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DRAFT ENVIRONMENTAL PROFILE ON LIBERIA

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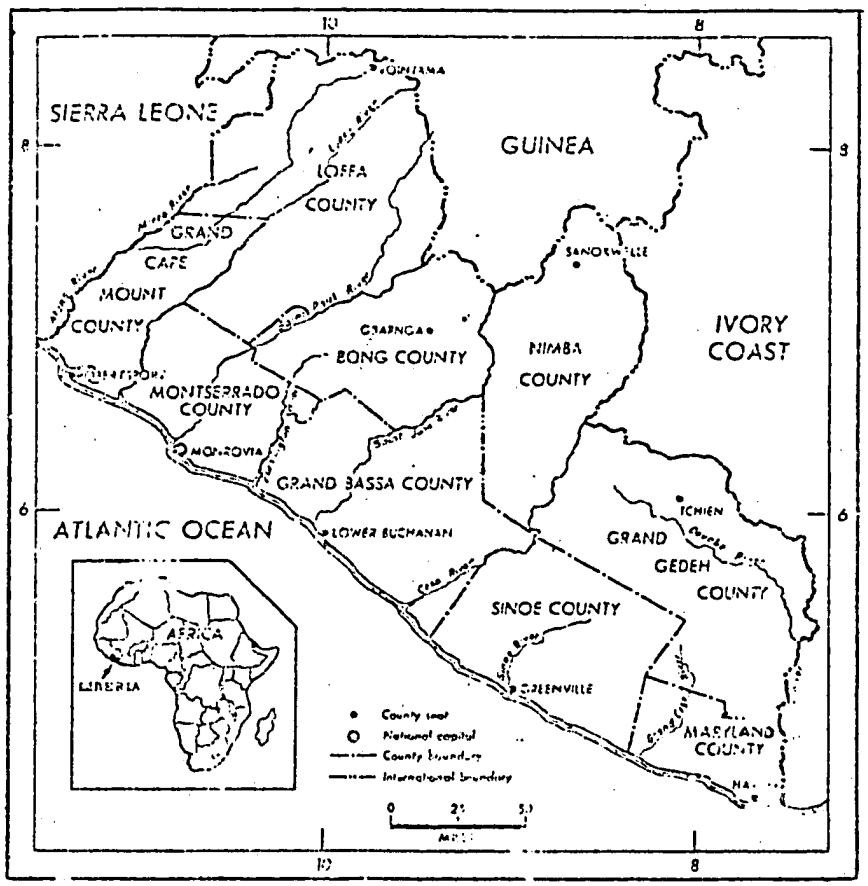


Figure 1. General Map of Liberia

INTRODUCTION AND SUMMARY

Location, Size and Population

The Republic of Liberia is the oldest independent republic in Africa, with a Constitution modeled after that of the United States. Bordered by Sierra Leone, Guinea and the Ivory Coast, Liberia is located on the great bulge of the west coast of Africa, a few degrees off the equator in the tropical zone. It lies within 806 kilometers (500 miles) of the Greenwich Meridian and 484 kilometers (300 miles) of the equator. Total land area is approximately 96,185 square kilometers (37,135 square miles).

Liberia is divided into fourteen major administrative units - five coastal counties with five coastal territories, and four northern counties. Liberia has a total population of approximately 1.8 million and an overall population density of about 48.5 persons per square mile, though its distribution is very uneven. Large parts of the country are still uninhabited or have very scattered populations, especially large sections of the forest belt in the southeastern third of the country and to the west in Lofa County. According to the 1974 census, 71 percent of the population is rural and 29 percent urban (communities of 2,000 or more people). Literacy is around 15 percent and the quality of education is generally poor. The level of health, too, is generally poor, especially in the rural areas.

Physical Characteristics

Most of Liberia lies within the tropical lowland rain forest belt of Africa, a narrow belt extending from the southern part of Sierra Leone down through Ghana, where it ends some distance inland from the coast. Only the northernmost part of Liberia extends into the belt of Guinean woodland savanna, which stetches across Africa from Senegal to Sudan. Liberia is characterized by four major physiographic regions lying parallel to the coast: the coastal plain, the belt of rolling hills, the belt of mountain ranges and plateaus, and the Northern Highlands.

The coastal plain averages 40 kilometers (25 miles) in depth and reaches an elevation of between 9 and 30 meters (30 and 100 feet). Its surface is flat or very gently rolling with a few isolated hills rising over 46 meters (150 feet). A few points along the shoreline such as Cape Mount, Cape Mesurado and Cape Palmas have palisades directly fronting the ocean. The surf is normally heavy all along the coast but is worst at the height of the rainy season. Along the coast are marine lagoons and, a bit inland, mangrove swamps and lagoons formed by estuaries of rivers and streams.

A belt of rolling hills borders the inner margin of the coastal plain. This region is marked by a distinct transition to a more rugged terrain with a general elevation of 61 to 152 meters (200 to 500 feet).

The belt of rolling hills is then interrupted by an abrupt change in elevation marked by waterfalls along major streams. This region of mountain ranges and plateaus forms the largest part of Liberia with a width of up to 129 kilometers (80 miles) and rising to 183 to 305 meters (600 to 800 feet) above the surrounding terrain.

The Northern Highlands are found in the northern parts of Lofa and Nimba Counties and form part of the Guinea Highlands. Two important mountain ranges dominate this region; the Wologisi Range (culminating in Mount Wutuvi, 1,356 meters or 4,400 feet) in Lofa County, and the Nimba Range (with an elevation up to 1,372 meters or 4,500 feet) which forms part of a mountain chain stretching across Liberia, Guinea and the Ivory Coast.

The tropical climatic pattern of Liberia favors high forest vegetation and is important to the understanding of the ecology of the area. Liberia's climate is characterized by two distinct seasons, rainy and dry. Each is approximately six months in duration, the rainy season lasting from May to mid-November and the dry season from November to April. The equatorial low-pressure belt, or intertropical front, separates two air masses of high pressure that circulate over Liberia - the continental and maritime air masses. Liberia has a fairly consistent temperature that rarely exceeds 97 degrees F. or falls below 68 degrees F. Mean temperatures vary between 75-86 degrees F. Relative humidity is generally high, especially in the coastal region where the average is over 80 percent.

Resources and Associated Environmental Problems

As with most African countries, Liberia has limited knowledge of its resource base and even less information on related environmental problems. The data-gathering and monitoring capabilities of the Government are weak or virtually non-existent in most areas. The development of such capabilities is essential if Liberia is to devise an effective program in environmental planning and natural resource management.

Water - Liberia has an abundant supply of surface water and significant quantities of groundwater. However, there is a lack of adequate data on the occurrence and availability of both surface and groundwater and other hydrological parameters. Liberia's rivers, streams and lakes are a major source of environmental disease since piped water is only available in four county capitals and there are few waste water and sewage treatment plants. Villages and industries have developed along the rivers and lakes, which has led to other pollution problems. The Mano and and St. John Rivers are becoming increasingly polluted by iron ore dust and other residues of the iron ore production process. No information was available on environmental problems associated with groundwater resources beyond the fact that wells dug for domestic use frequently become contaminated because of location, misuse and waterborne parasites. The coastal waters of Liberia, and of the Gulf of Guinea in general, are becoming increasingly polluted. Oil is the most serious pollutant and is the result of residue from large oil tankers, oil cargo handling and off-shore drilling of petroleum. Increased development along the coast, and the subsequent increased dumping of untreated sewage and waste water, is also contributing to the pollution problem.

Soils - Lateritic soil covers most of Liberia. Due to leaching, the soil is strongly acidic with a low silica content and a high proportion of hydrous oxides of iron and aluminum. It is basically fertile and best suited for tree crops. Soil problems stem from the system of shifting (slash and burn) agriculture and associated clearing of forest land. This clearing of forest land can destroy soil nutrient cycles (in soils already deficient in nutrients) and ultimately lead to soil erosion.

Minerals - The mining industry is the single most important sector in Liberia's economy, and Liberia is currently the eleventh largest producer of iron ore in the world. In addition to iron ore, Liberia exploits diamonds and gold. A geological survey has been underway in Liberia but is far from complete. Mining operations are a significant source of water pollution, though no data is available.

Forests - Liberia lies within the tropical rain forest belt and is one of the last West African countries with considerable reserves. Liberia has an estimated 12 million acres of forest land, and over 260 species of trees have been identified. The high forest areas of Liberia can be classified according to vegetational zones which roughly parallel the coastline and are dependent on annual precipitation. In a narrow strip of land from one to nine miles in width along the coast are found mangrove swamps and some coastal forest. Beyond this area, and extending inland up to about fifty miles, is the belt of broadleaf evergreen rain forest. Beyond the evergreen forest is the belt of deciduous forest, separated by a narrow transitional zone consisting of both evergreen and deciduous species.

Though Liberia still has ample forest reserves, they are being depleted at an increasingly rapid rate. The use of forests as a source of firewood was not mentioned anywhere in the literature as a problem, though it must be a major contributor to depletion based on FAO figures for wood production in Liberia. Three additional sources are contributing to the destruction of the forests - the concessionaires, the Government through its land clearing program, and farmers practicing shifting cultivation. A national reforestation program launched by the Government in 1971 has achieved meager results in comparison to the rate of cutting.

Wildlife - Although human encroachment along Liberia's coastal plain has led to the disappearance of most wildlife, the forests of the interior still support a wide variety of species. Most of this wildlife is restricted to high forest and inaccessible or undisturbed areas away from villages. In a somewhat dated study, over 100 species of mammals, 33 species of amphibians, 41 species of reptiles and 280 species and subspecies of birds were identified in Liberia.

Tremendous hunting pressure combined with loss of habitat have reduced the wildlife resource to a fraction of its former wealth and productivity. Wildlife has almost disappeared along the coastal plain and there are no longer any large herds of big game. Liberia does not have any national parks or game reserves, though one game reserve has been demarcated for approval.

Fisheries - Liberia has three sources of fish: freshwater bodies (lakes, rivers and inland swamps); inland saltwater bodies (lagoons and estuaries); and the ocean. The stock of freshwater fish has suffered slightly from overfishing. Marine life is more abundant in the estuaries where saltwater fish come inland. A wide variety of fish live off the coast. No information was available on specific problems with fisheries beyond a general reference to overfishing in the interior. The pollution of rivers by mining operations must also be having some negative effect on inland fisheries.

Organizational and Legislative Responses to Environmental Problems

Within the Liberian Government there is no central agency responsible for environmental matters. The newly created Forestry Development Authority comes closest to fulfilling such a role, though its responsibilities are restricted to the conservation and management of forests and fish and wildlife resources (and in any event is a poor candidate for the job due to its commercial bias). Liberia's Natural Resources Code was repealed with the creation of the Forestry Development Authority, and a new draft Code has yet to be passed by the Legislature.

At a regional meeting on integrated ecological research and training needs in the humid tropics convened by the Man and the Biosphere Program, the Liberian representative outlined the following problems requiring immediate attention:

- the effects of iron ore mining on the aquatic biomass;
- the effects of artificial regeneration on the ecosystem;
- functional analysis of the grassland ecosystem;
- investigation to determine the physical and chemical properties of the lesser known species.

1.0 POPULATION CHARACTERISTICS

The Republic of Liberia is located on the great bulge of the west coast of Africa a few degrees off the equator in the tropical zone. Liberia covers an area of approximately 96,185 square kilometers (37,135 sq. miles). The majority of the population is engaged in traditional shifting agriculture based on a system of land rotation.

1.1 General population statistics*

Total population: 1,800,000 (mid-1979 estimate)
1,503,000 (1974 population census)

Average annual growth rate: 3.3%

Average population density (1974): 48.5 persons per sq. mi.

Birth rate: 50 per 1,000

Death rate: 17 per 1,000

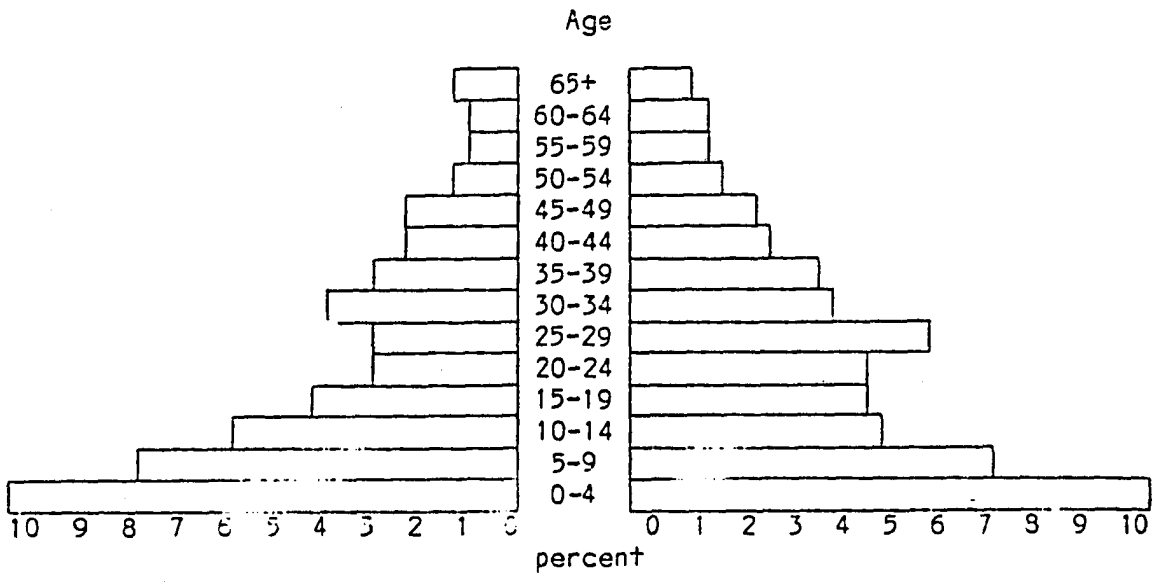
No. of years to double population: 22

Estimated population in year 2000: 3,500,000

Population under 15: 47%

Population over 65: 2%

Age/Sex Pyramid (1970)



*From the 1979 edition of the World Population Data Sheet, Population Reference Bureau, Inc., Washington, D.C.

1.2 Spatial distribution

Liberia is divided into fourteen major administrative units - five coastal counties with five coastal territories, and four northern counties (see map, p. 3). The counties vary significantly in size, population and population density as shown in Table 1 below and in Figure 3. The population growth rate varies among counties from 1.1 to 4.8 percent; with Grand Cape Mount, Montserrado and Nimba counties growing significantly faster than the national average and Grand Bassa, Grand Geden and Sinoe well below the average.

Table 1 Population and Regional Distribution (1962-1974)
(County and Major Urban Areas)

County (Urban Area)	Area Sq. Miles	Population 1962	Population 1974	Annual Growth Rate 1962-74 %	Share of Population 1974 %
Bong	3,650	131,528	194,191	3.3	12.9
(Gbarnga)		3,962	8,474	6.5	
Grand Bassa	5,075	131,840	150,926	1.1	10.0
(Buchanan)		11,909	24,375	6.2	
Grand Cape Mount	2,250	32,190	56,604	4.8	3.8
(Porkpa Dist.)		6,915	20,395	9.4	
Grand Gedeh	6,575	59,275	71,825	1.7	4.8
Lofa	7,475	123,165	180,737	3.2	12.0
Maryland	1,675	62,786	91,619	3.4	6.1
(Harper)		6,095	11,715	5.6	
Montserrado	2,550	258,821	439,997	4.5	29.3
(Monrovia)		80,992	204,213	8.0	
Nimba	4,650	160,743	249,702	3.8	16.6
(Yarmien clan)		11,637	31,938	8.8	
Sinoe	4,350	56,095	67,599	1.6	4.5
(Greenville)		3,962	8,474	6.6	

The overall population density of Liberia is about 48.5 persons per square mile, but the population is very unevenly distributed. Large parts of the country are still uninhabited or have very scattered populations, especially large sections of the forest belt in the southeastern third of the country (which forms the greatest area for future population development) and to the west in Lofa county. According to the 1974 census, 71 percent of the population is rural and 29 percent urban (communities of 2,000 or more people). Urban areas registered an annual growth rate of 7.9 percent compared to 3.3

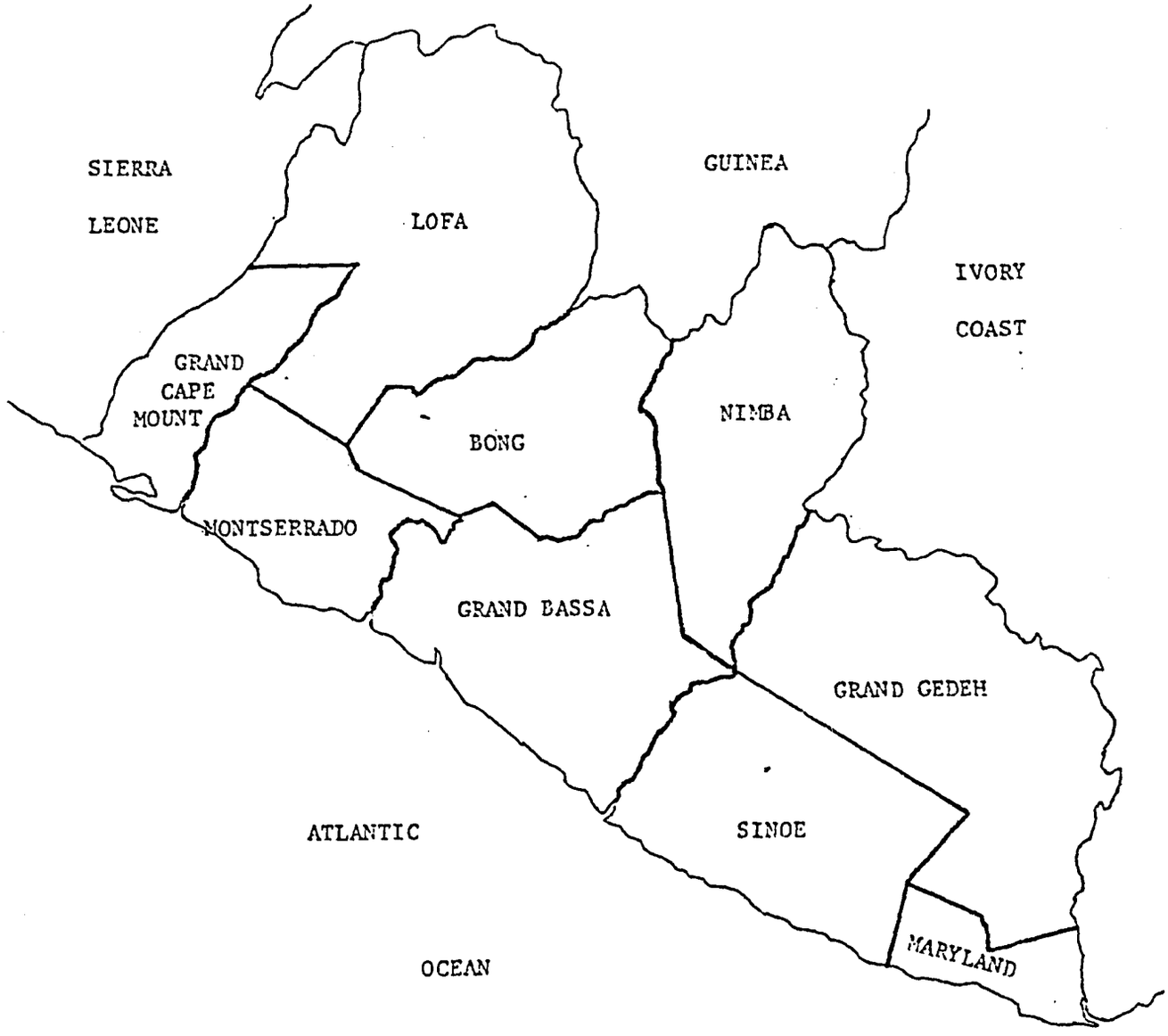


Figure 2. County map of Liberia

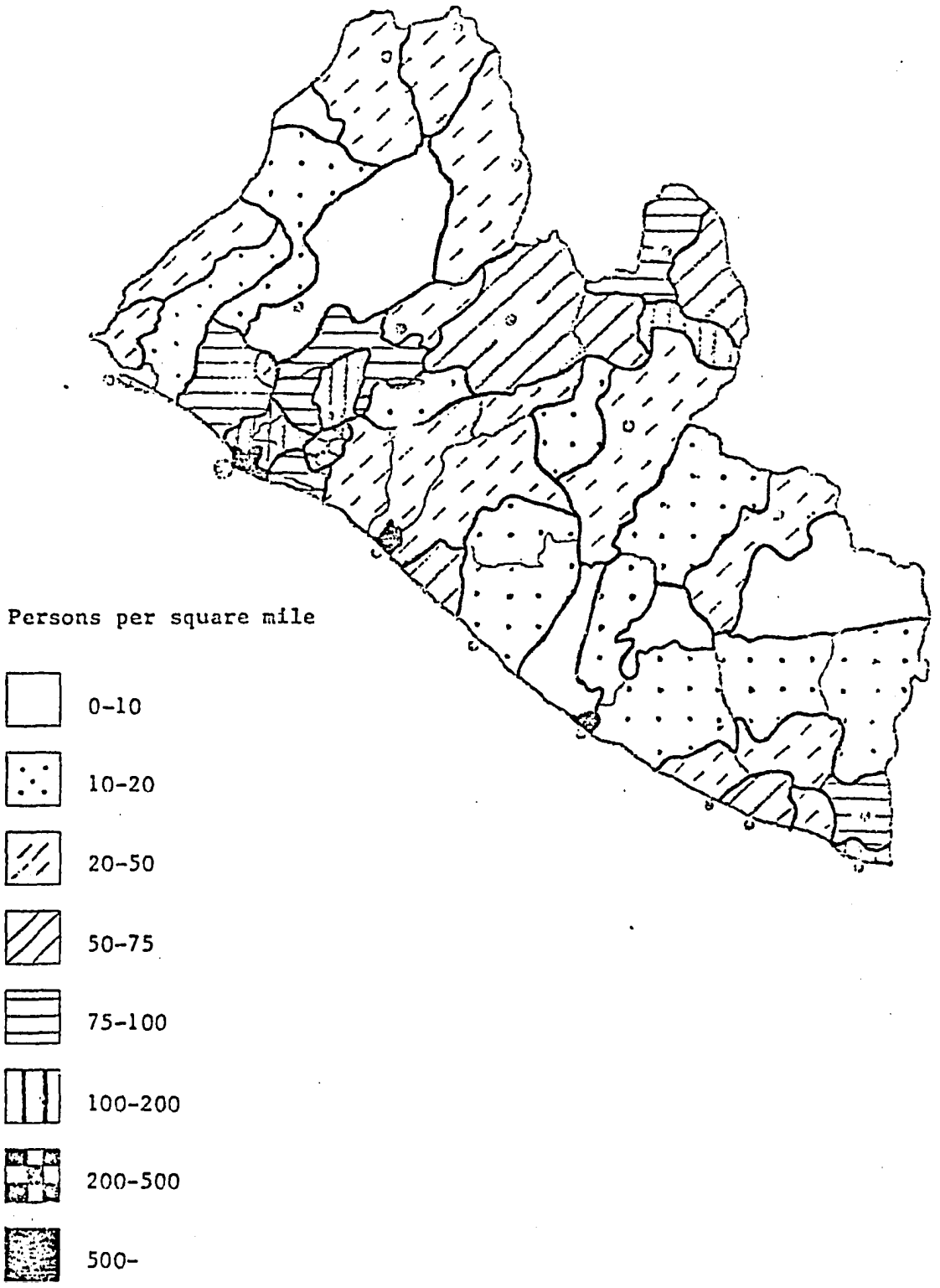


Figure 3. Population density, 1974

percent for the population as a whole, reflecting the general trend of migration from rural to urban areas that is evident in every county. The overall trend in migration is from the small villages to the larger villages and towns, and then on to the main center of migration, the capital city of Monrovia. Monrovia is the largest urban area in Liberia, with a density of 4,370 persons per square mile and a phenomenal 8 percent population growth rate. Close to one third of Liberia's population lives within a fifty-mile radius of the capital. For other major urban areas, see Table 1 above.

1.3 Ethnic and religious composition of the population

Liberia has a diverse population that includes 23 ethnic groups (see map, page 5). The largest tribes are the Kpelle, Bassa, Gio, Kru, Grebo and Mano. Most of these groups still retain a considerable amount of autonomy and do not identify closely with the nation. Thus various areas of the country are characterized by distinctive cultural traits and customs. Traditional African religious beliefs and practices are widespread despite intensive Christian missionary efforts. Roughly 75 percent of the population follows tribal religions, 15 percent Muslim, and 10 percent Christian.

1.4 Educational characteristics of the population

Percentage of literate population, 1974:	Total - 15%
Percent enrolled in school, 1975 (WPDS, 1979):	Males 6-11 - 45% Females 6-11 - 29% Males 12-17 - 59% Females 12-17 - 24%
Number of school-age children (5-19) per teacher, 1975 (WPDS, 1979):	117

Education is mandatory for all children between the ages of 6-16. Liberia has two separate and often conflicting systems of education - the traditional system based on tribal lore and teachings and centered in the "bush schools," and the modern system patterned after the U.S. The majority of children still receive a traditional education (especially in the hinterland), by which they are taught the values and practices of their ethnic group. The modern system is centralized under the direct control and supervision of the Department of Education.

The quality of education in Liberia is generally poor and the dropout rate very high. According to an official report, this is due to: an inadequate number of schools in light of mounting enrollments at all levels; inadequate incentives to attract and retain qualified people and reliance on expatriates; irrelevancy of textbooks to the Liberian situation; and insufficient logistical support.

In 1971 the Government initiated the "Community Schools Program" to improve

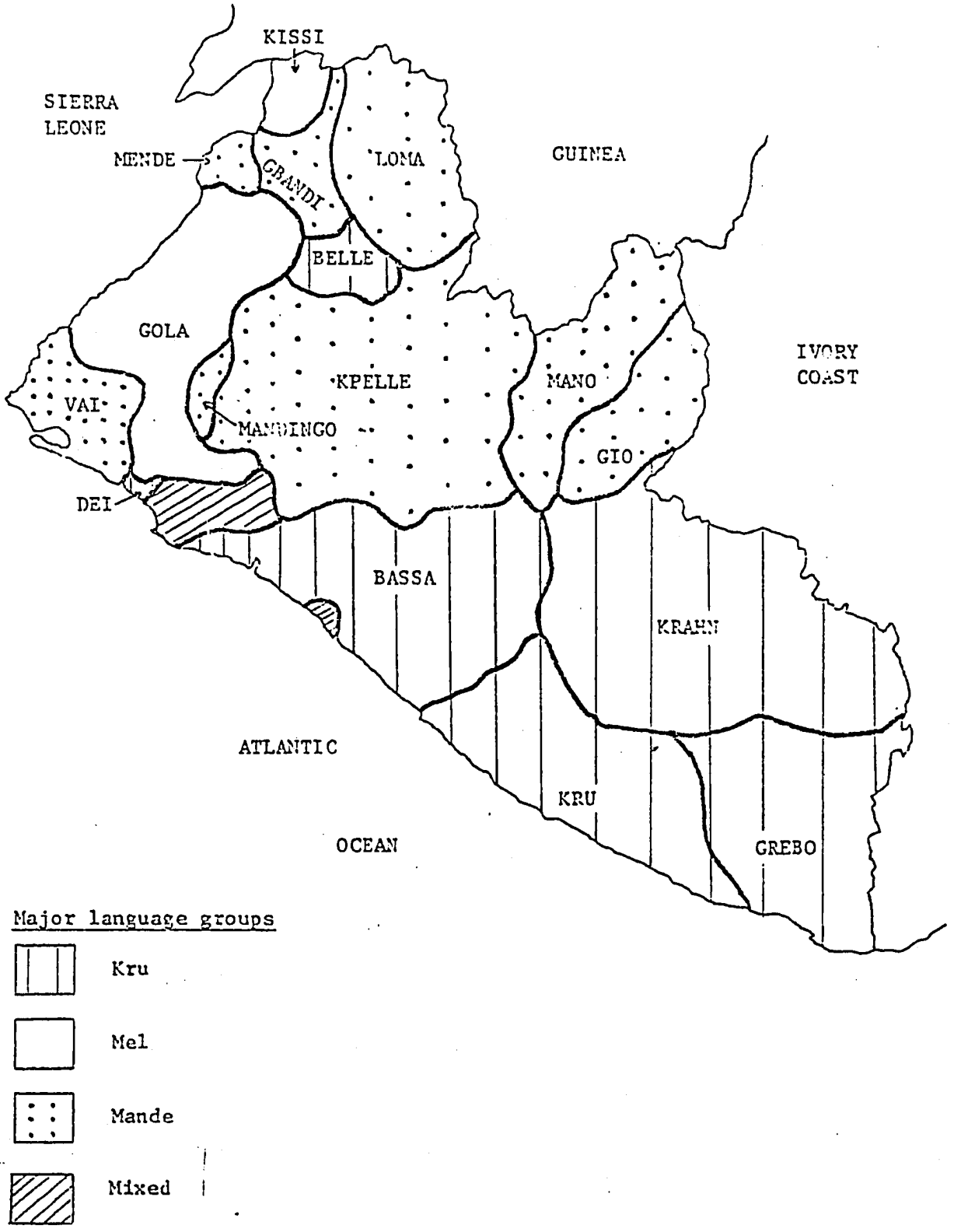


Figure 4. Major tribes and tribal boundaries

rural primary education. The program seeks to reorient the education system according to the needs of rural areas. The program also makes available school facilities for adult education and community development activities.

1.5 Health characteristics of the population

1.5.1 Basic health indicators

Life expectancy at birth (WPDS, 1979): 48 years

Death rate per 1,000 population (WPDS, 1979): 17

Infant mortality rate per 1,000 live births (WPDS,1979): 148

Population per hospital bed (UN, 1976): 509

Population per physician (UN, 1976): 12,576

Per capita calorie supply as percent of requirement (FAO, 1977): 86

1.5.2 Major health problems in Liberia

Four factors influence the generally poor level of health in Liberia as a whole and in the rural areas in particular; malnutrition, lack of potable water and inadequate sewerage disposal, indigenous disease and population growth and its distribution. Liberia's high population growth rate has a significant impact on nutrition and health care. At the present rate, the population will double every 22 years. This means that Liberia must, in the same span of time, double its agricultural output and health care and other institutional facilities simply to maintain the population's present inadequate level of general health.

There is general agreement that the nutritional condition of the Liberian population is inadequate. Children, in particular, suffer from high levels of chronic malnutrition and various problems associated with a deficient diet. Many factors contribute to the low level of nutrition including; the quantity and quality of food, consumption patterns of the population especially as influenced by tribal customs, and economic factors. On the whole, malnutrition is due more to ignorance and superstition than to poverty. Problems of particular concern associated with the poor level of nutrition include anemia, protein deficiency diseases such as kwashiokor, various forms of vitamin and mineral deficiency diseases, and problems associated with diarrhea and dehydration.

A number of indigenous animal vector diseases contribute to Liberia's health problems. These diseases are caused by poor health habits, contaminated surface water consumption, lack of sanitation facilities, and general lack of preventive care combined with low resistance to disease due to malnutrition. Malaria has the highest incidence among communicable diseases and is a severe problem. The infection rate in some parts of rural Liberia is said to be as high as 80 to 100 percent. The following table lists indigenous diseases and their prevalence as recorded for a nine month period by the Ministry of Health and Social Welfare.

Table 2 Indigenous Disease Incidence, Jan.-Sept. 1976

Disease	Cases	Deaths
Malaria	42,023	70
Schistosomiasis	1,077	-
Pneumonia	3,149	151
Measles	1,420	55
Dysentery	3,425	-
Choiera	508	8
Diarrhea	15,379	75
Leprosy	2,303	-
Tetanus	446	49
Pulmonary Tuberculosis	726	22
Pertussis	1,161	1
Onchocerciasis	1,082	-
Infectious Hepatitis	226	-

1.5.3 Health services

There is an extremely limited number of medical/health care facilities in Liberia and the existing public health system is largely ineffectual. There is also a marked disparity in the distribution of health services, both preventive and curative, between the coastal areas and towns where the elite live and such services are concentrated, and the rural areas where the majority of the population lives. There are about 200 government health clinics in the rural areas. Staffing of the clinics is about 50 percent of minimum requirements and much of the staff is inadequately trained and poorly equipped. The rural population still relies primarily on traditional tribal medical practices. Only about 15 percent of a very modest health budget is allocated to preventive health services.

The Ministry of Health and Social Welfare is the government's public health administration. Headed by a Minister with cabinet rank, the Service has three main bureaus: the Bureau of Curative Services, which includes hospitals and dental services; the Bureau of Preventive Services; and the Bureau of Planning and Development. Below the national level the Ministry lacks an infrastructure,

with local bodies responsible for the immediate administration of hospitals and clinics. Although government agencies have taken an increasingly active role in health matters since World War II, medical missionaries and the Firestone Plantations Company have played the principle role in popularizing modern medicine. It is estimated that the missions and concessions provide up to 50 percent of the medical care in the country. Overall, the public health system in Liberia suffers from a lack of systematic and unified health planning. The Government is attempting to rectify this situation in its current efforts to develop a national health plan.

1.5.4 Sanitation and water supply

Poor sanitation is the main environmental factor affecting the level of public health in both rural and urban areas. The most serious problems include lack of sanitary piped water, lack of waste water and sewage treatment plants, poor sanitation and sewage systems, and improper disposal of human waste. Piped water is only available in four county capitals. Water supply is usually limited to open sources such as streams, swamps and shallow, uncovered wells. Water borne insect vectors of disease thrive in such conditions and are a leading cause of debilitating disease. Sanitation in the cities and towns is wholly inadequate. Monrovia is the only city in Liberia with a sewage treatment system. Yet, a recent World Bank study noted that 5,000 gallons of liquid human waste and twenty tons of solid human waste are improperly disposed in public areas of Monrovia daily. The poor state of sanitation stems from a chronic lack of funds to support adequate progams such as the building of safe water supplies, sewerage systems and the drainage of swamps.

1.6 Birth control and population policy

Despite Liberia's high population growth rate of 3.3% per year, the Government considers the country to be underpopulated and, therefore, family planning activities are negligible, accounting for less than 0.1% of the national health budget.

2.0 THE ECONOMY OF LIBERIA

2.1 General economic picture (World Bank figures)

GNP (1976): $720 million

Per capita share of GNP (1976): $450

Real growth rate (1960-70): 6.4% (1970-76): 2.9%

Rate of Exchange: Liberia uses US currency 1.00 = US$1

External debt, December 31, 1975: $170 million

Table 3 Gross Domestic Product (GDP) and Employment By Sector

Sector	GDP ($ million - current prices) 1975 %	1976* %	Employment 1974 %
Monetary Economy			
Agriculture, Forestry & Fishing	9.1	9.9	17.2
- Rubber	5.5	5.3	
- Forestry	1.7	2.4	
- Other	2.0	2.2	
Mining & Quarrying	26.0	24.2	4.0
- Iron Ore	24.6	23.1	
- Other	1.4	1.1	
Manufacturing	4.5	4.4	1.6
Construction	4.5	4.5	.8
Government Services	6.6	6.7	5.2
Other	34.0	34.8	11.2
Total Monetary Economy	84.7	84.6	40.0
Traditional Economy	15.3	15.4	60.0
Total GDP	100.0	100.0	100.0

*Preliminary
World Bank Mission figures.

Table 4 Income Distribution (1974)

	Current Prices		
	GDP ($ million)	Population (thousand)	Per Capita GDP ($)
Traditional Economy	111.4	930	119.8
Monetary Economy	539.7	620	870.5
- Foreign Concessions	260.5	109	2390.0
- Non-Concessions	279.2	511	546.4
Total	651.1	1550	420.1

World Bank Mission figures.

2.1.1 Economic growth and structure

As shown above, Liberia has a dualistic economy with significant differences in production and income distribution between the monetary and traditional sectors as well as between foreign-owned concessions and the national economy. Five percent of Liberia's population earns 67.5 percent of national income while the poorest 20 percent earns 5.3 percent. The monetary economy accounts for almost 85 percent of GDP while 60 percent of the total population still live in the traditional economy and are involved primarily in subsistence agriculture. Liberia's economy is export-oriented and is dominated by the mining sector, especially iron ore mining. The mining sector averaged about 29 percent of GDP between 1964 and 1974. Agriculture is the second largest productive sector in the economy, accounting for one-fourth of GDP. Aside from mining and agriculture, Liberia has a very limited production base.

During the period 1960-1974, Liberia experienced a relatively high rate of overall economic growth as a result of expanding iron ore and rubber production. Between 1960 and 1970 the economy grew at an annual average real rate of about 6.4 percent. However, during the next four years the real rate of growth declined to about 4.2 percent. This was due to a decline in the growth of iron ore production as full capacity levels were reached and to stagnation in rubber production. The decline in the production of iron ore and other export-oriented commodities such as rubber, forestry products and diamonds continued as economic recession in the West reduced demand.

The vast export sector of the Liberian economy is almost exclusively controlled by foreign companies, a result of the country's "Open Door" policy encouraging private foreign investment. These export-oriented concessions have had a very limited impact on productive capacity and the production base of Liberia due to their enclave character and limited linkages with the rest of the national economy. Furthermore, it is estimated that in any given year almost one-fourth of GDP is repatriated abroad as factor payments. This implies that GNP is consistently less than 80 percent of total value-added in the economy. The country's external accounts are characterized by a relatively large surplus on trade balance, but due to the large factor payments abroad, Liberia traditionally has had a deficit on the current account. Recently, the surplus on the trade accounts has been declining while the deficit on the current account has

been increasing. This is due to the rising costs of oil and other imports together with the decrease in exports.

2.1.2 The public sector

The public sector in Liberia is made up of the Central Government, the County Governments and a number of non-financial public enterprises. These include a marketing agency (the Liberia Produce Marketing Corporation - LPMC) and fifteen other enterprises, the most important of which are the Liberia Electricity Corporation and the National Port Authority. The LPMC is a wholly-owned government corporation that is the effective price-setter for coffee, cocoa and other crops (in theory, prices are set by the Ministry of Agriculture upon the recommendations of LPMC). The Government also holds a 50 percent interest in the iron ore companies.

In the past the public sector played a limited role in directing the economic development of Liberia. With the introduction of Liberia's first Socio-Economic Development Plan 1976-1980, the role of the public sector has changed dramatically. The Government has adopted an increased commitment to development as shown by the steadily rising share of the total budget devoted to development activities since 1974 (14% vs. 47%). The Plan recognizes the need for diversification of the non-enclave economy and adopts an ambitious public sector investment program to achieve the following development objectives:

- Diversification of production;
- Geographical dispersion of sustainable socio-economic activities throughout the country;
- Greater participation of the entire population in development efforts;
- Equitable distribution of the benefits of economic growth and diversification so as to ensure an acceptable standard of living to all Liberians throughout the country.

The diversification strategy is based on integrated rural development. About 54 percent of the public sector investment program is allocated to basic infrastructure and about 20 percent to agriculture (including forestry). A high priority has been placed on agriculture as a means to achieve the objectives outlined above. This emphasis on agriculture will have implications for the development of the country's renewable natural resources, e.g., rubber and forestry.

The Government re-emphasized its new commitment to rural development with the issuing of Executive Order No. 1 in 1978. The Order established a Rural Development Task Force to be directed by the Vice-President. The Task Force is to develop practical ways to increase the participation of the rural poor in development decisions that affect them. The Order also calls for greater decentralization of the Government and for the Ministry of Planning to make rural development the central focus of the 1980-84 Development Plan.

2.1.3 Training and manpower

The lack of adequately trained manpower at all levels has been identified as

the single most important constraint to the economic development and diversification of the Liberian economy. The Government has established a National Council for Vocational and Technical Education and Training to coordinate and oversee the development of a training system to help meet the country's needs for trained manpower. Agricultural extension worker training is currently overseen by the Ministry of Agriculture. Several Government agencies operate training programs that respond to needs in particular ministries and sectors.

An agreement with Sierra Leone has led to the establishment of a training program to meet both country's needs for skilled workers in forestry. Training in the private sector is done principally by the large concessionaires.

2.2 Transportation system

The development of Liberia's transportation system followed the development of the enclave-based economy. The transport system is focused on Monrovia and consists of 4,600 miles of roads, three privately-owned railways totalling about 300 miles, four seaports and about fifteen airfields. The system is barely able to support the present enclave-based economy and will require extensive development and modernization to meet the Government's objectives of creating a more diversified agriculture-based economy. Improved road transport represents the largest percentage share of planned investment in the current Development Plan. The Government hopes to better integrate the traditional sector into the monetary economy through the improvement of primary roads and the construction of a comprehensive feeder and secondary road system.

Roads (see fig. 5) - Roads are the basis of Liberia's internal transportation system, and are the principal means of moving both passengers and goods other than iron ore. The road network is very unevenly distributed; more than half of all road transport is concentrated in the Monrovia region and along the Monrovia-Ganta axis. Liberia has 3,200 miles of public roads, of which 1,900 miles are all-weather roads, and 1,300 miles are roads that are only serviceable during the dry season. There are only 224 miles of paved roads, about 7 percent of the public road network. The remaining 1,400 miles of roads are private, mostly laterite-surfaced roads built by the rubber and lumber concessions. Many potentially productive areas of the country such as Lofa, Grand Bassa and Grand Gedeh Counties, have only poor and indirect connections to the ports and market centers, and other vast areas particularly in the Southeast are not served at all. Better feeder and secondary roads are needed in rural areas to improve the movement of rural agricultural products and support government efforts to improve rural health and education.

Rail (see fig. 5) - Liberia has no national railroad, instead depending on three private lines built by various mining companies. Railroads carry some 20-25 million tons of iron ore annually to the ports of Monrovia and Buchanan.

Air - Roberts Field, built near Harbel during World War II, is Liberia's international airport. National airfields exist near Monrovia, Kolahan, Samiguellia, Buchanan, Tchien, Greenville and Harper. Internal air transport is negligible.

Ports - Liberia has four seaports: Monrovia and Buchanan, which are deep-water ports and handle over 85 percent of all foreign trade; and Greenville and Harper, both shallow-water ports that handle mainly log exports.

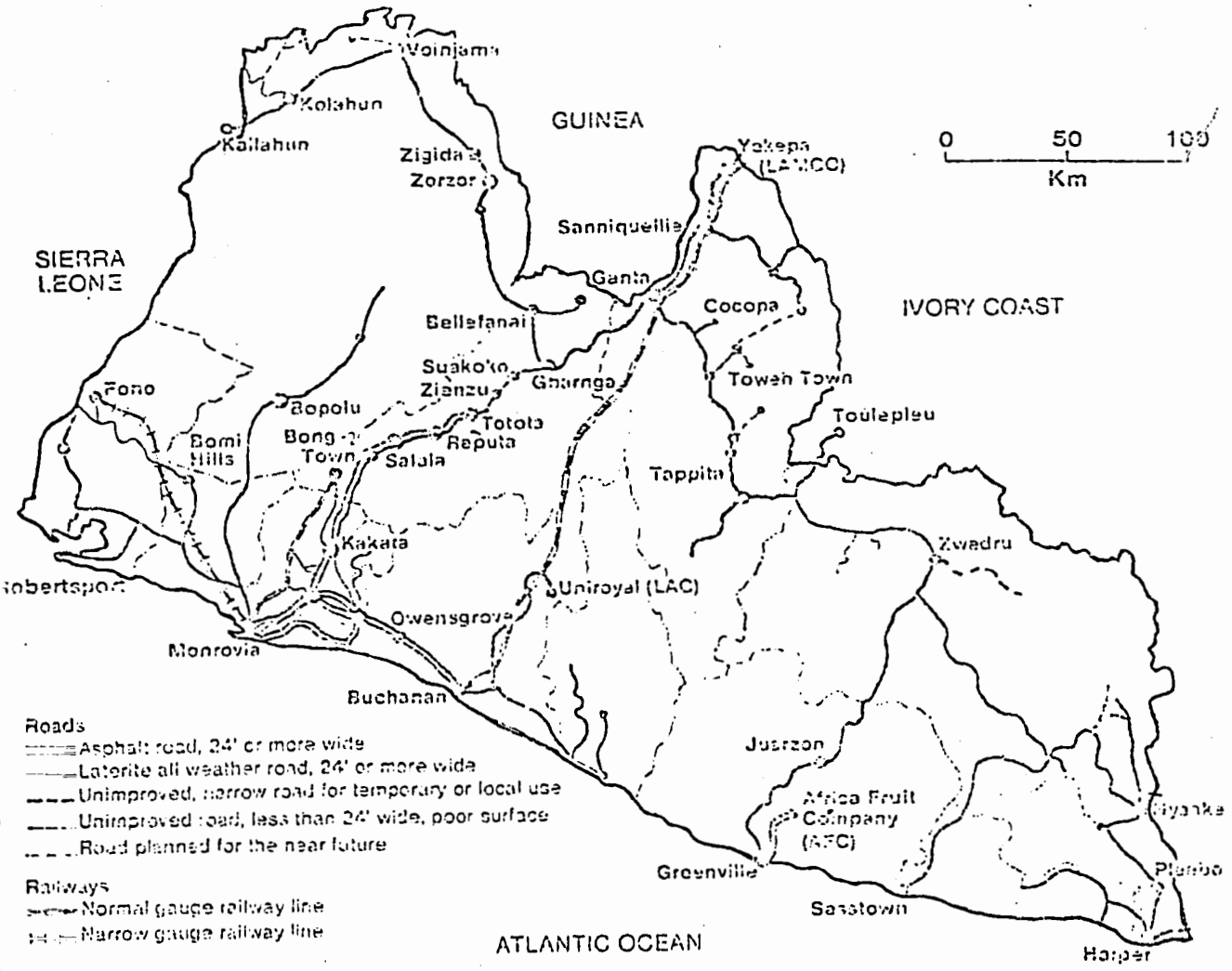


Figure 5. Main roads

2.3 Land tenure syste

There are two distinct systems of land tenure in Liberia; land administered by tribal authority, and land held individually. Liberia has traditionally allocated land in the rural areas to the tribal councils to be administered by the different clan chiefs according to tribal custom. This land is informally allocated on the basis of need and length of residence in the area. Normally, once the land is assigned it is not taken back; but since no deed or document is given, there is no guarantee of rights of ownership. In a recent proclamation, the President of Liberia declared that he wants all citizens to become land owners if they wish to do so; each person being entitled to ten acres of land.

2.4 Major sectors of the economy

2.4.1 Mining

The mining industry is the most important sector in Liberia's economy, with iron ore the most important product. Iron ore exports account for 60-70% of total export earnings. After averaging 30% of GDP between 1964 and 1974, its contribution declined to about 20% of GDP in 1977, and this decline is expected to continue into 1978. All mining production, which includes diamonds and gold, is exported. In 1975 Liberia had an iron ore production capacity of 25 million tons, making it the eleventh largest producer in the world behind Venezuela.

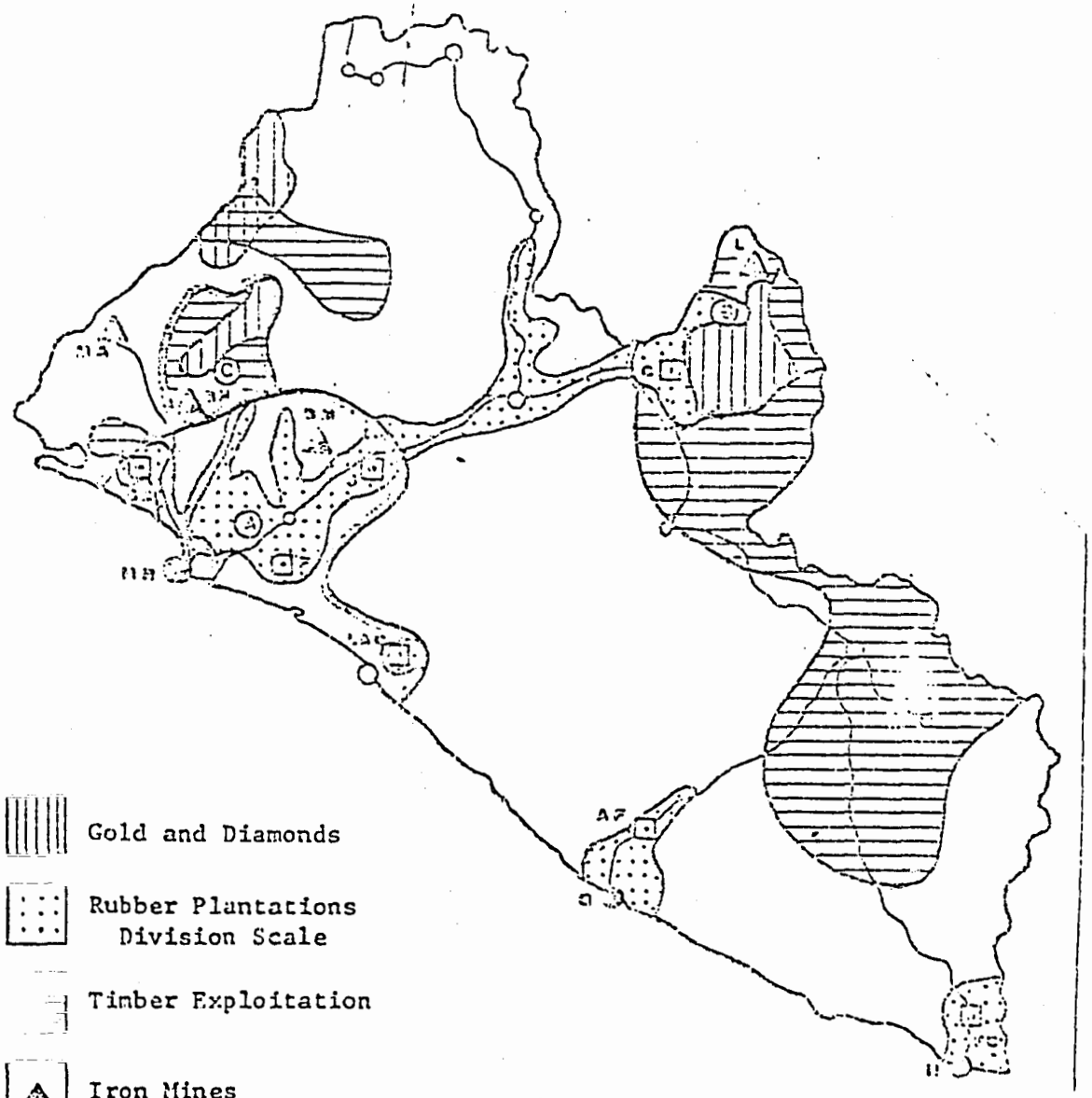
The iron ore mining industry is composed of three massive mining operations, all of which are foreign owned and controlled. The largest is the Liberian American-Swedish Minerals Company (LAMCO) which exploits the rich Nimba mountain deposits on the Guinea border. In 1974, its output accounted for 52 percent of total production. Other mining concerns include the German-Liberian Mining Company (DELIMCO), which operates in the Salala District in the southwest part of Bong County and accounts for 26 percent of production, and the National Iron Ore Company (NIOC) which operates the Mano River mine in Grand Cape Mount County (14 percent). Concession agreements for the development and exploitation of three other iron ore sites - the Wologisi range, the Putu range and Gbie Mountain - have been concluded or are in various stages of negotiation.

2.4.2 Agriculture

Agriculture is the second largest productive sector in Liberia and the most important economic activity in terms of labor force participation. Including traditional and subsistence farming, agriculture is estimated to contribute 25 percent of GDP. In 1976, about 76 percent of Liberia's population was engaged in agriculture; 60 percent in the traditional sector producing on small plots primarily for subsistence, and 16 percent in the monetary sector.

The rubber industry dominates the agriculture sector, providing more than half the sector's net output. The industry is characterized by large foreign-owned concessions and Liberian-owned rubber farms. There are six foreign-owned concessions which operate a total of 140,000 acres, utilizing capital intensive modern management techniques. The Liberian-owned private sector developed as an outgrowth of the foreign concessions during World War II. Though these farms comprise one half of planted acreage, they account for only one third of total rubber production. The generally low yield of these private plantations (an average of 568lb./acre compared to 1,285lb./acre on the foreign concessions) is due to poor planting material and low management standards.

The traditional agricultural sector comprises about 93 percent of the total farming population, who live on two thirds of the country's cultivated land. These are small scale family farms averaging five acres in size and yielding a typical annual income of only $54-70. There is little infrastructure, and farmers have very limited access to credit and other modern agricultural inputs, relying on traditional farming methods that result in low productivity. The traditional sector accounts for 60% of total agricultural output and is based on staple crops of rice, cassava and vegetables. Because of tribal differences in



Gold and Diamonds

Rubber Plantations
Division Scale

Timber Exploitation

Iron Mines

Rubber Plantations
Large Scale

Trading Center for Raw Materials

Main Zones

Figure 6. Main areas of raw material exploitation

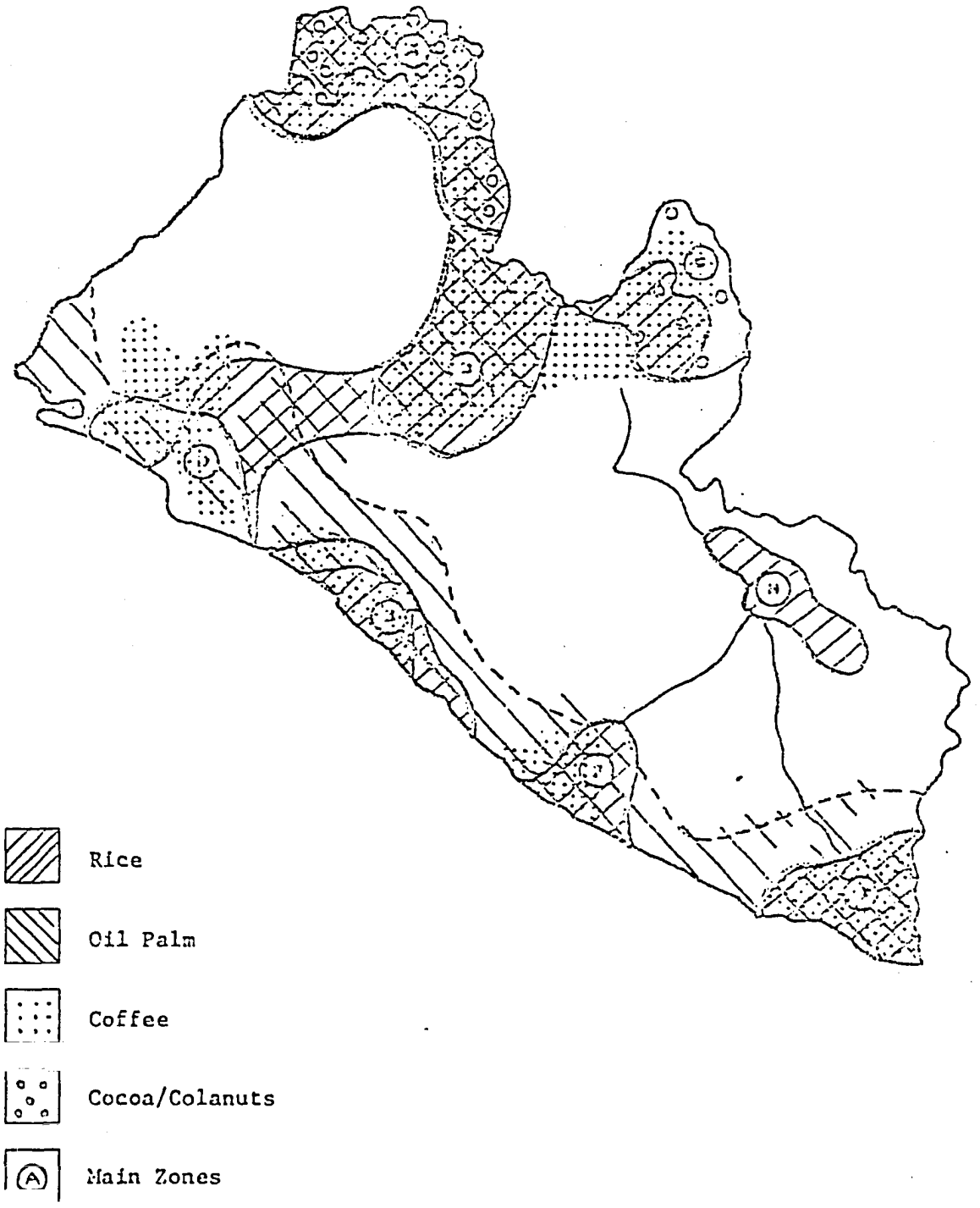


Figure 7. Main areas of subsistence economy

tastes and preferences, cassava is more common in the coastal regions than in the interior. In the interior one finds predominantly rice farms, whereas in the coastal areas rice is almost always intercropped with cassava. There is also some production of cash tree crops such as coffee, cocoa, oil palm nuts (mostly wild), sugar cane and fruits. The existing land tenure system in rural areas is considered a severe constraint on the development of the agricultural sector and the prospect of turning small scale farmers into economic producers.

3.0 RESOURCES

3.1 Topography and climate

Most of Liberia lies within the tropical lowland rain forest belt of Africa, a narrow belt extending from the southern part of Sierra Leone down through Ghana, where it ends some distance inland from the coast. Only the northernmost part of Liberia extends into the belt of Guinean woodland savanna, which stetches across Africa from Senegal to Sudan. Liberia is characterized by four major physiographic regions lying parallel to the coast: the coastal plain, the belt of rolling hills, the belt of mountain ranges and plateaus, and the Northern Highlands.

The coastal plain averages 40 kilometers (25 miles) in depth and reaches an elevation of between 9 and 30 meters (30 and 100 feet). Its surface is flat or very gently rolling with a few isolated hills rising over 46 meters (150 feet). A few points along the shoreline such as Cape Mount, Cape Mesurado and Cape Palmas have palisades directly fronting the ocean. The surf is normally heavy all along the coast but is worst at the height of the rainy season. Along the coast are marine lagoons and, a bit inland, mangrove swamps and lagoons formed by estuaries of rivers and streams. There are two types of marine lagoons. The first type is created by the formation of a sand spit which develops between two points on the coastline, thus cutting off a marine waterbody from the ocean. The second type develops under the influence of the ocean tide (the tidal range is moderate). Here the ocean water intrudes onto a flat onshore area through a small, low pass. Behind the pass, outgoing water carries away material from the bottom of the flooded area, carving out an oval-shaped form. Often, other marine conditions will cause the build-up of a beach sandbar that closes off the newly-formed lagoon from the ocean.

A belt of rolling hills borders the inner margin of the coastal plain. This region is marked by a distinct transition to a more rugged terrain with a general elevation of 61 to 152 meters (200 to 500 feet).

The belt of rolling hills is then interrupted by an abrupt change in elevation marked by waterfalls along major streams. This region of mountain ranges and plateaus forms the largest part of Liberia with a width of up to 129 kilometers (80 miles) and rising to 183 to 305 meters (600 to 800 feet) above the surrounding terrain.

The Northern Highlands are found in the northern parts of Lofa and Nimba Counties and form part of the Guinea Highlands. Two important mountain ranges dominate this region; the Wologisi Range (culminating in Mount Wutuvi, 1,356 meters or 4,400 feet) in Lofa County, and the Nimba Range (with an elevation up to 1,372 meters or 4,500 feet) which forms part of a mountain chain stretching across Liberia, Guinea and the Ivory Coast.

The tropical climatic pattern of Liberia favors high forest vegetation and is important to the understanding of the ecology of the area. Liberia's climate is characterized by two distinct seasons, rainy and dry. Each is approximately six months in duration; the rainy season lasting from May to mid-November and

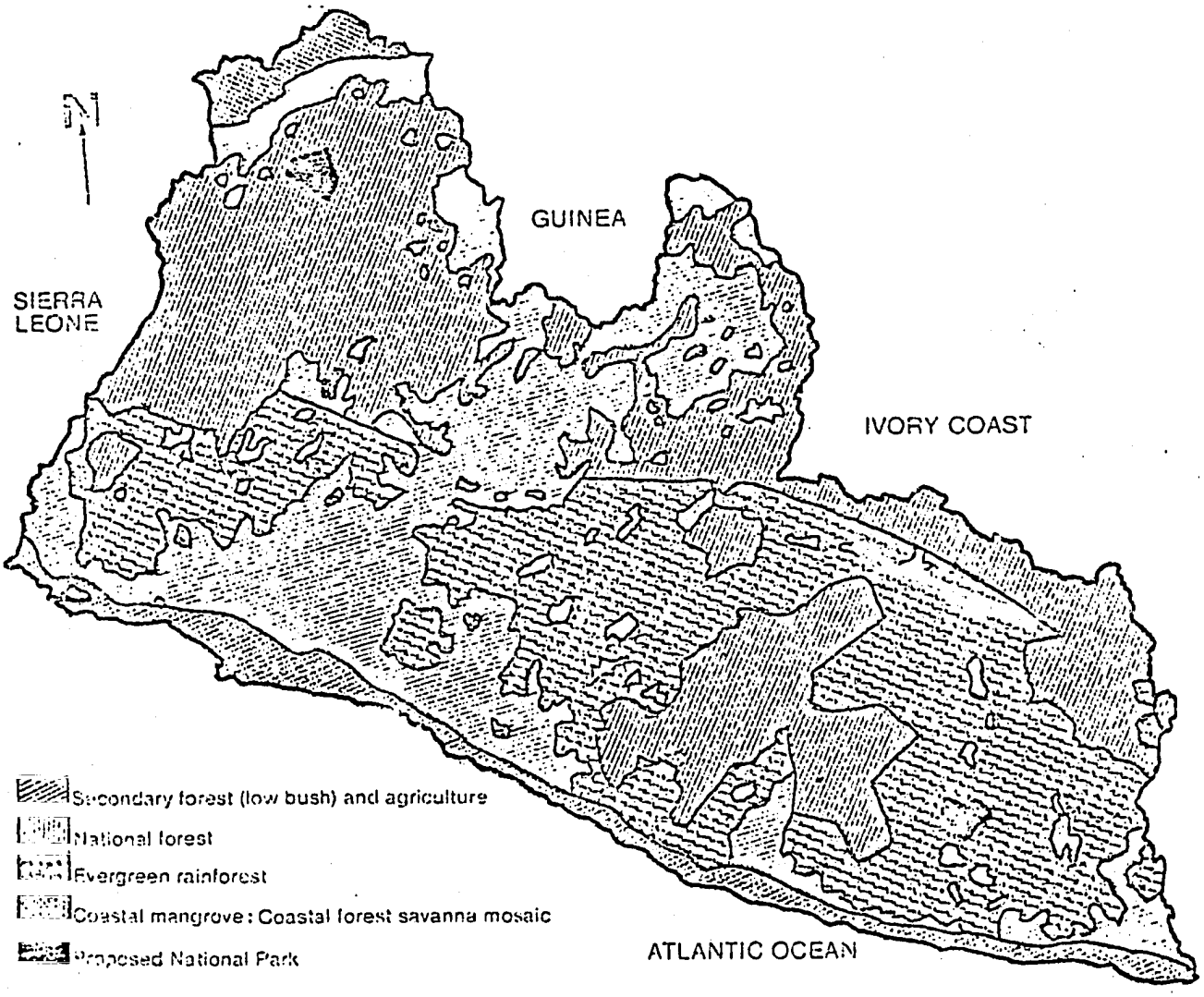


Figure 8. Vegetation map

the dry season from November to April. During the dry season the atmosphere is very stable with little vertical mixing. Haze is prevalent, especially when smoke from land burning is confined within the lower few feet of the atmosphere. During the rainy season the rain squalls increase vertical mixing of the atmosphere. The rainy season is interrupted between July and August by a pronounced drop in precipitation known as the "middle drys" which lasts for about three weeks. The coastal belt has the heaviest precipitation, ranging from up to 200 inches in the northwest to about 100 inches in the southeast. The amount of precipitation gradually decreases towards the interior to about 80 inches. It does occasionally rain during the dry season.

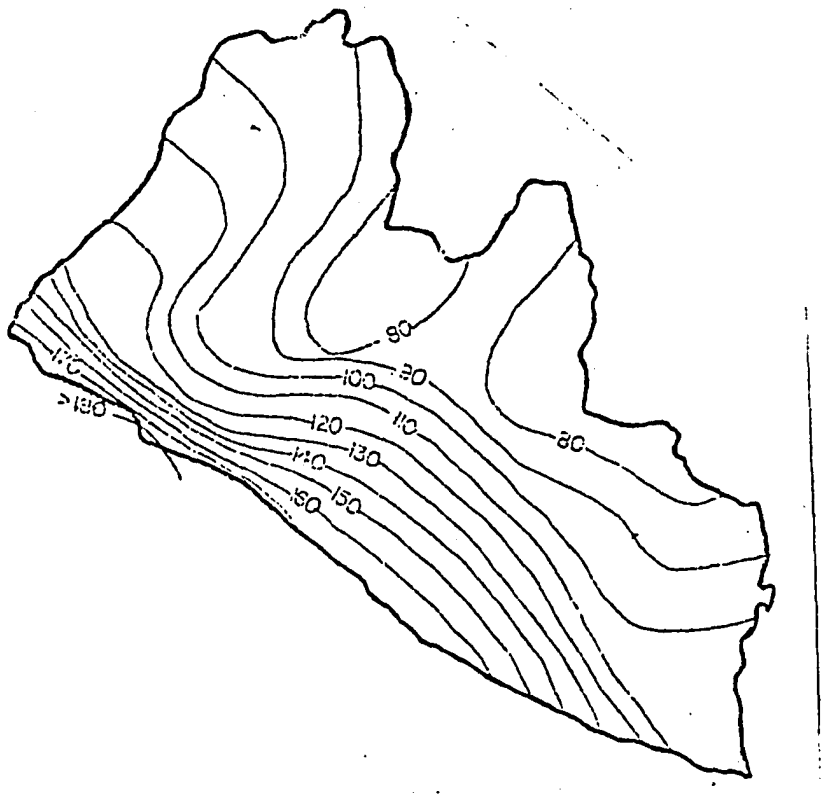


Figure 9. Average annual rainfall (inches)

The equatorial low-pressure belt, or intertropical front, separates two air masses of high pressure that circulate over Liberia - the continental and maritime air masses. The continental air mass is north of the front and has little moisture. Its prevailing northeast wind is the dry, dusty harmattan from the Sahara. The maritime air mass south of the front is warm and moist, with prevailing winds from the southwest. The frontal area between these two systems is a belt of instability, with variable winds and calms.

Liberia has a fairly consistent temperature that rarely exceeds 97 degrees F. or falls below 68 degrees F. Mean temperatures vary between 75-86 degrees F.

Mean diurnal temperature ranges are only about 10 degrees F. in the coastal region, but increase with altitude inland where they may be as much as 40 degrees F., depending on local conditions. Relative humidity is generally high, especially in the coastal region where the average is over 80 percent and readings seldom fall below 60 percent. Humidity is almost as great in the interior and mountainous regions, though there is a higher variation. During the dry season when the harmattan wind is blowing, humidity may fall below 50 percent.

3.2 Water

Liberia has an abundant supply of surface water and appreciable quantities of groundwater. However, Liberia suffers from a lack of adequate data on the occurrence and availability of both surface and groundwater and other hydrological parameters. This dearth of information is a major obstacle to maximum beneficial use of this resource (Ministry of Lands and Mines, 1976). The following table identifies hydrometric stations in operation as of 1976 (and also shows how inadequate the hydrometric system is).*

Table 5 Hydrometric Stations

Basin	Number of stations: On main river	On tributaries	Total	Number of automatic stations	Number of stations in operation for last 10 years
Cavalla	1	1	2	1	1
St. John	2	4	6	2	1
St. Paul	2	1	3	-	2
Cestos	1	-	1	-	1
Lofa	1	1	2	2	-
Mano	1	4	5	2	1
Sehnkwehn	1	-	1	-	1
Mafa	1	-	1	-	-
Small coastal streams/creeks	2	-	2	1	-
	12	11	23	8	7

Ministry of Lands and Mines, 1976.
*There are now 29 stations in eight river basins, and new stations are planned.

3.2.1 Rivers and lakes

Liberia is well watered by numerous rivers and lakes. The river system forms a uniform pattern from one end of the country to the other. All rivers, with the exception of the middle reaches of the Cavalla River, flow from the interior southwest to the Atlantic, perpendicular to the coast. There are sixteen river basins, of which the six largest are international. The river basins are narrow, and the major streams are spaced at regular intervals across the country. There are no well-developed valleys or flood plains.

There are significant variations in the volume of flow of the rivers due to the alternating rainy and dry seasons and rapid runoff in the watersheds. During the rainy season most rivers overflow their banks. Even during the rainy season, however, the rivers are not navigable for any important distance inland because of rocky rapids and narrow channels. In fact, little use is made of the major rivers and streams except for subsistence fishing and local water supply and by mining operations for various purposes.

The falls and rapids of Liberia's rivers provide a potentially significant source of hydroelectric power. In 1965 the Mount Coffee hydroelectric plant was opened on the St. Paul River. The Liberian Hydrological Service has initiated project studies on possible hydroelectric plants on the Mano, St. Paul and Cavalla Rivers and on the expansion of the Mount Coffee plant.

The major rivers of Liberia include:

Cavalla River - The right bank of the Cavalla River forms nearly three fourths of the border with the Ivory Coast along the eastern side of Liberia. Originating in Guinea and the Ivory Coast northeast of the Nimba Mountains, the Cavalla drains into the Gulf of Guinea about fifteen miles east of Cape Palmas. The river is used to some extent by the Firestone Cavalla Plantation and people along the Liberian bank.

Cestos River (River Cess) - The upper course of the Cestos River forms part of the border with the Ivory Coast, and drains the eastern side of the Nimba Mountains. A number of narrow basins that drain to the sea are located between the Cestos and Cape Palmas, including the Sangwin, Sinoe, Dugbe, Dubo and Grand Cess Rivers.

St. John River - The upper course of the St. John is called the Mani River and forms part of the border with Guinea. The St. John originates in Guinea northwest of the Nimba Mountains, and drains in the Atlantic about 25 miles southeast of the Farmington estuary. The St. John drains the widest basin among Liberia's rivers.

Farmington River - Though a small river, the Farmington is the only inland waterway of much commercial importance in Liberia. The Firestone Plantations Company ships rubber from Harbel (about 15 miles upstream) to the sea and on to Monrovia.

St. Paul River - The headwaters of the St. Paul River are in the mountains of Guinea east of Macenta. The river flows in a southwesterly direction and drains into the Atlantic about 7 miles north of Monrovia.

Lofa River - The headwaters of the Lofa River are also located in Guinea. The river flows through the Gola and Kpelle Forests and is navigable for about 20 miles inland.

Mano River - The Mano River forms roughly half of the border with Sierra Leone. It originates in the Guinea Highlands and flows southwest through the Gola Forest. The Mano River Union has been formed (composition unknown) to fully utilize the water resources of the Mano River Basin.

There are several lakes in Liberia, including Lake Piso (or Fisherman's Lake, which is rapidly becoming a tourist resort) and Lake Mawoa in Grand Cape Mount County, and Shepherd's Lake and Lake Klemoweh in Maryland County.

3.2.1.1 Environmental problems

Liberia's rivers, streams and lakes are a major source of environmental disease since piped water is only available in four county capitals and there are few waste water and sewage treatment plants. Waterborne parasites pollute these waters, especially during the rainy season when the rivers overflow their banks and create stagnant pools in which the parasites thrive. Villages and industries have developed along the rivers and lakes, which has led to other pollution problems. The Mano and St. John Rivers are becoming increasingly polluted by iron ore dust and other residues of the iron ore production process. The dumping of iron ore tailings into these rivers creates a stony red or yellow iron precipitate. Though the existence of these problems has been documented, they have not been monitored and no further information is available.

3.2.2 Groundwater

There is very little information available on the quantity and quality of Liberia's groundwater resources. Groundwater is used almost exclusively for domestic purposes, usually from wells dug near villages. It is known that Liberia has abundant springs that offer an easily developed water source for many towns and villages, but these springs have yet to be mapped. A report on groundwater in the Monrovia area revealed that the Edina sandstone may be capable of producing several million gallons of water a day to supplement the present city supply.

3.2.2.1 Environmental problems

As with surface waters, environmental problems associated with groundwater resources have not been monitored. Wells dug for domestic use frequently become contaminated because of location, misuse, waterborne parasites, etc.

3.2.3 Coastal waters

Liberia lies on the great western bulge of Africa with a coastline that extends 565 kilometers (350 miles). In 1977, Liberia extended its territorial sea from 12 to 200 nautical miles. The coastal waters of Liberia, and of the Gulf of Guinea in general, are becoming increasingly polluted. Oil is the most serious pollutant and is the result of residue from large oil tankers, oil cargo handling and off-shore drilling of petroleum. Increased development along the coast, and the subsequent increased dumping of untreated sewage and

waste water, is also contributing to the pollution problem. In response to the growing pollution of the Gulf, nineteen West African countries have joined together with the World Health Organization and other U.N. agencies to set up a program to tackle the problem. Under this joint effort, a coastal water quality program is planned involving four stages: assessment of the degree of pollution, determination of water quality; establishment of criteria for defining "acceptable risk"; and the development of control strategies and appropriate legislation.

3.3 Soils

The soils of Liberia have been formed from Precambrian bedrock. This bedrock consists mostly of granites, gneisses, gneissic sandstones and schists. Diabase dikes up to several hundred feet thick are abundant and cut the crystalline basement rocks in distinct zones. Near the coast, dikes and flat-lying diabase bodies cut sandstones of pre-Late Triassic age.

The lateritic soil that covers most of Liberia is the product of intensive weathering of this Precambrian crystalline rock. High temperatures decompose humus faster than the plants can use it for growth, and then heavy rains wash much of this excess away and penetrate deep below the surface to leach out nutrient matter. This process leaves the soil with a low silica content and a high proportion of hydrous oxides of iron and aluminum. The soil is strongly acidic but basically fertile, and is best suited for tree crops.

Along the coast the soil is generally very sandy compared to the lateritic soil found throughout the rest of the country. This soil used to support high forest (the forest still stretches down to the coast in some places), but a drastic change in vegetation took place after the areas were cleared for agriculture. After harvesting the first crop, the areas produced grass rather than woody species as the sandy soils would not support a second growth of timber. These grassy areas are burned over during the dry season, which creates a top layer of sterile white sand. Below this layer a darker sand, and at times a loamy sand, can be found.

3.3.1 Environmental problems

Though the soil is basically fertile, it is ecologically sensitive to disturbance by man due to the effects of leaching described above. Thus, the effects of shifting agriculture, the principal agricultural system in Liberia, can be all the more severe. Shifting cultivation, or slash and burn agriculture, results in considerable loss of timber. This clearing of forest land can destroy nutrient cycles and lead to further loss of nutrients and degradation of the soil. This process of degradation is increased by the effects of solar radiation and direct precipitation on the ground. The ultimate result of shifting cultivation is erosion of the soil.

Traditionally upland rice is planted in the first year after the land is cleared, followed by cassava in the second year. The land is then abandoned and a new plot cleared. This process occurs on a five to ten year rotational cycle. The majority of upland rice farms are situated on slopes, thus increasing the chances of soil erosion (especially during the rainy season). No figures were available on the extent of the problem.

3.4 Minerals

The geological survey of Liberia is far from complete (and presently not available). In addition to iron ore, diamonds and gold (which are currently being exploited), Liberia is known to possess copper, lead, zinc, tin, graphite, manganese, mica, rutile, ilmenite, zircon, monazite, barite, kyanite, corundum, bauxite, asbestos, monzanite, platinum, talc and tungsten.

3.4.1 Utilization of minerals

The mining industry is the single most important sector in Liberia's economy. All mining production is exported. In 1961, iron ore replaced rubber as Liberia's most important export commodity. In 1977, Liberia exported 17.4 million tons of iron ore worth $273.5 million, 61 percent of all export earnings. There are presently three mining operations in Liberia. The most important mine is at Mount Nimba. Deposits at Mount Nimba are estimated at 250 million tons of 67 percent iron content, and 700 million tons at 40-45 percent iron content. The other two areas are at Mano River and the Bong range, fifty miles northeast of Monrovia.

3.4.2 Environmental problems

See 3.2.1.1.

3.5 Forests

Liberia lies within the tropical rainforest belt and is one of the last West African countries with considerable forest reserves. Over 260 species of trees have been identified. The high forest areas of Liberia can be classified according to vegetational zones which roughly parallel the coastline and are dependent on annual precipitation.

In a narrow strip of land from one to nine miles in width along the coast are found mangrove swamps and some coastal forest. Beyond this area, and extending inland up to about fifty miles, is the belt of broadleaf evergreen rain forest. The average annual rainfall in this belt ranges ranges from a maximum of 180 inches to about 90 inches along the interior boundary of the belt. All the trees are broadleaved and are covered with foliage year-round, though there is a constant shedding of leaves throughout the year. Undisturbed, the evergreen forest has a closed canopy, often in several layers, with the taller trees often reaching 200 feet in height and allowing little undergrowth. It is estimated that there are 150 or more species that grow to commercial size, most of which have not yet been introduced on the market (there are no pure stands of any particular species). Among the more common species are red ironwood (Lophira procera), wismore (Tarrietia utilis), African pine (Didelotia spp.), Entandrophragma utile, Mimusops [illegible]elii, Canarium Schweinfurthii, and Terminalia superba.

Extending inland beyond the evergreen forest is the belt of deciduous forest, separated by a narrow transitional forest zone consisting of both evergreen and deciduous species. Typical species in this zone include Terminalia ivorensis, Chlorophora excelsa, Piptadenia africana, and several Afzelia spp. Deciduous forest is found in areas where annual precipitation

ranges between 70 and 90 inches per year. It resembles the evergreen forest in general appearance, but the dominant species are different and the growth is not so dense. In addition to the species mentioned above in the transition zone, other species typical of the deciduous zone are Triplochiton scleroxylon, Sarcocephalus Diderichii, Lovoa Klaineana, Khaya ivorensis and Khaya anthotheca. The most valuable commercial timber in the country is found within the deciduous zone.

3.5.1 Utilization of forests

Liberia has an estimated 12 million acres of forest land. The country's sustained yield is estimated at between 2-3 million cubic meters, of which only a small proportion is presently exported. The Forestry Development Authority (FDA) estimates that, on the average, the first felling cycle will last for at least 15 more years with six million acres of untapped forest resources (though this does not take into account the effect of shifting agriculture). Commercial exploitation of Liberia's timber resources began only eighteen years ago. Since then, timber concessions have become well dispersed over the country (see Figure 10, p. 28). In 1977/78 there were 31 concessions with valid Forest Products Utilization Contracts and 5 companies operating without concession agreements. Total area held by concessionaires amounted to 8,336,713 acres.

Table 6 Wood Production (in thousands of metric tons)

Product	1966	1970	1976
Roundwood production	1,098	1,460	2,051
Exports	23	149F	220F
Fuelwood and charcoal	991	1,170F	1,366F
Industrial roundwood	107	290	685
Exports	23	149F	220F
Sawlogs and veneer	42	220	605
Other industrial rw.	65	70F	80F

Figures from the FAO Yearbook of Forest Products 1976. All figures refer to non-coniferous woods.
F = FAO estimate.

As shown in Table 6, the bulk of wood production is utilized as a source of fuel. Firewood is the prime source of fuel in Liberia, as it is throughout Africa. However, the percentage of wood production devoted to firewood has been steadily declining, from 90 percent in 1966 to 67 percent in 1976. This is due to a significant increase in industrial roundwood production.

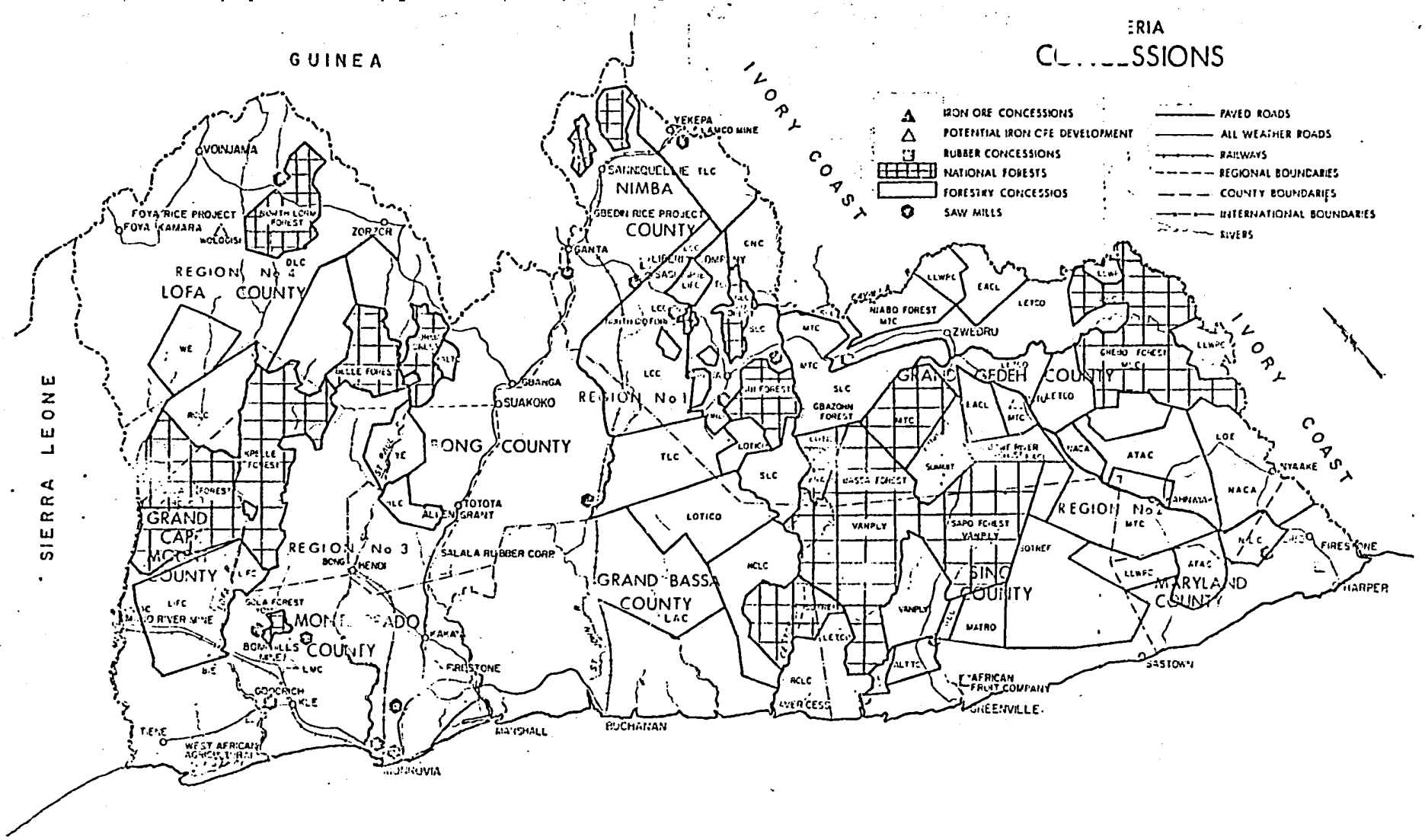


Figure 10. National Forests and Forestry Concessions

At present, Liberia does not have a concrete national policy on reforestation or management of existing forest reserves. The concessionaires are reportedly so large and powerful that they essentially dictate forest policy (Lausche, 1979). In consultation with the concessionaires, the FDA has formulated a set of rules, promulgated as a regulation, to eliminate needless waste in logging operations. No information was available on how effective this rule has been.

3.5.2 Environmental problems

Though Liberia still has ample forest reserves, they are being depleted at an increasingly rapid rate. The use of forests as a source of firewood was not mentioned anywhere in the literature as a problem, though it must be a major contributor to depletion. Three additional sources are contributing to the destruction of the forests - the concessionaires, the Government through its land clearing program, and farmers practicing shifting cultivation. According to an IUCN report based on a three-month survey in Liberia in 1977/78, "the number of logging concessions is so high that the whole of Liberia forests could be finished in the near future." In addition to the pressure of commercial logging, the Government has undertaken an ambitious land clearing program to establish plantations of fast growing economic species. This land had previously been a national reserve composed of virgin forest or a mixture of virgin and secondary growth. Perhaps the most severe source of pressure on the forests is from the practice of shifting cultivation (though no figures were available comparing the effects of shifting cultivation with that of the concessions and the land clearing program). The FDA estimates that depletion by selective logging is 1.6 cubic meters/acre, while depletion by shifting agriculture runs as high as 150 cubic meters/acre. The destruction of nutrient cycles when forests are cut and burnt for agricultural purposes leads inevitably to soil degradation and loss of nutrients. This, in turn, leads to soil erosion.

A further problem is the amount of waste involved in the harvesting of wood. Under current logging practices, 60 percent of all the logs harvested end up wasted; either as undesirable portions which are left in the bush, logs which roll off the trucks during transport, or slabs and chips left over after the logs are made round. In recognition of the problem, Liberia is experimenting with a very small charcoal operation to process some of this waste (Lausche, 1979).

In 1971 the Government launched a National Reforestation Program within the former Bureau of Forest Conservation of the Ministry of Agriculture. Under the program, since taken over by the FDA, the concessions are required to replant one acre with new trees for every 30,000 board feet (135 cubic meters) cut, or to pay $450 into a special fund for the reforestation program. As of 1978, 12,500 acres had been reforested primarily with teak, tropical pines and eucalyptus - not a very significant amount. The reforestation areas are Bomi Hills, Yekepa-Nimba National Forest, Cavalla Forest and Grebo National Forest.

The World Bank is involved in one reforestation project in Liberia. This is a $17.5 million project beginning in 1979 and scheduled to last five years. The main components of the project are:

- to strengthen the technical, administrative and physical capabilities of the FDA. This includes completion of the aerial photographic cover of Liberia, providing thematic maps for vegetational and land use studies and planning, as well as for forest management and control. Liberians will be trained to analyze and interpret all types of remote sensing.

- the establishment of a pilot industrial plantation of 4,000 acres in Grand Cape Mount County. This is the first stage in the development of a 160,000-180,000 acre pulpwood plantation, large enough to support a pulpmill in Liberia.

3.6 Wildlife

The wildlife of Liberia is adapted and specialized to the lowland rainforest ecosystem and its range of habitats: brackish and freshwater swamps, rivers, high forests and woodland savannas. Thus the animals are typical of the great African equatorial lowland rainforest, though Liberia does possess some unique species.

Although human encroachment along Liberia's coastal plain has led to the disappearance of most wildlife, the forests of the interior still support a wide variety of species. Most of this wildlife is restricted to high forest and inaccessible or undisturbed areas away from villages. In a somewhat dated study, over 100 species of mammals, 33 species of amphibians, 41 species of reptiles and 280 species and subspecies of birds were identified in Liberia.

In the waterways of Liberia are found the Nile hippopotamus, the pigmy hippopotamus (unique to Liberia) and three species of crocodile. There are 15 species of snakes, including water snakes, mambas, cobras, vipers and the python. Several types of monkeys live among the trees of the forest, including baboons, Colobus monkeys, white spotted nose monkeys, chimpanzees and a lemur called Bosman's potto. Other characteristic mammals are the elephant, buffalo, antelope, duiker, groundhog, mongoose, honey badger, tortoise and several members of the leopard group.

Liberia has a wide variety of birdlife. Waterfowl are abundant along the estuaries and tidal creeks where large flocks of white herons roost in the mangrove. Ibis, egrets and flamingoes are found in the mudflats and shallow waters. Game birds include guinea fowl, partridges, doves and pigeons. Other birds include hornbills, weaver birds, woodpeckers, kingfishers, curlews, phalaropes, parrots, plovers and many types of hawk and eagle.

3.6.1 Utilization of Wildlife

Serious depletion of wildlife throughout Liberia limits its potential as a significant source of protein, though the FDA reports that 70 percent of the rural population supplement their protein diet with bushmeat (or their income from the sale of it). With proper management, particularly with respect to land use, wildlife could become a major protein resource. Because ecological conditions in Liberia are unfavorable for large scale production of livestock, wildlife becomes all the more important as a future source of protein.

3.6.2 Environmental problems

According to an IUCN survey on wildlife, national parks and forestry conservation in Liberia during 1977/78, the "situation of wildlife is absolutely desperate..." Tremendous hunting pressure combined with loss of habitat have reduced the wildlife resource to a fraction of its former wealth and productivity. Wildlife has almost disappeared along the coastal plain and there are no longer any large herds of big game. Liberia has the highest number of guns per capita among West African countries and there is absolutely no banning of firearms.

The following species occuring in Liberia have been identified as endangered or threatened:*

Common Name	Scientific Name	Status
Mammals		
Chimpanzee	Pan troglodytes	Threatened
Elephant, African	Loxodonta africana	Threatened
Gorilla	Gorilla gorilla	Endangered
Leopard	Panthera pardus	Endangered
Mangabey, white-collared	Cercocebus torquatus	Endangered
Monkey, Diana	Cercopithecus diana	Endangered
Birds		
Rockfowl, white-necked	Picathartes gymnocephalus	Endangered
Reptiles		
Crocodile, African dwarf	Osteolaemus tetraspis osborni	Endangered
Crocodile, African slender-snouted	Crocodylus cataphractus	Endangered
Crocodile, Nile	Crocodylus niloticus	Endangered

The Annual Report of the Forestry Development Authority noted that the President has approved a list of fully and partially protected animals, but the origin and contents of the list were not identified. The Report also noted that the FDA has formulated a regulation for the protection of wildlife, but again no further information was available. Liberia does not have any national parks or game reserves, though the Tiempo Game Reserve has been demarcated for approval. Liberia is a signatory to the African Convention on Conservation of Nature and Natural Resources.

*See U.S. Department of the Interior, Fish and Wildlife Service. List of Endangered and Threatened Wildlife and Plants. Federal Register of Jan., 17, 1979, Part II.

3.7 Fisheries

Liberia has three sources of fish: freshwater bodies (lakes, rivers and inland swamps); inland saltwater bodies (lagoons and estuaries); and the ocean. The stock of freshwater fish has suffered slightly from overfishing. Among the varieties are several kinds of catfish and perch, carp and a large salmon-like hydrocyon. Marine life is more abundant in the estuaries where saltwater fish such as mullet come inland. Off the coast live wide varieties of fish, including many types of mackeral and snapper, barracuda, mullet, sole, tuna and grouper. There is also an abundance of crustacea such as lobster, crab and shrimp. The first National Fisheries Survey was conducted in 1975 by the then Bureau of Fisheries of the Ministry of Agriculture (this was not available).

3.7.1 Utilization of fisheries

No figures were available on the contribution of fish to protein supply. However, in view of the shortage of land-based animal protein, fishing has always been important in balancing the population's diet. The vast bulk of fishing today is done by ocean-going trawlers; most of them owned by, or under contract to, the Mesurado Fishing Company. The company has built up a system of refrigerated trucks and storage facilities which, together with cold storage facilities at Monrovia's port, have brought Liberian seafish to the interior.

No information was available on freshwater fishing in the interior of Liberia. The following table, based on FAO estimates from the Yearbook of Fishery Statistics, outlines Liberia's nominal fish catch for the years 1971-75.

Table 7 Total Fish Catch and Major Species (in metric tons)

Fish	1971	1972	1973	1974	1975
Total	15800	16500	16500	16600	16600
Major Species					
Snappers	200	400	900	1008	1008
Croakers, Drums	500	900	400	423	423
Sardinellas	3000	3000	3000	3000	3000
Clupeoids	2000	2000	2000	2000	2000
Tuna-like fishes	5500	5500	5500	5500	5500

3.7.2 Environmental problems

No information was available on specific problems with fisheries beyond a general reference to overfishing in the interior. The pollution of rivers by mining operations must also be having some negative effect on inland fisheries.

3.8 Air quality

There are two prime sources of air pollution in Liberia - smoke from slash and burn agriculture, and dust from lateritic roads. Slash and burn agriculture produces low to moderate levels of air pollution as a result of smoke created during the burning process. The burning takes place during the dry season when there is little wind and, as a result, smoke mixed with natural haze occurs from approximately 152 to 610 meters (500 to 2,000 feet) above ground. Harmful effects to the human population are kept to a minimum because of (1) the relatively short period of about one month when the smoke is prevalent. (2) the wide dispersal of the small farms on which the burning takes place, and (3) the distances between the upland farms and the centers of population.

A minor amount of dust is created during land clearing and cultivation. The prime source of dust is the movement of traffic and machinery on existing roads. Most roads are made of laterite and produce clouds of red dust during dry periods. A thick coating of this dust can be seen on vegetation and buildings paralleling the roads.

4.0 ORGANIZATIONS WITH INTEREST IN ENVIRONMENT AND NATURAL RESOURCES

4.1 Political and administrative structure of Liberia

The government of Liberia, the oldest independent republic in Africa, is based on a written constitution patterned after that of the United States. The government is divided into three branches - executive, legislative and judicial. Power has been concentrated in the executive branch, which is headed by a president elected to one eight year term. The national legislature, which is subordinate to the executive, is a bicameral Congress consisting of a Senate and a House of Representatives. The Senate has 18 members (two from each county) elected to six year terms and the House 84 members elected to four year terms. Every adult citizen over the age of 18 has the right to vote.

Liberia has a dual system of administration. Under the formal system of government, the country is divided into nine counties, which in turn are divided into territories, districts and towns. In addition to this administrative structure, there is the traditional system of leadership based on tribal lineages (see figure 4, p. 6 for approximate territorial boundaries of each major tribe). The tribal system is composed of paramount, clan, town and quarter chiefs who are responsible for tax collection and the administration of customary law and local government affairs. Many of these groups still retain a considerable amount of autonomy.

4.2 Government agencies

National Planning Council

The National Planning Council (NPC) has overall responsibility for development planning and the setting of priorities in the budget.

Ministry of Planning and Economic Affairs

The Ministry of Planning and Economic Affairs acts as the Secretariat to the National Planning Council and was responsible for drawing up Liberia's first National Socio-Economic Development Plan. The Ministry, with the aid of the other executive ministries, is also responsible for submitting to the NPC an annual progress report analyzing the implementation of on-going projects, and making recommendations on possible new projects and activities to be included in the annual development plan. The responsibility for project execution lies with the operating ministries and departments.

Forestry Development Authority

The Forestry Development Authority (FDA) became fully operational as a public corporation in 1977, taking over administrative areas (forestry and management of fish and wildlife resources) previously under the jurisdiction of the Ministry of Agriculture, Bureau of Forest Conservation. This has led to some friction between the two bodies, with Agriculture insisting on retaining its conservation responsibilities.

The FDA is responsible for all aspects of the management of Liberia's forest resources, and has the right to promulgate, issue, amend and rescind forestry

rules and regulations. The FDA is organized into five major functioning divisions: Administration; Planning, Statistics and Research; Forest Management and Wildlife; Utilization; and Finance. The wildlife director for the Government is presently located within the FDA. A Timber Marketing and Monetaring Center has been established within the Authority which concentrates on timber market analysis, price calculations for timber species and the opening of new regional and international markets.

There is at present no national policy on reforestation or the management of existing forests in Liberia. The FDA seems to be heavily influenced by powerful commercial interests - the concessionaires - leading to rising concern over the fate of Liberia's forest reserves (see § 3.5.1-2). The FDA has formulated a set of rules, promulgated as a regulation, designed to control wasteful practices of the concessionaires (this was not available). Activities of the FDA in its first full year of operation included forest management, utilization, plantation development, and wildlife management and conservation; though its main focus and interest was commercial exploitation. The Director of the FDA, Mr. Wood, is also the local contact for the IUCN.

Ministry of Agriculture

In recent years, the Government has increasingly emphasized agricultural development as an important factor in its economic policy. Most public expenditure for agriculture is channelled through the Ministry, which is involved in all support services for agriculture. The Ministry supervises agricultural research, organizes extension, credit, co-operative and production programs, and coordinates and consults with other agencies on agricultural marketing, prices, etc. The extension service directed by the Ministry in each county consists of an extension agent and assistant extension agent who supervise general extension aides. The Agricultural Extension Training Center (AETC), operated jointly with the University of Liberia, trains personnel for the service. The main emphasis of the Ministry has been rice and tree crop production. In recent years, the Ministry has progressively delegated operational functions to newly created special agencies, described below.

Central Agricultural Experiment Station

The Central Agricultural Experiment Station (CAES) is located at Suakoko in Bong County. CAES was established in 1947 and is the main research arm of the Ministry of Agriculture, conducting work in dairying, beef cattle, hogs, rice, vegetables, rubber, horticulture and fisheries.

Liberia Produce Marketing Corporation

The Liberian Produce Marketing Corporation (LPMC) is a wholly government-owned corporation created in 1975. LPMC is the effective price setter for coffee, cocoa, palmkernels and other crops; although the prices are in theory determined by the Ministry of Agriculture upon the recommendation of LPMC. LPMC also manages a tree crop development program (transferred from the Ministry of Agriculture) to promote palm, coffee, cocoa and coconut plantations. LPMC has two commodity corporation subsidiaries; the Palm Products Corporation, and the Coffee and Cocoa Corporation. Other such corporations include; the Liberian Rubber Processing Corporation, the Li-

berian Sugar Corporation (LIBSUCO), and the Rice Corporation.

Rubber Advisory Service

The Rubber Advisory Service was established by the Government to aid Liberian owned rubber farms. Working with expatriate specialists, the Service provides extension and training to rubber farmers and establishes rubber nurseries for replanting.

Mechanization and Land Development Corporation

The Mechanization and Land Development Corporation (AGRIMECO) is a wholly government-owned corporation established in 1972. AGRIMECO is charged with executing all facets of agricultural land development which include land clearing, levelling, planting, harvesting and construction of irrigation and drainage works. Other activities include the construction of airstrips and roads. AGRIMECO is currently responsible for carrying out the Government's ambitious land clearing program for tree crop and rice development. Plans were for AGRIMECO to clear a total of 36,000 acres of uplands and 17,000 acres of swamps by this year (15,000 acres of uplands and 1,140 acres of swamps had been cleared by 1976).

Ministry of Health and Welfare

As of 1976, the Ministry of Health and Welfare had a Division of Environmental Health responsible for environmental problems associated with urban and rural water supply and human settlements. No other specific information was available on the Ministry.

Ministry of Lands and Mines

No information was available on the Ministry of Lands and Mines, though a couple of vague references were made to the possible drafting of a mining code.

Ministry of Local Government, Rural Development and Urban Reconstruction

A division of the Ministry, the Office of County and Territorial Development Planning, has been assigned the task of establishing an environmental coordinating committee at the national level. This committee may be in the form of an environmental board, which would be serviced by a technical environmental agency. There is also the possibility that small, individual units will be set up within each ministry to handle that ministry's environmental problems. The Board would then act as a coordinating body for these ministerial units.

4.3 Non-government organizations

Family Planning Association of Liberia

Liberian Wildlife Society

The Liberian Wildlife Society was recently established and is presently

headed by the director of the FDA. No information was available on the activities of the Society.

Nimba Research Laboratory

This is a facility of the IUCN and is used as a base by research workers involved in biological and ecological research in the Mount Nimba region.

University of Liberia

Marine Biology Department

College of Agriculture and Forestry - Carries out applied research on forestry and annual crops. The College graduates 4-6 professional foresters each year. In 1973, the Forest Products Research Laboratory was established. The Laboratory emphasizes research on lesser known species and their potential uses.

4.4 Membership in regional and international organizations

Mano River Union - formed with Sierra Leone to fully utilize the water resources of the Mano River to the advantage of both countries.

Organization of Timber Producing and Exporting African Countries - with Ivory Coast, Ghana, Cameroon, Gabon, Madagascar, Equatorial Guinea, Zaire and the Central African Republic. Liberia reportedly intends to join the UNCTAD/GATT proposed Tropical Timber Bureau.

International Coffee Organization

5.0 LEGISLATION PERTAINING TO ENVIRONMENT AND NATURAL RESOURCES

The Liberian Code of Laws of 1956, a codification of all the statutes of Liberia enacted from 1847 to 1958, has been undergoing complete revision.* The new body of law, referred to as the Liberian Code of Laws Revised, incorporates all laws that have been enacted since publication of the old Code as well as revised versions of many of the earlier laws. Several Titles of the revised Code pertain to environment and natural resource matters, including: the Maritime Law (in draft form but not available), the Public Health Law (enacted), and the Natural Resources Law (in draft form). with the creation of the Forestry Development Authority in 1977, the existing natural resources code was repealed. Due to an ongoing debate between the Forestry Development Authority and the Ministry of Agriculture on who is to have jurisdiction over conservation in various sectors, the legislature has not acted on the new natural resources draft code. Thus all following discussion on the natural resources law, as well as the maritime law, is tentative.

The Natural Resources Law, Title 23 of the revised code, includes chapters on Forests, Fish and Wildlife, Soil, Water, and Minerals. Under the new law, Liberia adopts the following policy: ...to conserve, improve, and protect its natural resources and environment and, in order to enhance the health, safety and overall economic and social well-being of the people, to create and maintain conditions which will:

- Assure surroundings which are healthful and aesthetically pleasing;
- Guarantee attainment of the widest range of beneficial uses of the environment without undesirable or unintended consequences;
- Promote patterns of development and technology which minimize adverse impact on the environment.

5.1 Water

5.1.1 Natural Resources Law, Chapter 5

Chapter 5 directs the Ministry of Agriculture to prevent wastage and inadequate utilization of water resources and to develop and control those resources for the improvement of agricultural and forest lands, and for the present and future needs for domestic, municipal, commercial, industrial, power, recreational and other public purposes.

Chapter 3, section 3.12

This section of the Fish and Wildlife Law prohibits the pollution of public or private waters from any industrial or agricultural waste or other harmful substance in quantities injurious to fish life, protected wildlife or waterfowl in those waters.

*The earlier Code and the revised Code are both part of the Liberian Codification project, a joint effort between the U.S. and Liberian Governments and Cornell University.

5.1.2 Public Health Law, Chapter 24

The Public Health Law was enacted in 1977 as Title 33 of the Revised Code. Chapter 24 covers water pollution control, with "water" construed to include:

> "...lakes, bays, sounds, ponds, impounding reservoirs, springs, wells, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Atlantic Ocean within the territorial limits of the Republic and all other bodies of surface or underground water, natural or artificial, inland or coastal, fresh or salt, public or private."

The Ministry of Health and Social Welfare is charged with enforcing the provisions of this law, which include:

- a prohibition against the discharge of sewage, industrial or agricultural waste or other wastes into any of the waters of the Republic, unless granted permission by the Minister of Health and Social Welfare;
- proceedures for obtaining such permission;
- a strict prohibition, without reservations, against the pollution of drinking water supplies.

5.2 Soils

5.2.1 Natural Resources Law, Chapter 4

Chapter 4 charges the Ministry of Agriculture with the conservation and improvement of the soil by authorizing measures to:

- Provide for the control and prevention of soil erosion;
- Preserve and improve soil fertility;
- Promote the economic use of land;
- Reduce exploitation and wasteful and unscientific use of national soil resources;
- Protect rivers and harbors against the results of soil erosion in aid of maintaining the navigability of waters and water courses.

5.3 Minerals

5.3.1 Natural Resources Law, Chapter

The draft of this law was not available.

5.4 Forests

5.4.1 Natural Resources Law, Chapter 2

The purpose of this chapter is to conserve and extend the forested areas of the country in order to increase timber production, preserve aboreal species, improve water drainage and flood control, prevent soil erosion, protect wildlife, and improve recreational opportunities. The Forestry Development Authority (FDA, see p. 35) is responsible for administration and enforcement of the provisions of this chapter, and for supervising and administering in accordance with sound conservation principles all lands constituting the Government Forest Reserves, Native Authority Forest Reserves, Communal Forests and national parks.

Subchapter B: Forest Reserves

Empowers the FDA to create and establish Government Forest Reserves on publicly or privately owned lands, for the free use of all people subject to the restrictions of Subchapter C.

Empowers the FDA to create and establish Native Authority Forest Reserves embracing forests in areas held communally by one or more Tribal Authorities. Such reserves will be protected by the FDA as potential Government Forest Reserves. Regulations affecting forest reserves of this type shall be designed to minimize damage to the forest and avoid unnecessary depletion of their resources.

Empowers the FDA to create and establish Communal Forests to be administered by the Tribal Authorities concerned. These forests will be limited to small forest areas immediately adjacent to one or more tribal villages, and their use confined to the local population. No permits shall be granted to other persons to hunt, trap, fish or cut trees in any such area as long as it is maintained as a Communal Forest.

Empowers the FDA to create and establish national parks embracing any areas of the country (including privately owned land) having outstanding scenic, recreational, scientific or other pertinent values.

Subchapter C: Restrictions on Use

The following restrictions are placed on the use of Government Forests (Communal Forests excepted) except in accordance with the express terms of a concession agreement, mining claim or license, or permit issued by the FDA. No person shall:

- Cut, remove, injure or destroy any trees;
- Hunt or trap wildlife or fish;
- Disturb the vegetation, soil, or mineral resources;
- Reside, erect or maintain any structure;
- Build, alter or destroy roads or dams;
- Dig in the soil or prospect for minerals, coal or oil;
- Set fire to vegetation or logging slash, or materials other than fuel as permitted by regulations;
- Deposit rubbish;

- Raise crops or permit cattle or other domestic animals to graze or in any way engage in agriculture;
- Alter, deface, or obliterate any property mark placed on a tree;
- Fell and leave trees or other obstructions across any trail, road, or waterway;

Subchapter D: Commercial Dealings

The FDA, in accordance with sound conservation principles and other provisions of this chapter, may contract for the sale of timber. The trees to be cut shall be designated either individually, by location, or by description of diameter and species. The contract will contain restrictions and obligations necessary to prevent permanent damage to the forest, including a provision for reforestation. The subchapter also includes provisions on the responsibilities of timber concessionaires and minimum girth requirements for the cutting of various species.

Subchapter E: Forest Fire Control

Subchapter F: Forest Insect and Disease Control

Subchapter G: Protection and Maintenance of Forests

Empowers the FDA to:

- Fell, cut, damage, tap, or destroy trees in Government Forests and clear or remove timber for the purpose of planting trees, improving the growth of trees, or for better forestry management;
- Initiate educational programs on approved methods of forest conservation and the importance of forests as a valuable natural resource;
- Establish, operate and maintain nurseries for the production of trees to be used in reforestation;
- Conduct silvicultural research and experimentation in forestry science on public lands.

5.5 Wildlife

5.5.1 Natural Resources Law, Chapter 3

At present, the FDA is charged with responsibility for the management and conservation of fish and wildlife. This was previously under the domain of the Ministry of Agriculture, which is now insisting that it retain jurisdiction over this area. This conflict is apparently the reason behind the delay in enactment of the new Natural Resources Code, Chapter 3 of which covers fish and wildlife. The outcome of this debate will determine the final form of the law. The following is a general outline of those sections pertaining to wildlife:

Subchapter A: Purpose, Administration, Definitions

Subchapter B: Management of Wildlife Resources

§ 3.10 Restricted areas.

§ 3.11 Control of dangerous diseases.
§ 3.13 Destructive or menacing wildlife.
§ 3.14 Endangered species.
§ 3.15 Buying and selling unlawfully taken wildlife.
§ 3.16 Unprotected wildlife.
§ 3.17 Hatching and breeding stations.
§ 3.18 Wildlife research.
§ 3.19 National Zoological Park.
§ 3.20 Game animals in captivity.
§ 3.21 Exportation of live game animals.
§ 3.22 Taxidermy.

Subchapter C: Hunting and Trapping Licences

Subchapter D: Hunting

Subchapter E: Trapping

Subchapter G: Pesticides

5.6 Fisheries

5.6.1 Natural Resources Law, Chapter 3 (see note to 5.5.1)

An FAO consultant prepared a report for Liberia on fisheries legislation after the drafting of the new Natural Resources Law. The report was favorably received and will most likely lead to some changes in the draft law, which is outlined below:

Subchapter A: Purpose, Administration, Definitions

Subchapter B: Management of Fish Resources

§ 3.10 Restricted areas.
§ 3.11 Control of dangerous diseases.
§ 3.12 Polluting streams prohibited.
§ 3.14 Endangered species.
§ 3.15 Buying and selling unlawfully taken fish.
§ 3.16 Unprotected fish.
§ 3.17 Hatching and breeding stations.
§ 3.18 Fish research.

Subchapter F: Fishing

§ 3.60 Limitation of fishing by regulations.
§ 3.61 Restrictions on methods of taking fish.
§ 3.62 Unlawful possession of fish.
§ 3.63 Limit on amount of fish which may be transported.
§ 3.64 Reports of commercial fishing; processing.

Subchapter G: Pesticides

5.7 Air

5.7.1 Public Health Law, Chapter 21

Chapter 21 on "Nuisances" contains two general provisions that can be applied to pollution of the air. Under these two provisions, "local authorities" are responsible for regulating and controlling:

- any vehicle which is in such a state of condition as to be prejudicial, injurious or dangerous to health;

- any factory or trade premises causing or giving rise to smells or effluvia which are prejudicial, injurious or dangerous to health.

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