extent of the different land uses, and the density of population within the city. This Zoning Act could serve as a model for zoning regulations for other municipalities. The development and use of these plans in post-war Liberia presents an opportunity for planned growth that should not be squandered.

A controversial new settlement in Congo town, Monrovia, near the future home of the Ministry of Defence

Courtesy of Abdoulaye Sene

Land Tenure Issues

Land tenure is the legal, contractual and customary arrangement, whereby individuals or organizations gain access to economic and social opportunities through land. There are rules and procedures, which govern the rights and responsibilities of both individuals and groups in the use and control over basic land resources. In Liberia, the land ownership is based on land held under three systems or rights. They are:

- *Customary land tenure system:* Here land ownership is based on the oral history of family members and a council of elders. This system began with the ancestors who formulated an unwritten policy of giving joint ownership to families or tribes for farming and development of towns and villages. This system prohibited the direct sale of land as an economic resource. This system is still widely accepted in the hinterlands.
- *Anglo-American land tenure system:* This is a deed system where land is formally surveyed. There is both public and private ownership. The birth of this system marked the beginning of the record system for land ownership. All land is considered to be the property of the state, with the President as the chief custodian or trustee.
- *Land registration system*: This is a UNDP supported system introduced to prevent fraud, through a titling process. Prior to 1973, lands were deeded, but were not registered. Under this system, all lands deeded as private or public are registered in the national archives.

The confusion over land tenure dates back to the arrival of the settlers who introduced the Anglo American land tenure system, which was contrary to the customary system practiced by the indigenous people. For example, under customary law the amount of land under cultivation for agricultural purposes was small. The settlers wanted large tracts of land and so instituted a new land law. As evidence of ownership right, individuals or groups were issued a title deed. This Anglo-American system of land ownership deprived the indigenous people of much of their land.

Although land ownership was communal, the system of regulation of communal right has existed since 1822. But because land was never viewed as a saleable commodity, the idea of a title ownership was alien to the indigenous people. With the expansion of agricultural

settlement and development of the rural economy, however, conflicts over ownership and land-use increased.

This ambiguity over land tenure has contributed to a lack of land security and frequent conflict over property rights. The present land registration and administration system is outdated and this creates tenure insecurities, which ultimately restricts access to land-use for agriculture and investment purposes in the urban areas. A World Bank urban development project that sought to address this problem during the early 1980s by establishing an urban cadastral and ownership registry system was never implemented. Confusion over title and ownership rights remains and the situation has been compounded by the destruction of many legal documents during the fighting in Monrovia in 1996. Although land is being registered, records get tampered with. And landowners are now dubiously re-selling land. Land disputes are now a common occurrence. In urban areas the lack of spatial land-use development plans, particularly in relation to strategic investment development involving real estate, is also a problem.

Land-Use Systems

Land for Agriculture

Agriculture plays an important role in the country's economy. During the pre-war years about 70 per cent of the population lived in rural areas and depended on agriculture (crop and livestock production) for their livelihood. About 46 per cent of the total land area of 9.8 million hectare is available for agriculture (FAO 2005). Most agriculture is carried out on small holdings, many of which are still cultivated in the traditional ways of bush fallowing or shifting cultivation. There are also large individual and commercial plantations that use state-of-the-art technology to produce rubber, coffee, cocoa, palm kernel, and other export crops. Different farming systems characterize agriculture. These are described below.

Traditional/subsistence system: The traditional system of production is the shifting cultivation or slash and burn method. It is characterized by low productivity of land and labor, long fallow periods of 6-10 years and relatively short cultivation periods of 1 or 2 years. Upland rice and cassava are the main crops, although as many as 8-10 different other crops can be planted in a mixed cropping system.

The main environmental concern with regards to shifting cultivation is in the loss of valuable tree species. Normally, primary forest areas that contain mature tree species and secondary trees are cut and burned. This farming system reduces forest cover and contributes to tremendous heat build up on the soil surface. This results in a large quantity of soil organisms and other organic materials being destroyed as well as physical changes in the soil. Besides the loss of tree species and vegetation cover, wildlife is also affected.

Clearing for rice cultivation in southeastern Liberia using the slash and burn technique

Courtesy of Fauna and Flora International (FFI) – Liberia

Commercial plantations*:* This system is essentially the conversion of tracts of land into rubber and oil palm plantations. These plantations are owned and operated mainly by foreign multi-national corporations. State-owned enterprises are also engaged in coffee and cocoa cultivation. The land development process for rubber and oil palm plantation involves the use of heavy earth moving equipment. Natural vegetation of mixed species is cleared in favour of a monoculture. The common practice is to first clear the undergrowth, and then fell large trees and set them all ablaze after some time. This is similar to slash and burn agriculture. Box 3.2 describes some of the impacts of rubber plantations.

Pastoral Landscapes

There are fifteen or more pastoral landscapes in Liberia. They are used to raise large ruminants such as cattle and small ruminants such as goats and sheep. Permanent pastures accounted for two million hectares in terms of land-use in 1998 (FAO Report, 2001). The government of Liberia had established four major pasturelands intended to enhance and maximize livestock production. Most of these ranches are now colonized by weeds, as there are no more livestock, a condition created by the war.

Degraded land (derived savannah) after successive years of shifting cultivation

Courtesy of UNDP Energy and Environment Programme

Box 3.2: Rubber plantations in Liberia

There are eight large-scale rubber plantations in the country, owned and operated by foreign business interests. They include: Firestone Plantations Company in Harbel, Margibi county, Cavalla Rubber Corporation in Maryland county, the Cocopa Rubber Plantation, Nimba county, the African Fruit Company (now Sinoe Rubber Corporation) in Sinoe county, the B.F. Goodrich (now Gutrich Rubber Plantation) in Bomi county, the Salala Rubber Corporation, Bong county, Weala Rubber Corporation, Margibi County and the Liberian Agriculture Company in Grand Bassa county.

Development of rubber plantation poses threat to biodiversity and the environment, especially with establishment of rubber plantation involving clearing and excavation. During the process, many flora species are destroyed to make way for a monoculture. Habitats of faunal species and micro-organisms are also destroyed, therefore contributing to loss of biodiversity. There has also been outcry about the method of waste disposal from rubber processing facilities. For example, residue and other wastes from the Firestone Plantations Company is polluting the Farmington River. Another environmental problem created by the establishment of rubber plantations is the clearing of high elevation vegetation. In many instances, erosion occurs soon after clearing, leading to sedimentation and pollution of the rivers and creeks along the slopes. In plantation areas, such as Firestone and LAC that have left some of such vegetation standing, those areas have become spontaneous natural wildlife sanctuaries.

Institutional and Policy Framework for Land Management

The administration and management of land is the statutory responsibility of some Ministries and Agencies of Government. They are:

- ✓ **Ministry of Internal Affairs -** The Ministry is responsible for local government administration and Government functionaries within local and urban areas. It is the overseer of all chiefdoms and clans and has custodianship over all private and public properties within the territorial confines of the country, including all disputes arising from sale and ownership of land.
- ✓ **Ministry of Agriculture –** The Ministry is responsible for the planning, executing, administration, management and supervision of agricultural programmes, including extension programmes. It is involved with local farmers in the identification of suitable lands to encourage improved varieties of for food security.
- ✓ **Ministry of Lands, Mines and Energy –** The Ministry has the statutory responsibility for the development of minerals, water and energy resources of the country. It is the principle administrator of lands and including survey of private and public lands and issuance of deeds for all lands.
- ✓ **Forestry Development Authority-** The FDA is responsible for the sustainable management of the forest and associated resources, including forest lands. It provides medium and long term planning within the forest sector, as well as the preparation an promulgation of forest policy, law and administration. It is responsible for all forest concession agreements, monitors activities of timber companies and is in charge of protected area programmes and wildlife and national parks.

Conclusions and Recommendations

There are many competing land uses in Liberia from commercial, community and conservation interests. It is also true that there is lack of land-use planning. One way to address these competing demands is to ensure that the EPA in line with the Environment Management and Protection Law has sufficient capacity to harmonize the policies adopted in different government sectors, and to arbitrate in the disputes of land-use, using sound

technical criteria (UNEP 2004). Such a framework would ensure sustainable use of land resources through a cross-sectoral approach to land management. Other recommendations are to:

1. Conduct a land-use feasibility study in order to inform a substantive land-use planning,
2. Promulgate and enforce zoning regulations,
3. Review and revise, where appropriate, the land tenure system,
4. Constitute a land reform commission,
5. Encourage local communities to participate in physical planning,
6. Ensure that the development of commercial plantations is preceded by environmental impact assessment, and
7. Map all land parcels in order to separate public lands from private lands and to carry out a comprehensive land-use classification in order to develop a national land-use plan.

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4 WATER RESOURCES AND USE

Introduction

Water is essential for life and economic development. Although supplies of water in Liberia seem to be abundant, it is actually a scarce resource. Water is used in different ways. Each of which has different implications for the state of the environment in Liberia. For instance, in large towns and cities such as Monrovia, water bodies have been used as dumpsites for wastes. Also in many instances open toilets are built along river banks, polluting it for those living downstream.

Water bodies, including wetlands form about 12 per cent of the surface area of Liberia. Wetlands are discussed in more detail in *Chapter 5: Biodiversity resources and use*. Surface water comes from streams, rivers and lakes, requiring no infrastructure in order to have water supply. However, management and maintenance of water quality need urgent attention. The National Environmental Policy of Liberia acknowledges that supply and distribution of water are critical factors in the socio-economic development of the country. Rapid population growth, agriculture expansion, and industrialization require adequate and safe water supply. As is the situation globally, many people die from diseases that could be prevented through improved access to safe water and sanitation.

Surface Water

Liberia possesses abundant surface water supported by six main watersheds. The principal rivers that support the watersheds are Mano, Lofa, St. Paul, Cestos, Cavalla and St. John rivers. These are shown in table 4.1. There are also numerous other micro-watersheds or sub-watersheds. The country shares seven international catchments with its neighbours. The Mano and Cavalla are shared basins between Sierra Leone and Ivory Coast, respectively, while Lofa, St. Paul and St. John drain parts of Guinea.

Table 4.1: Major river basins

Basin	Area (km^2)	Annual flow (m^3/sec)
Mano	6,604	251
St. Paul	12,820	512.3
St. John	14,762	N/A
Cavalla	13,726	380
Cestos	10,000	60.3
Lofa	9,194	N/A

Source: Liberia Hydrological Services, MLME 1988

Rainfall is the principal contributor of water to surface water bodies. To a large extent, availability of rainfall has also influenced settlement patterns. Rainfall feeds surface water bodies through run-off, which in turn is governed by the combined effect of evapo-transpiration and rainfall events. In general, there are seasonal variations in the potential evapo-transpiration across the country. There are some instances of rainwater harvesting. Rain water is collected from roofs or protected ground run-off areas and stored in covered cisterns to prevent contamination.

Water resources management in Liberia is weak. Prior to the civil war, the Liberian Hydrological Service (LHS) of the Ministry of Lands, Mines and Energy, used to maintain a network of 28 hydrological stations covering eleven river basins around the country, where basic hydrological data were collected. These included special purpose small catchments stations. There were also 13 hydrometeorological stations in the network. Maintenance of these has not been re-established since the end of the crisis. Box 4.1 highlights some of the gaps in water management. Currently, the only data available for the flow of major watersheds is that acquired prior to 1990.

Box 4.1: Gaps in water management in Liberia

1. Lack of an integrated water policy,
2. Lack of a legal framework,
3. An outdated institutional framework that does not reflect present day reality,
4. Lack of management instruments such as a water monitoring system, and
5. The need to adopt the principles of integrated water resources management.

Ground Water

Groundwater is found in aquifers, which are water-bearing formations with hydraulic characteristics that allow water to be extracted in significant amounts through the use of boreholes and dug wells. Results of boreholes drilled and wells dug show the abundance of groundwater throughout the country. Recharge of the groundwater is based on the heavy tropical rainfall as well as the network of watersheds.

Water infiltrates downward until it reaches a depth where it fills all of the openings in the soil and cracks in rocks. Ground water development in Liberia dates as far back as the 1800's when individuals in rural and urban areas developed wells for domestic use. However, groundwater in Liberia though of relatively high quality, has not been fully developed. In the early 70s USAID, in conjunction with the then Ministry of Local Government, Rural Development and Urban Reconstruction (now Ministry of Internal Affairs) began the Rural Water Program. International NGOs and other organizations have since joined this effort providing rural populations with water wells.

Prior to 1990, there were 11 water supply systems developed for urban centers in Liberia. Four of these were based on groundwater sources. The destruction of most of these facilities means that today over 90 per cent of the population has to rely on groundwater for water supply.

Liberia has not had adequate hydro-geological programmes. At the height of its operation, LHS had only three hydro-geological monitoring stations in Liberia. Details of these are provided in table 4.2. Aquifers have not been adequately mapped to determine their extent and water quantity. To date no work has been done to map the number of aquifers that exist throughout the country. Studies have been undertaken on an ad-hoc basis.

Table 4.2: Hydrogeological observations and well descriptions

Well location	Diameter (m)	Depth (m)	Forestation (aquifer)
LGS well old road	1.00	6.55	Sandy, land-clay
UL Well Capital hill	0.25	75.38	Gneiss hard rock (drilled)
Sass town well	6.15	12.65	Lateritic sandy (drilled)

Source: Liberia Water and Sewer Corporation

The potential for groundwater development in the country is high as groundwater is readily available everywhere, but the implementation of a successful groundwater development

Program would be dependent on detailed investigation at the national level. One of two sedimentary basins south of Monrovia in Paynesville, which has been identified as showing promise for groundwater development, already has two drilled boreholes. This basin is now the major source of drinking water in Monrovia and its environs.

Water Supply and Demand

Urban water supply

The Liberia Water and Sewer Corporation (LWSC) is responsible by Legislative Act for the provision of water supply for urban communities. Rural water supply is the responsibility of the Ministry of Rural Development, under the Rural Water Programme. Prior to the onset of civil conflict in 1989 there were 11 cities with piped water supply. Table 4.3 shows the urban water supply system in Liberia.

In line with the Mar del Plata Action Plan, Liberia has made efforts to provide both rural and urban communities with safe drinking water. The target is to increase access to safe drinking water to 63 per cent of population nation-wide by 2015. The Mar del Plata Action Plan states that all people, whatever their stage of development and their social and economic conditions, have the right to have access to drinking water in quantities and of a quality equal to their basic needs.

Monrovia Water Supply

Greater Monrovia had the most sophisticated system with an impounding reservoir, treatment plant and distribution network. This system had a capacity of 8 million gallons per day and served a population of about 200,000. In the 1980's the facilities were expanded to a capacity of 16 million gallons per day, which served a population of about 450,000 inhabitants up to the civil crisis. Damage to the system as a result of the civil conflict brought the system to a halt in 1992 resulting in water shortages.

Table 4.3: Urban water supply system

No.	Town	County	Capacity* GD	Year of comp 1.
1	Greater Monrovia	Montserrado	16M	1885
2	Gbarnga	Bong	160,000	1978
3	Sanniquellie	Nimba	94,000	1979
4	Voinjama	Lofa	125,000	1980
5	Zwedru	Grand Gedeh	100,000	1980
6	Buchanan	Grand Bassa	200,000	1984
7	Kakata	Margibi	580,000	1985
8	Robertsport	Grand Cap Mount	90,000	1971
9	Greenville	Sinoe	85,000	1970
10	Tubmanburg	Bomi	N. A	N.A.
11	Harper	Maryland	N.A	N.A.

Source: Liberia Water and Sewer Corporation

To combat this supply problem, the LWSC operated two boreholes in 1993 in one of two sedimentary basins south of Monrovia. Water was trucked to other areas of the city and its environs, as the central system could only serve a small proportion of the city. The two boreholes now contribute about 100,000 US gallons per day to the water system. This was augmented by a system of nearly 250 shallow wells located in many parts of the city. These wells are difficult to maintain due to frequent disjoining of the shaft, water intrusion and frequent theft of hand pumps.

The Monrovia water supply which was partially restored is currently operating at about 11 per cent capacity producing less than 1.8 MGD for a population of about one million compared to the pre-war capacity of 15MGD for a far smaller population of 450,000 inhabitants. Figure 4.1 shows a map of the Monrovia water supply. Further exploitation of this coastal area for groundwater without proper monitoring might result in the inversion of the wells and boreholes with saline water when an imbalance has been created.

Water Supply to other Cities

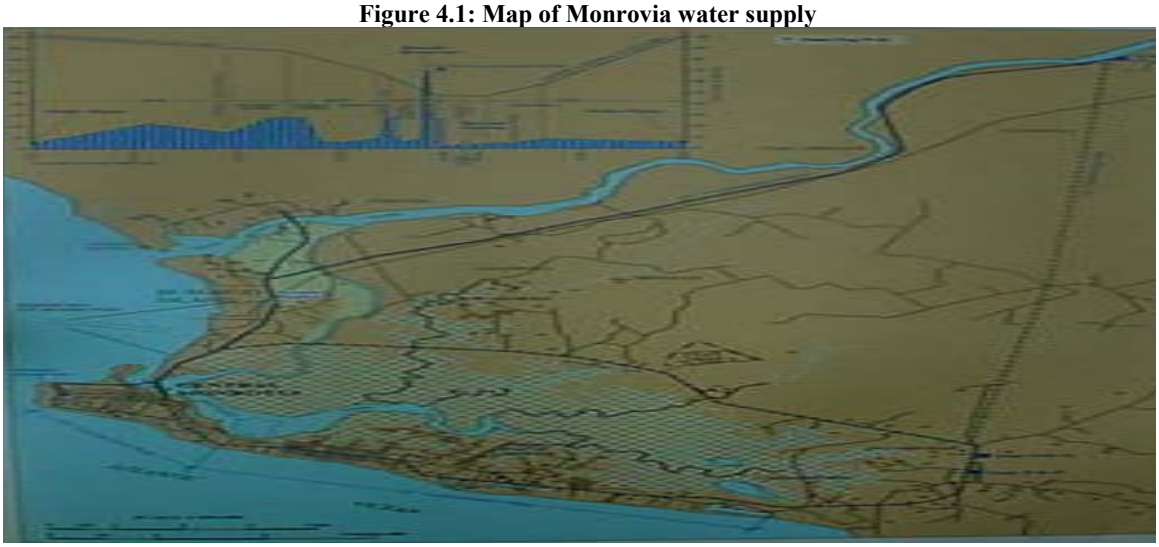
The LWSC had 10 outstations, which served the other urban communities in various counties. However, limitations in investment meant that not all the growing demand could be met. Priority was thus given to cities and towns that:

- Had potential for rapid industrial and economic development,
- Were endemic centres for water-borne diseases, and
- Were political and administrative centres.

These outstation water supply systems have not been in operation since 1990. Water supply in these areas has been made partially possible by means of wells (hand dug or drilled) with the interventions of international donor agencies and NGOs.
In addition to the ten outstations, there were other systems owned and operated by concessions. These included: 1) Yekepa in Nimba County and Buchanan both owned and operated by LAMCO, 2) Division 45 (Harbel, Firestone) owned and operated by Firestone Plantations Company, and 3) Bong mines owned and operated by Bong Mining Company. Of these only the system at Harbel is still operating. The others were damaged during the war. The water supply system throughout the country provided both private and public taps, with the latter distributed throughout residential areas.

Given the state of urban water supply, it is difficult to make any projections for the future. However, the immediate future needs would be the rehabilitation and restoration of all the facilities to full capacity throughout the country.

Figure 4.1: Map of Monrovia water supply



Source: Liberia Water and Sewer Corporation (LWSC)

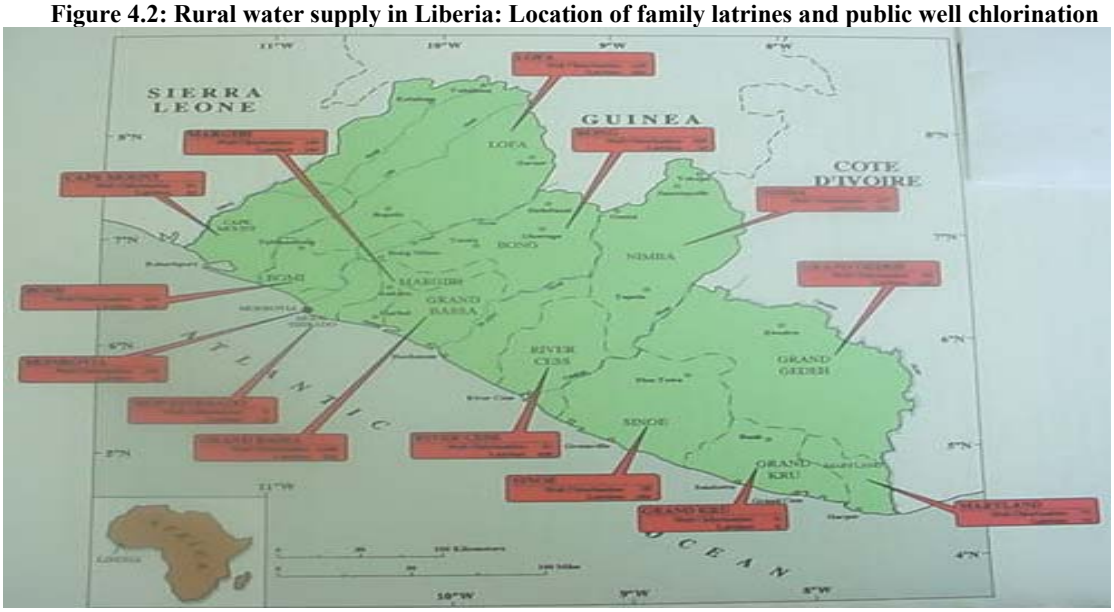
Rural Water Supply Program

Liberia had a predominant rural population, but the war has changed this. Rural livelihoods come from agricultural activities, hunting and fishing. Most of the rural settlements are situated at high altitudes with usually a river, stream or pond serving the water needs of the population. Water supply is always reliable except for the brief period during the dry season. The problem therefore is one of quality. Pollution of such sources is directly attributed to human action. Report of outbreaks of water borne diseases such as diarrhoea, cholera, and typhoid, are common. One of the impacts of this is a reduction in the productivity of the people.

There have been several implementing programmes for water supply in rural areas. In 1974, USAID was supporting a Rural Water Programme in the then Ministry of Local Government, Urban Reconstruction and Rural Development (see figure 4.2). At the same time, a similar programme was being implemented by WHO in the Ministry of Health and Social Welfare. However, with the creation of the Ministry of Action for Development and Progress in 1980 and subsequently the Ministry or Rural Development (MRD) in 1981 these programs were amalgamated into the National Rural Water Program (NRWP).

The NRWP is involved in the construction of low cost shallow hand-dug wells and also high tech-boreholes/wells fitted with hand pumps for rural communities. The NRWP has worked with several partners, including: US Peace Corps, USAID, CHAL, WHO, Plan International and UNICEF.

Figure 4.2: Rural water supply in Liberia: Location of family latrines and public well chlorination



Source: Liberia Water Sewer Corporation (LWSC)

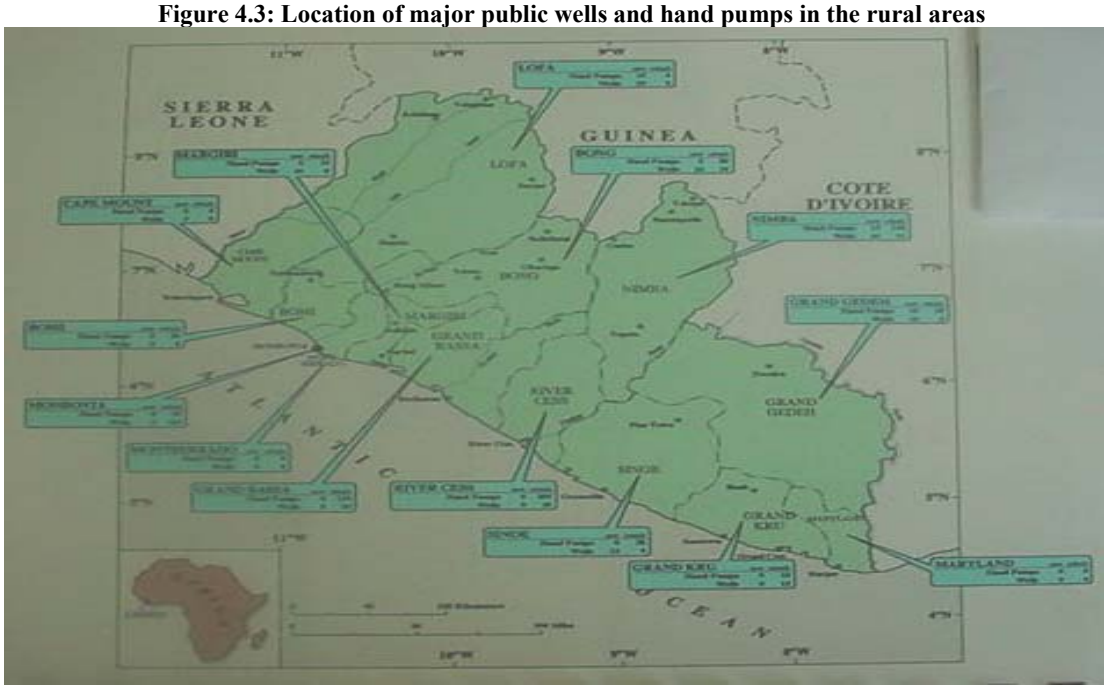
The implementation of rural water and sanitation activities has not been coordinated. One serious drawback of this is the uneven distribution of services to the rural communities. But there have been some successes. An estimated 1 700 water points were constructed and commissioned from 1974-1989. Two major drilling programs made a significant impact in the transformation of some rural communities. They were the Southeastern Village Water Supply Project (SVWSP) which constructed about 367 deep boreholes in Grand Gedeh County and about 75 shallow wells in Maryland County. Another project in the four EEC counties (Bassa, Sinoe, Grand Kru and Rivercess) provided 450 boreholes and wells. In

addition, MRD maintained a well-supported mobile drilling crew in each of the political sub-divisions. But it has to be noted that the lack of coordination in this sector could lead to overexploitation of certain areas with a high concentration of wells and boreholes. Figure 4.3 shows the location of wells and hand pumps in the rural areas.

The civil war of 1989 brought an abrupt end to any organized form of activity in the sub-sector. Equipment, tools and WATSAN facilities were looted, vandalized or abandoned. Trained personnel were displaced or became refugees. Some found employment elsewhere.

The program is still hampered by low human resources capacity, a lack of equipment, logistical support, and operational funds. However, together with development partners, the NRWP can still ensure a safe water supply to the rural areas. Indeed, a number of international organizations including NGOs' have became active in this sector. From 1991-1994, it is estimated that about 700 shallow wells were constructed for displaced people in shelters and Monrovia. The NGO partnership has proved very effective, given the continuing lack of capacity in the NRWP. UN agencies, OXFAM, SCF, CONCERN WORLDWIDE, LUSH, Action Contre la Faim (ACF), EEC and many other local NGOs continue to make immense impact on rural communities. However, government agencies, particularly the MRD/NRWP, remain an important factor in the execution of WATSAN programs.

Figure 4.3: Location of major public wells and hand pumps in the rural areas



Source: Liberia Water Sewer Corporation (LWSC)

Water for Different Uses

Access to Safe Drinking Water

Access to improved water sources (pipe borne and hand pumps) declined from 58.4 per cent of households in 1997 to 26 per cent in 1999 due to damage of water supply devices caused by war and the existence of shadow wells in Monrovia and its environs (MPEA Annual Report, 1999/2000). Wide disparities in water quality exist, with only 4 per cent of rural

households having access to safe drinking water, compared to 25 per cent of urban households.

The 1999 Liberia Demographic and Health Survey shows that 1.9 per cent of households in Liberia have access to piped water in their own dwellings, and 9.3 per cent have access to water from a public tap or a neighbouring dwelling (MHSW 1999). This makes a total of 11.2 per cent of households with access to pipe-borne drinking water. About 4.1 per cent of rural households have access to pipe-borne water; compared to about 24.9 per cent of households in urban areas. Over 82 per cent of all households depend on wells, springs, ponds and rivers for their drinking water, and about 28 per cent of these sources appear to be protected. Slightly more than 10 per cent of households in urban areas depend on water supplied by tankers as their main source of drinking water. Less than 4 per cent of households use rainwater as their major source of drinking water, in spite of the heavy and long rainy season in Liberia.

Most sources of water are very close to homes. About 56 per cent of households in both rural and urban areas take up to 10 minutes for a returned trip to their major sources of drinking water. If, however, access is defined in terms of access to the safest sources of water such as treated piped water, tube-wells and boreholes, then only about 25 per cent of the population (household) has access to safe drinking water. More than 50 per cent of the population (households) of Bomi (65.1 per cent), Grand Cape Mount (60.6 per cent) and Margibi (58.5 per cent) counties has access to safe drinking water; while Bong County (19.7 per cent) has the least access rate.

Water supply per capita for Liberia is low. A situation where majority of the people do not have access to safe drinking water, gives rise to health problems. Even before the war, water-borne diseases were a problem. This was exacerbated during the war when many water points and water systems were damaged. Notwithstanding, the GoL is currently working along with its partners to restore pipe borne water supply to Monrovia and its environs. The current ratio of water supply is estimated at 1.3 million people (Monrovia population) having access to 3.0 million gallons of water per day.

Available data indicates coverage ranging from about 5 per cent in some counties to about 30 per cent in others. In many cases, this water does not meet the world health organization (WHO) standards for drinking water. These guidelines are shown in table 4.4.

Table 4.4: WHO guidelines for drinking water

Parameter	Guideline value	Parameter	Guideline value
Color	15.00	Cadmium	0.005
Turbidity (NTU)	5.00	Chromium	0.050
p^H	6.5-8.50	Cyanide	0.050
Hardness as $CaCo_3$	500.00	Fluoride	1.500
Iron	0.30	Lead	0.050
Manganese	0.30	Mercury	0.001
Sulphate	400.00	Selenium	0.010
Total dissolved solids	1000.00	Zinc	5.000
Nitrate	10.0	Fcoli/100m1	0.000
Arsenic	0.05	T Coli/100,1	0.000

Note: All units, except pH in mg/l unless otherwise stated. WATSAN: 2001

Water for Agriculture and Industry

The demand for water for agriculture is not an issue. This is because irrigation is not a factor in increasing agricultural productivity in Liberia. The only forms of irrigation projects, which exist, are rice paddies in swamps. This form of irrigation involves the preparation of the nearby-inundated lands, which lie in the close proximity of streams or creeks, and consist of diversion channels, which can be regulated. Even though farmers are encouraged to use this form of cultivation (allows up to three crops per year), the majority continue to practice traditional upland shifting cultivation, which is dependent on seasonal rainfall.

The amount of water used by industry depends on a number of factors. The most important are the nature and volume of production, the technology involved and the specific water consumption per unit product, the mode of utilization (with or without circulating). The absence of industry utilizing much water means that water supply for industry is negligible at the moment.

Water for Energy

The intensive drainage pattern gives Liberia very high potential for hydropower development as a source of energy. A review of the hydrographic map of Liberia of scales 1:56,000 and 1:250,000 in conjunction with earlier study done by the Japan International Cooperation Agency (JICA) revealed 11 (eleven) potential sites for hydropower developments, which are presented in addition to the two which were already existing prior to the civil war. Pre-feasibility and feasibility studies have been done on only two of the eleven sites.

Those sites where feasibility studies have been carried out include Mano river site M-2 and St. Paul river basin – that which pre-feasibility study was done is the St. John River site St-2 while only preliminary and reconnaissance investigations are available for the rest of the sites. The energy potential of the various sites are given in table 4.5 below.

Table 4.5: Sites with hydro-electric generation potential

Sites	Capacity installed
Mano river	180 MW
St Paul VI	132MW
Mano river	12,000KW
St John SJ-1 SJ-2 SJ-3	10,000KW 18,000KW 39,000KW
Cestos river C-1 C-2	16,000KW 25,000KW
Lofa river L-1 L-2	10,000KW 19,000KW

Source: MLME Annual Report, 1981

Prior to the civil crisis in 1990 there were two hydropower stations with a total generating capacity of 64.8MW or 24 per cent of the total installed capacity of 304 MW in the country.

Mount Coffee Hydro-Station Project

The Mount Coffee Hydropower Plant was basically a run-off river type located on the St. Paul River about 21 miles from Monrovia. Owned and operated by the Liberia Electricity Corporation, the first phase of the project was completed in 1966 and consisted of two generating units with installed capacity of 34 MW. In 1973, two additional turbines were

added to increase the plant's output to 64 MW. The plant's dependable capacity is limited to 10 MW, which corresponds to generate at minimum flow (the normal flow) in the river during the dry season. This power station has not been operational since 1990 due to damage done to it during war.

Firestone Hydro-Electric Project
The first hydroelectric power station to be built in Liberia was constructed in 1942 at Harbel on the Farmington River to meet the demands at Robertsfield and the U.S Military Base. This station, which is still being operated by the Firestone Plantations Company, consists of four generators with a total capacity of 4.8 MW, which amounts to annual energy production of $1.6x10^3$ kWh.

Institutional Arrangements

Several agencies are involved in water resources management in Liberia. The Liberia Hydrological Services of the Ministry of Lands, Mines and Energy established in 1972 serves as the central point for data (hydrological) collection and storage including mapping, maintenance and installation of related stations. It provides technical support to other agencies in the water sector, giving advice on the design and the citing of water works (wells, infiltration gallons and spring boxes) and the availability of water for hydropower development. It also provides basic information on all aspects of water resources. The LHS carries out water supply investigations for small villages and medium to large towns and cities with a view to assessing the available surface and ground water potential and the water demand. The responsibility of this agency also extends to the analysis of the chemical quality of water.

The Liberia Water and Sewer Corporation was established by an Act of Legislature. It has a mandate to provide safe drinking water in both the urban and rural areas. However, it has only focussed its activities around urban settings. It operates mostly on commercial basis, but provides basic water requirements to the urban poor communities at no cost.
The Ministry of Rural Development is charged with the responsibility for providing water and sanitation services to the rural population of Liberia. This ministry uses boreholes, hand dug or wells and spring box development to provide water.

In addition to the above government agencies, several NGO's, international agencies are active in the water sector. They include UNESCO, WHO, EU, OXFAM, Save the Children, LIURD, MDF and ACIF.

With so many institutions working to provide water, coordination was a problem. To improve the management of the water sector, government created the National Water Resources and Sanitation Board (NWRSB) in 1980. It has 13 members. Its mandate was to coordinate, plan and supervise all water-related activities in Liberia. The LHS functioned as the secretariat of the Board. The NWRSB created an avenue through which agencies could channel their plans and in so doing avoid a fragmented approach. It also encouraged rational utilization of resources. The NWRSB operated up to the on set of the civil crisis in 1990. Coordination therefore remains a problem.

Since water is readily available throughout the country most of the year, water resource management issues are not high on the agenda of government. There is no comprehensive legal framework governing water resources and management in Liberia. The laws are

fragmented across several agencies and there are no proper enforcement mechanisms. For example, although the Health Act contains provisions for the protection of drinking water sources, the inspection of potential sources of pollution (excreta disposal units, bathing, animal water points), enforcement is weak. In addition, it does not address all management aspects of water. In 1981 the Liberian Hydrological Services with the assistance of UNDP prepared a draft water law. The law laid down a complete framework for water resources management in Liberia. This law has never enacted. However, UNEP is now funding the development of an Integrated Water Resources Management policy.

Conclusions and Recommendations

The country's reconstruction program and the even greater need for environmental management demands that attention be directed to the management of water resources. Progress in economic development and reconstruction of the society, as a whole must keep pace with water resources and its management. A review of the water sector reveals that Liberia's water resource potential is enormous, but poorly managed. There is a lot to be done. Achievements in the entire sector have been minimal over the years due to the lack of funds, technology and sufficiently trained manpower to implement and manage water resources programs. It has also not seriously considered environmental issues.

Water resources management should take a holistic approach of watershed management. Such an approach would consider the utilization of water resources, regulate the quality and quantity of water, and protect it against harmful actions. The way water is used in one place may have consequences (positive or negative) elsewhere within the same hydrological zone or basin. The National Environment Management Policy therefore recognizes water pollution as a major issue requiring action. Some recommendations by the policy are shown in box 4.2.

Box 4.2: Strategy actions for water management

- Development of a National Water Action Plan, which will establish an appropriate institutional and legal framework, standards and guidelines for different users based on ecosystem structures and functions;
- Development of programmes and projects for catchment areas aimed at soil erosion, water pollution control and siltation, in order to maintain productive soil and water environments;
- Promotion of regional cooperation in the development, management and equitable utilization of shared water resources.

Source: EPA 2002.

Other recommendations are listed below.

1. There should be a comprehensive programme in the areas of training, planning, and water resources assessment, equipment and instrumentations, water supply and sanitation, water quality, monitoring and water utilization for the various sectors of the economy like agriculture, energy, industries, tourism and recreation;
2. There should be a programme for hydro geological investigation, including mapping of aquifers to determine their extent and water quality;
3. Review and revise, where appropriate, legal instruments governing use and management of water resources;
4. Adopt an Integrated Water Resources Management Plan and make it functional
5. Revamp and maintain the 13 hydro-metrological stations;

6. Develop a national water action plan, to ensure the establishment of institutional and legal framework, standards and guidelines for different users based on ecosystem structures and functions; and
7. Promote regional cooperation in the development, management and equitable utilization of shared water resources.

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5 BIODIVERSITY RESOURCES AND LAND USE

Introduction

Biodiversity supports lives and livelihoods, by providing essential services. It is a source of harvestable goods including food, medicines and building materials. Biodiversity is also essential for the regulation of natural processes, and the earth's life support systems such as carbon sequestration, soil formation and water purification. It is also essential for pollination of commercially valuable crops and for the biological control of pests and diseases. Biodiversity is also a source of cultural, spiritual and religious enrichment and well-being.

The National Biodiversity Strategy and Action Plan recognizes the economic, ecological and socio-cultural benefits that Liberians derive from biodiversity. Biological resources represent one of Liberia's most abundant raw material resources. Biodiversity contains ecological, economic, and socio-cultural values that justify the need for conservation and sustainable use. The economic value of biodiversity is easily recognizable when you consider the goods like food and medicines that it provides. Other values such as those fulfilling a spiritual need are intangible, but no less valuable.

Liberia has a diverse plant and animal life with high species endemism. There are approximately 600 bird species, 125 mammal species, 74 reptile species and 1000 insect species. This biodiversity is under threat due to many factors such as ignorance, insufficient public education and awareness, shifting agriculture, unregulated logging, unplanned roads in logging areas, unplanned human settlements, fuelwood gathering, charcoal production, population pressure and establishment of rubber plantations.

Biodiversity of Different Ecosystems and Landscapes

Biodiversity is the range of animal and plant life in an ecosystem. In the very simplest terms, it means the diversity of life on the planet. This includes genetic diversity, species diversity, and habitat or ecosystem diversity. The range of biodiversity in Liberia includes forests, wildlife, mangroves, wetlands and swamps. It includes biodiversity in specific ecosystems such as mountains, wetlands, savannah grasslands and coastal and marine areas.

Forest and Wildlife Biodiversity

The forests of Liberia can be classified into four types as follows: a) coastal mangrove swamp, b) tropical evergreen forest, c) fringing forest, and d) transitional deciduous forest (Voorhoeve 1979). Further the forest ecosystem can be divided into four classes: a) primary dense forest, b) climax secondary forest, c) secondary forest, which has not reached climax, and d) other mixed vegetation. The Liberian forest ecosystem is a major component of the Upper Guinea Forest hotspot identified globally by Conservation International. The Mount Nimba, Cestos-Senkwen rivershed, Lofa-Mano, and Sapo National Park areas contain many endemic species. These four areas are among 14 other centres of plant endemism within the upper Guinea hotspot of West Africa.

The forests of Liberia are home to many species of fauna and flora. There are over 2000 flowering plant species, with 59 of them endemic to the country and one endemic genus. Among the plant species, there are about 240 timber species, of which 30 have been exploited. In 2002, a botanical expedition organized by the Universities of Liberia and

Wagenengen at Sapo National Park area sampled 353 higher plant species of which 78 are endemic to the Upper Guinea Forest ecosystem. Six of the species were entirely new to science. This level of undiscovered species is not common in Africa outside of the Congo basin. Considering that this discovery was made in 10 days, this number may be far higher. This indicates a need for more detailed study of Liberia's biodiversity, especially in the area of taxonomy.

The forests also contain many of the regions endangered species, including pygmy hippopotamus, forest elephant, Diana monkey, and Jentink's and zebra duikers. The consumption of bush meat is a threat to biodiversity. It is thought that Liberia's rate of bush meat consumption may be among the highest in Africa. Bush meat is sold openly in market places and along street corners. Arguably, the market will continue unless substitutes are available and affordable. There is also a need for more intensive public awareness about wildlife conservation.

The most extensive inventory of the forests was undertaken from 1960-1967. This marked the beginning of official commercial logging in Liberia. The inventory put the extractive potential of mature timber at 80 million cubic meters, and recommended a 25-year felling cycle for concession areas (Voorhoeve, 1979). The annual allowable timber cut was estimated at 3.2 million cubic meters. Forest cover has declined significantly over the years from 4.1 million hectares in 1992 to 3.48 million hectares in 2000/2001 (FFI 2001). The extent of forest cover removal does not match replacement. Up to about 480,000 acres (192,000 hectares) of forestland is lost annually due to logging, shifting cultivation and other activities. From 2001-2006, forest vegetation and small-scale rubber plantations between Monrovia and Gbarnga have been cleared for charcoal production (NBSAP, 2004).

Government has replanted less than 27,000 acres (10,927 hectares) since the inception of its reforestation programme in 1971 (FDA 2000). Currently, there are 11 national forests under partial protection. These forests are set-aside as production forests, from where concession areas are carved out. Conservation activities such as wildlife management are permitted, but no farming, hunting and human settlements (except logging camps and similar activities) are permitted in the national forests. These forests are situated mostly in the northwest and southeast of the country.

A road in a logging area in Rivercess County. The development of a logging road network has made it easier for hunters, miners and farmers to access forests. Road development is linked to forest change and fragmentation.

Courtesy of Fauna and Flora International (FFI) – Liberia

Aquaculture and Fisheries

Marine fisheries as well as inland fisheries and aquaculture are the two main components of the Liberia fishery system. There are about 159 fish species, although some reports put the figure higher at 162. Over harvesting of fish stocks is a critical issue.

Aquaculture was established in the early 1950s in Liberia. The aquaculture institutions are the Central Agricultural Research Institute, Lofa county Agriculture Development Project, Bong county Agriculture Development Project, Nimba county Agriculture Development Project and the Klay Aquaculture Fishery. These institutions were all active in constructing breeding sites and supplying local indigenous fingerlings such as *Tilapia* and *Clarias* to local fish farmers for stocking their ponds. The institutions were also involved in training fish farmers in aquaculture production. They were all destroyed during the war. Then in 2000, the Lutheran World Federation rehabilitated the Klay Aquaculture Hatchery, only to have it destroyed by renewed fighting in 2002. Aquaculture production contributed immensely in providing protein for farmers and their families. It also provided income to fish farmers from the sales of fish, thus contributing to poverty reduction.

Marine fishery accounts for most of the fish catch of the country (UNDP/EPA NBSAP REPORT, 2004). The continental shelf provides habitat for various fishes such as tuna, shrimp, lobsters and other fish with fins. It covers 70,000 sq. miles, but it is of irregular shape. Artisanal fisheries cover about 20,000 km^2 of fishing grounds. The sector accounts for a workforce of 10,000 including full time, part-time, sport fishermen and fishmongers. It generates revenue between US$10-15 million, corresponding to 12 per cent of agricultural GDP. Marine fishery provides 65 per cent of the protein needs of the country. Prior to the 1989 conflict, marine waters accounted for about 85 per cent of the annual fish consumption while the inland waters recorded 15 per cent. As seen in table 5.1, the total annual marine catch increased significantly in 1999 (Fishery statistics, MOA 2002). This was probably due to high national demand for fish coupled with an increase in the number of fishing companies. In 2002, a reduction in the total annual marine catch was recorded.

Table 5.1: Volume (metric tons) of fish produced 1995-2002

Year	*Artisanal*	Industrial	Total
1995	3 460	1 675	5 135
1996	2 036	1 104	3 140
1997	2 519	2 061	4 580
1998	3 757	3 071	6 830
1999	7 078	4 394	11 471
2000	5 331	5 003	10 334
2001	6 543	4 228	10 771
2002	4 899	5 009	9 908

Source: Statistics of the Bureau of National Fisheries, MOA 2002

The pelagic and some demersal fish species that are exploited are as follows: sardinellas (*Sardinella maderenensis* and *Sardinella aurita*), chub or Spanish mackerel (*Scomber japonicus*), bonga (*Ethmalosa fimbriata*) and anchovy (*Engraulis ecncrasicolus*). Species of the families Carangidae and Thunidae are also recorded. Other important demersal fish group exploited by marine artisanal fishers belongs to the families Sparidae, Pomadasidae, Scienidae and Serranidae.

Wetlands Biodiversity

Wetlands are transitional zones between terrestrial systems and open water systems. They may be permanent or temporary, with either static or flowing water. The water may be fresh,

brackish or may include areas of marine water, usually not exceeding a depth of six metres at low tide. Wetlands range in character from majestic swamps to shallow, unimpressive depressions, which hold water at most only a few weeks out of the year. They are characterized by the presence of hydrophytes and un-drained hydric soils. Wetlands often possess distinct trees, shrubs and grasses. The soil found under a wetland is quite different from the normal soil because it is formed under low oxygen conditions and is very heavy with clay or has large amounts of plant material (peat).

Wetlands are important for many reasons: some provide critical habitat for migratory waterfowl, while others check flooding and siltation on waterways. Some act as filters, removing and sequestering pollutants that might otherwise find their way into drinking water. Others provide recreational opportunities such as fishing and boating. Wetlands are highly productive areas rich in flora and fauna. Their economic and ecological functions attract human activities that eventually impact on biodiversity. Liberia has a few wetlands that provide both subsistence and economic benefits to its many inhabitants. Like wetlands all over the world, they have become stressed by human activities.

There are four wetland types in Liberia - inland riverine, inland swamp, coastal and coastal lacustrine. Presently, five of the eight wetlands of conservation status identified have been gazetted by the RAMSAR Secretariat (table 5.2 reflects the eight wetlands of conservation status).

In some estuaries, especially at Lake Piso and the mouths of the Lofa and St. John Rivers, there are a few sand spits. The only extensive sandy areas are situated between Lake Piso and the border with Sierra Leone. Aerial photographs put the total extent of natural sandy area with vegetation at about 2463 ha. The steepness of shoreline means that little additional sand or mudflats are revealed during low tide.

Table 5.2: Important wetlands of Liberia

S/n	Wetland	Type	Size (acres)	Conservation Status
1	Lake Piso	Coastal Lacustrine	76,091	Proposed Nature Reserve/Ramsar Site
2	Marshall	Inland Riverine	n/a	Proposed Nature Reserve/ Ramsar Site
3	Mesurado	Coastal	n/a	Ramsar Site
4	Lake Shepherd	Coastal	n/a	None
5	Bafu Bay	Coastal	n/a	None
6	Cestos-Senkwehn	Inland Riverine	n/a	Proposed Nature Reserve
7	Gbedin	Inland Swamp	n/a	Ramsar Site
8	Kpatawee	Inland Riverine	n/a	Ramsar Site

Source: EPA 2004

The Marshall wetlands at the estuary of the Farmington and Du rivers

Courtesy of FACE

Mangroves

Mangroves characterize the wetlands of Liberia and cover a small area along the coast, from Cape Mesurado to Cape Palmas, at the edges of lagoons, riverbanks, and river estuaries and in widespread areas of swamps. According to Gatter (1988), mangroves cover 0.5 per cent of the land surface of Liberia, which is equivalent to 500 km-wide belt extending along the total length of the coastline.

The mangrove is a tropical tree that grows in swampy environment. The roots are partly spread out in water where they serve as catechumen for sediments. They help to prevent sediments from being washed into the sea. Mangrove trees are found at the edge of lagoons, riverbanks and estuaries along the coast. The mangroves are strategically located between land and sea that they help to stabilize our shores and protect coastal communities from violent storms and powerful waves. They are vital coastal ecosystems providing habitat for fish, invertebrates and epiphytic plants; and are considered more efficient photo synthesizer than most plants. Essential services of mangrove forests are in box 5.1.

The most common mangrove specie is *Rhizophora racemosa.* Mature mangroves, reaching heights up to 30m are found along the lower Senkwen and some neighbouring rivers. Other mangrove species include *Rhizophora harrisonii*, *R. mangle* and *Avicennia africana* that occur together with impressive tracts of *Pandanus*. Except for a few places in the central part of the country, primary mangrove forest has been replaced by secondary ones.

Box 5.1: Essential services provided by mangrove forests

- Spawning grounds for many fish species, crabs, shrimps, mollusks and other forms of sea life;
- Habitats for many endangered species of manatees, crocodiles, turtles, migratory birds;
- Flood regulation and protection from violent storms;
- Protection of shorelines from erosion; and
- Water recharge and water quality.

The biodiversity of mangroves in Liberia is under serious threats from constant harvesting of the mangrove forest for fuel wood. This act continues owing to a lack of alternative energy source. Much of the mangrove destruction

appears to be concentrated along the edges of creeks, and particularly more widespread around the larger towns and cities, such as Monrovia, Buchanan, Greenville, and Harper.

Mangroves being cleared to reclaim land in Paynesville/Congo Town

Courtesy of UNDP Energy and Environment Programme

Swamps

Swamps serve two main purposes in rural Liberia. They are a source of herbs, and are used to augment agricultural production. They are cultivated but not to the same extent as the uplands. Swamps are important in certain societies. For instance, for the Gio and Mano tribes, swamps serve the primary purpose of augmenting upland rice production. In most cases the uplands are cultivated. According to the culture, withstanding the thorns, flies and ants is a demonstration of male masculinity. When a family has cultivated only swamp rice during a farming season, the explanation is that it was pressed for time and by other matters. A cultivated swamp is referred to as a woman's farm. As a result many swamps remain uncultivated thereby conserving their fauna and flora.

Strategy for Managing Wetlands

According to the National Environmental Policy of Liberia the importance of wetlands are not fully understood and they are therefore threatened with degradation due to pressures from firewood gatherers, pollution, unregulated settlements near wetlands, agriculture and industrial expansion.

Sections 74 and 75 of the Environment Protection and Management Law provide for the management and protection of wetlands. It stipulates a penalty of US$5,000 or imprisonment for a period not exceeding two years for violators. Some strategic actions recommended by the law include:

- Establishment of full protection status for wetlands of biodiversity significance,
- Development of wetlands policy and management plans, and
- Inventory of wetlands.

Biodiversity in Grasslands and Savannah Areas

Grasslands are characterized as lands dominated by grasses rather than large shrubs or trees. In many parts of the world, when ancient forests declined, grasslands became widespread. Following the Ice Ages, grasslands expanded in range as hotter and drier climates prevailed worldwide. There are two types of grasslands, tropical grasslands (savannahs) and temperate grasslands. Climate is the most important factor in creating a savannah. There are three types

of savannah. Savannahs resulting from climatic conditions (climatic savannahs), savannahs resulting from soil conditions (edaphic savannahs) and savannahs resulting from people clearing forestland for cultivation (derived savannah).

All three types of savannah occur in Liberia. They are classified into two - coastal and derived savannahs. Coastal savanna is a result of the combination of climate change and soil erosion in communities along the Atlantic Ocean, from Cape Mount to Cape Palmas. Coastal savannah is mostly found in southeastern Liberia, from Rivercess to Maryland counties, and more pronounced in Grand Kru County. The derived (northern) savanna is found in Lofa county, predominantly in Foya district near the border with Guinea. The expansion of the Guinea savannah is a major concern bringing with it the threat of desertification in Liberia.

Soils of the savannah are porous, with rapid drainage of water. It has only a thin layer of humus, which provides vegetation with nutrients. The predominant vegetation consists of small broad-leaved plants that grow with grasses, with deciduous trees and shrubs scattered across the open landscape.

Mountain Biodiversity

Mountains are perceived by some people as holy places. Such people believe that mountains are the bridge to the heavens or are the home of gods or spirits. Others value mountains as places of inspiration or rest. Mountains provide important ecological, economic and environmental services. They serve as water towers, areas of integrated land use, sources of energy and mineral wealth, tourist attractions, ecosystems rich in biological diversity. They are also centres of culture and traditional knowledge and indicators of climate change. For instance, some large rivers such as the St. John, Cestos, Cavalla, Lofa, Mano, and Nuhn derive their sources from mountains. The banks of the Mano, Cestos, St. John and Lofa rivers contain deposits of diamonds washed from the mountains from which they flow.

Data on mountain ecosystems in Liberia is scanty. There is no data on what area of Liberia is mountainous. They also seem not to have much tourism value. Apart from the rapid assessment of Mt. Nimba for the Mt. Nimba Tri-National Planning Meeting in January 2002, no assessment has ever been done specifically for the management of mountain ecosystems (see box 5.2 and table 5.3). The National Committee for the International Year of Mountains submitted a proposal to the FAO in 2003 for awareness and conservation of mountains in Liberia.

Box 5.2: Overview of Mt. Nimba

Mt. Nimba is part of a chain situated at the intersection of Cote d'Ivoire, Guinea and Liberia. It rises abruptly 1 000 meters above an almost flat, even surrounding glacis. The dissected topography gives rise to a variety of climatic conditions and vegetation types, from rain forest to diverse savannah-type systems and high altitude grasslands. There is great topographical diversity, with valleys, plateaus, rounded hilltops, rocky peaks, abrupt cliffs and bare granite blocks. The whole area constitutes a vast waterway that is of archaeological interest. It has high iron ore deposits. Species diversity is rich because of the variety of ecosystems created by the presence of grasslands laced forest. The mountains are surrounded by lowland rainforests and savannah. Montane forests are found at high elevations. The mountains contain high altitude savannah lands near the summits and woody plants such as *Protea angolensis* (mountain sugerbush) on the slopes. *Paranari excelsa* is the predominant species of the gallery forests that grow above 1,000 meters, along with some abundant epiphytes.

Source: IYM National Committee 2002.

The mountains of Liberia have great topographical diversity, with valleys, plateaux, rounded hilltops, rocky peaks, abrupt cliffs and bare granite blocks. Although there are communities near mountains in Liberia, there are actually no mountain people. The mountains contain some primary forests, which are located mainly on the foothills and in the valleys. More than 200 species of plants and animals can be found on the mountains of Liberia. Some of the species include *Terminalia ivorensis, Lophira alata, triplochiton scleroxylon, Chlorophora regia* and *Heritiera utilis*. *Triplochiton scleroxylon* can also be found in drier, mid-attitude areas of mountains. Also found are some important medicinal plants. These include *Parkia bicolor* (used for medicine and wood throughout West Africa) and *Pygeum africanum* (used to control urinary disorders in men). It is also a popular herbal supplement in several parts of the world for prostratic hyperplasia - an enlargement of the prostrate gland that can cause urination problems.

The chimpanzee is the most noticeable mammal found in the mountains. It lives in a variety of habitats, from humid evergreen forests to woodlands and deciduous forests to dry savannah woodlands. Also found is the Viviparous toad, the only amphibian in the world to give birth to fully developed baby toads. It is the world's only brown tail-less amphibian that is totally viviparous, and can be found in the savannah areas of Mt. Nimba.

Table 5.3: Important Mountains in Liberia

Mountain	Description/economic status	Location
Nimba	▪ Second highest in Liberia ▪ Exploited for iron ore ▪ Source of the St. John, Cestos & Cavalla rivers	Nimba county, northern Liberia
Wologisi	Unexploited	Lofa county, northern Liberia
Bong range	Exploited for iron ore	Margibi county, southern Liberia
Gibi	Unexploited	Margibi county, southern Liberia
Putu	Unexploited	Grand Gedeh county, northern Liberia
Bomi	Exploited for iron ore	Bomi county, northwestern Liberia
Wutivi	▪ Highest in Liberia ▪ Unexploited	Lofa county, Liberia
Mano	Exploited	Cape Mount county, western Liberia
Bea	Unexploited	Cape Mount county
Kpo range	Unexploited	Gbarpolu, northwestern Liberia
Wenegissi	Unexploited	Lofa county

Source: LIMINCO 2002 and EPA 2004

Coastal and Marine Biodiversity

The coastline is 350 miles long, more or less straight, with almost unbroken sand strip. About 90 per cent of the coastline consists of a narrow sand beach 20-30 meters wide, reaching 60-80 meters in some parts of eastern Liberia. It is a long stretch of beautiful beaches, which claims an Exclusive Economic Zone of 12 nautical miles and a territorial zone of 200 nautical miles (see box 5.3). The coastal zone consists of swamp related vegetation, which includes: mangrove forest and savannah related vegetation, which extends up to 25km inland. Also common in the coastal zone are palm trees, raffia palm, mango, other fruit trees and ornamental plants. Mangrove trees are harvested as firewood for local energy requirement and are also known to have tannic acid, used for the manufacture of leather.

Box 5.3: Exclusive Economic Zone (EEZ)

Under the UN Law of the Sea Convention (UNCLOS), countries with direct access to the sea have exclusive use of marine resources found along their coastline up to 200 nautical miles out to sea. This is called the Exclusive Economic Zone (EEZ). These resources are the waters, seabed, subsoil, living and non-living things. Beyond that limit, the resources fall under the worlds 'common heritage' and can be utilized by other states without permission, except where there are specific international laws demanding otherwise (such as the ban on hunting for whale for consumption). Under UNCLOS, countries are required to prevent, reduce and control pollution of the marine environment from dumping. States may adopt laws and regulations for their EEZ's that are compatible with international rules and standards to combat pollution. The law also requires approval by coastal states before dumping can take place in their territorial waters in the EEZ, and onto the continental shelf. Coastal states have a duty to make sure that activities in their EEZ do not harm the marine environment of other states. Under UNCLOS, land-locked and geographically disadvantaged States have the right to participate on an equitable basis in exploitation of an appropriate part of the surplus of the living resources of the EEZ's of coastal States of the same region or sub-region.

Source: WCED 1987; WRI 2003

Marine ecosystems play a significant ecological role, exerting influence over global processes such as the absorption of atmospheric carbon dioxide. They are home to a wide variety of species including plants, birds, mammals, fish and insects. They also provide many economic benefits by supporting industries ranging from fisheries to sustainable tourism.

Marine and coastal ecosystems are under threat. Both marine and land-based activities have impacts on them. These could come from activities such as intensive fishing, shipping, land-based pollution and development, the increasing human population and the introduction of aquatic alien species. The most serious threats to the coastline and marine environment are solid waste, beach sand mining and beach erosion.

Solid waste management: Disposal of solid waste especially the uncontrolled disposal of garbage is posing serious threat to coastline habitats. Settlements near the Mesurado River, West Point, Logan Town, Clara Town and many mangrove areas in Gardnersville and Fiama are good examples of places where waste is dumped uncontrollably. This situation also occurs in other coastal cities, but not as acute as in Monrovia.

Sand mining: Unregulated sand mining is causing slight embayment of the shoreline due to localized recession. The embayment serves as a void, which must be filled before sediments by-pass. The effect of this is that sediments in the near shore will be transported into the embayed area and there will be a retreat of bathymetric contours. For example, the Virginia beach near Hotel Africa in Monrovia is experiencing severe man-induced erosion as a result of beach sand mining. There are currently no regulatory measures in place to guard against the removal of sand from beaches.

Waste dumped on the beach in West Point, Monrovia

Courtesy of Varney Conneh of the EPA

Beach erosion: Liberia, like many coastal nations is faced with problems due to changes in the configuration of its shoreline from the action of ocean waves. Erosion is causing shoreline recession in some cities like Buchanan, Greenville, Harper and Robertsport. Incidents of beach erosion along some portions of the Monrovia coastline have resulted in the loss of land and shorefront properties. The changes in the balance of littoral transport, caused by blockage of natural sand drift from human interference, is a cause of beach erosion. For example, sand mining and dam construction at the Free port of Monrovia Breakwater, is causing the beach of the OAU village to recede. The rate has been estimated at 3m/yr (Gatter, 1988). Some of these impacts are due to a lack of environmental impact assessment, poor city planning and lack of zoning regulations.

Agricultural Biodiversity

Agricultural biodiversity refers to all components of biodiversity with relevance to food and agriculture. This includes the plants, animals and micro-organisms at genetic, species and ecosystem levels necessary to sustain key functions in the agro-ecosystem, its structures and processes. Agriculture biodiversity is characterized by domesticated plant and animal species, soil micro-organisms, pollinators, pests, wild relatives of domesticated crops and animals as well as plant and animal genetic materials including varieties, hybrids and different types of germplasm. Several distinct features of agricultural biodiversity are listed in box 5.4.

Box 5.4: Distinct features of agricultural biodiversity

- It is actively managed by farmers,
- Many components would not survive without human intervention,
- Indigenous knowledge and culture are integral parts of agricultural biodiversity management,
- Many economically important farming systems are based on alien crop species introduced from elsewhere (for example, rubber in Liberia). This creates a high degree of interdependence between countries for the genetic resources on which food systems are based,
- Diversity within crop species is as important as diversity between crop species;
- Because of the degree of human management, conservation of agriculture biodiversity in production systems is inherently linked to sustainable use –preservation through protected areas is of little relevance,
- In industrial-type agricultural systems, much crop diversity is now held ex-situ in gene banks or breeder's materials rather than on-farm.

The agro-ecosystem of Liberia is characterized by four major zones: coastal plains, hilly zone, mountain and plateau zone, and northern highland zone. Thirty percent of the land area is arable while 2.5 per cent is pastureland. Most of the upland soils are lateritic, acidic, infertile, and low in humus. The swamp soils are comparatively better in nutrients and humus but are waterlogged from May to October.

Traditional farming with its low technologies dominates the agriculture sector. Shifting cultivation and livestock production remain the norm. As a result, the use of chemical inputs such as fertilizers is not widespread. Pastureland estimated at 182,000 ha is largely unexploited because livestock production is still in its infancy. Most livestock and livestock products are imported.

The country's main staples are rice and cassava. Two species of rice are grown - an Asian rice species (*Oryza sativa*) and an African species (*O. glaberrima*). *O. glaberrima* has become rare. Other species of rice include 22 aquatic varieties (19 exotic and 3 indigenous) and 32 terrestrial (25 exotic and 7 indigenous) are available. Nearly all the exotic varieties were brought from the West African Rice Development Association (WARDA). About 90 per cent of the locally produced rice is grown upland. Other crops of economic importance are rubber (*Hevea brasiliensis*), cocal (*Theobroma cacao*), coffee, maize (*Zea mays*), yam (*Dioscorea* sp), cassava (*Manihot utihissima*), ground nuts (*Arachis hypogeae*) cow peas (*Vigna unguiculata*), cabbange (*Brassica oleracea*), oil palm (*Elaeis guineensis*), coconut (*Cocos nucifera*), papaya (*Carica papaya*), banana (*Musa sapientum*) avocado/butter pearl (*Persea americana*), sweet orange (*Citrus sinens*is), and mango/plum (*Mangifera indica)* (NBSAP, 2004).

It is estimated that less than 10 percent of the 4.6 million hectares of arable land is cultivated (FAO 2003). In order to expand the area under cultivation, it is proposed to promote swamp cultivation. While it is generally accepted that swamp cultivation is more productive than dry land cultivation, the conversion of swamps into agricultural areas could have environmental consequences including habitat loss. The urgent need to increase food production and self-sufficiency will have to be balanced against the potential impacts of converting areas to swamp production.

Alien Invasive Species (AIS)

Alien species are those that have crossed natural barriers and entered ecosystems where they have not existed previously in recorded history. They can include plants, animals, fungi, bacteria, algae or viruses. Such species are also often referred to as foreign, exotic introduced, non-indigenous or non-native. There are several recognized pathways by which AIS can reach new areas. These are through deliberate or accidental actions of humans. However range expansion is sometimes assisted by breaches in natural barriers such as canal building between watersheds or by phenomena such as climate change. Some organisms take advantage of the various means of transport used for global trade.

A small percentage of AIS adapt well to the new local conditions and reproduce so successfully that they become invasive. Because they are often free from predators or other natural limitations to their growth, they are able to dominate plant and animal communities either by out competing native species for space, light or nutrients, or through predation. The intentional introduction of species for the perceived short-term benefits to humankind can result in unforeseen long-term ecological and economic costs. The negative impacts of established alien species are hard to reverse, and attempts to control or minimize these impacts can be extremely expensive. Resources allocated to repairing or mitigating the damages is then lost to other uses. The costs of ignoring the problem may be even greater.

AIS can contribute to human vulnerability and may negatively impact on certain livelihood and development options. AIS are the second biggest threat to biodiversity after habitat loss. AIS are also made worse by other pressures such as habitat degradation, climate change, urban spread, and the impact of globalization on natural resources and biodiversity. Their influence can be felt on economic sectors such as agriculture, forestry, fisheries, tourism, water management and hydropower production and other water-based recreational activities, and could manifest through lost agricultural production and trade opportunities, spoiled crops, human disease and allergies, clogged catchments, reduced availability of water, threatened rural livelihoods, disrupted ecosystem services, and species extinctions. The impacts of AIS can be placed into three broad categories:

- *Ecological impacts*: Displacement of native species through competition for food and other resources, through predation, alteration of habitat and food webs.
- *Genetic impacts*: Dilution and potential loss of locally adapted gene pools caused by the introduction of non-locally adapted strains of the same species, or closely related species that are able to hybridize. This also includes indirect genetic effects brought about by ecological impacts, such as reduction in the size of gene pools from competition and predation.
- *Pathological impacts*: Infection of native animal and plant species by a variety of parasitical organism, such as bacteria, viruses, and fungi.

The Global Invasive Species Programme (GISP) has been designated by the Convention on Biological Diversity (CBD) as the lead institution to facilitate stakeholder consultations towards the implementation of Target 10 of the Global Strategy for Plant Conservation. Target 10 calls for the development of management plans for AIS. Meeting Target 10 by the year 2010 will require the sharing of experiences, expertise and resources in support of effective management plans. No measures have been instituted for the achievement of Target 10. For instance, there have been no stakeholder consultations and the country has not designated a focal point for AIS

There are many floral and faunal species that have invaded Liberia over the decades, but four main plants AIS are identified. These are *Chromoleana odorata, Acacia species, Eichornia crassipes*, and *Lucaena leucocephala*. The ecological impact of *Lucaena* is not yet as serious as the first three because Lucaena is still limited to the localities where it was originally introduced, but it colonises very rapidly. Acacia species introduced by the FDA in Zarwea, Grand Cape Mount County is rapidly spreading over the original forest and it requires quick attention lest the entire region is Acacia forest.

Chromoleana Odorata

Chromoleana odorata, a herb, is a typical pioneer species of secondary forest succession with a strong heliophilic character and vigorous vegetative development. Initially it spreads through seed dispersion, but after establishment it may also reproduce vegetatively from lateral branches. Regrowth occurs after slash and burn cultivation. It was introduced to West Africa around 1937 through contaminated seed lots of *Gmelina arbhorea*, a tree species imported into Nigeria from Sri Lanka for reforestation purposes. The first observation of *C. odorata* was made in early 1940s in Enugu, central Nigeria. The primary mechanism by which *C. odorata* spreads is through human activities. Such activities include road construction and maintenance of dirt or unpaved roads and railways, which are of major importance in Côte d'Ivoire, Liberia, Congo and the Democratic Republic of Congo.

C. odorata habitat and breeding spaces for harmful insects such as the variegated grasshopper, *Zonocerus variegates*, which then attacks cassava fields causing substantial yield losses. Due to abundant vegetative development, *C. odorata* out-competes yount trees leading to poor crop establishment. During the dry season, it constitutes a fire hazard. Roadsides and open places around human settlements are often overgrown by dense bush of *C. odorata,* making it a nuisance to settlement and traffic.

***Chromolaena odorata* in the field**

Source: NBSAP Report

The Water Hyacinth (Eichornia crassipes)

One of the most globally well-known water weeds is the Water Hyacinth. It occurs in the coastal areas of Liberia. The Water hyacinth is an exotic, free-floating aquatic plant with shiny, dark green, upper parts and a brilliant blue-purple flower with yellow markings. *E. crassipes* can form small colonies, "floating islands" or extensive mats that can cover thousands of hectares of previously open water. When invasive, water hyacinth forms a complete covering of the water surface that excludes most light and air for submerged

organisms thus depriving them of essentials for survival. A significant reduction of general aquatic biodiversity and a change of fisheries results from invasion. The mats can also have serious mechanical impacts on water supply systems, drainage canals, inflows to hydropower generators, and movement of shipping and river flows. The hyacinth increases evapo-transpiration leading to significant water loss from reservoirs and other water bodies. The crowding of plants at the edges of water bodies prevents access to the water for collecting water or fishing.

No inventory has as yet been done on AIS in Liberia. There is urgent need for research in this area. Techniques need to be developed to control the spread of these species. The Ministry of Agriculture which is supposed to regulate and quarantine the entry of alien species, has no capacity to do so.

The Management of Biodiversity in Liberia

Protected Areas

The CBD emphasizes the importance of the establishment and management of protected areas, and noted that this should be integrated in national forest and land-use plans. Protected areas are a vital contribution to the conservation of the world's natural and cultural resources. Their values range from the protection of natural habitats and associated flora and fauna, to the maintenance of environmental stability of surrounding regions. They can provide opportunities for rural development and rational use of marginal lands, income generation and creating jobs, research and monitoring, conservation education, and recreation and tourism. A comprehensive system of protected areas includes the designation, establishment and management of protected areas in landscape and seascape, in coastal and marine areas beyond national jurisdiction, subject to national legislation.

Liberia's protected area network has been based on terrestrial ecosystems. There are no marine protected areas. The country has two categories of protected areas - fully protected and partially protected areas. There are 11 partially protected national forest reserves. Here timber concession can be leased out, but activities such as hunting, farming, fishing and human settlements are prohibited. Most of the partially protected areas are located in northwest and southeast Liberia. Recently one of these forest reserves – the East Nimba Forest - was upgraded to a fully protected area. The current existing partially protected areas cover about 5.8 per cent of the area of Liberia (FFI- Forest Reassessment Report, 2005).

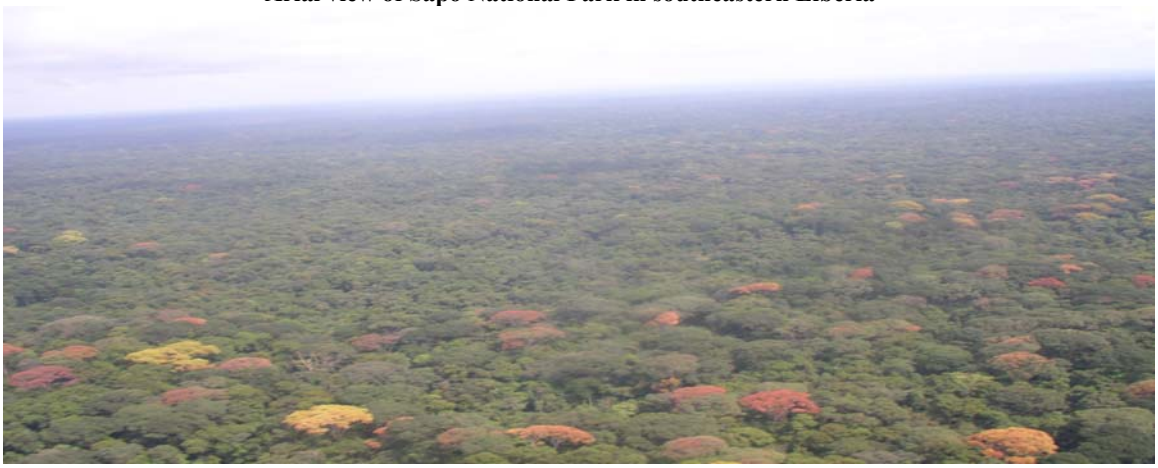
In 2003, the Government of Liberia approved a legislative Act for the establishment of a protected areas network, thus amending chapters 1 and 9 of the New National Forestry Law of 2000, Part II, title 23 of the Liberian Code of Law Revised. Nine new sections were added. Two separate Acts were passed in that year for the expansion of Sapo National Park and the creation of the East Nimba Nature Reserve. With the passage of these Acts, Liberia now has 2 fully protected areas – Sapo National Park and East Nimba Nature Reserve.

Sapo National Park is located in southeastern Liberia, between the Sinoe River to the south and the Putu Range to the north in the heart of the only remaining evergreen block of forest in the Upper Guinea Forest ecosystem. It was declared a national park in 1983 and covers an area of 445 667 (180 358) acres. It is a lowland forest.

Mount Nimba Nature Reserve is located in northern Liberia, within the Sanokole quadrangle sharing a massif with Guinea and Cote d'Ivoire. It covers an area of 28,969 acres (11,723 ha).

Due to the mountainous effect, the area has milder temperature during most of the year than Sapo National Park. The hills and mountain ranges are favorite migration wintering sites for migratory birds such as the European pied flycatcher, *Ficedula hypoleuca*, spotted flycatcher, and Garden warbler. There is an ecological boundary at about 850 meters from where a dense layer of clouds usually covers the slopes and ridges except during the dry months, November to March.

Arial view of Sapo National Park in southeastern Liberia



Courtesy of Fauna and Flora International (FFI) – Liberia

The two fully protected areas cover a total area of 446,636 acres (192,081ha) or 1.86 per cent of the land area of the country (FFI, 2003). Considering that partially protected areas are under severe threat due to excessive past logging pressure, Liberia's drive for protected area network to cover 10 per cent of the area should be intensified. There are opportunities for achieving this, but it would require political will and commitment. There has been political support for biodiversity management beginning with an IUCN survey of 1977-78, which recommended the gazettement of some protected areas. In 2002, the government committed itself to designating protected areas covering 30 per cent of the forest area, about 3.7 million acres. The declaration of Sapo National Park and Nimba Nature Reserve are a result of that survey and its associated recommendations. A further five areas are proposed for protection with an aggregate area of 1,319,800 acres (5.5 per cent of the land area). Table 5.4 shows the proposed protected areas.

Table 5.4: Proposed protected areas

Name	Proposed designation	Estimated (Ha/acres)	coverage	Estimated additional area (Ha/acres)	
Lake Piso	Nature reserve	30,766	76,025		
Cestos Senkwen	National park	91,698	226,595		
Wologezi	National park	80,001	197,690		
Grebo	National park	-	-	260,000	643,000
Wenegizi	National park	71,422	176,491		

Source: FDA

Indigenous Conservation Institutions and Practices

There are a number of traditional approaches for conservation and use of biodiversity in Liberia. These include secret societies, traditional healers and hunters, traditional norms and taboos, sacred groves, and rotational farming.

Secret Societies

One of the many institutions for conserving the environment in rural Liberia is the powerful Mande society called Poro. This is an all-male institution that imparts knowledge about the culture, traditions and customs of the society. The Poro is both a political and religious organization as well as a no-appeal court system for the tribe. Some of the Poro initiates are taught the sacredness of the environment and the need for conservation. As a political institution the Poro oversees the observance of taboos on sacred groves and water bodies. In addition, they can place a ban on hunting during certain times of the year to allow for reproduction of the species to go uninterrupted. Compliance with these provisions contributes to the conservation of plants and animals, including fishes.

Another traditional institution is the Sande, a Mande all-female institution. The society gives instruction to young women in the customs and traditions of the community, the role of women in society and their rights, duties and responsibilities. The Sande's contribution to conservation, as in the case of the Poro, begins during the period of initiation when initiates are imparted knowledge on flora, fauna and aquatic life. Prudent use of environmental resources forms a part of the curriculum in the Sande. At the end of the initiation period, a number of graduates go on to become herbalists and traditional healers.

The Poro and Sande Societies operate in absolute secrecy. They achieve their goals of protecting the environment when tribal societies exercise sovereignty and independence. However, times are changing and these societies are not as effective as they used to be. Many of their activities are now exercised by the Liberian state. Questions have arisen regarding the level of IKS disseminated by the Poro and Sande. Against this background civil society and the state should collaborate to strengthen the use of indigenous knowledge systems.

Norms

Norms are components of the indigenous knowledge system. The binding nature of tribal norms, as seen in Liberia, is universally accepted in traditional societies. Indigenous names are a sign of the community from which an individual comes. Decision-making and implementation are guided by norms. The perception of community in traditional society explains the binding force and legitimacy of norms. The sustainability of the community and conservation of the environment depends therefore on the legitimacy, which its members accord the norms of the society. The adherence of a community to its norms is normal and positively impacts environmental management.

Taboos

Taboos are useful in ensuring that certain faunal and floral species are conserved. In most cases these taboos are purposely made to protect specific habitats or species within a habitat. There are basically three types of taboos in Liberia. Those observed by individuals within the tribe as a condition resulting from intermarriage; those sanctioned by the community; and those observed by members of extended families and clans. Some taboos prohibit particular clans from eating certain fauna and flora. A clan taboo is observed by all of its members. Other taboos prohibit hunting in places regarded as abodes of ancestors and or evil spirits. Another kind of taboo prohibits fishing in certain bodies of water in which the fish are considered humans in fish form waiting to be conceived by barren women. Taboos are enforced by institutions such as the Poro and Sande societies, as well as by heads of extended families or clans.

Traditional Healers
Traditional healers help in conserving biodiversity. The trees and other plants are known by the community through its elders and if need be by the Poro and Sande. In this way flora species are conserved. The healers harvest in a sustainable manner only taking the required parts of a tree or shrub. They do not kill the whole plant. Previously when medicines were not for commercial consumption, depletion of these species was not an issue, but now propagation methods might be necessary. Among the Mande speakers, particularly the Poro, traditional healers are organized into guilds. Their advice and recommendations have led to restrictions on the felling of certain trees during the period of cultivation or without sufficient cause. The CBD recognizes the role of traditional knowledge in the conservation of biological diversity. The Working Group on Traditional Knowledge is calling on all contracting parties to organize traditional healers association. Liberia is set to respond to this call.

Traditional Hunters
Due to their vast knowledge of fauna, traditional hunters contribute substantially to wildlife conservation. Based on the life cycle of the animals, they know when to hunt and when not to hunt. For example on detecting a decrease in faunal populations they take a decision not to hunt and this is enforced by the community under the leadership of Poro and Sande societies. They hunt in a sustainable way only taking what they need to eat.

Rotational Farming
Also referred to as shifting cultivation, rotational farming is one of the few and most effective methods of conserving flora in the rural setting. The farmer abandons the area cultivated and leaves the land to fallow for at least five years. At the end of this period the soil is rich enough for cultivation.

Additional flora that were felled or cut during the previous period would have grown enough for use as firewood, timber and herbs, as long as the farmer returned to the same plots therefore the system remained sustainable.

Sacred Groves
The establishment of sacred groves has contributed immensely to conservation in Liberia. Perceived as abodes of ancestral and evil spirits, cutting of trees or hunting is prohibited in sacred groves. In this way they have become natural breeding ground for fauna and are gene banks for future generations. The sacred groves are basically a form of in-situ conservation.

Biotechnology and Biosafety

Introduction
The CBD defines biotechnology as any technological application that uses biological systems, living organisms, or derivatives to make or modify products or processes for specific use. The FAO acknowledges that interpreted in a narrow sense, biotechnology refers to a range of molecular technologies such as gene manipulation and gene transfer, DNA typing and cloning of plants and animals (CBD Text, 2000).

Currently, Liberia is one of the most food insecure countries in the world, with more than one-third of its population undernourished (UNEP Desk Study on Liberia, 2004). Domestic production of the country's staple foods, rice and cassava, still relies on a traditionally low input/low output, shifting cultivation, mixed crop system, which is inadequate to cater for

self-sufficiency in food production. The use of genetic engineering techniques in agriculture and food production is seen as an exciting and valuable development in light of the improvements in yields and nutritional value that they offer. Others object citing environmental, food safety, and ethical concerns. In light of food security issues and the requirement for long-term agricultural growth it is likely that the role of modern biotechnology in the economic transformation and sustainable development of Liberia, as elsewhere, will be the subject of intense debate.

Genetically Modified Organisms (GMOs)

Transferring genetic material from one organism to another creates a genetically modified organism (GMO). This process is called genetic engineering or modern biotechnology. Genetic engineering is least developed in Liberia. Public perception on GMOs is somewhat negative in Liberia, predicated upon the commonly conservative and traditional norms and customs of the society. This perception is expected to change in time with increased understanding of a wide range of social, ethical, environmental, trade and economic issues associated with the development and application of modern biotechnology.

Living Modified Organisms (LMOs)

Living Modified Organisms (LMOs) are GMOs that have not been processed, and that could live if introduced into the environment, such as seeds, fresh fruits or vegetables. The Biosafety protocol of the CBD lays down rules for international trade in LMOs. The results of a national survey on existing national legislation of Liberia, relevant to biosafety revealed that there are no laws in the regulatory regime and administrative system governing the following issues regarding LMOs:

- LMOs for direct use as food, feed, or for processing,
- Pharmaceuticals obtained from modern biotechnology,
- LMOs for deliberate release into the environment,
- Transit and contained use,
- Transboundary movement, and
- Notification and processing of application.

Status of Biotechnology in Liberia

Biotechnology is an emerging enterprise in Liberia whose progress was impacted by the civil conflict. As a result, information on the status of biotechnology is scanty. Apart from an inventory conducted at the early stages of the National Biosafety Framework Project in 2003-2004, no surveys have been undertaken to solicit public opinions about biotechnology or biosafety in Liberia (National Biosafety Framework of Liberia, 2004).

Before the war, research institutions that were involved with modern biotechnology research in the country include the Central Agriculture Research Institute (CARI), located in Suakoko, Bong county and Liberia Institute for Biological Research (LIBR) in Marshall, Margibi county. Biotechnology was being applied in the areas of agriculture (GMOs) and medicine (LMOs – vaccines), with the major thrusts being crop and human health improvement, respectively. For example, from the early 1980s, CARI was actively involved in the Liberia Smallholder Rice Seed Development Project (063 LI). The principal objective of the project was to institute a national rice seed improvement programme, and, through the provision of improved seed varieties, to increase the rice production efficiency of smallholder farmers. Self-sufficiency in rice has long been a major policy goal of the government.

At full development (year 7) the project was expected to reach 91,400 farmers, and the total area under the new varieties was expected to level off at 83,900 ha (209,750 acres), from project year nine onwards. The use of the improved varieties was expected to result in an incremental rice production of 343 tonnes in year 3 of the project, rising to 4,000 tonnes in year 5, and levelling off at 16,800 tonnes from year 10 onwards. Farm income was expected to increase from US$238-316 per year in the case of upland farmers and from US$102-165 per year in the case of swamp or lowland farmers. The project design rested on a number of key assumptions:

- that the Central Agricultural Research Institute (CARI) would provide breeder seed of high quality, and in the requisite quantity, and that the project would stimulate further rice breeding and testing activities at CARI,
- that CARI was committed to a programme of continually seeking better upland and swamp rice varieties through biotechnological means, and
- that the staff of the Ministry of Agriculture assigned to the project would not only be instrumental in promoting the use of project seeds, but that they would also ensure an equitable exchange of paddy for seeds, and would further help farmers improve their level of agricultural husbandry.

The project demonstrated the ability to produce adequate quantities of good quality seed rice. The RSPU was becoming the nucleus of a future seed industry. However, it would have probably taken another five years of development for the unit to even approach a state of self-sustainability. There were also logistical and operational issues. These efforts were shattered by the war.

Biosafety

Biosafety is a collective term used in reference to policy frameworks and actions for assessment and management of the safe application of modern biotechnology. Despite its potential, modern biotechnology brings with it a wide range of biosafety concerns. These concerns and the opportunities demand the development of policy, technical and legal instruments, to ensure the safe use of this technology in order to avert or minimize any possible harm to human health and the environment. This is of vital importance for the maintenance of biodiversity.

The Convention on Biological Diversity and the Biosafety Protocol

Liberia is a signatory to the CBD having ratified it on 8th November 2000, while the Cartagena Protocol was acceded to on 15th February 2002.

The CBD, one of the main outcomes of the 1992 Rio Earth Summit, aims to ensure the conservation of biodiversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. The CBD relies heavily on action at the national level and under other related treaties to achieve its objectives. The Convention is the first international agreement to view biological diversity as a resource like minerals or other natural resources over which nation states have sovereign rights.

The CBD calls on Parties to regulate, manage or control the risks associated with the use and release of LMOs resulting from modern biotechnology, which are likely to have adverse environmental impacts that could affect the conservation and sustainable use of biodiversity, taking into account the risks to human health. This obliges countries to institute a national regulatory system for risks arising from the use or release of such modified organisms. The obligation to regulate the transfer of such organisms between countries is addressed in Article

19(3) of the Convention, which says that Parties shall consider the need for and modalities of a protocol on biosafety, setting out appropriate procedures, including advanced informed agreement (AIA), in the field of the safe transfer, handling and use of any living modified organism resulting from biotechnology that may have adverse effect on the conservation and sustainable use of biological diversity.

The 2000 Conference of the Parties to the CBD adopted a supplementary agreement to the Convention known as the Cartagena Protocol on Biosafety. The Biosafety Protocol seeks to protect the environment from the potential risks of GMOs. It became law on 11 September 2003. The Protocol is the first international agreement, which clearly shows that GMOs are different from conventional organisms, and therefore require different treatment. It stands in contradiction to policies held by some countries, such as the U.S., which maintain that GMOs are not different from the conventional plants and animals from which they are derived.

The Biosafety Protocol makes reference to the precautionary approach contained in Principle 15 of the Rio Declaration on Environment and Development. It also establishes a Biosafety clearinghouse to facilitate the exchange of information and experiences (scientific, technical, environmental and legal) on LMOs and to assist countries in the implementation of the Protocol. For instance, any Party that approves for domestic use and marketing LMOs intended for direct use as food, feed or processing that may be exported will be required to communicate this decision and details about the LMO to the world community via the biosafety clearinghouse.

Effective implementation of the protocol is linked to the development of national biosafety systems. Hence, the UNEP-GEF global project on the development of national biosafety frameworks is one of such efforts. Therefore, in fulfillment of its obligations under the CBD and the Cartagena Protocol, the Government of Liberia has pledged to honor the precautionary principle in recognition of the need for environmentally safe management of biotechnology (National Biosafety Framework of Liberia, 2004).

Status of the National Biosafety Framework

A national biosafety framework is a system of legal, technical and administrative mechanisms put in place to address safety in the field of modern biotechnology. In compliance with the requirements of the Biosafety protocol, the final draft of the National Biosafety Framework for Liberia was completed in November 2004, and is awaiting adoption. The framework will ensure the implementation of actions for assessment and management of the safe application of modern biotechnology in Liberia. In the meantime, Liberia does not have any guiding principles for biotechnology and biosafety. The country also lacks the necessary technical capacity for risk assessment. Where this expertise exists, it is confined to isolated agencies some of which may not be involved in biotechnology research and development. It will be necessary to identify methods of bringing those with administrative responsibility into contact with those who have the expertise needed to assess risk and where appropriate, devise methods to minimizing risk to the environment and to human health.

The National Biosafety Framework hinges on the Environmental Policy of Liberia, which prioritizes capacity building in biosafety, conservation of biodiversity, safety of human health and the environment, development of a biosafety regulatory regime, information sharing at various levels ,public awareness and participation, and the preservation of cultural heritage. It also provides for establishment of legal and regulatory regimes to ensure the safe use of

biotechnology, and further proposes the setting up of institutional structure and mechanism for proper co-ordination. The institutional structure will consist of a competent national authority that will have oversight responsibility on biosafety matters, a national focal point, a national biosafety committee and a technical advisory committee.

Institutions for Biotechnology and Biosafety

There are a number of line ministries and agencies of government, non-governmental organizations and the private sector whose activities are relevant to the issue of biosafety or biotechnology in Liberia. The institutions listed below have statutory mandates in relation to specific categories of GMOs and LMOs in accordance with the National Biosafety Framework for Liberia:

1. *The Ministry of Agriculture, the Central Agriculture Research Institute (CARI), the University of Liberia and Cuttington University College*: These entities liaise with the Technical Advisory Committee of the National Biosafety Committee to carry out risk assessment or audit on GM plants and animals that are placed under both confined and unconfined conditions.
2. *Ministry of Commerce and Industry (MCI)*: The MCI is to ensure proper labeling, packaging and distribution of GM food products indicating their nature as genetically modified food.
3. *Ministry of Health and Social Welfare (MHSW) and Liberia Institute for Biological Research (LIBR)*: The MHSW and LIBR shall collaborate with the Technical Advisory Committee to perform risk assessment or audit for food safety. They shall also conduct risk assessment or audit on health related products obtained through biotechnology method. Examples of these may include clinical diagnostic products, recombinant therapeutic proteins and gene-therapy agents.
4. *Environmental Protection Agency and Forestry Development Authority*: The both shall work in conjunction with Technical Advisory Committee.
5. *Customs Division at the Ministry of Finance*: In order to ensure effective import/export procedures for GMO (including AIA procedure), the Customs Division at the Ministry of Finance shall work in close collaboration with the Environmental Protection Agency and the Ministry of Commerce.

Conclusions and Recommendations

Liberia's accession to the Cartagena Protocol on Biosafety should have significant impacts on food policy and poverty reduction in the country. The true test of this international agreement will be how effectively policy makers will use the country's membership in this regulatory regime to harness the opportunities of the technological revolution. After all, one of the applications of biotechnology is to improve on already existing food and agricultural technologies to produce higher yields. For example, Liberia's traditional fermentation and cross breeding programs, could make the country competitive and help secure a respectable share of the genetic food and agricultural products market.

Hunger and poverty reduction must be addressed by integrating modern agriculture with the traditional production system. New varieties should be introduced to expand Liberia's food and agricultural products base as a means of foreign earnings. The promotion of biotechnology should also incorporate educational programs to inform farmers about the seriousness of land fragmentation to food production programs.

Other pertinent measures for the growth and development of modern biotechnology and

biosafety are contained in the following recommendations:

1. The draft National Biosafety Framework for Liberia 2004 should be reviewed and adopted,
2. There should be public participation in decisions regarding LMOs. The public should be informed of the results of any such decisions and the means of accessing the biosafety clearing house,
3. There should be capacity building as the knowledge base and infrastructure of this sector is weak,
4. Government should gazette the proposed protected areas, in order to attain the 10 per cent land area for protection,
5. Border personnel should be trained and empowered to detect GMOs and AIS, and
6. Institutional reform must be initiated in the agricultural sector, including formulation of an agriculture policy and appropriate regulations. This should be done with the participation of all stakeholders.

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PART 3
THE HUMAN ENVIRONMENT

6 POPULATION AND SOCIAL DEVELOPMENT

Basic Population Indicators

With an average annual growth rate of 3 per cent, the population of Liberia grew from 1.55 million in 1974 to 2.7 million in 2002 and 2.9 million in 2004. In 2002, the fertility rate was 6.7 per cent (MPEA 1983). Population density has almost doubled increasing from 41-71 p/sq.mile in 1974 and 2002, respectively (MPEA 1983). Despite these increases, the population remains lower than those of neighbouring states on the West African Coast.

According to the 1974 census, 29.1 per cent of the population lived in urban areas and 70.9 per cent were rural dwellers. By 1981, the number of people living in urban areas had increased to 37.1 per cent (Planning and Development Atlas, 1983).

The population of Liberia is young. In 1984, it was estimated that 44 per cent of the population was younger than 15 years of age. Although the female population is larger than the male one, there are more literate males than females. Box 6.1 presents a summary of the key socio-economic indicators.

Box 6.1: Summary of key socio-economic indicators

Population size	2.9million
Life expectancy	47.7 years
Adult literacy rate	37.7%
HIV/AIDs prevalence	10-12%
Population on less than US$1/day	76.2%
Human development index	0.276

Source: UNDP 2004.

Sanitation and Waste Management

Less than 2 per cent of the population have access to pipe-borne water in homes. About 11 per cent of the population has access to potable piped drinking water. Over 82 per cent of the population depends on wells, spring ponds, or rivers for drinking water. With respect to sanitation, only about 11 per cent of households have access to flush toilets and 25 per cent have access to latrines. The majority of the population uses the bushes, rivers, streams to dispose of human refuse.

HIV/AIDS

Several things have combined to accelerate the spread of HIV/AIDS in Liberia. The 1970s saw positive changes in the political, social and economic lives of the people. The 80s brought social-economic decline and the 90s, a wave of military hostilities, poverty and internal and international mass migration of people. Persistent poverty and inadequate basic social services, notably health and education, wars and conflict provide an environment conducive for HIV/AIDS to thrive.

HIV/AIDS is generally considered one of the greatest development challenges. Its impacts are felt in all aspects of life weakening economies, impacting agriculture and rural development in terms of food security and environmental sustainability. Displacement and refugee circumstances and conflicts all undermine families and traditional authority

structures, and aggravates poverty increasing the vulnerability of families and communities to the disease.

The HIV/AIDs prevalence rate was 8.2 per cent in 2002 increasing to 12 per cent in 2004 (UNDP/Global Fund, 2004). But there are problems of gross under-reporting and irregular testing. The 2004 estimate is based on knowledge of happenings during the conflict and post-conflict era. This is steep rise compared to 1986 when the first 5 HIV/AIDS cases were reported constituting a rate less than 1 per cent. It has been reported that that HIV/AIDS prevalence rate is highest among people in border counties, especially near Cote d'Ivoire. The 12 per cent prevalence is concentrated around these areas. The HIV/AIDs situation could spiral out of control especially in light of the rather slow and weak national response.

Social Services

Limited access to electricity, water, energy, and communication has become an impediment to economic recovery. Access to health services is skewed in favor of urban areas. About 90 per cent of people in Monrovia, and some urban centers can reach health care facility in one hour or less, compared to only 48 per cent in rural areas. It is estimated that about 35 per cent of households in Grand Kru and Grand Gedeh counties walk an average of two or more hours to reach a health facility (MHSW, 2002). Only 30 per cent reside in communities in which the nearest health facility is less than one-hour's walking distance.

According to a recent demography and health survey of Liberia, there is only one doctor to every 56,000 inhabitants and one midwife for every 28 000 inhabitants, far below the standards set by the World Health Organization, which is one doctor for 10 000 inhabitants and one midwife for 5 000 inhabitants. Less than one in 6 children is immunised. Infant mortality rate in 1999 was 149 per 1000 live births, compared with the average for least developed countries is 104 per 1000 live births. Life expectancy in Liberia is 47.7 years, from 64 years for the pre-war era (MHSW, 2002).

Population dynamics have been influenced by a mix of factors. The population growth rate which is a function of high fertility, and mortality rate which is a measure of success in control of disease. Twenty-one diseases and health conditions are reported monthly from health facilities in Liberia. Of late, child mortality is on the increase due to a decline in healthcare delivery. Human mortality is caused mainly by malaria 16.5 per cent, anaemia 12.6 per cent, respiratory infection 12.5 per cent, diarrhoea 5.6 per cent, hypertension 4.6 per cent and malnutrition 4.4 per cent. These figures are thought to have increased in 2004.

Education

There are more schools in urban cities than rural villages and the quality of education is also better in the former. This is attributed to better incentives and adequate logistics in urban areas. About 50 per cent of males and 69 per cent of females in the rural areas have not completed any formal education. This compares with 24 per cent of males and 39 per cent of females in the urban areas.

In some counties, school attendance of girls is quite low. In Lofa, Grand Bassa and Rivercess counties, only 36, 40 and 41 per cent, respectively of females aged 20-24 years have ever attended school. Nationally, about 80 per cent of the school-age children 5-24 years have ever attended school. Eighty-three per cent of these are male and 77 per cent female. The combined gross enrolment ratio for males aged 5-24 years is 68 per cent, and for females 57

per cent. In absolute terms, 27 per cent of school-aged children are not in school, 27.5 per cent girls 27.3 per cent boys (Liberia Demographic and Health Survey – LDHS, 2000).

The illiteracy level is 63 per cent. About 50 per cent of male and 76 per cent of female are illiterate. The low levels of education is attributed to inadequate access to education services, lack of money, and the unavailability of functional schools in most parts of the rural areas.

Housing and Human Settlements
Settlement patterns in Liberia are influenced by economic activities like mining, telecommunication, road networks, timber and rubber production and the cultivation of crops such as cocoa and coffee. Changes in the administrative structure of the country have also contributed to the emergence of differentiated patterns of population distribution.

The National Housing Authority (NHA) created by the 1960 Act of Legislature of the Republic of Liberia, has the mandate to initiate, implement and execute housing development programs for the entire country. In keeping with this mandate, the NHA has oversight responsibility to execute shelter programs in mass housing sites, service provision, and urban program upgrading. However, due to numerous problems, the NHA has been unable to meet the housing needs of the country. Housing development is only confined to Monrovia.

Migration and Environment

Migration is the movement of people that leads to a change in the place of usual residence. It could be internal across county boundaries or international, across national boundaries. There are various reasons why people migrate including seeking better economic opportunities or as a result of war.

Rural-to-Urban Migration
Rural-to-urban migration is on the increase. Many migrants are attracted by potential economic and social opportunities, particularly trade, employment and education. Such population movements are important in providing the resources required for investment in rural production. Migration from the rural areas to the capital city and other large urban centers was common throughout the civil strife. Most urban dwellers are found in cities along the Atlantic coastline. Monrovia is the largest city with a pre-war population of about 450,000 people. Due to increasing insecurity in many parts of the country, exodus of people into Monrovia has swelled the population to more than one million people. This unplanned increase in urban populations has implications for service delivery. Currently there is no national urban centres development strategy in Liberia.

There are signs that rural-to-urban migration is having an impact on population growth. In rural areas, children are seen as assets or a form of riches. Children in rural areas perform tasks like farming and caring for the elderly, and the cost of education per child is quite low. In urban areas, life is more expensive and peer pressure leads children to demand more from their parents. These economic demands and pressures decrease the desire of adults to bear more children.

Population Displacement
The factor largely responsible for migration in recent times has been displacement due to the war. Before camps were organized for internally displaced persons, the tendency was to settle such people near large cities and allow them to clear land build shelters. Once the displaced people experienced life near cities, the chances of getting them to return to their original

homes decreased. In latter years, camps have been established far from large cities, housing large number of persons.

Liberia's challenge today is to resettle internally displaced people (IDP) and ensure that refugees return from neighbouring countries and are re-integrated with their communities. With support from the international community, UNDP, through its Disarmament, Demobilization, Re-integration and Rehabilitation (DDRR) programme, is assisting many IDPs to return to their homes. Between November 2004 and September 2005, a total of 216,098 IDPs received their return assistance representing a total of 41,759 families (OCHA, 2005). Details are shown in table 6.1.

Table 6.1: Movement of IDPs as of 17 September 2005.

Figures and categories
43 426 facilitated by IOM from 8 November 2004 through 17 March 2005
45 279 returned on their own and also linked to the International Organization for Migration (IOM) facilitated IDPs movement above
124 603 accelerated movement phase of the return beginning 11 March 2005 through August 19, 2005
15 500 total vulnerable IDPs moved by IOM
216 098 This figure represents IDPs assisted to resettle to their respective communities

Source: OCHA 2005

Environmental Impacts of Migration

Migration can have adverse consequences on the economy, environment, social services, and livelihoods. The unplanned influx of large numbers of people into cities can put pressures on resources and social services. The present population of Monrovia is around 1.3 million. The huge migration began with the war and continues today. This growth rate of the capital and other urban centers is partly based on migration due to the absence of basic infrastructures and basic social services in rural areas. Some examples are bad road network, poor public amenities and inadequate security.

Internally Displaced People's (IDP) Center near Kakata, Margibi County (2005)

Courtesy of Augustus Goanue, Center for Sustainable Energy Technology (CSET)

During mass movements, the people clear large areas for agriculture, settlements or to support livelihood and basic needs. Between 1993 and 1995 the research plantation of the University of Liberia at Fendell was cleared by charcoal producers, people scrambling for

food and fuel wood gatherers. The plantation was used by students of Agriculture and Forestry for several years, but that facility is no longer available to the University.

Other environmental impacts include biodiversity loss, degradation of ecosystems and the illegal exploitation of mineral resources. In 2003, approximately 2 000 people moved into the Sapo National Park during a round of hostilities between government forces and the rebel Movement for Democracy in Liberia (MODEL). Initially, a place of refuge, it later turned out to be an economic haven. Some engaged in alluvial mining for gold, while others set up hunter hamlets and used the proceeds to engage in other activities such as video clubs for entertainment. Others went into slash and burn agriculture. The IDPs cleared large tracts of intact forest and hunted some of the rarest and protected animals. The number gradually swelled to almost 6,000 people. Intensive negotiations ensued to remove them. The Government of Liberia and the United Nations Mission in Liberia classified them as internally displaced, while conservationists called them illegal settlers. They were eventually moved from the park in August 2005 without incidence.

In former IDP camps, the signs of environmental degradation are still very visible. Most of the places cleared to construct camps were large, and there was no environmental impact assessment (EIA), neither was a post-closure strategy developed. Biodiversity was destroyed and sanitation was a problem. In some places pit latrines were erected at elevations higher than drinking wells, contaminating the ground water. As normalcy returned, people returned home and all of the camps officially closed down, but the absence of post-closure plans has caused some concerns. Though GoL in collaboration with some development partners is intervening to address these concerns, rapid intervention or measures to mitigate the negative consequences of population displacement need to be prioritized.

The Population Policy

A National Policy on Population for Social and Economic Development was enacted on 21 July 1988. The Policy recognizes the need to preserve, protect and promote positive Liberian cultural values and to appreciate the interrelationship between population variable and socio-economic development for the enhancement of economic growth and poverty reduction. Some broad objectives of the policy are listed in box 6.2.

Box 6.2: Some Broad Objectives of the Population Policy

- Achieve effective contribution to poverty reduction and thereby improve the quality of life of the people
- Ensure that people have a proper understanding of the implications of population growth and associated characteristics for social and economic development
- Ensure that people have access to appropriate information and education that will facilitate rational decision-making on family matters including age at marriage, timing of birth, ultimate number of children to have, etc.
- Ensure that people live a healthy and long life by reducing the incidence of morbidity and mortality, particularly infant, child and maternal mortality
- Achieve sustainable utilization of the resources of the environment (marine and freshwater resources, forest products and biodiversity and minerals

Conclusions and Recommendations

A fundamental requirement for sustainable development is that of human-well being. It is an integral part of the diversity, productivity and quality of the environment. The quality of life of the majority of the people and the quality of the environment in Liberia have deteriorated over the last decade. In addition, some of the improvements of the early years have been eroded by high population growth, political conflicts and HIV/AIDS or other diseases.

Liberia's population is young and growing rapidly. They are a resource that can be harnessed for the production of goods and services in society. It is important that the government as part of its reconstruction strategy plans for their future. The following are recommended:

1. Development of human settlements should be planned in way that such development will not negatively impact the environment;
2. Social services should be provided equally to all sectors of the country and made affordable;
3. Public health education should be re-introduced in schools as a means of creating massive awareness about sanitation and waste management;
4. Government should conduct a nation-wide census so that population figures reflect present day realities;
5. Lands degraded by refugees and internally displaced people should be rehabilitated; and
6. Government must expand its school system and re-introduce the subsidy scheme to private schools.

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7 WASTE MANAGEMENT AND SANITATION

Introduction

One of the biggest problems facing post-conflict Liberia is that of poor waste management and sanitation. Poor waste management contributes to environmental conditions that may threaten human health and well-being. Pollution and wastes are often concentrated in urban centres due to high population densities and higher consumption patterns compared to rural areas. The deterioration and lack of capacity of the relevant urban authorities was also a contributing factor. Although waste collection and disposal systems used to exist in some municipalities, these are currently not functioning. Some of the problems include inadequate legislation, weak enforcement, lack of substantial financial and human resources, lack of appropriate technologies and an effective mechanism to coordinate stakeholders.

The government is stressing economic growth as part of its national strategy for development. This will result in an expansion of urban, agricultural and industrial activities. The demands placed on the environment to provide resources for development and to absorb wastes will continue to grow, presenting challenges for both authorities and communities. This is therefore one sector that needs urgent attention.

State of the Waste Management Sector

Overview

More than a decade of civil conflict has resulted in the destruction of infrastructure and disruption of basic services, including environmental sanitation and waste management services. Urban populations grew during the war and crowding is now a major problem further restricting access to basic services. For example, population density in Monrovia is estimated to have grown by 45 per cent in 2000 (EIU 2003).

Detailed statistics for the generation and disposal of wastes for Liberia are not available, but estimates around Monrovia indicate generation rates of about 145 000 tonnes/yr (UNICEF 2004). This includes wastes from the municipalities, hospitals, industrial facilities and construction areas. Although waste collection and disposal systems existed in some municipal areas such as Monrovia, Buchanan, Gbarnga, Greenville, Harper, Kakata and Robertsport, all of these are currently not functioning due to the war and the prevailing post-conflict economic depression.

In the absence of proper waste collection and disposal systems, solid wastes are currently disposed of in sensitive ecological zones such as river courses, marshlands or in abandoned quarries where the soil is permeable. There is a frequent build-up and open burning of waste, primarily in the streets and vacant plots. These methods of disposal present risks to the environment and human health, through air pollution, potential contamination of surface and ground water, as well as exposure to disease vectors and toxic substances.

The institutional and management framework for waste management needs to be strengthened. Liberia has never had a comprehensive waste management plan. Neither is there a recycling nor land fill system in place (UN/World Bank 2003). The division of roles and responsibilities between institutions involved in the sector is also unclear.

Waste Composition

Although there has been no comprehensive analysis of waste in Liberia, it is thought to be similar in composition to that of other developing countries in West Africa. A one-day study conducted in July 2004 in Monrovia provided an indication of waste composition. The analysis was based on samples taken from five communal storage points or transfer stations at different locations in Monrovia. Two were located near markets and three in residential areas. The data indicates a marginal density of 250 kg/m^3 for Liberia (UNICEF 2004). However, this is thought to be low. Other studies indicate that typical figures for lower income countries, is in the range of 250-500 kg/m^3 (Cointreau 1982). Emission levels of methane and nitrogen oxides from waste water and solid waste disposal could not be determined. This calls for more detailed study in the future. Table 7.1 and box 7.1 give some information on the different types and contents of solid waste.

Table 7.1: The composition of waste in Monrovia

Component	% by weight
Paper & carbonadoes,	10.0
Glass, ceramics	1.2
Metals	2.0
Plastics	13.0
Leather, rubber	0.2
Wood, bones, straw	4.6
Textiles	6.0
Vegetable/putrescible	43.0
Miscellaneous items	20.0
Total	**100.0**
Density	**250 kg/m^3**

Source: UNICEF 2004

Box 7.1: Solid waste in Liberia

Solid waste in this context refers to the following categories of wastes:

- *Medical wastes* - waste from medical laboratories, hospitals, and private clinics. It includes used syringes, tubes, and containers. Such wastes can transmit blood-borne diseases,
- *Trash* - paper, cardboard, old clothing, shoes, sweepings, dust, rags, bottles, cans or other waste that is a result of daily business life,
- *Construction wastes* - is a result of the renovation, construction or demolition of buildings. It includes waste such as lumber, roofing materials, bricks, zinc, nails, concrete blocks, plasters, gutters, sand, gravel,
- *Garbage*- includes animal and food items resulting from the handling, preparation and eating of food. It is usually organic matter and may rot. Decay can result in the generation of offensive odours. Such waste may serve as breeding or feeding material for flies, birds, insects, or animals.

Unsorted hospital waste on the SKD Boulevard.
Most waste in Liberia is not sorted, making it difficult to re-use or recycle

Courtesy of UNDP Energy and Environment Programme - 2006

Waste Generation and Distribution

Prior to the conflict, the Ministry of Lands, Mines and Energy estimated the per capita waste generation for Monrovia as $0.002m^3$/ p/day (or 0.5 kg/p/day). If Monrovia is estimated to have a population of 1.3 million people, and considering a per capita waste generation rate of 0.5kg/p/day, the corresponding total domestic waste generated in Monrovia and its environs would be 650 metric tonnes/day. An additional 0.1 kg/p/day is added to cater for commercial, institutional, industrial and hospital sources of waste generation amounting to a total of 780 tonnes/day. Estimates of the waste generated in the main division of Monrovia and its environs are presented in **table 7.2.**

Table 7.2: Estimated amounts of solid waste generated in Monrovia

Area/Zone	Communities	Estimated population	Waste generation (tonnes/day)
Central Monrovia	Central Monrovia A & B	237 210	142.33
Sinkor Area	Sinkor, Fiamah, Old Road & Congo Town	195 691	117.40
Bushrod Island	Logan Town, New Kru Town including Duala, Clara Town, West Point, Gardnersville, Barnesville & New Georgia	674 054	404.43
Paynesville	Paynesville Municipality	193 045	115.83
Total		**1 300 000**	**780.00**

Source: HIC 2003, MPEA 2004

There is a positive correlation between waste generation and economic growth. Although there has not been much economic activity over the past decade, there has been an increase in the number of urban households on account of the war. It is therefore reasonable to assume that the amount of wastes generated will continue to increase. Forward looking statements including projects are an essential part of planning for effective waste management. Indeed hypothetical growth figures are being used in the development of a waste management plan for Monrovia (UNICEF 2004). The Humanitarian Information Center and Ministry of Planning and Economic Affairs have made some waste generation projections Monrovia and its environs from 2004 to 2020 (HIC 2003, MPEA 2004). The data is shown in table 7.3. These projections were based on the following assumptions:

- Base population in 2004 is 1,300,000,
- Population growth rate is 2.5 per cent,
- Per capita waste generation rate is 0.6 kg/p/day,
- Waste collection coverage in 2004 is less than 15 per cent,
- Waste collection coverage will increase as capacity improves starting from 50 per cent in 2005.

Table 7.3: Projection of waste generation and collection coverage from 2004 to 2020

Year	Population	Generation (ton/yr)	Collection coverage (%)	Collection (ton/yr)	Collection (ton/yr)
2004	1 300 000	780.00	<15	-	-
2005	1 332 388	799.43	50	399.72	145 896.49
2006	1 365 698	819.42	60	491.65	179 452.72
2007	1 399 840	839.90	60	503.94	183 938.98
2008	1 434 836	860.90	65	559.59	204 248.90
2009	1 470 707	882.42	65	573.58	209 355.14
2010	1 507 475	904.49	70	633.14	231 095.92
2011	1 545 161	927.10	70	648.97	236 873.18
2012	1 583 791	950.27	75	712.71	260 137.67
2013	1 623 385	974.03	75	730.52	266 640.99
2014	1 663 970	998.38	75	748.79	273 307.07
2015	1 705 569	1 023.34	80	818.67	298 815.69
2016	1 748 208	1 048.92	80	839.14	306 286.04
2017	1 791 914	1 075.15	80	860.12	313 943.33
2018	1 836 711	1 102.03	85	936.72	341 903.75
2019	1 882 629	1 129.58	85	960.14	350 451.39
2020	1 929 695	1 157.82	90	1 042.04	380 342.88

Source: UNICEF 2004

Storage and Collection

Storage of solid waste can be divided into two categories, namely primary (or on-site) and secondary storage. Primary storage refers to the temporary holding of the solid wastes at or close to their point of generation for example at household level. Waste is stored in containers such as plastic bags, rice sacks, plastic and metal containers. Primary storage is usually the responsibility of individual households and adequacy of this function varies from one household to another depending mainly on factors relating to the level of awareness of personal and environmental hygiene practices and affordability of the services.

Secondary storage refers to that occurring at an intermediate point between the primary storage stage and ultimate disposal of the wastes. It involves the use of concrete bins – usually a three-walled enclosure located within selected communities. Many communities lack secondary storage facilities. For example, in the whole of Monrovia, only 11 concrete bins are currently in use – 6 in central Monrovia, 2 on Bushrod Island and 3 in the Sinkor area (UNEP 2004). As a result, solid waste is carelessly cast off on the ground along street edges, in drainage channels, on vacant plots in abandoned buildings and along river courses. In urban areas it is the responsibility of the municipal councils.

Box 7.2: The solid waste collection and disposal system for Monrovia

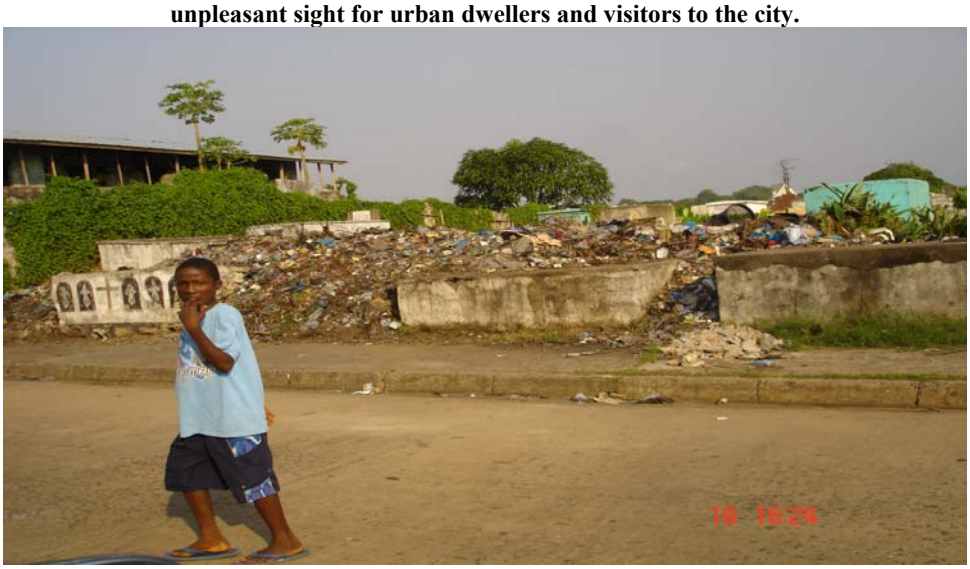
A solid waste collection and disposal initiative was in place for Monrovia. The Monrovia City Corporation (MCC) was responsible for collecting and hauling for disposal, domestic and commercial solid waste. They were assisted in this by a private waste collection system called "Betty Garbage System". In 1990, the population was 300 000 with an annual growth rate of 7 per cent, garbage collection and disposal in accessible areas was 85 per cent effective in Monrovia. The following equipment was used:

- 20 primary collection stations
- 8 dump trucks
- 3 garbage compactors
- 1 front end-loader
- 5 pick-up trucks
- 20 utility management operational vehicles
- 1 sanitation dispatch station
- Organized private collection system

The only municipality currently active to some extent in solid waste management is the MCC (See Box 7.2). Garbage is collected and transported to selected dumpsites by tipper trucks. They are loaded either manually or with the aid of a front-end

loader and off loaded in similar manner. Collection of waste from primary storage sites is done with the aide of wheelbarrows, rice sacks and other suitable containers. In some cases, private contractors use pick-ups to transport waste to disposal sites, while others use wheelbarrows and bags to transport waste to deposit sites for secondary collection and disposal. Even though there are no records on collection coverage by other municipalities in the country, the private sector or other service providers, the MCC Waste Management Department estimates its average daily collection as 21 tons, which is less than 5 per cent of the waste generated daily in Monrovia. Other municipal areas that had waste collection and disposal systems prior to the conflict included Buchanan, Gbarnga, Greenville, Harper, Kakata and Robertsport, but no management data is currently available. About 80 per cent of the uncollected domestic and commercial solid waste in the country ends up in drains, open lots and in abandoned buildings, thus encouraging the breeding of rodents and flies (UNICEF, 2004).

Waste dumped in the cemetery on Gurley street, Monrovia. **An inadequate number of storage facilities leads to waste being indiscriminately disposed of on streets or vacant plots. This makes an unpleasant sight for urban dwellers and visitors to the city.**



Courtesy of Abdoulaye Sene

Methods of Waste Disposal

There are several options for solid waste disposal currently in use in Liberia. These include open dumping, burning, burying, land-fills and various forms of resource recovery such as recycling and reusing. Open dumping, is most commonly used method. Dumpsites are generally located at various locations around communities. Many are located in open lots, wetlands or near surface water sources. These locations are not ideal and can cause environmental hazard. In some instances, waste disposal is used as a means of reclaiming land, especially in some urban communities.

In Monrovia, the officially designated waste disposal site currently in use is a mangrove swamp located at Fiamah, a residential area, about 4 km from the city center. Based on observation, the space available for waste disposal is limited and the site would have to be closed down within a few months (Mensah, 2004). Indeed due to recent pressures on the Fiamah site, Monrovia City Corporation has shifted attention to Gardnersville and Pynesville/Congo town. Waste disposal entities have been authorized by the Monrovia City Corporation to transfer all wastes to the Samuel Kanyon Doe Boulevard linking Paynesville and Congo Town. However, city authorities urgently need to identify suitable replacement sites for both temporary controlled dumping and long-term sanitary landfill.

Other methods of waste disposal, especially at the community level include the use of pits where waste is dumped and subsequently buried or burned. Burning and burying of wastes can also cause potential environmental problems such as pollution of both air and water. Communities, located within the proximity of watercourses dispose of their wastes directly into these water bodies. This is common in Paynesville, Gardnersville, Bardnersville, and Caldwell.

The disposal of hospital waste represents a special challenge for Liberia, especially in the urban areas where health centres are mainly located. An up-to-date list of urban-based hospitals and health facilities for the country is not available. However, some established health centres in Monrovia and its environs include:

- the St. Joseph's Catholic Hospital that has a modern incinerator to deal with medical waste and employs the services of a private operator for the collection and disposal of the domestic waste,
- the JFK Hospital that has an incinerator that has not worked for many years. Medical and domestic wastes are disposed of in the compound and burnt periodically in the open-air,
- the Redemption Hospital, operated by Medicin San Frontiers of Belgium which has a functioning incinerator for burning the combustible waste fraction. It has two separate aboveground filter-bed tanks used for placenta and bottles disposal, respectively.

In order to develop a comprehensive waste management plan for the country, other medical facilities in the country will have to be assessed. MCC and Paynesville City Corporation have no official arrangement specifically for hospital waste.

Recognizing the linkages between waste management and human well-being, the Energy and Environment Unit of UNDP is implementing some initiatives in and around Monrovia. Meetings have been held with key stakeholders including mayors and municipal leaders, civil society organizations like the Drivers, Tailors and Transport Unions. Private sector institutions, such as Libra sanitation were also involved. Recommendations included the need for government to allocate suitably located land for a dumpsite, greater public awareness and the involvement of all stakeholders in the sector.

Waste dumped on the roadside. Exposure of workers to infected materials and human tissue, the danger of injury and infection from sharp objects is a danger

Source: Energy and Environment Unit, UNDP Liberia: photo needs to be replaced

Environmental Health and Sanitation

Sanitation and sewerage are two important environmental issues with direct bearing on the health and well-being of humans. In Liberia, there are variations in accessibility to sanitation. In urban and rural communities the majority of the population uses either pit latrines, toilets connected to septic tanks or open defecation. In some cases, especially in urban communities, faeces are put in plastic bags and disposed of in drainage channels or with domestic waste (UNEP, 2004). Residents living near rivers in both, urban and rural areas commonly use the river banks for both solid and human waste disposal.

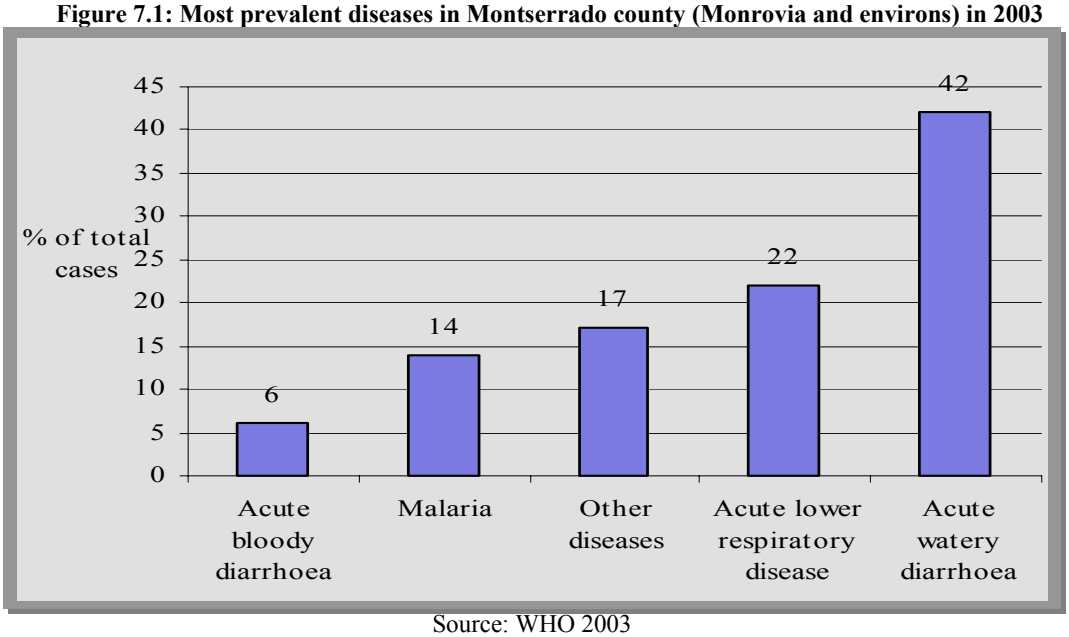
The only functioning sewage system in the country is in Monrovia. The city has however, been unable to balance the pace of infrastructure and service provision with rapid urban growth. The plant has been broken since the beginning of the civil war. The sewage system was designed to provide sedimentation and secondary treatment with trickling filters. It was also designed to handle sanitary wastewaters. The effluent is supplemented with storm water due to illegal connections with drains from infiltration of ground water. Because the plant and the pumping stations have not functioned consistently for more than a decade due to disrepair and shortage of electricity, raw sewage has been frequently allowed to flow directly into lagoons, rivers and the Atlantic Ocean. Some residents of Monrovia still use the sewage system, causing a build-up of sewage within low points in the pipeline. Benson Street and Camp Johnson Road are good examples.

Adverse environmental impacts include pollution of groundwater, rivers and coastal waters as a result of untreated sewage and leachates from poorly managed waste disposal. Poor sanitation also encourages rodents, flies and other disease vectors. The direct impact of this are increased health hazards such as outbreaks of water-related and other diseases. The most common diseases associated with poor environmental health include cholera, malaria, diarrhoea and respiratory infections. According to the WHO, diseases such as diarrhoea, cholera, typhoid and intestinal worms, together account for 69 per cent of disease occurrence and are attributable to poor environmental conditions (WHO 2003). Malaria, which accounts for about 15 per cent is also related to poor environmental sanitation conditions. In 2003,

Monrovia experienced an outbreak of cholera. By December 2003, a cumulative number of 26,651 cases with 34 deaths were reported (UNEP, 2004). Figure 7.1 shows the incidence of these diseases in Monrovia over this period.

These problems are borne disproportionately by the urban poor. The concentration of large numbers of people in refugee camps, where unsanitary conditions prevail, the breakdown of water and sanitation systems, widespread food insecurity and other consequences of protected conflict increase the vulnerability of the urban poor to disease are the main causes of the extreme vulnerability of the population to the determinants of ill-health.

Figure 7.1: Most prevalent diseases in Montserrado county (Monrovia and environs) in 2003



Source: WHO 2003

Institutional and Legal Framework

Sector Institutions

The Environmental Protection Agency (EPA) was officially established in December 2003. Under the Act, the EPA has overarching responsibility for environmental management in Liberia. This includes waste management and sanitation. The EPA is also to serve as a reservoir of technical expertise, and to have a coordinating and supervisory function. Although the EPA has been legally established it still remains to be fully operationalised if it is to fully carry out its mandate. Capacity in terms of administration, staff and equipment are urgently required. Only then will it be able to adequately monitor and supervise waste management activities.

Apart from the EPA, implementation of waste management and sanitation activities is spread over other government institutions including the Ministry of Health and Social Welfare, Ministry of Lands, Mines and Energy, Ministry of Planning and Economic Affairs, Liberia Water and Sewer Corporation, Monrovia City Corporation.

The statutory roles of these entities are as follows:

1. *Ministry of Health and Social Welfare (MHSW)*: The Division of Environmental and Occupational Health of this ministry handles matters relating to water and sanitation, periodic assessment of the status of food hygiene in public eating places, construction

and/or supervision of water wells and pit latrines and the promotion of community health education. MHSW provides for capacity building and training of environmental health technicians and is mandated to conduct sanitary inspections, including drinking water surveillance and water quality monitoring, towards the evaluation of compliance with Public Health Law and national standards.

2. *Ministry of Lands, Mines and Energy (MLME)*: The MLME among other things, supervises the development and management of water resources that are central to the water and sanitation sector, and conducts scientific and technical investigations required for environmental assessments. The implementation of water and sanitation activities is done through the Department of Mineral and Environmental Research of the ministry, which houses both, the Liberian Geological Survey (LGS) and the Liberian Hydrological Service (LHS). The LHS is responsible for collecting data on the quality, sources, and quantity of water resources in Liberia and is responsible for monitoring rainfall and stream flow in river basin as well as ground and surface water quality. Training of technicians of the Ministry of Rural Development for emergency disinfection (chlorination) of open wells has also been undertaken by MLME. The LHS mandate dictates that it be involved in special projects on the evaluation of urban sanitation, particularly the provision of guidance for geotechnical investigation of solid wastes landfill disposal sites.
3. *Ministry of Planning and Economic Affairs (MPEA)*: The MPEA is responsible for regional development planning and co-ordination. It is also responsible for identification, development and preparation of suitable development programs and projects; both for the public and private sectors development. The MPEA provides technical guidance to all governmental agencies in preparation of development programs and projects.
4. *Environmental Protection Agency (EPA)*: The mandate of the EPA is to set environmental quality standards and ensure compliance for pollution control. The Agency is responsible for the provision of guidelines for the preparation of Environment Impact Assessment and Audits, and the evaluation of environmental permits. These may include certification procedures for landfill and other activities potentially damaging to the environment.
5. *Monrovia City Corporation (MCC)*: The MCC is responsible for the management of Monrovia including environmental sanitation primarily in the form of beautification, street cleaning, and solid waste collection and disposal. Several departments within the MCC are jointly responsible for planning, development, operation and maintenance of solid waste management systems; these include the Departments of Waste, Environmental Health and Sanitation, General Services, Community Services and Commercial.
6. *Liberia Water and Sewer Corporation (LWSC)*: The LWSC is a state owned enterprise with a commercial orientation and mandated to provide water supply and sewerage services to urban centers, including Monrovia and the capital cities of the various political subdivisions.
7. *Ministry of Public Works (MPW)*: The MPW is responsible for the design, construction and maintenance of roads and highways, bridges, storm sewers, public buildings and other civil works in the country. Additionally, it has responsibility for the administration of urban and town planning, as well as provision of architectural and engineering services for all ministries and agencies of government. In principle, it is responsible for the installation of the entire infrastructure required for waste management delivery services including the construction of sanitary landfill facilities.
8. *Ministry of Rural Development (MRD)*: The MRD is mandated to ensure that safe drinking water and adequate sanitation facilities are provided in rural communities. It also ensures the provision of policy direction on the construction, utilization and maintenance of low-cost facilities that are appropriate for rural communities, such as Roads and hand pumps.

Environmental management in Liberia has been fragmented with each public agency governed by its own policies. The roles and responsibilities amongst the principle agencies waste management is ambiguous and overlap in some cases. For example, the mandate of MCC overlaps with that of the MHSW regarding environmental health inspection activities. These mandates will require further clarification, especially during the development of appropriate institutional framework for the management of solid waste and sanitation.

Policy and Legal Framework

Many of the earlier policies and legislative provisions are not clear on the issue of waste management. The 1973 Act of the Republic of Liberia grants municipal governments a "Charter" status, authorizing them to enact all necessary municipal laws and ordinances as may be necessary for city administrative purposes. The Public Health Law of 1975 places the responsibility for ensuring clean and sanitary environmental conditions on the Municipal Authorities, but is vague on the issue of solid waste management.

The Environment Protection and Management Law empowers the EPA to develop and publish national guidelines for solid waste management in cooperation with relevant institutions and in consultation with other stakeholders. It sets a target of November 2003 for this, being 12 months after the date of promulgation of the law. This document has not yet been prepared due to administrative and technical reasons. The National Environment Policy 2003 is definitive on waste management ad sanitation and proposes several strategic policy measures to address gaps in this sector. These gaps are summarised in box 7.3.

Box 7.3: Summary of the constraints in the waste management sector

- Fragmented environmental policies, with each sector agency governed by its own policies;
- Failure to make the Environmental Protection Agency function fully;
- Insufficient political commitment on the part of the central government;
- Absence of cooperation and/or coordination between the EPA and other sector agencies, and municipalities in waste management;
- Absence of an institutional framework for the other types of wastes (non-domestic): In view of the specificities and nature of these wastes, and of the limited municipal capacities to manage the other types of wastes, and more particularly the industrial ones, the current situation is characterized by the absence of an adequate institutional framework, which requires coordinated action to manage this type of waste in an efficient way that is observant of the protection of the environment;
- Absence of a national integrated waste management system in Liberia;
- Lack of basic information on waste composition analysis for Liberia;
- Limited financial capacity for waste management activities and programmes.
- Inadequate equipment and infrastructure.
- Inadequate human resource capacity for planning and execution of waste management programmes
- Inadequate public education and awareness

Conclusions and Recommendations

The challenges facing the waste management sector in Liberia are immense. The current methods of disposal, storage and management leave a lot to be desired. With increasing population, changing consumption patterns and economic growth, it is likely that waste generation is going to increase. Government has recognized this and has made waste management one of its reconstruction priorities. Some of the key policy responses required include:

1. A clear definition of the roles and responsibilities of the principle agencies involved in waste management and sanitation. Their activities should be coordinated so as to avoid overlapping and duplication of functions,
2. Specific policies relating to waste management are either non-existent or inadequate. In adherence to the 1973 Municipal Act of Liberia, all policies and legislative provisions on waste management should be reviewed and revised, where possible,
3. It should be mandatory for all facilities that produce a lot of wastes, such as factories and hospitals install and operate incinerators for burning their combustive waste fractions,
4. The official waste disposal site in Fiamah should be abandoned. A new dumpsite should be gazetted in an appropriate location,
5. There is need for thorough environmental and public health impact study of solid waste and sewage on the environment,
6. A well coordinated public awareness and education on waste management and sanitation must be organized, backed by intensive capacity building initiatives,
7. An integrated waste management strategy for Liberia should be developed,
8. Waste management-related laws and regulations should be formulated and existing laws and regulations updated to meet the demand of present realities, and
9. Guidelines for disposal of wastes from villages and rural communities should be developed.

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8 INDUSTRY AND TRADE

Industry

Trade and industry are vital to the development of the country. They can create employment, foreign exchange earnings and savings, backward and forward linkages to the natural resources base and support the fight against poverty. This sector had severe setbacks because of the war, poor management and shortage of inputs. With peace and a new government in place there are opportunities for improvement. The Liberian industrial sector includes mining, manufacturing, construction, tourism and service activities such as transport. Mining is the major activity in the sector with the remainder being predominantly trade and service related activities.

Construction
The construction industry is not well developed. Reliable data on the number or names of construction firms in the country is unavailable. It is not uncommon to find a construction firm, which is actually an individual, or group of individuals. However, there is potential for growth and expansion in light of the amount of reconstruction required. This is an opportunity to ensure that the sector is adequately regulated.

Manufacturing
Fifteen years of conflict has left the manufacturing sector in a weak condition. The number of operational companies dropped from 850 in the mid-1980s to 350 in 1990 (MOC Report 2006). Current numbers are unknown. Most facilities are mainly located in and around Monrovia and are largely restricted to textile/clothing, furniture, brewing and non-metallic mineral products. However information on waste management and other environmental impacts is unavailable.

There is a cement grinding plant in Monrovia. It re-opened in mid-August 2003 with a limited number of employees. The plant grinds imported clinker and gypsum into a fine "pure cement" powder. Secondary constituents are then added to make blended cements. The finished products are stored in large silos from where they are dispatched in bulk or in bags. Cement grinding operations generate particulate emissions and can be noisy. It was reported that the plant operates in accordance with local regulations. Nevertheless, there have been complaints regarding transportation of the raw material from the port to the factory site. The raw material is transported in open trucks, with particles filtering in the air in all directions.

The main brewery in Monrovia, Monrovia Breweries Inc., was damaged during the summer of 2003, but is currently operational. The main issues of concern are the sources of water, treatment details and the management of effluent waste.

There is an automotive battery manufacturing plant at Gardnersville in Monrovia that is no longer functional. Surrounding soils are thought to be polluted with lead and battery acid. As in the case of the Monrovia Brewery, there is concern about their method of effluent discharge as no information is available.

Services

By the end of 1982, there were 3 062 commercial and service establishments throughout the country employing about 13 729 persons, a 22.7 per cent increase over the 1981 figure. Monrovia accounted for 11,180 persons or 81.4 per cent of total employment in this sector (MEPA Planning and Development Atlas, 1983). The main categories of service and commercial establishments are listed in box 8.1. Over 70 per cent of these establishments are owned by Liberians but they contribute only a minor share of the total output of this sector.

Box 8.1: Service and commercial establishments

- Financial institutions – (banks, insurance and credit unions);
- Real estate;
- Wholesale and retail trade or general merchandise;
- Repair businesses;
- Hotels, restaurants and cook shops;
- Sanitation (plumbing, etc);
- Beauty salons; and,
- Recreational and cultural services.

Mining

Mining and Mineral Resources

The discovery of minerals in Liberia dates back to the 1930's, when a preliminary survey conducted by the Holland Syndicate, led to the discovery of gold and iron ore. Before that the local inhabitants mined and used these metals for trading purposes. Prior to the civil war, there were over 75 000 people engaged in artisanal mining. Its contribution to the GDP at constant factor cost increased from 29.8 per cent in 1981 to 32.0 per cent in 1982 (MLME 2005). This increase can be attributed to the increase in diamond production and quarrying. The decline of the domestic oriented sector of the economy also contributed to the increase in mining's share of the GDP.

The main mineral resources are iron ore, gold and diamond. Gold and diamond operations are limited to alluvial activities. Other minerals include rutile, clay, kyanite, and silica sand. There is also exploration for uranium and petroleum. Mining for iron ore is the main activity, and has dominated the mining industry for more than two decades. In 1951, the first iron ore company, Liberia Mining Company, started production. From that time the mineral industry started making substantial contribution to the Liberian economy.

Iron Ore

For several years prior to 1979 Liberia was the second largest producer of iron ore in Africa. The country had proven reserves of more than 3 billion tons with an iron ore content amounting to 35-59 per cent. Iron ore mining was undertaken in Bomi, Bong Mines, Mano River and Nimba. Tables 8.1 and 8.2 show the current status of iron-ore mines in the country. In the decade prior to the war, iron ore production accounted for about 23.5 per cent of GDP. Due to adverse conditions in the international economy, there was a decline in the world steel market in the mid 70's and early 80's. As a result, the Liberian iron ore industry suffered a severe setback and was further constrained by the increasing depletion of the high-grade iron ore reserves. This situation was made worse by the war and culminated in a complete shutdown of operations in 1990.

Table 8.1: Present status of iron-ore mines in 2001

Name of mine	Location	Production (MT)	Reserve (MT)
Nimba (LAMCO)	8°40"W/7 °11.N	435	235
Bomi Hills (LMC)	10° 58"W/6°36"N	150	4.5
Bong Mines (BM	10° 09"W/6°42"N	266	90
Mano Mine (NIOC)	10 °52"W/7°32"N	100	85

Source: LIMINCO, 2001

Table 8.2: Known iron-ore deposits that have never been developed (2001)

Name of mine	Location	Geological reserve (MT)
Bie Mtn	10 °54"W/7 °15"N	1B
Wologisi	9 °56"W/8 °21"N	1B
Goe	10 °8"W/6 °21"N	48
Putu range	8 °04"W/5 °55"M	456
Webbo hill	4 °58"W/7 °35"N	60

Source: LIMINCO, 2001

Iron ore production in 1982 was 18.2 metric tones. This was a 9 per cent decrease from the previous year (MOC 1986). This was the result of a decline in production at the National Iron Ore Company due to financial and technical problems and at the Liberian American Swedish Minerals Company, where production fell as a result of low world market demand for the metal. The value of metal, on the other hand, increased from US$300.5 million in 1981 to US$320.4 million in 1982 (M0C). All mining operations ceased in 1990. The iron ore-mining sector accounted for 4.2 per cent of the work force in the monetary economy (excluding traditional agriculture) during 1982. Total employment in the iron ore mining industry was 8,634 in 1982 as compared to 8,815 in 1981 (MOL 2005). The drop in employment is attributed to retrenchment measures affected by the mining companies as a result of mounting financial problems facing them.

Gold and Diamonds

Gold mining in Liberia dates back to the 1920's, though references of the gold recovery were made as early as the 1860's. A production record of 30,833 troy ounces was reached in 1943. Production however dropped significantly when the miners abandoned the gold fields and went instead to search for diamonds. This downward trend continued until the 1960's when production picked up again and gold exports rose to 5,025 troy ounces in 1967. Production figures for the period 1971-1978 are not available at present. From information gathered it is believed that the production of gold was consistent in the 1960s. Thereafter, production dropped again and then steadily increased to 16,886 troy ounces in 1981. Production peaked again in 1989 when 23,585 ounces were produced (MLME 2005).

Abundant gold deposits are typically associated with greenstone belts of the cratons. Where there are major occurrences, it can be noted by the presence of rocks associated with banded iron formations. Alluvial gold deposits are widespread in rivers draining gold bearing bedrock and eluvial (in situ) deposits; these deposits are known to occur in highly weathered lateritic soils where small nuggets typically form. There are many indications of secondary deposits of gold yielding 3.5 grams or more per cubic yard of gravel with a purity rate of between 90 and 98 per cent. These deposits occur in areas such as Bokonjilay, Tapita, Bella Yellah, the Bie Mountain, Silver Hill and Kokoya.

Diamonds were discovered by the Holland Syndicate in 1934 in western Liberia. However, it was not until the early 1950's when intensive mining actually began. Mining started along the Lofa River near Wuesua, western Liberia, and gradually spread downstream in adjoining tributaries. The Kakata area, about 40 miles north of Monrovia was also mined in the early 1950's. In 1955 mining started in Gbapa and Bahn (Nimba County) and extended to the Kumgbor (Gbapolu County) area in about 1962.

Placer mining operations (used for gold and diamonds) are not systematic. This results in very low recovery rates rendering alluvial mining operations uneconomical. Placers occur in

Precambrian greenstone belts. Some placers are products of prolonged weathering and erosion of small deposits. The gold is generally concentrated in the lower part of the gravel or on the decomposed bedrock locally called “chalk”. The diamonds were separated from other materials by the use of sluice boxes or simple hand jigs.

Artisanal Mining

Diamond and gold in Liberia are mined in small-scale operations, although smuggling makes accurate estimation almost impossible. In 1999, the Ministry of Lands, Mines and Energy estimated that there were 5 000 unlicensed and 1 000 licensed and dealing operations in the country. Artisanal mining of gold and diamonds results in the clearing and excavation of large areas of forest and river beds, the uncontrolled discharge of suspended solids, and the discharge of metals, metalloids and cyanides. In addition, artisanal and small-scale gold mining uses the mercury-based amalgamation process. Mercury vapour is released into the air, which has effect on human health and the environment, as it is discharged to soil and surface water. It has been estimated that two grams of mercury are released into the environment for each gram of gold recovered (Nylander, J. and Mayson, V: 1999). In addition, sulfide gold ores are often purified by roasting and emitting sulfur and arsenic oxides.

Environmental Impacts of Mining

The nature of mining is such that various tools, chemicals and processes are used for the extraction process depending on the nature of the mineral ore, its geological location and the scale of the undertaking. As a result a variety of environmental impacts are experienced. Mining can lead to pollution of air, land and water, siltation, loss of biodiversity, deforestation, degradation of the landscape and soil fertility, and contribute to the spread of disease. In most cases, there are no post-extraction plans, and as such, pits not reclaimed, leaving scattered ponds/lakes.

Alluvial mining in Western Liberia

Courtesy of UNDP Diamond for Development Programme - Liberia

The concessions for the mining of iron-ore resulted in widespread clearance of the tropical rainforest for mines, open-cast pits, processing plants, housing and roads/railways and unmanaged disposal sites. Environmental impact assessments have not been conducted at the sites and potential chemical risks are unknown. One site of particular concern is the Nimba mine which has about 300 million tones of mining waste deposited in surrounding forest areas. In this respect samples from the LAMCO mine area showed Fe content 20 times greater than allowed by US Public Health Standards and the taste and the colour of sections of the Rivers Ya and St. John made them unsuitable for human consumption.

The fertility of soils is affected by mining operations, and can be greatly reduced as vegetation cover is removed resulting in excessive leaching and eorsion. Almost all of the iron ore mining areas (Yekepa, Bong, Mano River and Bomi Hills Mines) suffered from this effect. Usually, large areas were cleared and exposed to severe and accelerated erosion.

The removal of vast quantity of soil, overburden, and bed-rock to extract iron ore destroys ecosystems and habitats. Production figures of the Bong Mining Company from 1965 to 1971 show that about 230 million tons of overburden was removed in order to produce 62.5 million tons of crude ore. The huge overburden removed during excavation or iron was usually disposed of by transportation to lower places. Material would accumulate to the point of obstructing the normal flow of creeks or streams, engendering flooding. This once happened in the Sekar Valley, Yekepa where rice paddies were buried. Sometimes the overflow of tailing impoundment causes the spilling of mud and slurries containing anomalous or lethal amounts of trace metals or residues of chemicals used for processing. Structuring failures of such tailing ponds can be the cause of mudflow such as what happened at NIOC's Noway Camp in 1982, where residential areas were destroyed and more than 50 people killed. The dumping of wastes from mines may often result in the damming of rivers, causing flooding of the surrounding areas. Dumping affects the aesthetic appeal of the landscape and run-off can lead to toxic chemical pollution of the water.

Because of the way in which they occur, gold and diamonds were mined mostly by collapsing the riverbanks into the channels, by laying out large pits or trenches along so-called mineralized veins. Sometimes river courses were dammed or diverted to scoop out the mineral-containing alluvium. Consequently, aquatic ecosystems were disturbed, streams or rivers suddenly changed course, food chains were disrupted, and there was an increase in the siltation and turbidity of the water. The Lofa basin is one of those localities that suffered and continues to suffer from such adverse mining effects.

In some cases, goblets of mercury have been reported in some areas in gold mining like Tawalats, Henry town and Kokoya where gold has been mined. The environmental impacts of mercury are well documented. Aesthetic features or agricultural potential of the land in some parts of these mining districts have also been greatly damaged as a result of failure of miners to reclaim parcels of land mined and areas where the dugout soil piled. Abandoned pits have been filled with water and provide breeding places for disease vectors such as mosquitoes.

The destruction of habitat can also lead to a decline in the populations of wild animals that traditionally prey on vermin and other nuisance animals. In the Bong mines, and LAMCO mining areas where wild animals and other predators had been driven away, rodents began to attack agricultural crops such as rice and sugar cane. Table 8.3 summarises some of the environmental impacts associated with mining.

Table 8.3: Environmental impacts of mining

Adverse impacts	Effects
Water pollution	- aquatic life disturbed ; - reduction of necessary photo-chemical reactions; - river remained turbid; - certain fish varieties disappeared; - water unfit for domestic and industrial use; - increase of acidity of water by the decomposition of mineral such as pyrite; - rise of sulphuric acid
Siltation	- changing depths of affected streams; - smaller streams or creeks fragmented or killed
Air pollution	- diseases such as siderosis and silitosis
Acceleration of rate of erosion	- excessive leaching
Effect on wildlife	- increase in the population of nuisance animals and vermin
Improper disposal of overburden	- floodings
Slurries & mud from tailings	- mudflow

Source: MPEA, 1983. *Planning and Development Atlas*

Mining Legislation

The first legislative reference to mining was a 1956 provision called Mining Legislation and Regulation (from the Liberian Code of Laws, Chapter 24, entitled, National Resources Laws, Liberia Code of Laws of 1956). This instrument provided guidelines for the mitigation of adverse effects of mining or prospecting on the physical environment and the prevention of mining related accidents, health hazards and injuries to employees. The salient points of the 1956 document are:

1. Excavations, whether in use or not, shall be maintained or protected so that they shall not constitute a danger to persons or domestic animals.
2. When prospecting or mining operations are abandoned, all excavations, dump dams and other works shall be left in a state such that they do not pose danger or risk to the health of persons, or a danger to domestic animals, with the ground left reasonably level and free from hole or other breeding places for mosquitoes.
3. Persons authorized to carry out prospecting or mining operations be held responsible for the safety and health of their employees in accordance with labor laws.
4. Explosives at any mines are to be properly stored; external parts of machinery used in all plants or upon any mine are to be in good working condition.

The New Minerals and Mining Law adopted recently, stipulates in its Chapter 8 that:

1. The responsibility of each Mineral Right Holder to take reasonable preventative, corrective and restorative measures to limit pollution or contamination of, or damage to, streams, water bodies, dry and land surfaces and the atmosphere as a result of exploration or mining.
2. The requirement of each Mineral Right Holder to restore/reclaim the terrain of any land disturbed by exploration or mining to its previous state before operation;
3. Restoration of water bodies to the original state, polluted or disturbed by exploration or mining activities to be done by the licensee in accordance to rules and regulations set forth by the Ministry of Lands, Mines and Energy;

4. The requirement of each applicant for the exploration or mining license in the A or B category to submit to the Ministry of Lands, Mines and Energy a detailed Environmental Impact Assessment (EIA) study before being granted the right to operate;
5. The requirement for the submission of an environmental Management programme to the Ministry of Lands, Mines and Energy to be met by the holder of the Mining Right before carrying on mining or other related operations on the surface of the land concerned; and
6. The periodic review of the Environmental Impact Assessment (EIA) by the Minister of Lands, Mines and Energy in collaboration with the operator, as defined in the regulations.

Trade

Trade activities, whether they are domestic or foreign, have varying and considerable impacts and linkages to the environment. Changing trade regimes affect the environment, and stricter environmental regulations and public environmental awareness affect trade. Some international environmental treaties related to trade that Liberia is signatory to include the Convention on Trade in Endangered Species of Wild Fauna and Flora (CITES), the Montreal Protocol on the Phase Out of ozone Depleting Substances and the Convention on the Trans-boundary Movement of Hazardous Wastes.

Foreign Trade

Analysis of the country's trade statistics shows that the export sector is limited to few unprocessed primary agricultural and mineral products with limited value added. These include round logs, rubber, cocoa, coffee, gold and diamond. Major imports have been fuel and lubricants, transport equipment, foodstuff (mainly rice), manufactured goods and chemicals. These items averaged about 83 per cent of total imports during the decade before the war (MOC 2006).

Foreign trade is one of the major contributors to GDP. Exports and imports accounted for 64 per cent of the GDP in 2000 and 44 per cent in 2001, which are approximately 73 per cent of 1989 pre-war level. The growth in export earnings, estimated as 14 per cent in 2000/2001 was attributed to increases in rubber and logs export of 9 per cent and 46 per cent, respectively. The trade deficit increased from US$69.2-83.7 million in 2000 and 2001 respectively, an increase of 21 per cent.

The sluggish performance of the foreign trade sub-sector is attributed to the overall poor macroeconomic policy and structural weaknesses in the economy. These weaknesses hinge on good governance concerns, in respect of creating the enabling environment for private direct investment and entrepreneurs financing. The heavy reliance on few primary exports also makes the economy vulnerable to the volatility of commodity markets. Diversification and value addition to locally produced raw materials will be required to overcome such dependence in the future.

Timber Trade

From 2000-2002, forestry represented the country's most important economic activity, responsible for 50-60 per cent of the nation's foreign exchange and accounting for 26 per cent of GDP in 2002. Foreign exchange earnings due to timber in 2002 were in excess of US$85 million (CBL 2002). Other important forest products include sawn timber, round logs, round poles and charcoal. In 1998 export of round logs totalled US$12.3 million and rose to US$23.4 million in 1999, and US$59.5 million in 2000. Due to the UN sanctions on timber, there have been no official exports since May 2003. However, domestic timber trade

continues, with the products coming mostly from illegal operations, using traditional method of operation (pit-sawing).

In March 2003, the IMF stated that the near-term growth prospects of the Liberian economy would rely primarily on timber products from the regions unaffected by the conflict and warned that without effective control mechanisms the viability and long-term sustainability of the forests would be endangered (IMF/MPEA 2003).

Rubber

Rubber is one of the main exports in Liberia. According to IMF, rubber exports have increased rapidly from 1US$9.4 million in 1997 to an estimated US$57.4 million in 2002, despite falling international rubber prices over the period. Rubber production accounted for an estimated 99,569 tons in 2002 (IMF/MPEA 2003). Most of the rubber produced is exported, and only limited rubber processing is undertaken in Liberia.

Domestic Trade

During the conflict most businesses were destroyed and many foreign investors left the country. However, the business sector is now making a slow recovery. It is still small and consists mainly of petty trading in the informal sector.

Fuel Wood and Charcoal

The production of fuel wood and charcoal is also an important source of employment and sale of these goods is a source of supplemental income for many families. In some cases it supplements as much as 40 per cent of their total income. In 1999, charcoal production contributed two per cent of GDP compared to nine per cent in pre-war times. FAO reports that charcoal is being manufactured for export to neighbouring countries that are suffering from a lack of fuel wood due to deforestation (FAO 2002). Liberia's forests are facing significant pressures as trees are cut to meet growing national and regional charcoal demands.

Bushmeat Trade

Wildlife is a major source of protein to rural Liberians, as well as, a source of cash income. Animals are killed and may be eaten locally, or sent raw or smoked to urban areas for sale. Hunting is traditionally a male activity, principally done with firearms, snares and pits, while females sell the bush meat on the roadside or in market places. Most hunting is for domestic consumption. However, with intense forest loss in Sierra Leone and Cote d'Ivoire, bush meat tade in border areas with these countries is increasing.

Surveys over the past years indicate that most Liberians believe stocks of bush meat and wildlife to be inexhaustible, and that hunting has no impact on wildlife populations. By 2002, a large-scale commercial bush meat industry in southeast Liberia began to emerge to meet the growing demand. Traders from Liberian cities, as well as neighbouring countries supply cartridges to local hunters or professional hunters who set up camp deep in the forest. Most of the animals killed are exported. Many forest dwellers are abandoning agriculture in favour of hunting.

Sawn timber hauled to a road-side depot (top), and eventually stockpiled-ready for the market (bottom)

Courtesy of Fauna and Flora International (FFI) – Liberia

Sawn timber hauled to a road-side depot (top), and eventually stockpiled-ready for the market (bottom)

Courtesy of Fauna and Flora International (FFI) – Liberia

Excessive hunting can eliminate almost all animal life in those portions of the forest that are easily accessible and result in what is known as the "empty forest" effect (Hoyt, 2002). Surveys in the forests of Rivers Cestos and Senkwehn surveyed in early 1999 and then again in early 2003 showed a significant decline in the density of wildlife. No reliable estimates

exist on the quantities of animals killed, nor of such meat. As commercial hunting increases, previously held taboos that serve to protect selected species are ignored and resulting in all species being hunted. Commercial hunters are particularly indiscriminate, tending to favour large animals so as to get the biggest return for their efforts.

Hunting is governed by a permit system managed by the Wildlife and National Parks Division of the Forestry Development Authority. But limited logistics and a lack of implementation capacity make the enforcement of the legislation problematic.

Tourism

Introduction

Tourism is the world's fastest growing and largest generator of jobs. It is a principal export earner for developing countries and the most significant source of foreign exchange after petroleum. Tourism creates employment directly or indirectly, facilitates balance of payment, creates wealth and generates tax revenue. It is an economic, social and cultural phenomenon that must grow in harmony with the environment. The Liberia Tourism Industry is a component of this global tourism village.

In 1972 the government of Liberia having realized the economic and social importance of tourism and the discovery of Liberia's natural scenic sites, passed an act creating the Bureau of Tourism within the Ministry of Information, Culture and Tourism. The Bureau's term of reference or general function is to foster, coordinate, supervise and promote the nation's tourism industry. Following the enactment, a 27-man National Tourist Board, chaired by the Minister of Information, Culture and Tourism was created. After the creation of the Bureau of Tourism and the National Tourist Board, a short-term plan was prepared which included a policy framework for the development of tourism in Liberia. Following this, some potential tourist resorts were identified. They are listed in box 8.2.

Box 8.2: Potential tourist resorts

a) Massatin island on Lake Piso
b) Providence island
c) The National Cultural Center
d) Beaches
e) Mining and agricultural installations
f) Hotels, Motels, Historical sites and special habitats suitable for the development of a viable eco-tourism sectors

Liberia Tourism Industry, like other tourists generating and receiving countries, indicates positive sign of rapid economic growth. It is one of the nation's biggest foreign exchange earner and a major source of employment directly and indirectly. As a result of Liberia's flexible Free Enterprise System, many foreign and local entrepreneurs have invested in the Liberia Travel and Tourism industry, including the accommodation sector.

Potential Sites for the Development of Eco-Tourism

There are considerable numbers of potential natural tourist sites and bathing beaches that provide the basis for the development and promotion of tourism in Liberia. Among these are the country's special habitats. Special habitats are areas rich in biodiversity. They also accommodate endemic, threatened and endangered species of wild fauna and flora. Their functions range from regulatory to productive. Because of their important contributions to society, it is useful to have them protected and conserved.

The preceding chapters have adequately described the rich natural resources that Liberia has. These have included lagoons, islands, lakes, rivers, mangroves, rivers, wetlands, and sandy

beaches. These resources all provide opportunity for recreational activities such as fishing, swimming, and surfing among others. As such they can support a vibrant tourism industry. For instance, apart from their beautiful landscape wetlands and swamps are home to mangroves, assorted fish species, catfish, tilapia, the pygmy hippopotamus, crocodile, snakes, migratory waterfowls and other exotic species. Some wetland areas that are potential tourist attraction are described in box 8.3.

Box 8.3: Some wetland attractions in Liberia

The Marshall wetlands

The Marshall wetland is located within the Farmington and Du river basins. The catchment area of the combined Farmington and Du river basin is approximately 4,000 sq km. It has some of the most attractive sites in Liberia. The mangroves are intact and fish, and birds are in abundance. This wetland contains few uninhabited islands. The adjacent Biological Laboratory (VILAB) is re-introducing chimpanzee in the wild. The chimpanzees are caged in research laboratories where they are being used for hepatitis (A, B &C) research. The New York Blood Center, an affiliate of the Laboratory plans to build an Environmental Resource Center for nature study and tourists.

Gbedin wetlands

Gbedin is an island extended swamp area located in northern Liberia between Ganta and Sanniquellie, Nimba County, and is known for swamp rice reproduction. Gbedin falls within the Upper Guinea Forest priority status (B5).

Kpatawee wetlands

Kpatawee, an inland riverine, is located about 105 miles north of Monrovia in Bong County. The Kpatawee Special Rice Project was introduced by the Ministry of Agriculture and was successful until the civil crisis.

Cestos-Senkwehn riversheds

The Cestos-Senkwehn wetlands are small and narrow inland basins situated between the Cestos and Senkwehn rivers in Sinoe and RivercesscCounties. The catchment area of the Cestos river basin is approximately 14,000 sq. km., of which 11,500 sq. km is in Liberia and 2,500 sq. km in the Ivory Coast. The total catchments of the Senkwehn River Basin is about 5,500 sq. km and is totally located in Liberia. Although characterised by little disturbance, human activity is on the increase especially from human settlements, hunting, logging and mining.

Bafu bay wetlands

This is located in the southeast along Bafu river in Sinoe county. Beach deposits are mainly of unconsolidated deposits of white quartz and from savannahs near the coast. Lagoon deposits include silt, sand and clay. These deposits are derived from the sea via tides and become trapped in mangrove swamps. This area is one of the few places along the coast adjacent to the evergreen forest (Upper Guinea Forest-C1) and with potential for tourism. The major activity in this area is fishing.

Mesurado river wetlands

This area covers about 60 per cent of Monrovia. Due to its proximity with Monrovia, it is under intense pressure from human activitiy. The area is noted for many birds, fruit bats, crocodiles, duikers and monkeys. The river banks and mangroves contain shrimps, crabs, lobsters and oysters.

Lake Shepherd

Lake Shepherd is located in Harper, Maryland county and is about 7 km long and less than 1km wide. It has been best described as a long and narrow lagoon parallel to the coast. The coastal area is characterized by narrow sandy lagoon parallel to the coast by narrow sandy beaches separated by rocks and backed by broad rolling savannahs. Beach sands lagoon deposits obscure much of the underlying rocks in the area. The presence of the sand bars especially during the Rainy Season makes navigation difficult by canoes; as such, the inhabitants are compelled to open the sand bars two to three times a year. Accordingly, navigation is only possible when the lake is filled, and a high water level facilitates fishing.

Historical Heritage
Liberia's historical heritage finds expressions in buildings, monuments, sites, and archives. Museums and archives are fewer in the country than buildings, monuments and sites. In the hinterland, only a few buildings and sites are identified, explained in part by the absence of record keeping.

Buildings of Historical Significance
There are two main types of buildings in the rural areas. One for use by the Poro and the other designated for deliberation on issues relating to Sande. Also in the rural areas are structures that used to be used by blacksmiths to produce old-fashioned farming tools, knives for daily use, as well as implements for war, A few of these structures still stand today.

Most of the historical buildings are in the urban centres. A number of these structures date from the middle of the nineteenth century and were constructed by settlers. The residence of President William David Coleman is one of the historic buildings. Coleman was the first president to initiate a policy of national integration. President Coleman's residence is a one storey building located on Gurley and Sao Boso Streets in Monrovia.

The house in which the organization of African Unity (OAU) was born is dilapidating slowly in Sanniquellie city, Nimba County. Here in July 1959, President William V.S. Tubman of Liberia, Prime Minister Kwame Nkrumah of Ghana and President Sekou Toure of Guinea met and drew the blueprint for the OAU.

The Law Library on Ashmun Street in Monrovia is another building of historic significance. It is also of American south design. The house was built by President Joseph Jenkins Roberts, the first President of Liberia, and used by him as his official residence and later by other chief executives as State House.

Law Library Building on Ashmun Street

Courtesy of UNDP Energy and Environment Programme - September 6, 2006

An important monument stands in Voinjama city, Lofa County. After a century of social and political conflict, the Unification monument was built as a sign of reconciliation between two

Liberian cultural groups. At the top of a stone elevation is a statute of a man dressed in western attire – a three-piece suit.

Historic Sites

Like historic buildings, many of the historic sites are found in urban centers along the coast as a result of the Americo-Liberians. It is likely that there are a lot more historical sites in the hinterland, which have not been identified. One unidentified site in Monrovia, is the intersection of Ashmun and Center streets. It is the scene of the Battle of Fort Hill, fought on (November 1, 1822) between a handful of settlers and a horde of natives. Later this was declared a national holiday to be known and observed each year as Thanksgiving Day. Other sites include:

- Less than a hundred yards off the shore of Monrovia is perhaps the most important historic island in Liberia, Providence Island. Originally known by Dei name, Dazoa Island, this is where the first settlers landed on January 7, 1822. Providence is used today for recreational purposes and not as a tourist center or historic site. Sadly, some portion of the Island is used as dumpsite.
- A square block known as Government square, in Monrovia contains several of Liberia's historic heritage, monuments and buildings.
- In Government square a monument erected to the memory of Matilda Newport, heroine of the Battle of Fort Hill fought in November 1822. Also in Government Square is a monument, obelisk in form, erected in 1922 to commemorate the centenary of the landing of the settlers on Providence Island. The tomb of Liberia's eighteenth and longest serving president, William V. S. Tubman, is located in Government Square.
- The grave of seven Bandi leaders in the Kolahun area of Lofa County. This is where seven opinion leaders of the Bandi tribe were made to dig their own graves for refusing to accept the legitimacy of an imposed government official. This occurred during the first decade of the twentieth century.
- In Gompa city, Nimba County is an unidentified historic site that is the grave of the Mano warrior-king who led the migratory march of the tribe from present day Guinea. According to oral history the general was interred with some of his war implements. Although descendants of the king look up the site, it does not appear different from any other grave surrounding the area.

Museums

The perception of museums and their contents is a presentation of the nation's history and the cultural orientation of its people. There are Americo-Liberian artifacts, found in museums, which fall into two broad categories of public and private monuments. The implements of a warrior's family, for examples, fall into the category of private collections. All other tools used by the Poro and other secret societies are preserved in private museums scattered all over the country and not recognized at national level.

Museums of national importance date back only to the administration of President Tubman (1944-71). Before then they were private collections in homes. The National museum in Monrovia is the only one of its kind in the nation. Its contents are largely Americo-Liberian. This is explained by the fact that it is Americo-Liberians who determined the course of Liberia history for over a century. The National museum did not escape the horrors of the civil war and is in need of urgent repair. It is also recommended that the contents of private and individual museum be consolidated.

Masonic Temple – Benson Street, Snapper Hill, Monrovia

Courtesy of UNDP Energy and Environment Programme - September 6, 2006

Archives

One of many marks of a historical conscious society is its archives or its organized body of records. This is institutional memory. By this definition tribal society is an exception since archives are not a part of tribal culture due mainly to the absence of indigenous writing. The archived material was passed orally down the generations and was not for public use or consumption. Rather it was religiously guarded by either the Poro or Sande societies.

From 1848 to the turn of the nineteenth century, archives in Liberia were represented by private collections. Given the shared values of the settler community personal archives were treasures honoured by the community. Since the end of the nineteenth century public and private interest in archives declined due in part to the diversion of human and material resources from aesthetics and other social activities to territorial expansion and other aspects of nation building. The result has been a lack of development of the archival industry. Liberia has only one archive, the National Archive in Monrovia. Its contents are neither comprehensive in terms of time nor are they representative of the entire spectrum of the nation. The administrative personnel lack capacity. During the war it was looted and vandalised. Recently, the public building constructed for the Archive Centre was instead given to the National Investment Commission during the administration of President Charles Taylor.

Transport

Transport is important factor in the support of development as it facilitates trade, tourism, mobility and cultural exchange. Roads are the major form of transport in Liberia, but many of the roads are in poor condition and the vehicle fleet especially taxi cabs are not well

maintained. Many rivers in Liberia are not navigable and, therefore, do not support water transport. The transport sector is highly vulnerable to sudden disruptions caused by failures in the oil important system and fuel price increases.

Walking is the major means of transport especially outside of Monrovia. About 75 per cent of the people walk between towns and villages. In the rural areas, less than 2 per cent of the people rely on commercial transport for their daily activities, formal sector work, shop, markets, schooling, hospital and visiting. About 90 per cent of households in the rural areas depend on walking, while 47 per cent of those in the urban center walk (MHSW 2002). The sick and elderly are sometimes carried in wheel barrows and makeshift transport equipment. Some makeshift transport equipment are used also to transport people on abandoned railways.

"Make it Rail" – a local transport system-Kokoya, Bong County

Courtesy of UNDP Energy and Environment Programme - February, 2006

There is no national organized transportation system, except for the Monrovia Transit Authority (MTA), which mostly caters for Monrovia and its environs. During the war, the headquarters and fleet of the Monrovia Transport Authority were looted and vandalised. There are no private transport companies, and so there is over-reliance on individual vehicles registered to serve the public, mostly taxicabs and mini buses. Most of the vehicles are based in Monrovia, and getting in out of Monrovia by means of public transportation is extremely difficult.

One problem is the lack of organized terminals and taxi stands. Although there are transport unions, buses and taxis organize their own parking places. In most cases these are at commercial centres. This situation poses serious environmental problems, as the parking lots are not well maintained. They are littered with plastics and empty cartons. In most marketplaces where this occurs, drainage channels get clogged with debris and can lead to flooding during the rainy season.

Conclusions and Recommendations

The trade and industry sector has contributed immensely to economic and social development of the country from the early 60s to the mid 80s. But its effects on the physical environment, especially the mining sector, were and still are apparent. The following are some recommendations for improvements in the sector.

1. Excavations in mining areas should be maintained and protected so that they do not pose danger to people and domestic animals; all dump dams should be left in a state that does not endanger lives and property;
2. Use of mercury in mining contaminates ground and surface water; use of mercury should therefore be well regulated;
3. There should be environmental impact assessment for mining areas so as to avert the situation of polluting water bodies; there should also be institution of public health standards, including use of protected shields;
4. Rubber produced in Liberia is processed out of the country; there is need for a legislation to compel major rubber companies like Firestone to process rubber in country to produce tires and other finished products;
5. Campaign should be mounted to identify historical sites, monuments and buildings outside of Monrovia and other large cities;
6. Encourage the return to blacksmithing as a means of inducing appropriate technology;
7. Refurbish the Sanniquellie house of the birth of the Organization of African Unity and memorial to William V. S. Tubman, Sekou Toure and Kwame Nkrumah;
8. Erect/construct more museums and return the National Archives Building on Tubman Boulevard to the rightful bureau of the Government; and
9. There must be regulation to mandate the transport union acquire parcels of land all over the country for parking lots.

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9 ENERGY AND CLIMATE CHANGE

Introduction

Liberia is experiencing an energy crisis that was compounded by the civil crisis. The absence of electricity coupled with the lack of substitute energy carriers such as LPG and bio-fuels (gasoline extenders) is expected to escalate the pressure. Increasing population and demand for fuelwood and charcoal is putting pressure on environmental resources. The inefficient use of fuelwood and charcoal at the household level also has implications for health.

This chapter describes the energy situation and efforts to deal with the country's energy problems. It also describes the state of climate change in Liberia and the action being taken to address the potential consequences of climate variability and change. Although Liberia's contribution to global greenhouse gas emissions may be negligible, it is very vulnerable to the impacts of climate change. This is therefore a problem it cannot afford to ignore.

State of Energy Production and Use

Liberia has significant primary energy resources. The major ones are biomass, hydro-electricity, petroleum and renewable energy resources. The sector plays a crucial role in the development of the economy. It is a major component of the country's infrastructure and supports economic activities and social development. For example, it is well documented that energy is central to reducing poverty and hunger, improving health, increasing literacy and education and improving the lives of women and children.

Before the civil war, it was estimated that the total installed electricity generation capacity was 412 MW. Over half of this was owned by the private sector. The Liberian Electricity Corporation (LEC) had a 64-MW installed hydel capacity, accounting for 33 per cent of its total pre-war capacity. Overall, 52 per cent of pre-war capacity was heavy fuel (bunker) oil (HFO) thermal, 31 per cent light oil thermal and 17 per cent hydel (CBL 2000).

The civil war destroyed the nation's energy infrastructure. But it provided the impetus to switch from the 120/240V, 60Hz North American Power System to the 400/230V, 50Hz IEC/West African Power System. This has enhanced its chances of interconnecting to the power facilities of the neighbouring countries such as Cote d'Ivoire.

Biomass Energy

The proportion of the population relying on biomass (firewood, charcoal and palm oil) for their energy needs is 99.5 per cent (UNDP 2004). This trend poses a threat to biodiversity and forests, since the production of these traditional fuels is done in an unsustainable manner. It is estimated that 960,000 trees are cut down annually to produce charcoal for the Monrovia area alone (CBL 2000).

The fuelwood and charcoal market is a lucrative one, generating employment and sometimes as much as 40 per cent of their total income. For example, the Central Bank of Liberia reports that in 1998 a total of about 14,800 kilograms of charcoal were produced, rising to 225,600 kg in 1999. Charcoal production in 1999 accounted for 9 per cent of GDP, up from only 2 per cent before the war (CBL 2000). The FAO reports that charcoal is fast becoming an

important export commodity. The slow pace of restoring electricity supply will result in the continued use of charcoal (FAO 2002).

An important social issue concerning fuelwood use is indoor pollution and the time and distances traveled to collect firewood. The rural three-stone and urban cook stoves are inefficient technologies, and the smoke produced especially where ventilation is poor results in health problems especially for women and children.

Electricity

Demand and Growth

Beginning in 1960, with the creation of the Monrovia Power Authority, power consumption in the capital grew exponentially over the first 10 years while fuel was cheap. From 1970-80, growth was much slower as tariffs increased drastically to meet rising fuel costs. On average over this 20-year period, electricity generation grew at 12.6 per cent annually from 45-428 GWH, while peak demand increased at 11.2 per cent annually from 9-68 MW.

Under the rural electrification programme, which began in 1978, total installed capacity was 13 MW in 1990. In 1981, peak power demand ranged from 100 kW in Bellefanai with a 3 per cent annual projected growth rate, to 1.4MW in Gbarnga with a 7 per cent projected annual growth rate. By 1988, Bellefanai's peak load had increased to 160 kW. Rivercess had come on stream at 110kW and Gbarnga had grown to 1.98 MW. Future projections were based on an average 5 per cent growth rate with 20.5 MW predicted in 1999 (Konai 2004).

Demand for electricity is forecast to rise at an average of 10.3 per cent per year to 2010, then average 3.4 per cent to 2020. Peak power demand forecast for 2020 is 120 MW, and energy demand 1,100 GWh (Konai 2004).

Generation Facilities

Before the war, the Monrovia Power System consisted of both thermal and hydro-generating facilities with a combined installed capacity of 182MW. The Mount Coffee Hydro Power Plant accounted for 64MW and thermal power plants consisting of the gas turbines plant, the slow-speed diesel (Luke Power Plant) and the medium-speed diesel (Bushrod Power Plant) contributed 68MW, 40MW and 10MW respectively. The average annual energy production of these plants stood at 435.0GWh in 1989 (Konai 2004).

Today, the LEC Monrovia Power System consists of one generating plant with a combined installed capacity of approximately 6.9MW. The Bushrod Power Plant consists of 5x1720kVA medium-speed SKODA diesel generating units (Konai 2004).

Transmission and Distribution

The transmission and distribution facilities consisted of ten manned and six unmanned substations with a combined installed transformer capacity of 260MVA. The transmission network consisted of double and single circuits 69-kV lines that spanned about 460km strung on wooden poles, lattice steel towers and tabular steel poles and extended 45km northeast to Kakata City, 29km northwest to Tubmanburg and 121km southeast to the City of Buchanan. The distribution network consisted of approximately 800km of 12.5kV overhead and underground circuits. All of these facilities were virtually damaged due to the civil conflict. To date, over 12km of 11-kV distribution lines spanning parts of Bushrod Island and central Monrovia have been rehabilitated using retrieved materials. This rehabilitated portion of the

network constitutes about 25 per cent of the first-phase zone that was earmarked for Project LUX.

With all of the LEC facilities damaged as a result of the war, it became appropriate to effect the long-awaited power system frequency change-over. Until then, Liberia was the only country in Africa that operated a power system based on the North American standard of 60Hz, 220/110V customer voltage. Today, Liberia has effectively converted its power system from the North American standard of 60Hz, 220/110V to the IEC or West African standard of 50Hz, 400/230V customer voltage.

System Losses

Non-technical losses have been very high over the years, in particular, when limited operation re-commenced three years ago. These losses accounted for nearly 40 per cent of the generation. High-energy theft rate on the LEC distribution network continues to be the main factor responsible for the LEC's inability to sustain its operations**.** The high losses hamper efforts to allocate resources efficiently which in the long run could adversely affect the environment. The LEC recently established the Energy Monitoring Department to address the matter.

Tariffs

Operating expenses between 1970 and 80 increased sharply due to increased fuel prices and general inflation. In 1974 tariffs were increased 40-60 per cent, depending on consumer category, in order to meet operating expenses. The current tariff is US$0.25 per kilowatt hour (kWh). This is not felt by the general public due to the absence of electricity supply. With 100 per cent electricity production generated from oil products, increases in crude oil prices will have devastating effects on the cost of electricity (ECOWAS 2006). When electricity is restored, there will be need to initiate social tariffs especially in light of the poverty situation. Social tariffs are designed to serve social and welfare objectives.

Rural Electrification System (RES)

The development of rural electrification dates as far back as 1954, when four individual power stations with a total installed capacity of 13-MW were constructed in Robertsport, Grand Cape Mount county, Buchanan, Grand Bassa county, Greenville, Sinoe county, and Harper, Maryland county. Eleven outstations were established before the war and an additional three were under construction at the onset of the war. At this time, the Rural Electrification System had 90 miles of 12.5-kV three-phase and 7.2-kV single-phase distribution lines and 26 miles of low-voltage service lines, about 570 distribution transformers and more than 1 700 wooden poles. At the onset of the civil war, the total number of consumer connections had grown to about 9 000, of which the Gbarnga outstation was by far the largest with 2 500 connections. The Rural Electrification System served people in eleven population centers in rural Liberia.

The principal goals for rural electrification are to:

- further the economic and social development of all parts of Liberia by providing reliable, reasonably priced power for the major centres of economic activity in the interior areas, and
- make use of local wood and hydroelectric energy resources for electric power generation in these demand centres, whenever these can be developed at costs below those for petroleum fuels. The recommended general institutional policy direction is to increase local responsibility and authority for electricity supply in rural areas.

Hydroelectric Power

Prior to the civil crisis in 1990 there were two main hydropower stations with a total generating capacity of 64.8MW or 24 per cent of the total installed capacity of 304 MW in the country. These were the Mount Coffee and the Firestone hydro-power plants. A community micro-hydro power station of 30 kW was also operational at Yandahun in Lofa County). The Mount Coffee and Yandahun Plants were destroyed during the war but the Harbel plant is still operational.

The Mount Coffee Hydropower Plant was basically a run-off river type located on the St. Paul River about 21 miles from Monrovia. Owned and operated by the Liberian Electricity Corporation, the first phase of the project was completed in 1966 and consisted of two generating units with installed capacity of 34 MW. In 1973, two additional turbines were added to increase the plants output to 64 MW. The plant's dependable capacity is limited to 10 MW, which corresponds to generate at minimum flow (the normal flow) in the river during the dry season. This power station has not been operational since 1990 due to damage done to it as a result of the war.

The Firestone hydro-power project was the first hydroelectric power station to be built in Liberia. It was constructed in 1942 at Harbel on the Farmington River to meet the demands at Robertsfield and the U.S Military Base. This station, which is still being operated by the Firestone Plantations Company, consists of four generators with a total capacity of 4.8 MW, which amounts to annual energy production of 1.6x10 3 KWH.

Firestone Hydro –Electric Dam – Harbel, Margibi County - Liberia

Courtesy of UNDP Energy and Environment Programme – May 2006

Petroleum Products

Liberia Petroleum Refining Company (LPRC)

The Liberia Petroleum Refining Company (LPRC) was established in 1978, following the Government's purchase of the assets of Liberia Refining Company, owned by two American firms, Sun Oil Company and Dynalectron Corporation, and Liberian shareholders. The refinery was operated by Sun Oil until late 1976, when it was shut down as a result of a major fire. Although the refinery's rated capacity was 15,000 barrels of crude a day, actual output

never exceeded 12,700 barrels per day (b/d). Production capacity included 200 BDOE of LPG, 2,300 b/d of gasoline, 1,200 b/d of jet fuel/kerosene, 3,300 BDOE of gas oil, and 7,500 b/d of fuel oil.

In 1983, The People's Redemption Council decided that LPRC should import all its products, in effect shutting down the refinery. To date, all petroleum products are imported in the country. In 1982, the country's oil import bill was US$94 million, representing 22 per cent of its total import bill.

Petroleum Exploration and Development

Exploration for petroleum in Liberia's offshore areas began in 1968 when seismic studies and drilling took place in the shallow waters of the continental shelf. Despite several encouraging findings during this early period of exploration, work was stopped in 1972 after four dry wells had been drilled. In 1980, a World Bank loan was obtained to carry out seismic studies in the hope of attracting renewed interest on the part of oil companies. This proved successful in 1983, when Amoco obtained the rights to explore six of Liberia's nine offshore "blocks". Drilling commenced in October1984. The first two wells showed interesting conditions, but no significant quantities of oil or gas. Another loan in 1984 was to provide funding for more detailed seismic exploration in the blocks not taken by Amoco.

Onshore exploration for oil and natural gas began in the Roberts and Bassa basins in 1981 when exploration rights were granted to a private group, Katana Resources, Incorporated. Air-borne gas sensing surveys were carried out, and plans were made for drilling. However, in 1982 Katana experienced financial problems and relinquished its rights in the area.
According to the ECOWAS white Paper for Regional Energy Policy, Liberia is among the countries with no crude oil reserves, no natural gas reserves and no coal reserves (ECOWAS/UEMOA 2006).

Development of Renewable Energy Technologies

Renewable energy (sources) includes all sources of energy that are captured from on-going natural processes, such as solar power, wind power, water flow in streams (hydro power), biomass, bio-diesel and geothermal heat flows. Renewable energy technologies are environmentally benign. They include sources of energy captured from natural on-going processes such as solar power, wind power, hydro-power, biomass, bio-diesel and geothermal heat flow.

The LEC has already recognized the need to pursue the development of small to medium scale renewable energy sources such as solar, mini-hydro and biomass and this must be supported and encouraged. These options should be considered as part of a plan to provide electricity services in areas not served by the Monrovia grid. UNDP has undertaken solar energy needs assessment, and has initiated a process that would enable provision of solar panels to some rural communities in Grand Cape Mount and Bong Counties. The communities will expand depending on realization of the MDG Village concept in Liberia. UNDP sees this as a way of reducing energy shortage and a means of poverty reduction.

For the many people without access to basic energy services and with no prospects of getting such access, renewable energy can often be the cheapest option in the long run. However, scarce financial, human and institutional resources as well as cultural issues constrain the sector. For instance, socio-cultural beliefs surrounding the use of human waste as biogas feedstock, and high investment costs have hampered the development of biogas in Liberia.

The available data indicates that only one biogas digester exists in Liberia and it is located in Galai, Suakoko district, Bong County. Other issues in the development of renewable energy technologies are highlighted in box 9.1.

Liberia is situated in a low wind region. Although information is scanty, wind power does not offer promising potential as a renewable energy resource. Liberia's high rainfall climate means annual insolation (sunshine) levels are generally very low along the coast but significant inland. So solar photovoltaic (PV) and thermal applications offer the greatest potential inland, especially for medical facilities where cold facilities are required.

Box 9.1 Major constraints to the development of renewable energy technology

- Lack of baseline data on renewable energy resources,
- Lack of an integrated national energy policy that identifies the feasible niches for the development of RET,
- Low level of skills in renewable energy technical;
- Inadequate dissemination and commercialization strategies,
- Lack of community education and public awareness;
- Lack of investment to develop RETs, and
- Failure to ensure that RETs are properly integrated into the economy, environment and culture of local target beneficiary communities.

Energy and Climate Change

The Link between Energy and Climate Change

Energy production and use are contributing to a global phenomenon called climate change. Climate change is one of the most serious threats to the environment today (IEA 2004). It is caused by the emissions of greenhouse gases into the earth's atmosphere. The greenhouse gases of interest to Liberia are: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbons (CFCs). Carbon dioxide (CO_2) is responsible for 50-60 per cent of the local emissions into the atmosphere in Liberia (NBSAP 2004). Most of these come from the consumption of petroleum products.

Key sources of greenhouse gases in Liberia include fuel combustion in power plants and transport, the use of charcoal and fuelwood, burning of forests products for agricultural purposes and the burning of solid wastes. There are other minor sources such as industrial fuel combustion and emissions from vehicle and aircraft exhausts. Thermal power plants are a major source of greenhouse gases as well as suspended particulate matter and oil waste. The breakdown in electricity supply over the years led to the proliferation of generators in the country. It is estimated that there are about 45 000 small privately operated generators, concentrated mainly in Monrovia (EPA 2004). Air pollution from vehicle emissions is increasing especially in Monrovia where the main fleet is concentrated and traffic jams are a common feature. The majority of imported vehicles are second hand, their efficiency is low and they are prone to above average emissions.

The National Capacity Self-Assessment project identified a number of activities in Liberia that contribute to climate change. These include:

- Shifting cultivation with a fallow period of less than 12 years,
- Uncontrolled logging,
- Charcoal production,
- Lack of resources to develop adaptive capacity,
- Lack of public awareness, education and training,
- Lack of data on national GHG emissions, and
- Improper waste disposal.

Some suggested measures for adapting to and coping with these issues are: cultivation of climate-tolerant varieties of plants and animals; promotion of irrigation; sustainable forest, fishery, wetland and water resources management; development of partnership and technology transfer; and the implementation of identified mitigation and adaptation strategies.

On a global scale, Liberia's contribution to global warming is negligible. But chances are if climate change continues, Liberia is likely to be disproportionately affected by the impacts of climate change.

Impacts of Climate Change

Increasing GHG emissions may cause dangerous changes in the climate system. Higher temperatures and more extreme weather events are likely to have major impacts on people and the environment. These impacts will be most severe in the least developed countries where people depend on climate-sensitive sectors for their livelihoods. Liberia will be highly vulnerable to climate change due to limited adaptive capacities and widespread poverty.

Sea level rise and increased flooding are some of the expected impacts. It is predicted that global warming will be accompanied by a rise in sea levels of as much as 60-100cm over this century (EPA, 2005). This could result in the subsidence of low-lying coastal areas or communities such as West Point Township and Buchanan with consequences for Liberia's coastal communities, biodiversity and ecosystems.

Over the past 40 years Liberia has experienced a number of climate-induced disasters, including floods in West Point Township (1965), Kakata (1983), Suakoko District, Bong County (1984), Jagaka town, Grand Cape Mount county (1997), Zoe-geh and Gbelly-geh districts, Nimba County (2001), and Gbarnga (August 2005). The Meteorological Service of UNMIL predicted that a violent hurricane would hit Monrovia on July 25-26, 2005 but fortunately this never occurred.

It is said that global warming could extend the range of disease-causing vectors such as mosquitoes. This could lead to an increase in diseases such as malaria. Forests and wetlands could be affected by higher temperatures and changes in rainfall. The possibility of forest fires becoming more intensive and frequent will be high. Any significant change in the climate in Liberia will also disrupt the growth of some crops in certain seasons. Farming practices will also be expected to change with the change in climate.

Efforts to Deal with Climate Change

The UNFCCC and Kyoto Protocol

A number of international responses to climate change have been adopted. These include the United Nations Framework Convention on Climate Change in 1992 and the Kyoto protocol in 1997. The Kyoto Protocol set legally-binding GHG emissions reduction targets for industrialized nations (Annex I Parties). Several mechanisms are available to help the Parities achieve their commitments, including emissions trading, joint implementation (JI) and the Clean Development Mechanism (CDM).

Implementing the UNFCCC in Liberia

Liberia ratified the UNFCCC in November 2002 and began an 18-month National Adaptation Programme of Action (NAPA) project in February 2004 in line with Decision 28/CP.7 of the

Conference of the Parties of the UNFCCC. This project, funded by the Global Environment Facility (GEF), is implemented by the United Nations Environment Programme (UNEP), and executed by the Environmental Protection Agency (EPA). The project management team is directly supervised by the National Committee on Climate Change (NCCC), consisting of a number of key stakeholders from civil society, the public and private sectors. The NCCC, chaired by the Ministry of Lands, Mines and Energy was established to coordinate all climate change enabling activities such as policy and community education and public awareness initiatives. The NCCC liaises and collaborates with the UNFCCC Secretariat and the IPCC Secretariat through the climate change focal point at the EPA. The NCCC comprises Task Forces on GHG Inventory, Mitigation, Cross-cutting Issues, and Vulnerability and Adaptation.

Each party to the UNFCCC is required to prepare and submit national communication to the UNFCCC Secretariat, spelling out adaptation options and mitigation strategies. Article 4 requires parties to compile, periodically update and publish national inventories of anthropogenic GHG emissions and sinks, using comparable methodologies. The Global Environment Facility (GEF) is providing financial and technical assistance to Liberia to conduct its national inventory.

The National Capacity Self-Assessment (NCSA) Project
The National Capacity Self -Assessment (NCSA) project aims at identifying gaps and priority needs for capacity building at various levels. The purpose is to meet successfully Liberia's obligations under the three Rio Conventions – the UNFCCC, CBD and UNCCD. The National Capacity Self-Assessment project identified a number of key issues and actions that need to be taken into account when efforts are made to address climate change in Liberia.

Policy and Legal Framework for the Energy Sector

Energy Legislation
The National Environmental Policy, the Environmental Protection Agency Act and the Environment Protection and Management Law provide the basis for any discussion of sustainable energy systems in Liberia. The Policy in Section 5.4 recommends the development and use of renewable energy resources, energy conservation, and the equitable access to energy for all socio-economic sections and geographic regions of the country.

The ECOWAS Energy Protocol
The ECOWAS energy protocol was signed by ECOWAS heads of state in December 2003. It establishes the framework for promoting long-term cooperation in the energy field to facilitate increased investment in the energy sector and increased energy trade in the region. The energy protocol calls for the swift elimination of cross-border barriers to trade in energy, and encourages investment in the energy sector by providing for investor friendly terms.

Institutions in the Energy Sector

National Energy Committee (NEC)
In 1980, the government created the National Energy Committee with the mandate of coming up with an integrated national energy program for Liberia which was finalized in 1985. The NEC was an inter-agency body of six ministries and 3 public corporations including the Liberia Electricity Corporation, Liberia Petroleum Refining Corporation, Forestry Development Agency, the Ministry of Planning and Economic Affairs as well as Lands,

Miners and Energy. In June 1985, the NEC submitted to government the Integrated National Energy Program representing the culmination of over three years of energy data collection, analysis and institution-building efforts. Constitution of the NEC should be revisited, and its mandate should be renewed to conform to present-day issues and realities.

Other Institutions

There are many organizations engaged in energy-related programmes which include specific concerns with one or more aspects of energy supply and consumption. These include:

- Liberia Electricity Corporation (LEC) – Planning, generation, transmission, distribution and sale of public electricity;
- Liberia Petroleum Refining Company (LPRC)- Importation, storage, transportation and sale of petroleum products;
- Forestry Development Authority (FDA)-Regulation of biomass energy production, research and development of biomass technology;
- Liberia Water and Sewer Corporation (LWSC) – Significant use of energy for the production of drinking water;
- National Oil Corporation of Liberia (NOCOL)- Domestic petroleum exploration and development;
- Ministry of Rural Development (MRD)-Energy for water provision in rural areas;
- Ministry of Lands, Mines and Energy (MLME)-Coordination and supervision of energy sector activities;
- Ministry of Transport (MOT)- monitoring, among other things, of GHG emissions and pollution by transport vehicles and equipment;
- Ministry of Planning and Economic Affairs (MPEA)-Coordination of planning activities in the energy and other sectors;
- Environmental Protection Agency (EPA)-monitoring and evaluation of impacts of economic activities in the energy and other sectors on human health and the environment.

Strategy for Improving Energy Services

A three-pronged strategy has been proposed for enhancing the delivery of energy services. These include reform of the electricity sector, rehabilitation of the Monrovia power system and the use of independent power producers.

Electricity Production in Liberia

Electricity Sector Reform

The Special Executive Committee on Electricity (SECE) established by the National Transitional Government with support from the European Union undertook a study on the "Liberalization of the Electricity Sector". The main objective was to encourage private sector participation in the sector. The EU has also funded other activities including studies on institutional, legal, regulatory, transmission, distribution and demand issues. These have been consolidated in the "Strategy Blueprint for the Liberalization of the Electricity Sector of Liberia".

Monrovia Power System (MPS)

The initial strategy is to commence rebuilding the system in Monrovia by installing a modular plant capable of taking over from the SKODA diesel generators. The SKODA sets would be kept functional as long as possible and will provide some back up to the modular plant. The distribution network will be extended as required. The overall strategy for the

medium term is to work toward a combined thermal and hydro generation system similar to what existed before the war but based on diesel or heavy fuel oil-fired.

Independent Power Producers (IPP)
In the interim leading to the full realization of liberalized electricity sector for Liberia, which is being vigorously pursued, the Government is under tremendous pressure to provide the City of Monrovia some level of electricity supply. In response the Energy Power Project was inaugurated on 26 July 2006 with the aim of providing electricity on the streets and public facilities.

Electricity Production in ECOWAS
The West African Power Pool is an ambitious project initiated by ECOWAS energy ministers. The WAPP aims at integrating the fragmented national power systems of West Africa as a means of increasing access to stable, reliable electricity at affordable costs. It provides a great opportunity for Liberia, to act in concert with the other ECOWAS states to address the power problems afflicting the region.

Energy Efficiency and Conservation
Liberia's per capita energy consumption is very low and the efficiency with which energy is used in the economy has deteriorated over the years. The potential for more efficient use of energy exists, but should be identified and implemented in a strategic manner. Considerable room for improvement seems to exist in the efficiency of Liberian cooking stoves. The Environmental Foundation for Africa, with support from UNHCR, has produced the eco-stove. Consumption of charcoal, using the eco-stove, is low and yields the same result as the traditional charcoal stove. Consequently, a family using eco-stove consumes one third of the charcoal per week that a family using the traditional charcoal stove uses. This simple and appropriate technology needs to be widely adopted.

Conclusions and Recommendations

Achieving a sustainable energy supply is central to sustainable development and poverty reduction efforts. It is well documented that energy is central to reducing poverty and hunger, improving health, increasing literacy and education and improving the lives of women and children. Given the magnitude of the present national energy crisis, there is need to design a comprehensive national energy policy that will ensure sustainable development and management of national energy resources. It should incorporate all energy options in light of the vision of the national socio-economic development plan as well as provisions of the international energy conventions Liberia is party to.

It is likely that the use of biomass energy is set to increase in Liberia. Therefore more efficient technologies for consuming fuelwood are thus required. These improved technologies would reduce on indoor pollution and contribute to better health for both women and children. The national policy should encourage the development of renewable and traditional energy sectors. This will strengthen institutional coordination and reduce pressure on forests through less wasteful energy use, deforestation and health problems.

Specific activities that could be carried out include:
- A series of workshops on sustainable energy should be held to discuss the potential economic, social and environmental benefits of developing and adapting small-scale

decentralized power supplies that use renewable energy resources and are aimed at rural communities in Liberia,

- Implement an 'energy villages' project on different energy options that if successful may be replicated in other areas of the country,
- Create an independent national energy commission to supervise, monitor and regulate the energy sector,
- Create local rural electricity authorities to manage, operate and maintain rural energy schemes under the supervision of a national rural electrification body. These should be independent of the Liberia Electricity Corporation,
- Rehabilitate existing electrical infrastructure and expand their capacity where possible,
- Support continuing efforts to develop and demonstrate more energy-efficient technologies such as eco-stoves.

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PART 4
ENVIRONMENTAL GOVERNANCE

10 ENVIRONMENTAL GOVERNANCE

Introduction

Liberia has put in place several policies and signed a number of protocols aimed at improving environmental management in the country. These range from national laws, regulations, policies, strategies and action plans to multilateral environmental agreements. As the government tries to put the country back on the path of sustainable development, the challenge will be the effective implementation of these various laws and regulations. The Environmental Protection Agency (EPA) is the government authority mandated by law to monitor, coordinate and supervise environmental issues in the country. There are also many other stakeholders involved in the sector. However, the overall responsibility for managing the environment lies with every Liberian.

Institutional Framework

History of Environment Management in Liberia
Environmental concerns in Liberia were of no consequence prior to the 1992 Rio Conference on Environment and Development. At this time, environment was only talked about in connection with the need to conserve natural resources, primarily forests and wildlife resources.

After Presidential elections in 1997, as people began to rebuild their lives and the shattered economy, environmental pollution and deforestation became national development issues. Concerns were also raised about the scope and complexity of environmental issues and their impact on national socio-economic development, lack of a national institution with authority for overall management of the environment and the lack of a national policy and framework law on environmental protection.

So, in 1999 the Government of Liberia established the National Environmental Commission of Liberia (NECOLIB) and charged it with executive authority over all programmes and activities relating to environmental matters in the country. NECOLIB has since evolved into the Environmental Protection Agency (EPA).

The Environmental Protection Agency (EPA)
The principal agency for the management of the environment in Liberia is the Environmental Protection Agency (EPA). The Act creating the EPA was approved on 26th November 2002. The EPA has been officially functional since February 2004 under an interim management team, but not fully operationalised until 2006, after the inauguration of Madam Ellen Johnson-Sirleaf as President of Liberia. Immediately following her inauguration in January 2006, the President constituted the Policy Council chaired by the Hon. Minister of Lands, Mines and Energy, and the Board of Directors chaired by the Hon. Minister of Planning and

Economic Affairs. In July 2006 the President appointed an Executive Director based recommendation by the Policy Council. The Board of Directors is yet to appoint a Deputy Executive Director in consonance with the Act creating the EPA.

The mandate of the EPA is to coordinate, monitor and supervise all activities in the field of the environment. The EPA is placed under the office of the President and holds one of the highest positions of all public institutions in the country. This is intended to enable it to voice its concerns on environment at high levels of decision-making and policy formulation and to give it the necessary political clout.

The key functions of the EPA are:

1. Co-ordinate, integrate, harmonize and monitor the implementation of environmental policy and decisions of the Policy Council by the Line Ministries,
2. Propose environmental policies and strategies to the Policy Council and ensure the integration of environmental concerns in overall national planning,
3. Collect, analyze and prepare basic scientific data and other information pertaining to pollution, degradation and on environmental quality, resource use and other environmental protection and conservation matters and undertake research and prepare and disseminate every two years a report on the state of the environment in Liberia,
4. Ensure the preservation and promotion of important historic, cultural and spiritual values of natural resources heritage and, in consultation with indigenous authority, enhance indigenous methods for effective natural resource management,
5. Encourage the use of appropriate environmentally sound technologies and renewable sources of energy and natural resources,
6. Establish environmental criteria, guidelines, specifications and standards for production processes and the sustainable use of natural resources for the health and welfare of future generations,
7. Review and approve environmental impact statements and environmental impact assessment,
8. Initiate and co-ordinate actions required in a state of environmental emergency or any other situation which may pose serious threat to the environment and public health,
9. Function as the national clearinghouse for all activities relating to regional and international environment-related conventions, treaties and agreements, and as national liaison with the secretariat for all such regional and international instruments, and
10. Advise the state and participate in the process of negotiating, ratifying or acceding to relevant regional and international environmental agreements

The Act creating the EPA establishes a National Environment Policy Council as the ultimate policy-making body on the environment. The Council provides policy guidance and formulates and coordinates policies and regulations on the environment. The EPA also has Board of Directors to oversee the implementation and successful operation of the national environment management policy and functions of the EPA. The government recently constituted the Policy Council (box 10.1), Board of Directors and the Executive Director. The institutional framework for environmental management in Liberia is shown in figure 10.1.

The EPA structure is intended to allow for quick flow of information, and to strengthen the functions of coordination and monitoring for environmental management. Perhaps more importantly, it provides a framework for a bottom-up approach to both environmental and national planning processes.

Prior to constituting the Policy Council, a Task Force on the Environment was organized to serve in the interim until the Policy Council and Board of Directors could be put in place. The Task Force was chaired by the Ministry of Planning and Economic Affairs, and co-chaired by UNDP.

Box 10.1: Members of the National Environment Policy Council

1. Two members of the Senate Committee on the Environment
2. Two members of the House of Representatives Environment Committee
3. The Association of Architects and Engineers
4. Ministry of Agriculture
5. Liberia National Bar Association
6. Liberia Chamber of Commerce
7. The Council of Chiefs and elders
8. Ministry of Gender and Development
9. Ministry of Health and Social Welfare
10. Ministry of Commerce and Industry/Bureau of Standards
11. Ministry of Lands, Mines and Energy
12. Ministry of Planning and Economic Affairs
13. Ministry of Transport
14. Ministry of Information, Culture and Tourism
15. Ministry of Public Works
16. Ministry of Education
17. Bureau of Maritime Affairs
18. Forestry Development Authority
19. Ministry of Rural Development
20. Ministry of Internal Affairs
21. Liberia Electricity Corporation
22. Liberia Petroleum Refining Corporation
23. Liberia Water and Sewer Corporation
24. University of Liberia
25. Federation of Liberian Youth
26. Liberia National Student Union
27. Head of the Interfaith Council
28. Representative of environment-related NGOs
29. Liberia Marketing Association;
30. Eminent female citizen

Horizontal Linkages with Line Ministries

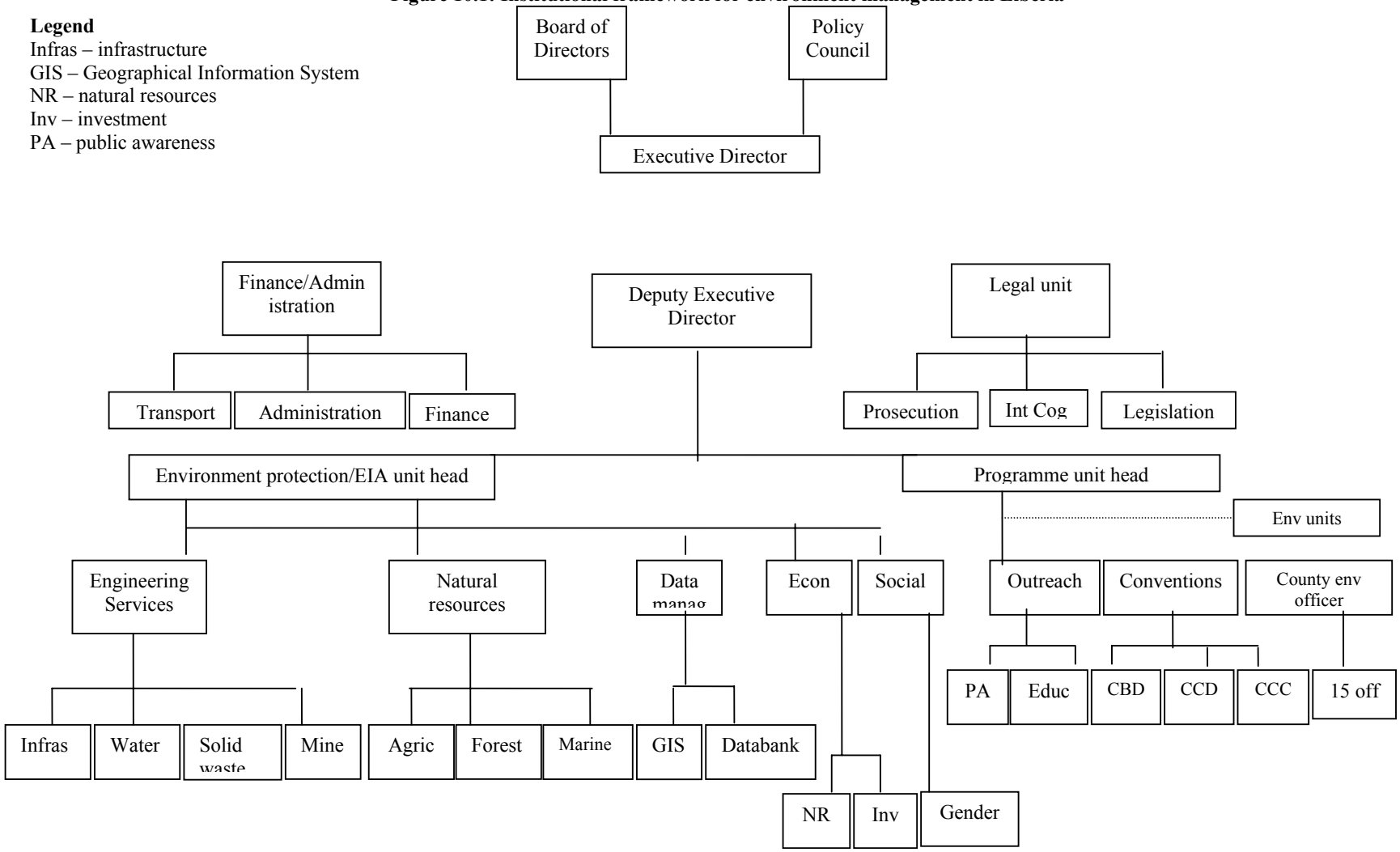
There are ministries, departments and institutions with their own legal mandates to address specific environmental issues or to manage specific resources. The EPA has a mandate to work with these line ministries. As an operational strategy, each relevant government ministry and agency is expected to establish an environmental unit to ensure sustainable management of the environment under their mandates.

Vertical Linkages with Local Government

In order to ensure effective environment management at the local government level, the EPA Act provides for the establishment of county and district environment committees. The main function of these committees is to ensure integration of environmental concerns in plans and projects of local governments, formulate bylaws, and promote the dissemination of environmental information. These committees are to be assisted by County and District Environment Officers as the case may be.

Figure 10.1: Institutional framework for environment management in Liberia

Legend
Infras – infrastructure
GIS – Geographical Information System
NR – natural resources
Inv – investment
PA – public awareness



Linkages with Civil Society, Development Partners and the Private Sector
The Policy Council of the EPA consists of one representative of all environment-related NGOs selected by the NGO membership or from their umbrella organization. The Board of Directors consists of a member of the private sector. Unlike the local government administrative structure, which is linked to the EPA, it is more complicated to deal with the NGOs and private sector due to inherent differences in bylaws, organizational structures and strategic plans. Though the NGOs have an umbrella organization, it is not representative of all NGOs, and thus has not been effectively functional due to allegiance to sectoral umbrella organizations in their specific areas of environmental management. NGOs are accredited by the Ministry of Planning and Economic Affairs without reference from the so-called umbrella organization.

There are other society organizations, including youth clubs that advocate for environmental sustainability. The Liberia Women Initiatives represents the voice of women. The AME University in Monrovia observes the last Friday in each month as Environmental Day, dedicated to promoting environmental advocacy. A local NGO, Promoting Activities for Development and Sustenance (PADS), based in Kakata, Margibi County, is engaged in civil education among the youth, including environmental advocacy. With support from UNDP, schools have begun to organize environmental clubs as a way of using the students as advocates for the environment. Two clubs have so far been formed - the Kakata Highs Environmental Club and AME University Environmental Club. Environmental clubs in Harbel, Buchanan, Paynesville, Sinkor and Congo Town are in formative stages. All of these clubs are targeting high school students.

Use of Technical Committees
Some environmental issues require detailed study or consultation before policy decisions are taken or implemented. In such instances the EPA is allowed to appoint a technical committee to give advice on specialized subjects relating to the environment. The membership of these committees is composed of representatives from government, private sector, NGOs and academic institutions. The standing committees established by the Act are: lands and mines; pollution control; health and sanitation; environmental impact assessment; biotechnology; forestry, agriculture or wildlife; and coastal and marine ecosystem. None of these standing committees has as yet been formed.

Use of Economic Instruments
Economic instruments are mechanisms, measures or tools that affect costs and benefits of alternative actions open to various economic agents with the effect of influencing behaviour in a way that is favourable to the environment. Many countries have used them to complement command and control in eliciting compliance for environmental management. The National Environmental Policy is silent on this issue. But the Environment Protection and Management Law emphasizes the use of economic instruments (incentives and disincentives) in promoting compliance. There are some examples to show that economic instruments have a lot of potential in environmental management. The Forestry Development has promulgated some regulations in this light. The Ministry of Agriculture also makes use of such instruments.

Legal and Policy Framework
Liberia was founded by free slaves, brought back to Africa after the abolition of slavery in the Americas. They later declared independence in 1847. At the time of independence, they had no policy and legal instruments as far as the environment was concerned. Most laws were

geared towards specific resource uses, and the inter-relationship among them was not strongly emphasized. In addition, at that time there was no attention paid to biodiversity, Environmental Impact Assessment, wetlands and community participation, either nationally or globally. The constitutional backing was also weak, and there was too much reliance on command and regulation and not enough on economic instruments. Compliance was therefore poor. Significantly, right from this time, there was the conflict with the indigenous people for the control of natural resources, especially land that had always been communally owned.

Before the creation of NECOLIB there were sectoral policies, laws and regulations relating to the environment. Consequently, the problem in Liberia has not been the absence of policy and other legal frameworks. The problem has been one of policy, institutional and administrative failures that have reduced the value of environmental resources to society through wastage, poor management and governance and outright lack of conservation. These failures have existed in the past, and some still exist today. In recognition of that, government, private institutions, NGOs, donor agencies and individuals are each responding differently and within their means to address them. Some of the types of responses are found in box 10.2.

Box 10.2: National responses to various environmental problems

- Involvement of local communities through participatory approach;
- Empowerment through public education and awareness, information exchange and networking;
- Sectoral reforms (legal, policy and institutional) and re-organization;
- Gender sensitivity and equity
- Poverty reduction initiatives; and
- Bilateral and international cooperation.

In order to ensure a coordinated and participatory approach to environment management, the government established NECOLIB. With support from UNDP, NECOLIB prepared the Environmental Protection Agency Act 2002, National Environmental Policy 2002, the Environment Protection and Management Law 2002.

The ultimate aim of the Policy is to ensure improvement of the physical environment, quality of life of the people, the economic and social living conditions of the citizenry. This includes present and future generations. It also aims to ensure reconciliation and coordination between economic development and growth with the sustainable management of natural resources.

The Law establishes the legal framework for sustainable development, management and protection of the environment in partnership with government, other organizations and the people of Liberia. It provides for the provision of high quality information and advice on the state of the environment and related matters. The law and the policy are legal basis for the operational effectiveness of the Environmental Protection Agency. The law outlines the general principles of environment management, by which it is guided. These are:

1. the principle of sustainable development,
2. the precautionary principle,
3. the polluter-pays principle,
4. the principle of inter-generational equity,
5. the principle of public participation,
6. the principle of international cooperation in the management of environmental resources the shared by two or more states, and
7. any other principles relating to natural resources and environmental management.

Other Laws Pertaining to the Environment

The National Environment Policy of Liberia and the Environment Protection and Management Law are also complimented by many sectoral laws and Acts, which preceded them. The major ones are listed in table 10.1.

Table 10.1: Major environmental sectoral laws

Sectoral law	Year	Key implementing agency
Customary Laws of Liberia	N/A	Ministry of Internal Affairs
Regulation on Operation of the Fishing Industries	1957	Ministry of Agriculture
Public Health Law	N/A	Ministry of Health and Social Welfare
New Mineral and Mining Law	1999	Ministry of Lands, Mines and Energy
Industrial Licensing Act	N/A	Ministry of Commerce and Industry
Wildlife and National Parks Act	1988	Forestry Development Authority
New National Forestry Law	2000	Forestry Development Authority
National Planning Council Act	N/A	Ministry of Planning and Economic Affairs
Agriculture Law	N/A	Ministry of Agriculture
Zoning Law of Liberia	1957	Ministry of Internal Affairs
Zoning Act of the City of Monrovia	1958	Monrovia City Corporation
Vehicle and Traffic Law	1972	Liberia National Police
Maritime Law of Liberia	N/A	Bureau of Maritime Affairs
Transportation and Communications Law	1979	Ministry of Transport and the Ministry of Post and Telecommunications
Public Safety Law	1968	National Fire Service Bureau
Education Law	N/A	Ministry of Education
General Construction Law	N/A	Ministry of Public Works
Labour Law of Liberia	N/A	Ministry of Labour
Local Government Law	N/A	Ministry of Internal Affairs
Natural Resources Law	1956	Ministry Agriculture and Ministry of Lands, Mines and Energy
Patent, Copyright and Trade Mark Law	2001	Ministry of Commerce and Industries
Patriotic and Cultural Observance Law	N/A	Ministry of Foreign Affairs

Regional and International Conventions

Liberia is an active member of the international community. As part of the global body politic, it participates in a number of cooperative arrangements that have and continue to evolve to ensure a coordinated response to regional environmental problems. Examples include the Economic Community of West African States (ECOWAS) and the Mano River Union. Liberia is also party to some multilateral environmental agreements. These are listed in table 10.2, along with the key institutions responsible for implementation.

Environmental Information and Public Participation

Environment Information

Environmental information can be defined as information in any form that pertains to the state of the environment. It can include quantitative facts like data and statistics or other qualitative measures. It basically includes all information that may be required for decision-making in support of environment management policy and legal framework of Liberia.

Environmental information can come from diversified sources and be disseminated in a number of formats such as radio, print or hardcopy. One example is the Liberia MDG 2004 report (see box 10.3). Liberia's efforts towards attaining these goals are a rallying point for

development efforts and resource allocation for optimal outputs. Addressing environmental issues is critical for sustained poverty reduction and in order to achieve the MDGs.

Table 10.2: Multilateral Environmental Agreements ratified or acceded to by Liberia

Agreement	Year	Key implementing agency
Convention on International Trade in Endangered Species of Wildlife Fauna and Flora (CITES)	1981	Forestry Development Authority
The African Convention on the Conservation of Nature and Natural Resources	N/A	Not yet assigned
The Lusaka Agreement	N/A	Not yet assigned
Convention to Combat Desertification	1998	Environmental Protection Agency
Convention on Biological Diversity	2000	Environmental Protection Agency
United Nations Framework Convention on Climate Change	2003	Environmental Protection Agency
Convention of World Cultural and Historic Heritage	2002	Ministry f Education
Ramsar Convention on Wetlands of International Importance	2002	Environmental Protection Agency
Cartagena Protocol on Biosafety	2002	Environmental Protection Agency
Convention on Migratory Species		Environmental Protection Agency
Kyoto Protocol on Climate Change	2002	Environmental Protection Agency
Vienna Convention on the for the Protection of the Ozone Layer	1996	Environmental Protection Agency
The Convention on Persistent Organic Pollutants	2002	Environmental Protection Agency

Box 10.3: The Liberia 2004 MDG report

This Millennium Development Goals Report (MDGR) captures an assessment of the current situation in Liberia relative to the global MDGs/targets; translates the global MDGs/targets into national targets; and during that process, builds national capacity in assessing, monitoring and reporting on the global MDGs/targets.

The guiding principles in preparing the report have been ensuring broad-based national participation and ownership, with full involvement of all stakeholders and Government playing a leading role in the entire process. Other key stakeholders, including development partners (USAID, EU), CSOs, I/NGOs, private sector and academic institutions, were instrumental in researching, discussing, and reaching consensus on the national indicators, and preparing this MDGR on Liberia.

The MDGs will complement on-going national framework initiatives and processes, such as the National Reconstruction and Development Plan (NRDP), modified United Nations Development Assistance Framework (UNDAF) and the Results Focused Transition Framework (RFTF), as well as the frameworks of other development partners. The NRDP activities are central to Government commitment to integrate development priorities and recovery processes, especially community based rehabilitation programs.

Source: UNDP 2004

State of the Environment Reporting

State of the environment reporting is a relatively new phenomenon in Liberia. It is a requirement under the environment law for a national SOE report to be produced every 5 years. Each county also has to produce a county SOE report every 5 years. Apart from supporting development planning and decision-making the SOE report is a tool that can be used for environment education and awareness. Environmental issues have been in the public arena for long, but it is only recently that people have begun to take an interest in them. Public awareness programs are now part and parcel of projects that are being carried out by government, NGOs and development partners. For instance, a recent public awareness campaign in Monrovia (Hoyt 2002) focused on three main messages: wildlife species can

become extinct from over-exploitation; protected species should not be killed; and natural resource management is a partnership between the government, conservation organizations and citizens. These are all issues that have been highlighted in this SOE report.

Capacity Building for Information Management

The provision of up-to-date and timely information on the environment requires that a comprehensive environment information management system be put in place. While there is dire need for sound environment information, Liberia lacks the capacity to ensure this. Consequently, there is no regular exchange and dissemination of information on the environment. This is so because there is a lack of resources and skills in most of the national institutions responsible for generating and disseminating environmental information. There is, therefore, need to build adequate institutional capacity in the country. In so doing, institutional, technical, systemic and individual needs must be taken into consideration if tangible benefits are to be obtained.

Such a process could include:

- Assessment of the resources and skills in place in relevant institutions, and each organization's plans for the future in this area,
- Consultation with the relevant institutions on capacity building needs and identification of capacity gaps, so that gaps analysis is carried out across relevant institutions,
- An analysis of the prioritization of needs and anticipated outputs,
- Environmental assessment and management training activities under regular curricula, targeted thematic sessions, and
- Development of a plan for capacity building with an indication of the investment required, identifying specific measures to be undertaken in relevant thematic areas in the short-, medium- and long-term.

The National Capacity Self-Assessment project (NCSA) funded by the Global Environment Facility (GEF) has addressed these issues in its synergy report across three convention areas of Climate Change, Biodiversity and Land Degradation. This project only identified the capacity needs, but funds are now required to institute a strong capacity building programme, as recommended by the project**.**

Public Participation

The provision of environmental information will eventually lead to increased public awareness in environmental matters and improve environment management. Greater public awareness encourages the free exchange of views and affords more effective participation by the public in environmental decision-making. There are a number of mechanisms that aim to enhance public participation and access to environmental information. These include the Aarhus convention (see box 10.4), the New Constitution of Liberia, the National Environmental Policy and the Environment Protection and Management law.

Box 10.4: The Aarhus convention

The Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters adopts a rights-based approach, requiring parties to guarantee rights of access to information. It also provides for public participation in decision-making and guarantees access to justice in environmental matters. It acknowledges the right of every person of present and future generations to live in an environment adequate to health and well-being, which represents a significant step forward in international law.

The Aarhus convention is a European law but can apply even outside the European Union. Its principles can be used to guide better access to environment information in Liberia.

The New Constitution of Liberia of 1986 provides for the full participation of all citizens in the protection and management of the environment and natural resources. The National Environmental Policy of Liberia provides for the encouragement of individual and community participation in improving the environment. According to the Policy, participation of the people in resource management and environmental protection is intended, not only to enlist their support, but to also influence change in their behaviour and attitudes. Box 10.5 contains some of the strategic actions recommended by the Policy.

Enhancing the participation of women and men and civil society

The policy further calls for recognition of Gender and Women's issues. According to Section 6.5 of the policy, it is imperative to promote integration of gender concerns into environmental decisions, and particularly consider the role women play in environmental protection. Besides NGO and private sector participation, the policy calls for the full and effective participation of CBOs, PVOs and Youth Clubs. The policy further states that it is in the interest of the country to recognize and strengthen the role of individuals, NGOs, Community-based Organizations, Community Development Councils and youth groups in sustaining the environment and also seek the business communities and international communities cooperation in the formulation stage of environmental policy development and implementation.

NGOs and the media are key allies in sustainable environmental management. Their engagement with stakeholders from the local to the international level can offer invaluable help in framing policies for better environmental management, creating awareness, lobby and advocacy. NGOs created the awareness on the dangers of uncontrolled beach sand mining, threats to biodiversity as a result of bush meat hunting and unnecessary network of logging roads and lack of sanitary land fills. The NGO Coalition also exposed chemical pile up of Mobil Oil in Liberia. It was also through their active participation that illegal occupants were evacuated from the Sapo National Park without incident. Furthermore, their role in implementing policies is crucial from a technical assistance point of view and as a means of facilitating people's participation at the local level.

Box 10.5: Strategic actions to improve public participation in environment management

1. Ensure full participation of stakeholders in the implementation of national environmental policy and program;
2. Bridge the information gaps between central management, local communities and resource users by developing information collection and dissemination;
3. Encourage the involvement of women and children in environmental planning and decision-making;
4. Develop guidelines that involve and benefit the most disadvantaged groups; and
5. Conduct appropriate educational activities for awareness of people's responsibilities towards and benefits from the environment and capacity building programmes be carried out for Government and citizens to help people utilize these benefits.

EPA 2003

Participants (a two-day environmental awareness workshop in Buchanan, Grand Bassa County)

Courtesy of UNDP Energy and Environment Programme - June 17, 2006

Recently, the Environmental Protection Agency and partners have involved all segments of the society in environmental work, particularly in forums such as workshops and stakeholder meetings. The environment policy, law and EPA Act were all subject to wide public consultation in 2001. Two national and four regional workshops were held. In 2002 the public was also invited to a national forum to update the Management Plan of Sapo National Park, including expansion of the Park. In 2003, the public was involved in discussions in preparation of the National Biodiversity Strategy and Action Plan at three regional and two national workshops. In 2004, two national and four regional workshops were held under the NCSA project. Stakeholders from a wide range of institutions were also involved in the validation of the National Adaptation Plan of Action (NAPA) on climate change, the National Biosafety Framework, the report on Persistent Organic Pollutants and National Action Plan for the Coastal Profile of Liberia.

Even in the preparation of this SOE report the public was involved. An inter-agency working group guided the process and 2 national consultative stakeholder workshops were held to review and validate the report. In all these meetings, people from the 15 political sub-divisions participated and their opinions were respected. They included NGOs, CBOs, religious, youth and student groups, private sector and the academic community.

Involvement of the private sector has been much more complicated. The EPA recognises that there are inherent differences in the way the private and publics sectors handle environmental matters. But it is still committed to having a linkage with them. To maximize on cost effectiveness, it is for a start, attempting to establish environmental liaison units (ELU) in some of the institutions. Arrangements are being made to encourage NGOs to design a strategy on how best and cost effective they should link to EPA. It will also set criteria on which NGOs will deal with the EPA. The issue of the *bona fide* status of an NGO is crucial

and they should be seriously evaluated before EPA enters into any meaningful and effective arrangement with them.

Conclusions and Recommendations

1. The EPA has operated for more than two years without oversight due to Government's failure to constitute the Policy Council and Board of Directors as required by the Act,
2. The EPA has confined its activities in Monrovia with the absence of County and District Environmental Committees, and appointment of Regional, County and District Environmental Officers. The committees and officers in questions should be put in place so as to ensure integration of environmental concerns nation-wide,
3. In response to Goal 7 of the Millennium Develop Goals on Environmental Sustainability and its link to Goal 1 on Poverty Reduction, there is urgent need to develop a poverty reduction strategy paper for Liberia,
4. Although Liberia participated in Rio Conference, the country has not elaborated its national Agenda 21 or its National Environmental Action Plan. All efforts should be exerted to prepare the two documents,
5. The EPA should work with partners to constitute environmental standing committees and the environmental units in relevant agencies of government,
6. Integration of gender concerns into environmental decisions should be promoted, and the participation of CBOs, and Youth Clubs be promoted,
7. Institutionalize environmental programme so as to allow for the systemic networking in order to prevent overlapping of functions amongst various environmental institutions/agencies,
8. Law enforcement capability on the environment should be improved and effective to prosecute violators,
9. Existing Laws on the protection of the environment should be reviewed and revised, as appropriate,
10. The Ministry of Planning and Economic Affairs should ensure that any environmental NGO seeking accreditation should be recommended by the NGO coalition,
11. The private sector should be encouraged to participate in environmental activities and support environmental projects, and
12. Government should set up a special environmental trust fund as a major economic instrument for the management of the environment in Liberia

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ANNEXES

Annex 1: Acronyms

AIS	Alien Invasive Species
CARI	Central Agriculture Research Institute
CBD	Convention on Biological Diversity
CBL	Central Bank of Liberia
CBO	Community Based Organization
CI	Conservation International
ECOWAS	Economic Community of West African States
EEC	European Economic Commission
EPA	Environmental Protection Agency
EU	European Union
FACE	Farmers Associated to Conserve the Environment
FAO	Food and Agriculture Organization
FDA	Forestry Development Authority
FFI	Fauna and Flora International
GDP	Gross Domestic Product
GEF	Global Environment Facility
IDP	Internally Displaced People
IMF	International Monetary Fund
IUCN	World Conservation Union
LAMCO	Liberian-American-Swedish Minerals Company
LDHS	Liberia Demography and Health Survey
LEC	Liberia Electricity Corporation
LHS	Liberia Hydrological Service
LPRC	Liberia Petroleum and Refining Corporation
LRNBF	National Biosafety Framework of Liberia
LUSH	Liberians United to Serve Humanity
LWSC	Liberia Water and Sewer Corporation
MCC	Monrovia City Corporation
MOC	Ministry of Commerce
MDG	Millennium Development Goals
MEA	Multilateral Environmental Agreement
MGD	Ministry of Gender and Development
MHSW	Ministry of Health and Social Welfare
MLME	Ministry of Lands, Mines and Energy
MOA	Ministry of Agriculture
MPEA	Ministry of Planning and Economic Affairs
MRD	Ministry of Rural Development
NAPA	National Adaptation Programme of Action
NBSAP	National Biodiversity Strategy and Action Plan of Liberia
NCCC	National Committee on Climate Change
NCSA	National Capacity Self-Assessment
NEC	National Energy Commission
NECOLIB	National Environmental Commission of Liberia
NGOs	Non-governmental Organizations
NHA	National Housing Authority
NIOC	National Iron Ore Company
NRWP	National Rural Water Project
NTGL	National Transitional Government of Liberia
NWRSB	National Water Resources and Sanitation Board
SOE	State of the Environment
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Education, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
UNMIL	United Nations Mission in Liberia
USAID	United States Agency for International Development
WATSAN	Water and Sanitation
WHO	World Health Organization

Annex 2: Glossary of terms

Agricultural biodiversity - all components of biological diversity of significance and relevance to food and agriculture, including the variety and variability of plants, animals and micro-organisms at genetic, species and ecosystem/habitat levels

Alien species - species that have crossed natural barriers and entered ecosystems where they have not existed previously in recorded history.

Aquifers - water-bearing formations with hydraulic characteristics that allow water to be extracted in significant amounts though the use of boreholes and dug wells.

Biodiversity – the range of animal and plant life in an ecosystem; the diversity of life on our planet, which includes genetic diversity, species diversity, and habitat/ecosystem diversity

Biosafety – collective term used in reference to policy-frameworks and actions for assessment and management of the safe application of modern biotechnology

Biotechnology - used to describe a set of tools that have application in a wide variety of biological endeavors ranging from diagnostics and therapeutics to pathology, plant and animal breeding, environmental remediation, and industrial production of various products

Climate change - a study dealing with variations in climate on many different time scales from decades to millions of years, and the possible causes of such variations.

Coastal zone – swamp related vegetation made of mangrove forest and savanna related vegetation, extending up to 25km inland.

Construction wastes – disposable materials from building or repairing houses such as lumbers, roofing materials, bricks, zinc, nails, concrete blocks, plasters, gutters, sands, gravels or other substances used in repairs or alterations of existing buildings or construction of new buildings, or results from breaking down of existing buildings.

Garbage - spoiled food wastes, agricultural wastes, by-products of animal or vegetable food items resulting from the handling, preparation, cooking and eating of food, or other matters subject to decomposition, decay, or the generation of noxious or offensive gases or odors, or which during or after decay, may serve as breeding or feeding material for flies, birds, insects, or animals.

Genetically Modified Organisms (GMO) - crops modified utilizing the modern techniques of genetic modification, termed recombinant DNA. The term, GMO or genetically modified organism, in this modern usage refers to a plant or animal altered using the new genetic techniques.

Grasslands - lands dominated by grasses rather than large shrubs or trees, in some cases, which have been formed when ancient forests declined

Invasive alien species - species, which have been introduced outside their normal current or past, range, and whose introduction and spread cause harm to human health, the economy, and/ or the environment.

Land – defined as the territory over which rule or control is exercised; the solid part of the earth's surface; the corresponding portion of a celestial body

Living Modified Organisms (LMO) - basically genetically modified organisms that have not been processed, and that could live if introduced into the environment, such as seeds, fresh fruits or vegetables.

Mangroves - tropical vegetation found in swampy environment, with roots partly spread out in water where they serve as catechumen for sediments.

Medical wastes - garbage from medical laboratories, hospitals, and private clinics in Monrovia. The refuse contains used syringes, tubes, and containers. Such wastes can transmit blood-borne diseases.

Norms – components of the indigenous knowledge system, become binding and universally accepted in traditional societies

Physical planning - the process of devising and carrying out a course of action to reach an identified objective

Protected areas - areas set aside to contribution to the conservation of the world's natural and cultural resources, with values ranging from the protection of natural habitats and associated flora and fauna, to the maintenance of environmental stability of surrounding regions

Rotational farmer – Also referred to as shifting cultivation, is a method, whereby, the farmer abandons the area cultivated and leaves the land to fallow for at least five years. At the end of the period the soil is rich enough for cultivation

Sacred groves - Areas set aside perceived as abodes of ancestral and evil spirits, where felling of trees and hunting are prohibited, natural breeding grounds for fauna and as gene banks for flora species

Tourism - a phenomenon involving the temporary, short-term movement of people to destinations outside the places where they normally live and work, including activities during their stay at these destinations

Trade - the act or process of buying, selling, or exchanging commodities at either whole or retail, within a country or between countries

Traditional healers - medical practitioners who rely sole on indigenous knowledge, practices and innovations

Traditional hunters - subsistence hunters who kill wildlife in a sustainable way and only taking what they need to eat with no drive for commerce.

Trash - waste accumulation of paper, cardboard, old clothing, shoes, sweepings, dust, rags, bottles, cans or other matter of any kind, other than garbage, which come from running various businesses.

Water - the common name applied to the liquid state of the hydrogen-oxygen compound H_2O; a basic element typifying all liquid substances

Wetlands - areas neither fully terrestrial nor fully aquatic, ranging in character from majestic swamps to shallow, unimpressive depressions, which hold water at most only a few weeks out of the year.

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