

ISN 12998

RS/SA/TOA-1-77

931113

DEI-AAA-974

DRAFT ENVIRONMENTAL PROFILE  
ON JAMAICA

Under AID/S&T/FNR Contract No. RSSA SA/TOA 77-1  
with U.S. Man and the Biosphere Secretariat  
Department of State  
Washington, D.C.

May 1982

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THE UNITED STATES NATIONAL COMMITTEE FOR MAN AND THE BIOSPHERE



Department of State, IO/UCS

WASHINGTON, D. C. 20520

An Introductory Note on Draft Environmental Profiles:

The attached draft environmental report has been prepared under a contract between the U.S. Agency for International Development (AID), Bureau of Science and Technology (ST/FNR) and the U.S. Man and the Biosphere (MAB) Program. It is a preliminary review of information available in the United States on the status of the environment and the natural resources of the identified country and is one of a series of similar studies now underway on countries which receive U.S. bilateral assistance.

This report is the first step in a process to develop better information for the A.I.D. Mission, for host country officials, and others on the environmental situation in specific countries and begins to identify the most critical areas of concern. A more comprehensive study may be undertaken in each country by Regional Bureaus and/or A.I.D. Missions. These would involve local scientists in a more detailed examination of the actual situations as well as a better definition of issues, problems and priorities. Such "Phase II" studies would provide substance for the Agency's Country Development Strategy Statements as well as justifications for program initiatives in the areas of environment and natural resources.

Comments on the attached draft report would be welcomed by US MAB and ST/FNR and should be addressed to either:

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## SUMMARY

Jamaica is a small, densely populated Caribbean island of 4244 square miles and 2 million people. It is a country both blessed with natural resources and physical beauty and plagued by debilitating economic, demographic and environmental problems. The island is endowed with equable year-round temperatures, a wide range of micro-climates and habitat types, adequate water and valuable mineral resources. It is physically a beautiful island, understandably a source of pride to Jamaicans and fascination to the geographer, ecologist, naturalist and tourist. At the same time, it is an island beset by serious problems. The price of petroleum on which the economy depends has rapidly escalated in the last decade, consuming an increasing proportion of foreign exchange. The steep decline of the country's economy coupled with political sensitivities have been both causes and effects of a drop in internal and external investment and increased emigration of skilled professionals. Agricultural productivity has decreased, unemployment has risen well into the 30 percent bracket, serious problems are resulting from large-scale migration mainly of rural youths to urban areas in search for employment, and there is that ever-present, ever-growing problem of over-population putting increased strain on limited land and natural resource bases.

## CLIMATE AND TOPOGRAPHY

Jamaica's climate is tropical, with warm, equable temperatures throughout the year and relatively high rainfall brought by the prevailing northeast winds. A wide range of micro-climates are created by the island's rugged topography. Geographically the island consists of three regions: 1) the interior mountain ranges, the highest of which is the Blue Mountains, reaching over 7400 feet in eastern Jamaica, 2) the limestone plateaux, karsted to varying degrees, lying between 1000-3000 feet and covering two-thirds of Jamaica's surface; and 3) the flat, fertile coastal plain, seldom more than two miles wide along the northern coast but widening out into broad embayments in areas along the southern coast.

## DEMOGRAPHY

Jamaica's demographic characteristics include high but declining fertility, low mortality, high internal and external migration and urbanization. Although the population growth rate in recent years has decreased to 1.2 percent, rapid growth in the past few decades has left 46 percent of the people under the age of 15, setting the stage for rapid population expansion in the years ahead. The population is estimated to double in size every 31 years.

About one-third of the people live in the capital city, Kingston. Other concentrations are in parish capitals, along the coast, and in upland settlements on interior valleys, arable slopes and along watercourses. Much of the population has traditionally relied upon small-scale agriculture for a living. Population pressure, high unemployment and growing dissatisfaction with agricultural work and rural life have resulted in migration, especially of young adults to the Kingston Metropolitan Area. The metropolitan area has been unable to adequately accommodate the needs of the newcomers. Housing shortages have become critical because construction cannot keep pace with urban migration, giving rise to shanty towns. Public health services are inadequate and the unemployment rate in Kingston is one of the highest on the island.

Although emigration to other countries has been high for several decades, in recent years there has been an increased proportion of professional people in the migratory stream, signifying a "brain-drain" which may have serious consequences for the country's future development. Ironically, at the same time that there are serious shortages of skilled personnel, unemployment has reached 31 percent and is predicted to be 39 percent by 1983, attesting to the critical need to expand training programs for the burgeoning youth population.

#### HEALTH AND EDUCATION

Jamaica has relatively well-developed educational and health care systems. Deficiencies of both the education and health programs, however, include inadequate coverage in the rural areas, administrative weaknesses and shortages of qualified personnel. In testimony to weaknesses in the educational system, 40-50 percent of the population over 15 years of age was estimated to be functionally illiterate in 1971. A subsequently initiated adult literacy program has been quite effective in decreasing illiteracy. The level of health is considered to be adequate by world standards, but maternal and child health care services are weak and there are pockets of malnutrition among the poor.

#### ENERGY

Next to population growth, one of the most serious problems of Jamaica is her dependence on petroleum for energy. Petroleum imports, which have absorbed an increasing proportion of Jamaica's annual budget since the early 1970s, amounted to over 30 percent of total imports in 1979. Without development of alternative sources of energy Jamaica's economic development is jeopardized. Exploration for local petroleum resources has to date been unpromising. Further exploration for petroleum and limited research efforts for solar, wind, biogas, sea thermal gradient and geothermal energy have been initiated recently, but there is a need for environmentally-sound development of local energy sources.

#### MINING

The growth industries -- bauxite mining and manufacturing -- employ relatively few people and depend largely on foreign technology and, with mining, foreign capital. Jamaica is the world's third largest bauxite ore producer. In the last decade the country has become economically dependent upon mining; it provides about 12 percent of the country's Gross Domestic Product and 74 percent of exports. These essential financial benefits, however, do not come free; there are associated environmental and economic problems. The main environmental problem is disposal of the red mud residue produced by alumina processing. There is evidence of contamination of local aquifers by the caustic waste. The economic problems include lack of forward and backward linkages with other sectors of the country's economy, dependence on foreign technology and sensitivity to external economic and political forces.

## AGRICULTURE

Although limited by the rugged topography, infertility of some soils and variable rainfall patterns, Jamaica has relatively good agricultural potential. In addition to a year-round growing season, the wide range of micro-climates and habitats provide Jamaica with the capacity to grow a great variety of crops for food and other commercial products. However, this potential is not fully utilized. The distribution of land is radically skewed, reflecting the historical emphasis on production of a few major crops for export. The major crops are sugar cane, bananas, coconut, cocoa and citrus. Most of the prime agricultural lands -- the coastal plains and interior valleys -- are in large plantations producing these export crops, while small marginal hillside farms produce crops for internal consumption. Only 6 percent of agricultural land is used for production of domestic crops. Land ownership patterns are similarly skewed. About 80 percent of the farms are under 5 acres in size but make up only 15 percent of total farm acreage. In contrast, about 43 percent of the farm acreage is in a small number of farms of over 500 acres each.

Other problems of the agricultural sector include lack of modern equipment and modern farming techniques on the small and medium-sized farms, the migration of rural youths to the urban areas which has raised the average age of farmers, inefficient marketing resulting in high waste of food, and the private sector's growing reluctance to invest in agriculture. Agricultural research is limited and focuses mainly on export crops, and extension services to the small farms are inadequate.

## RURAL DEVELOPMENT

During the last several years there has been considerable emphasis placed on integrated rural development, or providing increased services and infrastructure to rural areas in an effort to stem the tide of urban migration. Efforts have been made to improve agricultural productivity through increased extension assistance, credit availability and soil conservation work; improve health and education programs; and expand electricity and water services in rural areas. Forestry, as a soil conservation measure, has also been an important component of rural development projects.

## FORESTRY

Because of its potential for foreign exchange savings through import substitution and its capacity for employment generation, particularly in rural areas, development of Jamaica's forest industries has received much attention during the last decade. Presently about one-fourth of the land area is covered by forests. At one time a greater proportion of the island was forested, but the land was cleared for agriculture, resulting in some serious soil erosion problems. Consequently, forestry activities before the mid-1960s were aimed at soil and water conservation. Since then, however, the emphasis has been on establishing plantations of Caribbean pine (Pinus caribaea) and, to a lesser extent, blue mahoe (Hibiscus elatus), eucalyptus (Eucalyptus spp.) and teak (Tectona grandis) for commercial harvest. The greatest potential for industrial forestry development opportunities lies in growing Caribbean pine in the Blue

Mountain region. In order to become self-sufficient in softwood sawnwood, an estimated 100,000 acres must be planted in Pinus caribaea. Most of the suitable land in the Blue Mountain area is privately owned and half of it is in agricultural production, so conflicts in land use and difficult social questions will have to be resolved if such extensive planting of this area is to be carried out.

## WATER

Jamaica's surface and ground water resources are sufficient to meet the country's water supply needs for the foreseeable future, but the resources are undeveloped and supplies are insufficient to meet domestic and agricultural needs. Development of water resources are hindered by two problems: 1) the unfavorable geographic distribution of the major sources of supply relative to highest demand, requiring long-distance transport of supplies; and 2) the highly irregular flow of the rivers, necessitating storage reservoirs to maximize use. Optimum development of water supplies therefore, requires high capital investment.

Jamaica's water supply comes from the island's streams and rivers, and underground water of the alluvium deposits of the coastal plains and the aquifers in the limestone regions. The greatest density of rivers is in the eastern region where rainfall is highest and the impermeable bedrock of the Blue Mountains give rise to permanent rivers with highly irregular flow. Because of the permeability of the limestone plateaux, large areas in central and western Jamaica are devoid of surface run-off. The limestone aquifers in these areas and the alluvial aquifers of the southern coastal plains provide good sources of water. Two-thirds of the water used in Jamaica is drawn from these underground reserves.

The demand for water is concentrated in southern Jamaica, in the Kingston Metropolitan Region for domestic, commercial and industrial use and in the prime agricultural lands of the St. Catherine and Clarendon plains for irrigation. The local water supplies of these areas are now being almost fully tapped, yet demand is outstripping supply. The agricultural potential of the plains is not fully utilized for lack of irrigation and water has been rationed in Kingston during most dry seasons of the last decade. In some places overdrawn of groundwater has resulted in localized salt water intrusion. Further development of the water resource for the Kingston area is clearly needed in the immediate future. This will have to be achieved through large, expensive dam and transport systems, now being considered.

Water supplies for the rest of the island are drawn from wells and small volume reservoirs. Although the resource is plentiful and the needs of the population for water are not met, the resource is being under-utilized. Further development of water systems is needed, especially in rural areas.

The recurring water shortages in the Kingston area, stress on available resources by the growing population, and increased attention on hydropower development have stimulated the planning of water projects. There is a critical need to develop a National Water Plan and revise the body of water-related legislation which is now fragmented and unclear, in order to provide for rational planning of water to meet future demands.

## NATURAL AREAS

Jamaica was once extensively covered by forests and wetlands, but several hundred years of settlement and agricultural expansion have reduced the forest cover to 24 percent. Less than one-third of this, or 7 percent of the island, remains in relatively intact natural forest, with most of the rest in ruinate, or degraded, secondary forest left from the clearing and burning of the original vegetation for agriculture. Until recently, the areas remaining in natural cover have been protected from destruction by their inaccessibility or inhospitable qualities: the Cockpit Country by its almost impassible terrain, the Hellshire Hills and Portland Ridge by their aridity, and the montane forests by their steep slopes.

Recently these areas have been feeling the effects of over-population and various development activities. The land-poor rural population has been nibbling off small bits of land for farm plots, roads are being extended into the Cockpit Country, the Hellshire Hills are being developed as an extension of Kingston and forestry operations are being initiated in areas of the Blue and John Crow Mountains better left under natural cover. In addition, wetlands are being drained for agricultural, urban or tourism development. This habitat destruction poses the single greatest threat to plant and wildlife species, many of which are found only in these few remaining undisturbed areas, and several of which are now endangered.

Limited protection to the land and wildlife is provided to areas designated Forest Reserves, but the legislation has weaknesses and is not well enforced. Some of these and other ecologically significant areas have been identified by the National Physical Plan (1971) which proposes designation of these areas as national parks. Adequate legislative protection of these areas however, does not yet exist. In addition, legislation providing protection of threatened or endangered species is insufficient and ineffective. Although the Natural Resources Conservation Department established in 1975 provides the needed institutional structure to manage and conserve the country's natural resources, it has not received adequate financial or political commitment since its inception to provide the required stewardship. In addition to financial constraints, the NRCDC suffers from a lack of adequately trained personnel for wildlands resource management.

## COASTAL AREAS AND FISHERIES

Jamaica's coastline is a valuable resource as it provides the island's coastal fishery and recreation areas of great value. In addition, coral reefs and mangrove swamps provide protection of the land from storms and important breeding grounds for aquatic species. The quality of the coastal area has declined in recent years. Development along the coast has destroyed wetlands; rivers with high sediment loads emptying into the coastal areas have damaged coral reefs; dumping of domestic sewage, industrial wastes and oil from ship's bilges has polluted coastal waters; and overfishing has depleted the fish stock of the coastal fishery. The nearshore fishing grounds have been overfished, yet the fishing boats are not large enough to reach the offshore grounds which have a greater fishing potential. Almost all the fish caught comes from the coastal areas; comparatively little is from off-shore fishing grounds and almost none from inland fisheries. Jamaica imports almost half the fish it consumes. Careful

management of the coastal fishery, development of inland fisheries and coastal aquaculture and developing a fleet of medium-sized ships to tap the off-shore fishery would provide employment opportunities, provide the people with a good source of protein, and benefit foreign exchange. Careful coastal development planning is needed for the protection of valuable habitat and breeding grounds provided by mangrove swamps and coral reefs, for the physical protection of the coastline from storms and floods and for maintenance of a healthy, high quality environment.

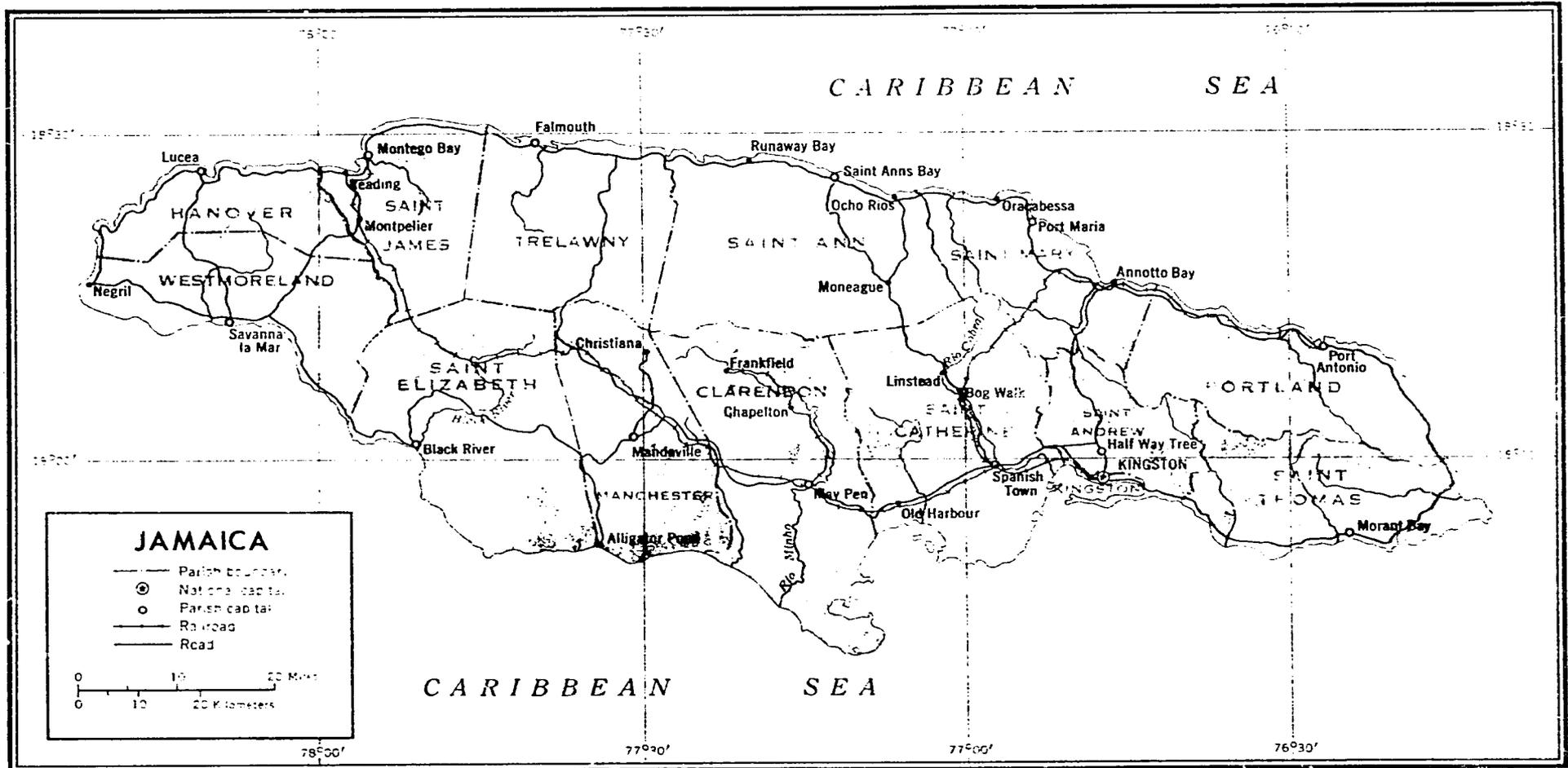
#### ENVIRONMENTAL CONDITIONS

Environmental health services are far more available in urban than rural areas. While essentially all urban dwellers are provided with drinking water (almost all through house connections), only 74 percent of rural inhabitants have easy access to water (34 percent through house connections). Only half of the drinking water supplies (serving 72 percent of the people) are chlorinated. Although the water quality is considered to be acceptable in Kingston, it is significantly lower in rural areas, representing a potential source of disease. Upgrading the supply, availability and quality of water to rural areas is clearly needed. As for sewage disposal, only 7 percent of the population (all urban) is served by sewage systems; the rest use pit latrines and septic tanks. The problems related to waste disposal are most pronounced in the Kingston Metropolitan Area due to its concentration of people and commercial activities. Inadequate sewage disposal has resulted in surface water pollution and nitrate contamination of the groundwater. In addition to threatening the water supply, this has contributed significantly to serious pollution and eutrophication of Kingston Harbour.

Kingston Harbour, the most intensively used of Jamaica's coastal bodies, has felt the effects of pollution more than elsewhere along the coast. The harbor is polluted by the discharge of rivers and gullies carrying domestic and industrial wastes, the dumping of solid waste and the discharge of oil from ships. In some areas, these practices have caused high bacterial contamination of the water, eutrophication, decimation of fish and invertebrate populations, and fouling of local beaches by tar. Dredging and filling operations have often exacerbated the problems. This situation has progressed to the point of being a health hazard and an aesthetic blight.

Other problems particularly acute in the Kingston area are inadequate solid waste disposal and air pollution problems related to vehicle emissions, manufacturing, oil refining and generation of electricity. In the other parts of the island, environmental problems include: surface water pollution from the discharge of sugar factories' waste water; disposal of red mud residue and high dust production associated with bauxite operations; and pollution of coastal waters.

This profile is limited by lack of current information and by lack of perspective -- on relative severity of problems and priorities for action -- both best sought in Jamaica. The profile was designed to be followed by in-country studies which will draw on written information and on local expertise in the government, university and private sector. Those in Jamaica working in the natural resource or environmental fields are in the best position to speak on environmental concerns and needs for action, and the indications are that, indeed, there is a group of insightful, well-informed resource managers that are well-qualified to do so. Their advice will be sought in follow-up studies. Despite possible weaknesses, this profile is useful as a source of background information and can be used to flag issues of concern that merit closer examination and discussion with those in Jamaica working on the problems.



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Figure 1

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## 1.0 GENERAL DESCRIPTION

### 1.1 GEOGRAPHY

(Sources: Clarke and Hodgkiss, 1974; Furnia, 1976; Jamaica. DOS, 1973a; Jamaica, MFP, 1971b; USAID, 1979)

Jamaica is located in the Greater Antilles, approximately 90 miles (145 km) south of Cuba and 100 miles (161 km) west of Haiti. It is the third largest island in the Caribbean with a total land area of 4244 sq. mi. (roughly the same as Connecticut). Jamaica is 146 mi. long and 51 mi. wide. The island's topography consists of a highland interior, formed by a backbone of peaks and plateaux running the length of the island, surrounded by flat coastal plains. Over half the island lies more than 1000 ft. above sea level. The highlands, consisting of two major land forms -- mountain ranges and limestone plateaux and hills --, are varied and in some places extremely rugged. The topographic features include steep-sided mountains, highly karsted land, high plateaux, rolling hills and some large interior valleys.

#### interior mountain ranges

The highest peaks are the Blue Mountains in the east. The crest of these mountains is formed by a 10 mi. long NW-SE oriented range of peaks exceeding 6000 ft. (1800 m) and reaching a maximum height of 7200 ft. at Blue Mountain peak. Long spurs run north and south from the central ridge to the coastal plain, in some areas only 10 miles away, forming a series of steep-sided, often severely eroded valleys. To the south, the Port Royal Mountains, foothills lying between the Blue Mountains and Kingston, form a chain of peaks over 4000 ft. high.

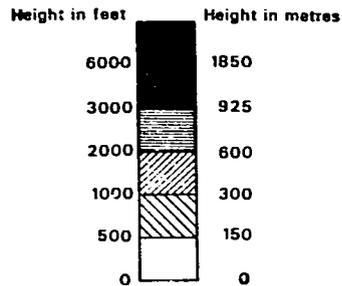
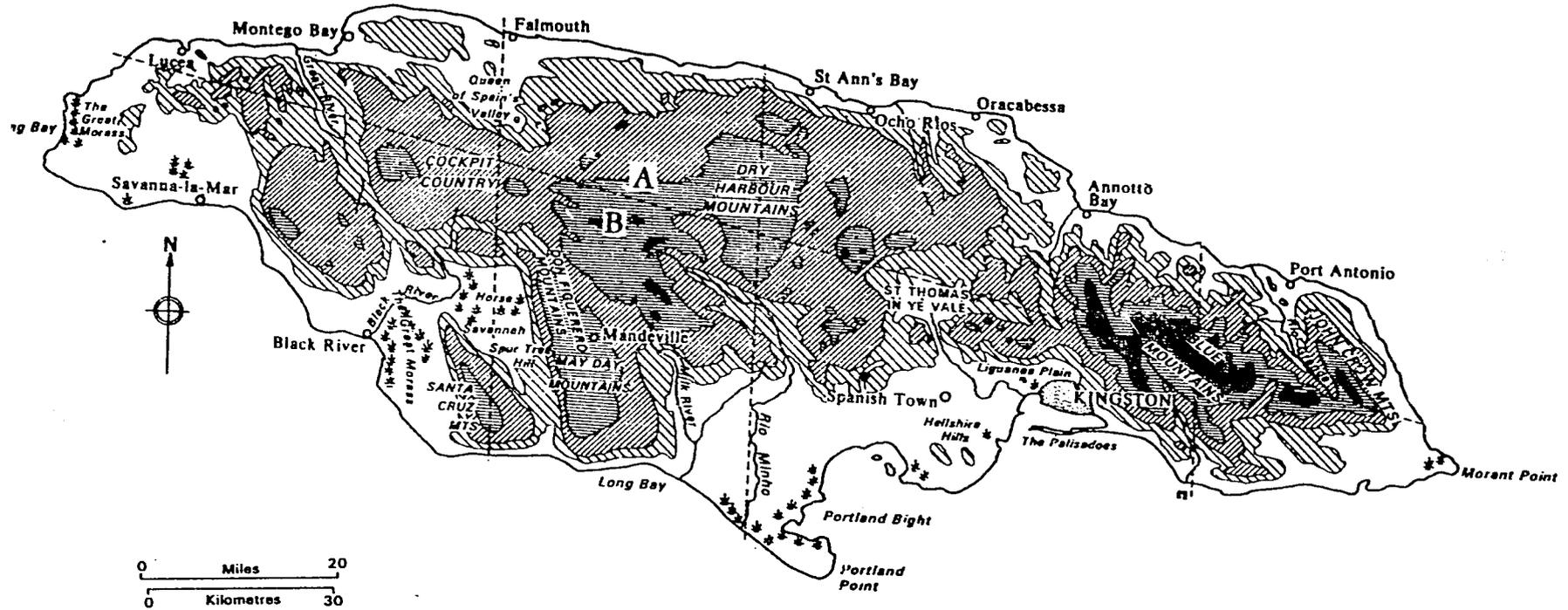
#### limestone plateaux and hills

The central and western interior region, occupying more than two-thirds of Jamaica's land area, consists of limestone hills and plateaux. Although the highest areas, the Dry Harbour, Santa Cruz and May Day Mountains, lie between 2000-3000 ft., the majority of the plateaux lies between 1000-2000 ft. The plateaux are dissected by faults and have been karsted to varying degrees. The most developed karst topography is in the Cockpit Country and to a lesser extent in the Dry Harbour and John Crow Mountains. The predominant landforms in these areas are cockpits, which are rounded or conical mounds with intervening circular depressions and steep, irregular sides. Elsewhere, the karst is less developed so that the terrain takes the form of rolling hills, shallow sinkholes, ridges and open knob-and-valley country. Caves are common features of the limestone region, 380 have been located and registered.

#### coastal plains

The coastal plain is less than two miles wide along most of the north coast and areas of the south coast. In some other places the plain widens to form broad embayments, the most extensive of which are located at the eastern and western ends of the island and the Clarendon and St. Catherine Plains on the south coast. Queen of Spain's Valley in the north and Horse Savannah in the south are partially enclosed embayments. In addition to coastal lowlands, there are two major interior valleys: St. Thomas in the north and another south of Montego Bay along the Great River. The coastal plains and interior valleys are the prime agricultural lands.

Figure 2



source: Clarke, C.G. and A.G. Hodgkiss.  
 1974. Jamaica in Maps. N.Y. Africana  
 Publishing Co.

Some areas of the coastal plain are in swampland. The major swamps are the Upper and Great Morasses in the southwest, and the Westmoreland Plain north of Savanna-la-Mar and the Great Morass both at the west end of the island.

#### coastline

Jamaica's 550 mi. long (885 km) coastline is varied. The south shoreline is edged by long, straight cliffs, mangrove swamps and black sand beaches. The north coast has white sand beaches, the finest of which stretches for 4 mi. along the west coast at Negril. The northeast coast is very rugged. Around the entire island the coastline is irregular, indented with bays and extended by sand spits and bars. Sixteen of the bays act as commercial harbors. Kingston Harbour, sheltered by the Palisadoes, an 8 mi. long sand spit, is one of the largest and most well protected ports in the Caribbean.

Between Kingston Harbour and Black River Bay, a shelf less than 120 ft. deep extends offshore for 5-20 mi. The south coast has some barrier reefs and numerous sand cays, the most well-known being just off Kingston. Much farther offshore lie the larger Morant Cays (33 mi. SE of Morant Point) and Pedro Cays (on Pedro Bank about 40 mi. S-SW of Portland Point). Unlike the south coast, the north shore has no shallow marine flats or shelves; the sea-bottom plunges steeply to depths of 5000-30,000 ft. (1,500-9,000 m) in the Bartlett Trough. Fringing reefs have developed in places along the north and northeast shorelines.

#### volcanoes and seismicity

(Sources: Periera and Turnovsky, 1978; Tomblin, 1976)

Lava cones in the Blue Mountains and hot springs are vestiges of volcanic activity. Jamaica, located within the seismic zone of the Antillean arc, has in the past experienced numerous tremors and a few serious earthquakes. Port Royal was destroyed in 1692 and in 1907 Kingston suffered extensive damage from an earthquake followed by fires and a tidal wave. The Kingston area experiences an average of 20 seismic events annually. Because it is built on unconsolidated alluvial sands and gravels (the Liguana Plain), Kingston is more susceptible to tremors than other areas of the island. One of the largest events of the century took place on February 26, 1978. This quake was of Richter magnitude 4.5 and had its epicenter in Portland.

## 1.2 CLIMATE

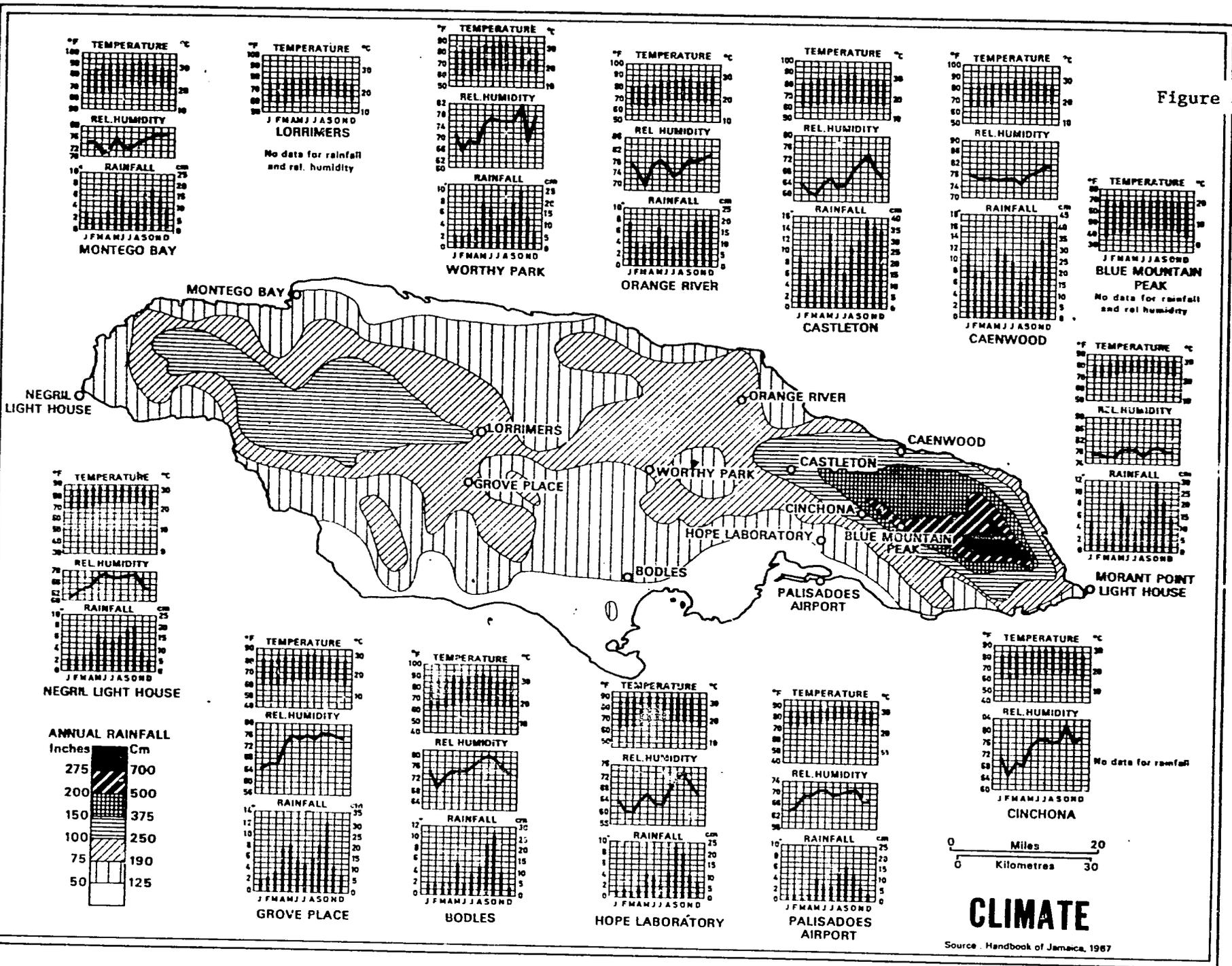
(Sources: Clarke and Hodgkiss, 1974; Furnia, 1976; Jamaica. DOS, 1973a)

Jamaica's tropical maritime climate is modified by north or northeast trade winds and land-sea breezes. Rainfall and temperature patterns vary locally according to location and altitude. Figure 3 shows climate patterns for various sites around the island.

#### temperature

Temperatures in the coastal lowland are fairly uniform. The average temperature is 80° F (27° C), ranging from 74-79° F in the coldest months (January and February) to 82-83° F in the warmest (July and August). Temperature varies

Figure 3



source: Clarke, C.J. and A.G. Hodgkiss. 1974  
Jamaica in Maps. N.Y., Africana Publishing Co.

with altitude; there is a 3.5° F temperature drop per 1000 foot increase in elevation. The mean annual average temperature for Blue Mountain Peak is 56° F (13° C), with a 10-year recorded low of 38° F (3° C). Diurnal fluctuations are often considerable (15-20° F on the coast, 20-25° F in the interior), while variation in mean annual temperature is small (6° F).

#### humidity

Humidity also varies with elevation. Usually the humidity is above 60%, and is generally highest in the morning (85%), dropping by mid-afternoon.

#### rainfall

Rainfall in Jamaica is marked by monthly, annual, and spacial variability. The average annual rainfall for the entire island is 77.1 inches (195.8 cm). The Blue Mountains and northeast coast lying in the path of the tradewinds receive the highest annual rainfall, over 200 in. (508 cm), while Kingston, in the lee of the range, receives less than 30 in. (76.2 cm). Water shortages are characteristic of the southern coastal lowlands, making irrigation necessary for agriculture. The island's rainfall is bimodal, with peaks in May and October and minima in March and June. Since 1870, Jamaica has experienced island-wide droughts in 1871-77, 1880-85, 1920, 1922-23, 1946-47, 1967-68, and 1975-76. The droughts in the late 1960s and mid 1970s resulted in domestic water shortages and serious agricultural losses. Damaging rains are associated with tropical storms, hurricanes, and "northers", cold winter air waves which mainly affect Jamaica's northern side. The year 1979 was the wettest of the decade. The heaviest of four periods of high rainfall occurred on June 12 and caused extensive flooding, particularly in the western end of the island. The estimated damage was U.S. \$ 100 million.

#### hurricanes

Hurricanes are generated in the Atlantic and move in a westerly direction through the Caribbean. The hurricane season is June to November with the highest risk in August. Jamaica is not located on a main hurricane track, so although seldom hit directly, a combination of high winds and torrential rains may cause considerable flooding and damage. Only 16 hurricanes between 1880 and 1980 have struck the island. The most serious occurred in 1880, 1886, 1917, 1944, 1951 and 1980. Most of the hurricanes move westward along the north coast, so that since 1880 Kingston has been hit only two times (once in 1951). The most recent hurricane, Hurricane Allen, struck Jamaica on August 6, 1980, leaving in its wake 8 persons dead, hundreds homeless, and extensive damage to crops, roads and buildings. The parishes of Portland and St. Mary were the hardest hit.

### 1.3 POPULATION CHARACTERISTICS

#### 1.3.1 Demographic Characteristics

(Source: Jamaica. DOS, 1979)

At the time of the last census in 1970, the population was recorded as 1,854,300. By 1979 it had increased to an estimated 2,160,900. Jamaica's demographic

characteristics include high but declining fertility, low mortality, substantial internal migration, urbanization and emigration. The dominant feature in population growth in the last decade has been emigration, which in 1979 numbered 21,400 or almost one-third of the number of newborns that year. This has been mainly responsible for the low annual growth rate of 1.2 per cent in 1979. Rapid growth in the previous few decades, however, has left almost half the population under the age of 15 and approaching child-bearing age. This, coupled with the fact that a sustained high rate of emigration cannot be relied upon, creates potential for serious population acceleration in the next few decades.

1.3.1.1 General population statistics

Total population (1): 2,160,900

Annual growth rate(1): 1.2%

Population in year 2000 (3): 3,425,000 \*

Number of years to double population(2): 31

Population under age 15 (2): 46%

Population over age 65 (2): 6%

Life expectancy at birth (2): 70

Urban population (4): 48.2%

Sources:

(1) Jamaica. DOS, 1979

(2) World Population Data Sheet, 1980

(3) Tsui. 1979

(4) USAID, 1980

FIGURE 3

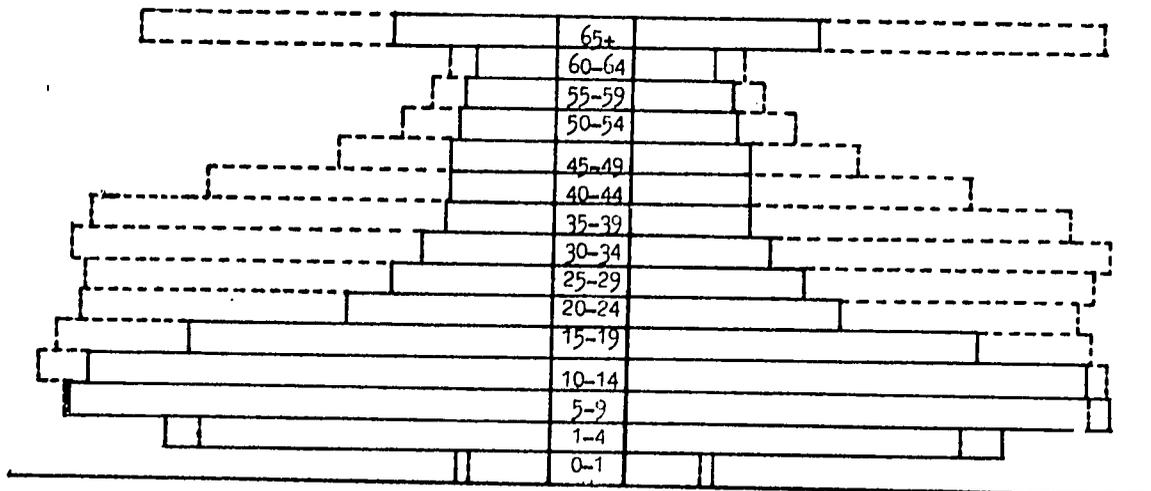
AGE-SEX PROFILE  
1975 & 2000

MALES  
(in 1000s)

1975	2000
54	138
27	36
30	42
32	51
35	72
35	115
36	153
43	160
53	156
68	157
121	165
154	170
160	161
128	118
31	27

FEMALES  
(in 1000s)

1975	2000
62	157
27	39
34	46
35	54
40	76
40	113
40	148
47	160
58	155
70	150
114	155
153	160
160	154
126	112
29	25



(source: Tsui, 1979)

\* Differs significantly from World Pop. Data Sheet (2,871,000) which puts more emphasis on emigration.

1.3.1.2 Population density, distribution and growth

With a population density of 495 per sq. mi. (191 sq.km), and 1134 per sq. mi. (438/sq.km) on arable land, Jamaica is among the more densely population countries of the world. Table 2 shows distribution, density and growth of the island's population by parish between 1970 and 1979. (See figure 1 for parish boundaries.)

Population by Parish

Parish	Area (mi <sup>2</sup> )	Percent of land	Population		Density pop/mi <sup>2</sup> (1979)	Percent of pop		Percent growth 1970-1979
			1970	1979		1970	1979	
Kingston and St. Andrew	194.7	4.6	562416	643800	3307	29.7	30.5	14.5
St. Thomas	286.8	6.7	72051	78100	272	3.8	3.7	8.4
Portland	314.3	7.3	69038	74500	238	3.7	3.5	8.3
St. Mary	235.7	5.5	100966	108900	462	5.3	5.2	7.9
St. Ann	468.2	11.0	123006	134300	287	6.5	6.4	9.2
Trelawny	337.7	7.9	61917	67600	200	3.3	3.2	9.2
St. James	229.7	5.4	106942	122800	535	5.7	5.8	14.8
Hanover	173.9	4.1	59799	64200	369	3.2	3.0	7.4
Westmoreland	311.6	7.3	114205	121600	390	6.0	5.8	6.5
St. Elizabeth	468.1	11.0	127911	139000	297	6.8	6.6	8.7
Manchester	320.5	7.5	125478	142600	445	6.6	6.8	13.6
Clarendon	461.9	10.8	178474	193900	420	9.4	9.2	8.6
St. Catherine	460.4	10.8	188500	217900	473	10.0	10.3	15.6
Jamaica	4263.5*		1890700	2109300**	497			11.7

\* note that other sources give total area as 4243.6 mi<sup>2</sup>

\*\* figures elsewhere in same publication give total 1979 population as 2160900

(sources: Jamaica. Dept. of Statistics, 1979  
Europa Publications, 1978)

1.3.1.3 Urban-rural population distribution

(Source: USAID, 1979; Clarke and Hodgkiss, 1974)

The population lives in 4 types of settlements: the capital city, small towns, villages, and dispersed rural dwellings. The proportion of urban population has increased steadily, from 34 per cent in 1960 to 48 per cent in 1978. About 30 per cent of the population lives in the Kingston-St. Andrews metropolitan area. In 1970 the four other major urban areas, Montego Bay, Spanish Town, May Pen and Savanna-la-Mar, had a combined total of about 129,800 or 7 per cent of the population. The heaviest rural concentrations are associated with coastal settlements, the sugar areas and in the upland areas on interior valleys, arable

slopes, and along watercourses. The Cockpit Country, due to lack of accessible water and rugged topography, and the Blue Mountains, due to the steep slopes, have the lowest population density.

#### 1.3.1.4 Population movement: internal and external migration

(Sources: Jamaica. DOS, 1978; Clarke and Hodgkiss, 1974; Jamaica. NPA, 1973)

Jamaicans are highly mobile; in 1960 one quarter of Jamaicans were living outside their parish of birth. The most mobile are young adults. High population pressure, unemployment, and a growing stigma against agricultural work among rural youth have led to migration from the upland farming areas. The principal migratory stream is directed toward Kingston, which grew by 30 per cent in the decade of the 1960s and 14.5 per cent during the 1970s. Other important reception areas are the small towns and sugar estates of St. Catherine and St. James (which includes Montego Bay) and the bauxite mining areas of St. Elizabeth, Manchester and St. Ann. (See population by parish, section 1.3.1.2)

For decades, emigration from Jamaica has provided a means for personal advancement and a safety valve for the country's population pressure. Since 1960 emigration has been high (288,000 in the 1960s, about 200,000 in the 1970s). Almost three-fourths of the migrants go to the United States; most of the others go to the United Kingdom and Canada. Data suggest that in recent years professionals, management personnel, and skilled workers have made up an increasing portion of the outflow. Owing to the already existing scarcity of these personnel, this "brain-drain" has serious implications for Jamaica's future social and economic development.

#### 1.3.1.5 Population growth projections

Tsui (1979) predicts a substantially higher population figure (3,425,000) for the year 2000 than does the World Population Data Sheet (1980) (2,800,000). The population projection by Tsui is shown below. (See also section 1.3.1. Age and Sex Profile.)

	<u>Projected Population Growth</u>					
	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>1995</u>	<u>2000</u>
total (in 1000s)	2042	2330	2641	2939	3200	3425
female	1035	1176	1319	1463	1591	1704
male	1007	1154	1322	1476	1609	1721
urban	928	1152	1411	1685	1962	2230
rural	1114	1178	1230	1254	1238	1195

Tsui predicts that with a 67.7 per cent increase in the population of Jamaica between 1975 and 2000, there is expected to be a 142 per cent increase in the labor force and a 140 per cent increase in the urban population. This growth, especially of youths, will put severe pressure on schools, employment opportunities, housing, medical and environmental health services and facilities, infrastructure, and natural resources. A 223 per cent increase in the age group of over 65 will place a heavy burden on the working population.

#### 1.3.1.6 Population control

(Sources: Furnia, 1976; Jamaica, DOS, 1979; Kaplan et. al., 1976)

The first substantive government effort at population control was the establishment in 1968 of the National Family Planning Board (NFPB) as a unit within the Ministry of Health and Environmental Control (MOHEC). The NFPB is responsible for the family planning program which provides services through 163 clinics (1975). Of these, 41 are in the Kingston-St. Andrew area (receiving half the number of visits to all clinics) and the rest are scattered around the island. In addition, there are two clinics operated by the Jamaican Family Planning Association (an affiliate of the International Parenthood Federation) which began its activities in Jamaica over 20 years ago.

Data show that 50 per cent of all women under twenty and 30-40 per cent of those over twenty use an inefficient or no method of birth control. Although the GOJ has devoted substantial effort and funding in the promotion of family planning, the program has met with only moderate success due to financial and cultural-sociological constraints. In 1970 clinics had served 12 per cent of the number of women in the age group 15-44.

#### 1.3.2 Ethnic, linguistic and religious characteristics of the population

(Sources: Furnia, 1976; Kaplan, et. al., 1976; USAID, 1979)

The Arawak Indians, the inhabitants of Jamaica at the time of the Spanish settlement in 1509, had died out by the time of the British conquest in 1655. The present population is largely descended from the British colonialists and slaves imported from Africa. About 77 per cent of the Jamaican people are of unmixed African descent, 17 per cent are Afro-Europeans, 1 per cent European, and the remaining are of East Indian, Chinese and Middle East extraction.

English is the official language of Jamaica. Jamaican English, or Standard Jamaican, which closely resembles British English, is spoken by the well-educated upper classes. The majority of the people, however, speak English-based Jamaican Creole which has a strong West African influence.

Religion plays an important role in Jamaica life. Several Christian denominations are represented, the largest being the Anglican Church. Other churches include Roman Catholic, Presbyterian, Methodist, Baptists, Church of God and Seventh Day Adventist. Afro-Christian cults, with elements of revivalism and spiritualism are popular mainly with the lower classes. One of the most popular is Rastafarianism.

#### 1.3.3 Economic and Social Stratification

(Source: Furnia, 1976)

Two principal cultural systems have evolved in Jamaica. One cultural system, based on the African heritage of the majority of Jamaicans, arises from folk beliefs, patterns and values of African roots and from conditions imposed by slavery. The other cultural system is European in origin and tradition.

Black Jamaicans constitute almost all the agricultural working class and a growing commercial and industrial proletariat class. A small but growing middle class consists of several ethnic groups including Chinese, Syrian, Lebanese, East Indian and a growing number of Afro-Europeans. The small upper class was until recently restricted to Caucasians. More social mobility has been afforded in recent years.

While Jamaican political structure, language, some traditions, and technical improvements are largely legacies of British rule, culturally, the predominant influence for the majority of Jamaicans is their African heritage. One characteristic which can be traced to practices under slavery as well as present attitudes of Jamaican men and women to each other and to family life, is polygamy. Within the lower class, comprising 85 per cent of the population, common-law cohabitation and visiting unions are far more common than legal marriage, which is reflected in a high illegitimacy rate (over 70 per cent). Families from common-law and visiting relationships are largely matriarchal. Fragmented, matriarchal family life, where the father is either absent or paternal leadership is compromised and in which the mother must work to support the children, is a major contributor to inadequate child care, malnutrition and high child mortality. The instability of family life contributes to the lack of general family planning.

Inequitable land ownership patterns and the Jamaican custom of distributing land to each child rather than following principles of primogeniture, have resulted in a preponderance of farms of uneconomic size. Men and women commonly supplement their incomes with seasonal work as migrant laborers on plantations, another destabilizing force in family life.

Underlying the structure of a stable democratic government, a relatively advanced economy, and many values and traditions left from the British, there are strong undercurrents of instability in Jamaica, stemming largely from marked social and economic stratification and, within the lower class, from unorthodox family life and unstable social relationships. The effects of the latter are over-population, migrant work patterns, and health problems.

#### 1.3.4 Health characteristics

(Sources: Furnia, 1976; Jamaica. NPA, 1973; Jamaica. NAC, 1974)

The health environment in Jamaica has shown substantial improvement in the last three decades, as reflected in a decrease of the crude death rate (11.8 in 1950<sup>3</sup>, 6.2 in 1979<sup>5</sup>), infant mortality rate (73.3 in 1950<sup>3</sup>, 16.2 in 1979<sup>5</sup>), and an increase in life expectancy at birth (57.5 years in 1950<sup>3</sup>, 70.0 in 1980<sup>5</sup>). In general the level of health in Jamaica is considered "satisfactory" by World Health Organization/Pan American Health Organization (WHO/PAHO) standards.

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1 World Pop. Data Sheet, 1980

2 Jamaica. NPA, 1979

3 Furnia, 1976

4 Jamaica. NAC, 1974

5 Jamaica. DOS, 1979

Although the health environment is within the context of a developing country, it more closely resembles that of a developed industrial country. Health characteristics in common with an industrial society include a predominance of degenerative diseases, fairly low incidence of communicable diseases, and a relatively low crude death rate.

In the 1960s the government of Jamaica concentrated mainly on providing secondary and tertiary health care through new and renovated hospitals, health centers, and medical personnel training in an effort to reach the rural population. Emphasis during the 1970s, however, has been on primary health care at the community level. Other priorities are environmental health (drinking water supplies and waste disposal) and nutrition.

### Basic Health Statistics

Life expectancy at birth (1):	70		
Crude birth rate (1):	29 per 1000 *		
Crude death rate (1):	7 per 1000 **		
Infant mortality (1):	15.0 per 1000 live births		
Child death rate (ages 1-4) (1):	3.0 per 1000		
Physicians per 10,000 population (2):	1.9		
Hospital beds per 1000 population (3):	3.7		
Daily per capita calorie supply (4):	2945	<u>Recommended levels</u> <u>WHO/PAHO</u>	<u>CFNI***</u>
Daily per capita protein supply (4):	75.4	2248	2455
		46.3	65.0

### Mortality and Morbidity

The leading causes of death in 1973 were heart disease and other diseases of the cardiovascular circulatory system (49%), cancer (16%), pneumonia (9%), enteritis and other diarrheal diseases (7%), and diabetes (6.3% in 1971, the third highest in Latin America). The incidence of these degenerative diseases has increased while that of communicable diseases have dramatically declined since the last decade, indicating an overall higher standard of living.

Causes of morbidity include accidents other than automobile accidents (16%), enteritis and other diarrheal diseases (7%), complications of pregnancy and childbirth (6%), heart and circulatory illness (6%), genito-urinary diseases (5%), bronchitis (4%), and cancer 3%).

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* Jamaica. DOS, 1979 records figure as 27.1	1 World Pop. Data Sheet, 1980
** Jamaica. DOS, 1979 records figure as 6.2	2 Jamaica, NPA, 1979
*** Caribbean Food and Nutrition Institute	3 Furnia, 1976
	4 Jamaica. NAS, 1974
	5 Jamaica. DOS, 1979

### other health problems

In addition to the above mentioned causes of mortality and morbidity, the following problems have serious present and potential consequences for the health environment in Jamaica: overpopulation; inadequate health services (especially in rural areas); limitations of MOHEC in planning, management, collection and analysis of data (vital statistics collection is notably inadequate); widespread malnutrition especially among young children and pockets of rural and urban poverty; serious deficiencies in maternal and child health care contributing to a high maternal death rate and high incidence of diarrheal diseases especially among children under 5 years old; and poor environmental conditions, including much substandard housing, increasing numbers of slum and shanty towns and inadequate or non-existent water supply and waste disposal systems.

### malnutrition

(Source: Jamaica. NAC, 1974)

The seventh most prominent cause of death is nutritional deficiency, which is especially serious among children under 5 years of age. The death rate attributed to malnutrition is high (22.7 per 1000 population), exceeded in Latin America only by Guatemala and Columbia. Nutritional data show that about 20 percent of children under 4 years of age are significantly underweight for their age. In addition, about 45 percent of pregnant and lactating women are anemic, resulting in prenatal and postnatal complications.

Although per capita calorie protein supplies are well above recommended allowances, difference in protein and calorie availability is marked between income groups. The low income group, comprising 75 percent of the population, has an average intake of calories that falls short of the recommended amount by 27 percent, and of protein, by 14 percent. The majority of the food for low income groups is imported.

### health services

(Sources: Jamaica, NPA, 1979a; Furnia, 1976)

Most health services are supplied by the Jamaican government through MOHEC supplemented by a very limited private health sector. The physical facilities in 1979 included 23 general public hospitals, 7 specialized hospitals (all in Kingston), and 5 private hospitals (for a total of 6408 hospital beds, 1760 of which are for psychiatric care), 154 health centers and dispensaries providing out-patient and preventive services, and 163 family planning clinics. Loss of professionals through emigration has been especially serious for the health sector. The number of doctors practicing on the island decreased from 530 in 1974 to 361 in 1977. The nurse and dental professions are also seriously understaffed. The shortage of health personnel is most critical in rural areas. In response to the problem, the Community Health Program was instituted in 1972. Under the program, community health aids (CHAs), members of the community supervised by a public health nurse, provide services that need not be performed by professionals. By 1978 there were 2000 CHAs. In order to

promote and integrate maternal and child health care, family planning and nutrition, the Cornwall Project, a World Bank supported pilot project in Cornwall County, was initiated in 1976. CHAs and midwives provide primary health care to the communities. If successful, the project will serve as a model for future programs.

### 1.3.5 Housing

(Source: USAID, 1979)

Housing shortages have become critical as construction cannot keep pace with urban migration. Squatter communities with substandard housing and inadequate sanitary facilities have developed in parts of Kingston and Montego Bay. In addition, 33 per cent of urban housing and many rural dwellings are considered substandard. A 1970 survey reported that most housing units are small (2.4 rooms) and average 4.3 inhabitants. Almost half the houses are concrete, while a third (mostly in rural areas) are wood. About 46 per cent of the houses (mostly in urban areas) have water piped inside the dwelling or the yard 42 per cent have access to public standpipes, and 13 per cent draw water from springs or other water bodies. Only 8 per cent of houses (all urban) have sewer connections. More than three-fourths of the houses are served by pit-latrines. Sanitary facilities are lacking particularly on the western end of the island. An estimated 35 per cent of households are supplied with electricity. However, most lower income urban and many rural inhabitants have no electric service and use kerosene lamps for lighting (IBRD, 1979a). Owner-occupation is the norm in rural areas; in urban areas most people rent. The Ministry of Housing is responsible for constructing dwellings for low-income families.

### 1.3.6 Education

(Sources: Furnia, 1976; Jamaica. DOS, 1978; Jamaica. NPA, 1979b; Jamaica, MOE, 1977; Kaplan et. al., 1976)

#### primary, secondary and higher education

The education system consists of public and private schools, generally well-distributed throughout the island. With a strengthening of the public school system there has been a decline in the number of private schools, so that the vast majority of institutions are state-run with free tuition. Responsibility for public education lies with the Ministry of Education (MOE). The system is basically divided into primary (grades 1-6), secondary (grades 7-11), and higher education. MOE statistics for 1976/77 show that:

- 83% of 6-12 year olds receive a primary school education
- 56% of 12-15 year olds receive a secondary education (grades 7-9)
- 22% of 15-17 year olds receive a senior secondary education (grades 9-11)

#### post-secondary education

While further education is offered at eight teacher training colleges, four community colleges, the Jamaica School of Agriculture, and the College of Fine Arts, Science and Technology, university-level education is available only at

the University of the West Indies (U.W.I.). U.W.I. is a regional institution administered by the governments of former and present British Caribbean territories. The original and largest campus is at Mona, Jamaica, just outside Kingston. The faculties of arts, social sciences, natural sciences, medicine, education, general studies, law and library studies are represented at Mona. Other campuses are at Trinidad (agriculture, engineering, arts, natural sciences, social sciences), and Barbados (arts, natural sciences, law). In 1976/77 the three campuses had a total enrollment of 6917, almost half of which were Jamaicans. Out of 600 degrees awarded to Jamaicans in 1977, 126 were in the natural sciences and 4 were in agriculture (Jamaica. MOE, 1977). In addition, many students go to Great Britain, Canada or the United States for a university education.

#### weaknesses in the education sector and illiteracy

As outlined in the Five-Year Development Plan, 1978-82, major problems still exist in the educational system. The physical facilities are inadequate and construction of new schools lags behind the birth rate. Attendance is low (65-70 per cent), learning disabilities are discovered late, there is a serious shortage of trained teachers, and management skills are lacking. The direct result of these weaknesses in the system is that 40 per cent of the primary school graduates lack basic skills in reading, writing and math.

In 1971, the National Planning Agency estimated that 40-50 per cent or 400,000 to 500,000 people over 15 years of age were functionally illiterate. (Illiteracy figures previously given were 11-18 per cent.) With the goals of eradicating illiteracy in the shortest possible time and to prepare adults for further training, a program in adult literacy, Jamaica Movement for the Advancement of Literacy (JAMAL) was launched by the Ministry of Education in 1974. Since then the program has reached over 100,000 students and has gained international recognition.

#### training needs and programs

In Jamaica a high level of unemployment exists along with acute shortages of skilled labor in almost every sector of the economy. The problem of absorbing the youth population into the employment market has become increasingly difficult due to the rapid growth of this age group. In 1975, the youth population (ages 15-29) accounted for 25 per cent of the population; by 1983 it is predicted to be 32 per cent. Presently the resources and facilities for training youth are grossly inadequate.

In recognition of the problem and of the importance of education to socioeconomic development, the Ministry of Education has emphasized training of the youth population by making changes in the secondary educational system to provide students with vocational skills, and by expanding non-formal training programs (farmers' training center, youth camps, trade training centers). Many ministries operate their own training programs. In addition, several other institutions or associations are involved in non-formal/continuing education programs, such as Jamaica Youth Corps, agricultural Commodity Boards, Jamaica Agricultural Schools and 4-H. The Youth Corps is a vehicle for involving youth in national development through voluntary services. In 1978, 5,000

volunteers worked on projects in rural development (forestry, soil conservation, land reclamation, community facilities, and housing), social services (education and health), job skill training, agriculture and handicrafts.

### 1.3.7 Unemployment

Unemployment has been high in Jamaica since the 1930s. In 1979 it had reached 31 per cent and by 1983, is predicted to be near 39 per cent (USAID, 1981). The labor force continues to expand rapidly while employment opportunities have decreased. In Jamaica, GDP tends to grow much more rapidly than employment because the fastest growing sectors of the economy, mining and manufacturing, have fairly limited employment opportunities.

## 1.4 GOVERNMENT AND POLITICAL GEOGRAPHY

Jamaica gained independence from Great Britain on August 6, 1962, and is a member of the British Commonwealth of Nations. The form of government is constitutional monarchy in which the Queen is titular sovereign and is represented on the island by a Governor-General. The executive branch is made up of the Governor-General, the Prime Minister and the Cabinet. The Governor-General appoints the Prime Minister, and on the latter's recommendation, other Ministers who make up the Cabinet. The legislative branch consists of the Senate of 21 members (appointed by the government) and the House of Representatives of 60 members (elected by the people). The judicial branch of the government is represented by the Court of Appeal.

The Cabinet is made up of the Prime Minister and the heads of the ministries. The Ministers are generally named from the members of the House, but may be appointed a Senator, then designated a Minister. Each Minister has a permanent secretary, a civil servant in charge of the general administration of the ministry. In 1978 there were 20 ministries: Minister of Agriculture; Ministry of Mining (Ministry of Mining and Energy); Ministry of Housing; Ministry of Education; Ministry of Health (Ministry of Health and Environmental Control); Ministry of Local Government; Ministry of Finance and Planning; Ministry of Industry and Commerce; Ministry of Works; Ministry of Foreign Affairs; Office of the Prime Minister; Ministry of Defense; Ministry of Social Security; Ministry of Justice; Ministry of Youth and Sports; Ministry of Parliamentary Affairs; Ministry of Public Service; Ministry of Public Utilities and Transport; Ministry of Labour; Ministry of National Security.

Jamaica is divided into three counties (Cornwall, Middlesex, Surrey) which are in turn divided into 14 parishes for the purpose of local government. (See figure 1.) The parishes of Kingston and St. Andrew are linked together for administrative purposes as the Kingston and St. Andrew Corporation. The local affairs of each of the other 12 parishes are administered by the Parish Council. The parishes are divided into electoral constituencies (60 total) from each of which one House Representative is elected. Representatives are elected for five years by universal suffrage, the voting age being 18.

The Constitution allows for unlimited number of political parties, but there are essentially only two, the Jamaica Labor Party (JLP), and the People's National Party (PNP). The JLP won the elections of 1962 and 1967, but lost

in 1972 to the PNP led by Michael Manley. In October 1980 the JLP under Edward Seaga regained control of the government.

Michael Manley, an advocate of democratic socialism, put great emphasis on social reform, economic independence and a policy of non-alignment in foreign relations. Manley developed closer ties with Cuba, wholly or partially nationalized some industries, and sought to increase Jamaica's involvement with Third World issues. These actions undermined the confidence of some domestic and foreign investors. Internal forces (including a decrease in investment) and external forces (e.g., rapidly increasing fuel prices) have contributed to the poor economic performance of the country since 1974.

The Seaga administration's strategy is to promote foreign investment, encourage the private sector (especially in manufacturing), reduce bureaucratic interference in the economy, and introduce rigorous fiscal management (USAID, 1981). A continuation of firm commitments to social programs, a mixed economy, and rural development illustrated by Manley government is pledged by the Seaga administration (JLP, 1980).

In reading this profile, one must realize that the policies given (unless specified as Seaga's) are those of the previous administration. Given that the new administration's strategies for economic development are significantly different, there will undoubtedly be many policy changes, most of which have not yet been announced.

## 1.5 ECONOMY

(Sources: USAID, 1981; James, 1981; JLP, 1980; Clarke and Hodgkiss, 1974)

The most immediate challenge to Jamaica is its precarious financial position. Following seven consecutive years of economic decline resulting from a rapid rise in the price of oil and stagnating productivity in most sectors, the projected gap in this year's foreign exchange budget is U.S. \$750. million, leaving the country with serious fiscal problems (James, 1981). Coincident with Jamaica's weak economic state is an increase in the unemployment rate to over 30 per cent (up from 21 per cent in 1974), a decline of 26 per cent in per capita income since 1973 (J \$1272. in 1973, J \$940. in 1980 in constant 1974 values), an increase in malnutrition, a decrease in many social services and increased emigration of skilled personnel.

Since the change in administration in October, 1980, greater emphasis has been placed on stimulating the private sector, encouraging foreign investment, and introducing austere fiscal management. To provide some immediate economic relief, negotiations with the International Monetary Fund (IMF) have been renewed (they were terminated in 1980 by the then Prime Minister, Michael Manley) and in March, 1981, 11 Western countries agreed to provide loans totalling U.S. \$350. million for the 1981-82 fiscal year. Additional loans from international banks, as the World Bank and Inter-American Development Bank, are being sought. Although Jamaica's outlook is more promising than a year ago, its economic problems will not be quickly or easily alleviated.

The Seaga administration's strategy is to use much of the loan money for importing productive inputs for the manufacturing and agricultural sectors and to direct output from the two sectors at the export market. Expansion of the tourist and mining sectors will also be encouraged. The sectoral origins of Gross Domestic Product in constant 1974 prices since 1974 have been:

	<u>1974</u>	<u>1976</u>	<u>1978</u>	<u>1980(proj.)</u>
	(in millions of Jamaican \$ at 1974 prices)			
<u>GDP at Market Prices</u>	2,265	2,028	1,955	1,864
Agriculture and Fisheries	162	158	187	172
Mining	298	184	222	232
Manufacturing	386	375	323	300
Construction and installations	214	169	133	122
Electricity, gas and water	22	24	24	23
Services	1,183	1,118	1,066	1,012
	(as per cent of total)			
Agriculture	7.2	7.8	9.5	9.2
Mining	13.2	9.1	11.3	12.5
Manufacturing	17.0	18.5	16.5	16.1
Construction and installation	9.4	8.3	6.8	6.6
Electricity, gas, and water	1.0	1.2	1.2	1.2
Services	52.2	55.1	54.7	54.4

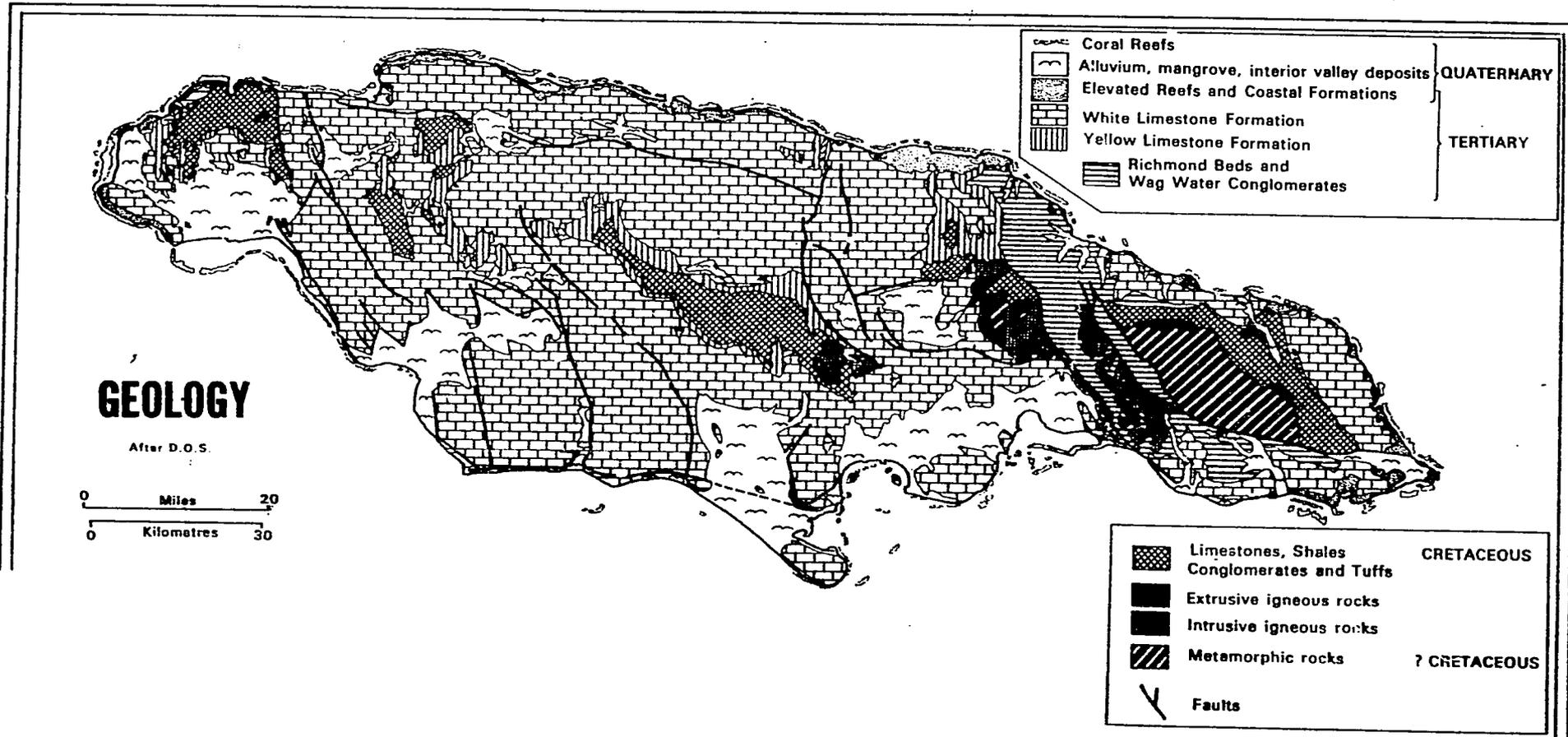
(source: USAID, 1981)

Employment is not expected to increase over the next few years as the largest growth industries--mining and manufacturing-- are capital rather than labor intensive. Another problem is that tourism and mining are not well integrated with the local economy. Economic enclaves, with accompanying localized inflation have developed along the coast in connection with tourism and in the interior with mining. Due to the lack of forward and backward linkages of these sectors and the dual nature of the culture and distribution of wealth and land, the majority of the population (the small-scale agriculturalists/rural inhabitants) will probably derive little immediate benefit from growth of the mining, manufacturing and tourism sectors. The emphasis on agriculture will be on export crops, so that assistance will be directed at the large and medium-sized farms rather than at the 1-5 acre farms.

It is difficult to assess how the state of the economy will affect resource management and environmental conditions in Jamaica. Increased activity in the

mining and manufacturing sectors without proper planning and regulation has potential for negative environmental impact. Growth of the tourist industry can be environmentally beneficial or detrimental depending on what value is placed on protection of resources which attract tourists (eg. clean beaches and water, protected natural areas with flora and fauna of interest to the tourist) and the degree of impact the tourist industry may have on water supply, sewage, waste water and solid waste disposal, and modification of natural areas (eg. wetlands) by construction of roads and buildings. The present economic problems of the country place constraints on programs for monitoring environmental quality, city, regional and national planning, and programs by the Ministry of Agriculture, Forest Department, Natural Resources Conservation Department, and water agencies. Although there is an awareness of the problems and sound proposals of programs aimed at monitoring environmental conditions and alleviating the problems have been put forward, lack of funds for implementing the projects is a serious deterrent.

Figure 4



source: Clarke, C.G. and A.G. Hodgkiss.  
1974. Jamaica in Maps. N.Y., Africana  
Publishing Co.

## 2.0 NON-RENEWABLE RESOURCES AND ENERGY

### 2.1 GEOLOGY AND MINING

#### 2.1.1 Geology

(Sources: Clarke and Hodgkiss, 1974; Jamaica. DOS, 1973a; Zans et. al., 1962)  
(See figure 4)

The geological history of Jamaica consists basically of alternating periods of igneous and metamorphic activity and submergence under sea level. The oldest rocks of Jamaica are igneous and metamorphic -- shists, amphiboles, and serpentines -- which form the core of the island and outcrop on the southern side of the Blue Mountains. These rocks date between the Paleozoic and lower Cretaceous. During the Cretaceous, under conditions of periodic subsidence of the land under sea-level, conglomerates, shales and limestone were laid down. Volcanic ash brought into the area was interbedded with the shales and limestone. These Cretaceous deposits are exposed in nine inliers across the island. The two main ones are the Blue Mountains and the Central Inlier. A period of metamorphism followed in the late Cretaceous. During that time, intrusive igneous rocks (granodiorite) were deposited in conjunction with folding activity to the west of the Blue Mountains. Following this, during the Eocene, the Wag Water Belt (a sinking trough between the granodiorite intrusion and Blue Mountain massif) and the Richmond Bed conglomerates were deposited.

In the mid-Eocene most of the island was again submerged, leading to the sedimentation of the Yellow Limestone in the central and western parts of the island. Formed in a shallow marine environment, the Yellow Limestone Formation consists of limestone interbedded with a considerable amount of tufts, shales, and estuarine deposits eroded from the exposed land areas. The White Limestone formation, dating from the Middle Eocene to lower Miocene, overlies the Yellow Limestone. Formed in deeper seas, it is purer, or contains less terrigenous material, than the Yellow Limestone. These Tertiary limestones cover more than two-thirds of the surface area of Jamaica.

The mid-Miocene to late Pliocene was a time of major metamorphic activity throughout the island. The main uplift of the Blue Mountains and the major faulting in the White Limestone plateaux occurred during this time. The limestone blocks formed by faulting were subsequently tilted. Since that time the limestone areas have been undergoing karstification with resultant formation of terra rossa soils and bauxite. Coastal formations were laid down along the north and south edges of the island which were still below sea level. They are composed of limestone, corals, sands and gravels.

During the end of the Tertiary and into the Pleistocene, the north side of the island was uplifted while the south subsided. This tilting of the island produced a steep scarp along the north coast composed of the Tertiary coastal formations and resulted in subsequent build-up of a coastal shelf along the south coast.

Recent (Quaternary) geologic activity is characterized by erosion and deposition of alluvial, deltaic, estuarine, and lagoonal sediments. The coastal plains are down-faulted areas on which these sediments have accumulated. Uplift in the Blue Mountains has deeply entrenched the river valleys. In some areas of the plateaux, the White Limestone has been breached, revealing Yellow Limestone deposits below. In a few places, the Cretaceous shales, conglomerates and limestones under the Yellow Limestone have been exposed.

In general terms, Jamaica has an igneous and metamorphic core, covered to a great extent by limestone deposited during periods of marine submergence. About two-thirds of the island is covered by limestone, the other third by igneous and metamorphic rocks, shales and alluvium.

## 2.1.2 Mining

(Sources: Jamaica. NPA, 1979a,b; Jamaica. MFP, 1971a,b; Lyew-Ayee, 1979)

The minerals found in Jamaica include asbestos, baryties, bauxite, ceramic clays, cobalt, copper, gypsum, iron, lead, limestone, manganese, marble, cave phosphates, silica sand, talc, and zinc (Zans, 1951; Caribook, 1980). Presently only bauxite, gypsum, limestone, marble and silica are of economic significance. Bauxite and alumina are the major mineral products, accounting for over 97 per cent of mineral outputs in 1979. In 1977, the value of the mining sector amounted to 10.7 per cent of Gross Domestic Product (Jamaica. DOS, 1978). Production figures for 1976-79 are:

### Mining Production (1976-9)

	<u>unit quantity</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>
industrial lime	'000 MT*	122.0	144.1	157.4	203.9
glass	'000 MT	14.5	18.4	14.8	n.a.
gypsum	'000 MT	253.2	214.2	134.5	58.0
silica sand	'000 MT	30.2	28.4	14.4	10.6
marble	'000 MT	0.8	0.1	0.1	0.0
sand & gravel	'000 cu. m.	3823.0	3823.0	3823.0	4400.0
fill (marble, rubble)	'000 cu. m.	3823.0	3823.0	3823.0	5400.0
bauxite ore	'000 MT	6284.0	6355.0	6488.0	6400.0
alumina (bauxite equiv.)	'000 MT	4012.0	5078.0	5288.0	5105.0

(Jamaica. NPA, 1979a)

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\* MT = metric ton.

### bauxite

Jamaica is the third largest bauxite producer (behind Australia and Guinea), producing 13 per cent of the world's bauxite in 1979. As one of the major revenue earners in Jamaica, it is of critical importance to the country's economy. Payments to the GOJ of the production levy and royalties by the bauxite and alumina companies amounted to U.S. \$ 195.8 million in 1978. The industry accounts for 30 per cent of the government's non-loan revenues, about 11 per cent of GDP, and 74 per cent of Jamaica's exports (Jamaica. NPA, 1979b).

The economy of Jamaica is dependent upon the continuation of bauxite mining, but along with the financial benefits come problems related to poor integration of the industry with the rest of the economy and negative environmental impacts.

### bauxite industry

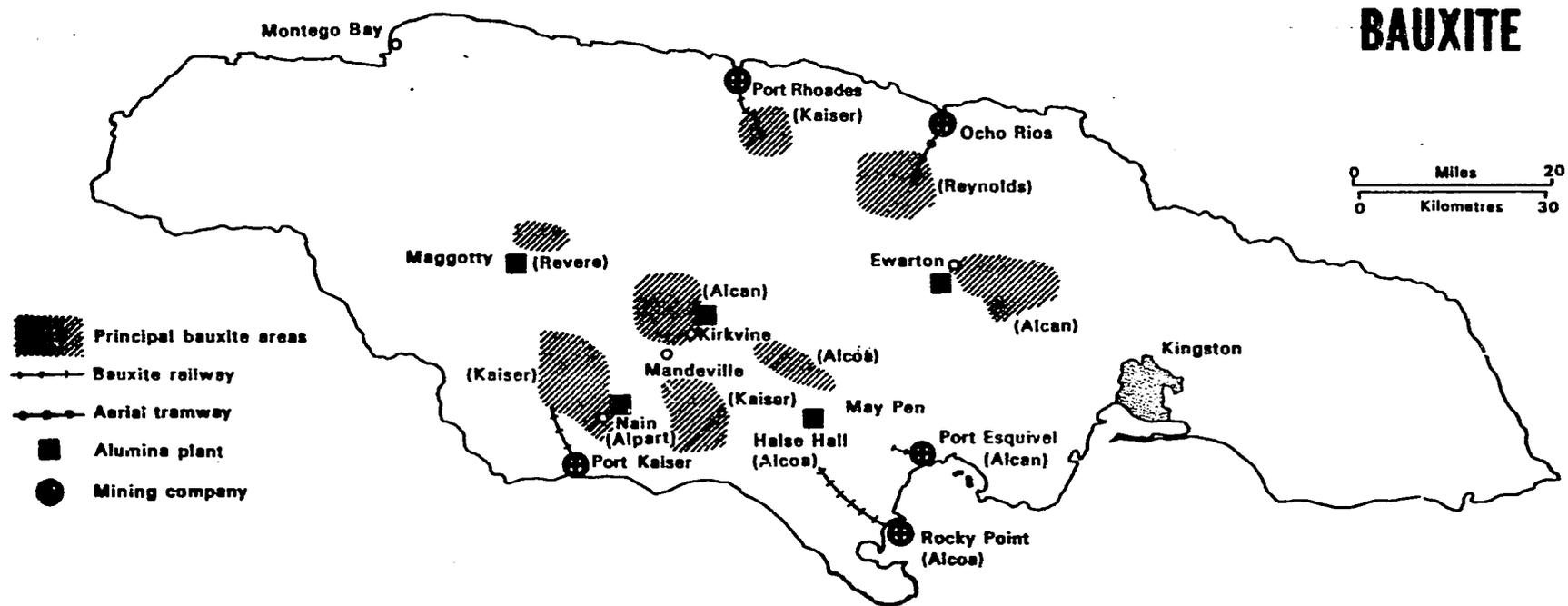
The bauxite industry in Jamaica consists of three steps: mining, drying and treatment to produce alumina. (Aluminum smelting is done elsewhere, largely because of the high energy requirements.) As there is a large increase in value added at each stage in processing, Jamaica has encouraged expansion of processing and installation of alumina plants. Before the mid-1970s, the industry was controlled by six transnational companies and the revenue paid to Jamaica only remotely reflected the price of alumina on the world market, changes in the quality of ore and production costs. While Jamaica has derived several benefits from the presence of bauxite companies, including revenue from the levy and royalties, increased income from use of rail-ways and ports and introduction of innovative agricultural techniques on land previously owned by the companies, the industries have tended to form enclaves within the Jamaican economy. Most of the companies have developed their own ports and some have built private railways. There are few forward or backward linkages; most of the inputs are imported, and no aluminum smelting or prefabrication is done on the island. In addition, the bauxite industry is capital intensive and employs fewer than 10,000 people, although wages are high and it does provide some opportunities for technical/professional employment to Jamaicans.

Currently bauxite is being mined by five large companies:

- 1) Alcan Jamaica Ltd., now JAMALCAN  
- a subsidiary of the Aluminum Company of Canada
- 2) Kaiser Bauxite Co., now Kaiser Jamaica Bauxite Co.  
- a subsidiary of Kaiser Aluminum and Chemical Corp. (U.S.)
- 3) Reynolds Jamaica Mines Ltd., now Jamaica Reynolds Bauxite Partners Ltd.  
- a subsidiary of Reynolds Metal Co. of U.S.
- 4) Alcoa Minerals of Jamaica Inc., now JAMALCO  
- a subsidiary of the Aluminum Company of America
- 5) Alumina Partners of Jamaica Ltd., or ALPART  
- a consortium of Reynolds, Kaiser and Anaconda

Three of the companies -- ALPART, Alcoa and Alcan -- produce alumina on the island.

Figure 5



source: Clarke, C.G. and A.G. Hodgkiss.  
1974. Jamaica in Maps. N.Y., Africana  
Publishing Co.

With the election of the Manley government in 1972, the GOJ undertook to increase its revenues from bauxite and to acquire more sovereignty over the resource. In 1974 the government imposed a production levy which was tied to the price of aluminum. This increased Jamaica's income from bauxite six-fold. The government also entered into negotiations with the individual transnational companies with the purpose of: i) acquiring all the land owned by the companies except that which is integral to the mining and processing operations (93.5 per cent); ii) making bauxite reserve allocations to each company based on 40-year reserve supply; and iii) purchasing a 51 per cent share of the mining asset or an equivalent value in the alumina operation where one exists. Revere Jamaica Alumina Ltd. had elected to close its operations in Jamaica with the ~~introduction~~ introduction of the bauxite levy; but the government has signed agreements with the other companies. In addition, Jamaica has been instrumental in the establishment in the mid-1970s of the International Bauxite Association. The IBA, an OPEC-like organization of the seven leading bauxite producing countries, coordinates negotiations with bauxite users to increase its members' sovereignty over their resources.

Since 1974, Jamaica's contribution to world bauxite production has fallen significantly. The causes cited for this include the companies' reduction of bauxite production in Jamaica and redirection of all new investment to other bauxite-producing countries in response to the bauxite levy and partial nationalization of the industry; the U.S. recession causing decreased demand for aluminum; labor strikes and accidents at some of the operation sites; and, the closing of the Revere operations. The capacity of the existing plants is only partially utilized (60-90%). The resulting negative effect on the economy reflects Jamaica's reliance on the bauxite resource and her vulnerability to international forces.

#### bauxite resource

Bauxite is derived from the bauxitic, or terra rosa, soils of the White Limestone Formation. It occurs in two types of deposits: pocket type deposits up to 30 meters thickness in sinkholes mainly on the north side of the island, and blanket-type deposits 5-7 meters thick mainly on the south side of Jamaica in depressions of tilted fault blocks. Reserves of bauxite are estimated at 1.2-2.0 billion MT, or at present production rates enough for 60-100 years (Jamaica. NPA, 1979b).

Approximately 7 per cent or about 200,000 acres of Jamaica's land surface is scheduled to be mined over the next 35 years. Currently less than 20 per cent of this land is being mined for bauxite. The unmined land is in agriculture or forestry. The bauxite companies have used these lands for livestock grazing, citrus production and forestry operations. The Manley government's policy was to purchase the companies' holdings and grant mining leases on lands representing 40 years bauxite reserves to each company with strict use and rehabilitation requirements. Jurisdiction over the use of lands within a company's lease which are not to be mined within 5 years has been transferred to the Commissioner of Lands (Mullings, pers. comm.). Some

of these lands have already been distributed for small-scale agricultural use under Land Lease (see section 3.2.5). The future of the bauxite companies' livestock, timber and citrus operations is not clear. The GOJ now has partial ownership of these assets. It is not known how the Seaga government's policy toward bauxite companies will differ from that of the Manley administration.

#### environmental impacts

##### mining and reclamation

The companies are required by law to rehabilitate the mined areas. Bauxite is either pit mined, in the case of pocket type deposits, or strip mined as with blanket type deposits. In both cases the bauxitic soils are generally mined down to the underlying limestone. After mining has been completed, the topsoil which had been initially removed is replaced, forming a cover generally about 20 cm over the limestone. If necessary, this is supplemented with soils brought in from other areas. The land is seeded, thus returned to vegetative cover, and, if possible, agriculture. Restoration of strip mined bauxite lands in Jamaica began in 1953. Some lands have been restored primarily to livestock pastures, others to forest. Reclamation attempts have met with mixed success depending on the site and degree of regulation by government officials.

Topsoil of reclaimed land has been found to be low in fertility. Improvement of the soils for economic crop production requires substantial use of fertilizers and soil amendments. One problem is that plant root development is severely limited by the shallow depth of the soil. While the mining companies' use of reclaimed lands as pasture (forage crops tend to accumulate organic matter in the root zone and provide protection against erosion) and forest or orchard (requiring mainly only basic NPK treatments), has been shown to be fairly successful, it is the opinion of some that these lands should not be turned over to small farmers for a long time. More intensive use, such as growing heavy yielding crops (e.g., root crops), would require higher fertilizer and other soil amendments. If lands were to be used by small farmers within a few (e.g., 5) years after reclamation, it is recommended that high calibre extension supervision be provided to ensure that the proper soil improvements are carried out, erosion control measures implemented, and if in pasture, the land is not overgrazed (Williams and Thomas, 1976).

##### red mud waste

Disposal of the red mud waste from alumina processing is the major environmental problem associated with the bauxite/alumina industry. Jamaican bauxite produces about one ton of red mud slurry per ton of bauxite refined, equalling a total of 3000-20,000 tons per day or 10,000 acre feet per year. The solution, composed of aluminum and sodium compounds with some iron impurities, is caustic and has a pH of 11-13. The small particle size of the suspended solids accounts for the notoriously poor settling properties of the mud. When dried, the mud will shrink and crack in a columnar configuration.

The red mud slurry is diverted from the processing site to an abandoned mine pit or natural hollow of 5-100 acres in size. (Each year several hundreds of acres are converted to red mud ponds.) In the past, few if any precautions have been taken against infiltration into the substratum. There has been evidence of significant contamination of the nearby aquifers (red color, pH of about 8.5, odor, high turbidity of groundwater samples taken) (Wedderburn, 1977). In many areas, these contaminants prevent use of the water for domestic, agricultural, and sometimes even industrial use. Some colonization of abandoned ponds may begin after 5 years but limitations have been found to restrict the development of secondary vegetation even after 15 years (Alcan, 1979). Leaching of the chemicals out of the upper layers will eventually allow colonization of the area by vegetation, but may threaten groundwater quality.

An economically feasible use of the red mud materials has not yet been found and the technology to successfully contain these wastes is not yet available. The problem will only increase in magnitude with continued production until some solutions are found.

In summary, bauxite is a critical component of the Jamaican economy and will probably continue to play a major role in the country's balance of payments for at least the next 30 years. Although Jamaica now has an advantageous position regarding the industry, the country's economic future in regard to bauxite is ultimately dependent upon world demand and prices, and also on economic and political sensitivities. Another factor is availability of alternative sources of alumina. Investigations are currently being undertaken by aluminum companies in the U.S. to develop means of utilizing domestic aluminum clays. On one hand Jamaica hopes that technologies for exploiting other sources of aluminum will not be developed until the country's bauxite resources are fully utilized, yet the red mud problem will not be resolved without the development of new industrial technologies.

## 2.2 ENERGY

### 2.2.1 Current Sources of Energy

(Source: Jamaica. NPA, 1979a)

Petroleum and petroleum products account for 98.8 per cent, and hydropower 1.2 per cent of commercial energy use. Non-commercial energy consumption is based on bagasse used as fuel in sugar plants. In 1972 this accounted for 11.4 per cent of total energy use in Jamaica, and in 1976, 9.8 per cent. Total fuel consumption for the island in 1976 was:

	in '000 barrels F.O.E. *	
Commercial energy		
petroleum	15132	
hydropower	194 **	
Non-commercial energy		
bagasse	1665	
	<hr/> 16991	(Jamaica. NPA, 1979a)

\* F.O.E. = fuel oil equivalent

\*\* represents 110 million Kwh

The cost of petroleum imports in 1979 was U.S. \$305 million, equalling 31 per cent of all imports that year (up from 9 per cent in 1972). As use actually decreased in the latter half of the 1970s due to lowered productivity (especially significant in the mining sector) and an increased tax on gasoline, the high cost is almost wholly attributed to a precipitous rise in price. Petroleum imports are putting an increasingly severe burden on foreign exchange. As Jamaica's mining, transportation, commercial and industrial sectors are all dependent upon energy, the escalating price of oil threatens the entire economic base of the country, and poses one of the most serious problems to Jamaica's development.

2.2.1.1 petroleum

(Source: IBRD, 1979a)

cost

The table below provides figures of petroleum imports and total cost from 1972-79:

	<u>average price per barrel crude oil (US\$)</u>	<u>petroleum imports mill. barrels</u>	<u>cost of petroleum imports (US\$ million)</u>
1972	2.91	16.1	57.3
1973	3.77	20.3	71.5
1974	10.45	18.5	194.7
1975	11.29	17.5	208.2
1976	11.77	15.6	200.4
1977	13.33	16.4	219.6
1978	13.51	16.1	215.6
1979	19.21	16.7	304.7

(Jamaica. NPA, 1979a)

product imports

About 60-70 per cent of the petroleum is imported in the form of crude oil. The Exxon owned and operated refinery on the island produces fuel oil in sufficient quantities to meet most petroleum demand. An additional 20-25 per cent of the imports is in the form of gasolines and auto diesel. The rest of the consumption is composed of aviation gas, jet (turbo) fuel, liquid petroleum gas, kerosene, and marine diesel.

consumption

The bauxite/alumina sector, the largest single consumer of petroleum, accounted for 40 per cent of use in 1973. Another 30 per cent of total consumption is absorbed by transport, including bunkering for ships and aircraft, public

and commercial transportation, and private passenger cars. Power generation (electricity) accounts for about 15 per cent of the petroleum use, with the remainder for the industrial, commercial and agricultural sectors.

electricity generation and service

In 1977 Jamaica's installed generating capacity was about 705 MW, about 64 per cent of which was part of the public service system operated by the Jamaica Public Service Co. (JPSC), and the rest was generated internally by the bauxite/alumina (31 per cent), sugar and cement (5 per cent) industries. JPSC generates most of its electricity by steam plant, but to a small extent by gas turbine, diesel plant and hydro.

The mining, industrial and commercial sectors use over 75 per cent of the electricity generated annually. As for domestic use, only 35 per cent of Jamaican households are connected to the power system; 50 per cent of potential customers in Kingston and other urban areas and 11 per cent of rural households are connected. The quality of service has deteriorated over the last decade. Labor disputes, inadequate maintenance and management problems have resulted in frequent power disruptions. Needed improvements in the electricity sector include increasing system reliability and expansion of the service to rural areas. Since 1975 the World Bank has made substantial loans to JPSC to upgrade and expand service, specifically in the rural areas.

#### 2.2.1.2 hydropower

(See also section 3.7.5.4)

Several hydro plants with a combined capacity of about 21 MW are currently operating. This accounts for only 8 per cent of the total electricity generated on the island, compared with 34 per cent in the 1960s. The small contribution by hydropower reflects the substitution of oil as an energy source in the 1960s. There is an underutilized potential for hydropower generation but development of the resource is only now becoming economically competitive with petroleum. The newly-elected government has expressed some interest in construction of mini-hydroelectric generating plants in mid and western Jamaica (combined capacity: 15-25 megawatts) and a large section in the Blue Mountains (50 MW) (JLP, 1980).

#### 2.2.2 Development of Future Energy Sources

The prospects of developing substantial energy resources through exploitation of non-renewable mineral fuels (petroleum -- oil and gas; coal -- lignite; nuclear fuels -- uranium and thorium; and geothermal energy) is not encouraging. Although the supplies of these resources are not precisely known, it appears that with the possible exception of petroleum and lignite none of these resources are plentiful enough to provide significant energy for the future.

##### Hydrocarbons

(Sources: IBRD, 1979a; Jamaica. NPA, 1979a)

Only limited exploration for oil and gas has been undertaken in Jamaica. Seven wells drilled between 1955-1973 (one on the Pedro Banks and 6 on land) were dry, but a seep of mature gas was found near St. Ann's Bay in 1977.

A review of the 1977 report by consultants who reviewed exploration done to date recommended a drilling program both on- and offshore. Recent data indicate good petroleum prospectivity over a large part of the Pedro Bank. A vigorous oil and gas exploration program in 5 areas offshore and on the Pedro Bank is being conducted by the Petroleum Corporation. In 1979 a large part of the Bank area was opened for exploration rights to private foreign and state-owned Jamaican companies. In addition, external financing has been acquired from Norway and the U.K. for ring and interpreting onshore seismic data.

#### peat reserves

(Sources: Robinson, 1980; IBRD, 1979a; Jamaica. NPA, 1979a)

The Ministry of Mining and Energy, Petroleum Corporation of Jamaica, and U.W.I are presently investigating the use of Jamaican peat for fuel. Peat reserves on the southern coast and western region are estimated at 16-20 million dry tons, or enough to fuel an 80 MW power plant (equivalent to one-third the total present electricity generated by JPSC, or roughly 5 per cent of total energy needs) for 30-40 years. The Irish Peat Authority and Ewbanks Engineering have carried out assessments of the quantity and quality of the resource, and found that mining and energy generation of the resource is feasible. The two largest deposits are located in the Lower Black River Morass and Negril Morass. The major environmental problems from peat mining which will create extensive lakes in the morass areas and severely alter water dynamics, are loss of protective (flood-control) function of the wetlands, drastic alteration or destruction of habitat for economically, scientifically, or aesthetically valuable wetland species including some endangered species (e.g., the crocodile, manatee and certain birds), and negative aesthetic and ecological effects on the quality of nearby tourist areas which are important to Jamaica's economy.

#### renewable energy resources

(Source: Jamaica. NPA, 1979a)

Rural areas have traditionally used wood and charcoal for fuel, but they have been largely replaced by kerosene and liquid petroleum gas. Wood could contribute more to meeting energy requirements. The World Bank Forestry Project includes a study to determine Jamaica's fuelwood requirements and potential. In 1979 the government manufactured 15 efficient charcoal kilns which it installed in rural areas. An efficient two-burner stove design was developed locally and stoves are now being manufactured commercially.

As for work on conversion of organic material to biogas, a project for use of animal or vegetable wastes in energy production for farm and rural households is being carried out. Another project presently being developed involves production of alcohol from charcoal, wood, plants and animals.

#### solar energy

A major project for solar water heating is being implemented and a large-scale solar crop-drying project is being planned. In addition, studies are being carried out for other systems and uses for solar energy (Jamaica. NPA, 1979a).

### wind energy

A wind mapping program conducted in 1979 indicated that prevailing winds in Jamaica could be utilized for pumping of water. The Ministry of Mining and Energy and the National Water Authority are developing a program in which windmills will be used in the place of the Authority's existing electric and diesel-operated pumps run for irrigation (Jamaica. NPA, 1979a).

### energy conservation

The Ministry of Mining and Energy with the National Advisory Committee on Energy Conservation are implementing fiscal policies and direct energy conservation systems. These measures focus on: i) reducing petroleum imports; ii) rationalizing prices and taxes; iii) rationalizing commercial and private transportation; iv) controlling energy use by the public sector; v) improving the efficiency and developing a new tariff structure for the JPSC; vi) auditing energy use; and vii) conducting an on-going public education program to increase public awareness and participation (Jamaica. NPA, 1979a).

### other energy sources and needs for energy development

Alternative energy sources which require extensive research and development now being studied are geothermal, sea thermal gradients and hydrogen (Jamaica. NPA, 1979a). Although the feasibility of using ocean thermal energy conversion has not yet been assessed, the conditions (the deep Barlett Trough in very close proximity to the north coast) are certainly favorable and the possibility merits future research. Another possibility not fully considered is use of crops specifically planted for use in biogas generation. Instead of using only plant and animal residues, the feasibility of planting high yielding crops for the purpose of energy production should be seriously considered. (Tom Goreau, pers. comm.). Although there is research being conducted on solar, wind and fuelwood energy resources, it is fairly limited. There is a need to increase the research effort with greater financial support and political commitment by the government, and to stress energy conservation.

### 2.2.3 Administration

(Source: Jamaica. NPA, 1979a)

The responsibility for the energy sector lies with the following groups:

a) Energy Division of the Ministry of Mining and Energy

- responsible for formulating energy policy, regulating pricing, coordinating research and development, establishing a National Energy Accounting System (with UNDP assistance) which will provide data on energy consumption and simulate implications of different energy paths over a 20-year period, and disseminating information on the energy situation to the public.

b) Petroleum Corporation of Jamaica

- established under the Petroleum Act of July, 1979
- has exclusive right to explore and develop the petroleum resources of Jamaica, including refining, marketing, transporting, storing, selling and distributing petroleum and petroleum products.

c) Renewable Energy Division of the Scientific Research Council

- carries out research in the field, tests and modifies technology and non-conventional energy sources

d) National Energy Commission

- advises the Ministry of Mining and Energy on policy formulation and implementation

e) National Advisory Council on Energy Conservation

- advises, evaluates, and monitors proposals and projects for energy conservation.

The Manley government's objectives as stated in the National Energy plan of the Five-Year Development Plan, 1978-82, were to:

- i) reduce dependence on imported energy and diversify energy supply away from imported petroleum.
- ii) accelerate exploration and development of indigenous sources of energy supply.
- iii) reduce energy intensity of the economy while sustaining economic growth
- iv) cushion the impact of increasing oil prices on the low income groups and adopt pricing policies appropriate to promotion of plan objectives.

The Seaga government's policy seems to be consistent with these objectives. The government plans to implement specific programs of conservation (enforced legislation and tax incentives), fiscal measures, orderly development and regulation of all aspects of the petroleum industry, and development of indigenous energy resources. Plans for development of alternative energy resources include increasing hydroelectric power generation by constructing mini-hydroelectric plants and the Blue Mountain multi-purpose scheme, exploiting the peat resources of the Lower Morass, introducing legislation to encourage the installation of solar water units in commercial and residential buildings, exploring the possibilities of developing ocean thermal energy conversion and lignite deposits, and continuing oil and natural gas exploration using funds provided by the World Bank and inducing major oil exploration companies to come to Jamaica (JLP, 1980). (See also appendix VIII for international assistance in the energy sector.)

### 3.0 RENEWABLE NATURAL RESOURCES

#### 3.1 LAND USE

##### 3.1.1 Distribution of Land Use

Distribution of land use in Jamaica is as follows:

<u>Land Use</u>	<u>Acres</u>	<u>Per Cent</u>
Forest	655,000	24.1
Other woodland	538,000	19.8
Agriculture, including pasture	1,258,000	46.4
Natural range and grassland	103,000	3.8
Swamp	50,000	1.8
Mining	7,000	0.4
Urban	100,000	3.7
Barren	4,000	0.1
	2,715,000	100.0

(Source: Jamaica. MFP, 1971b)

##### 3.1.2 Institutional Focal Points

Overall land use planning for the island is carried out by the National Planning Agency, Town Planning Department, and Survey Department, all within the Ministry of Finance and Planning. Land use planning for agricultural purposes (including croplands, pastures, grasslands and forests) falls under the Agricultural Chemistry Division of the Ministry of Agriculture.

##### 3.1.3 Status of Information - Surveys

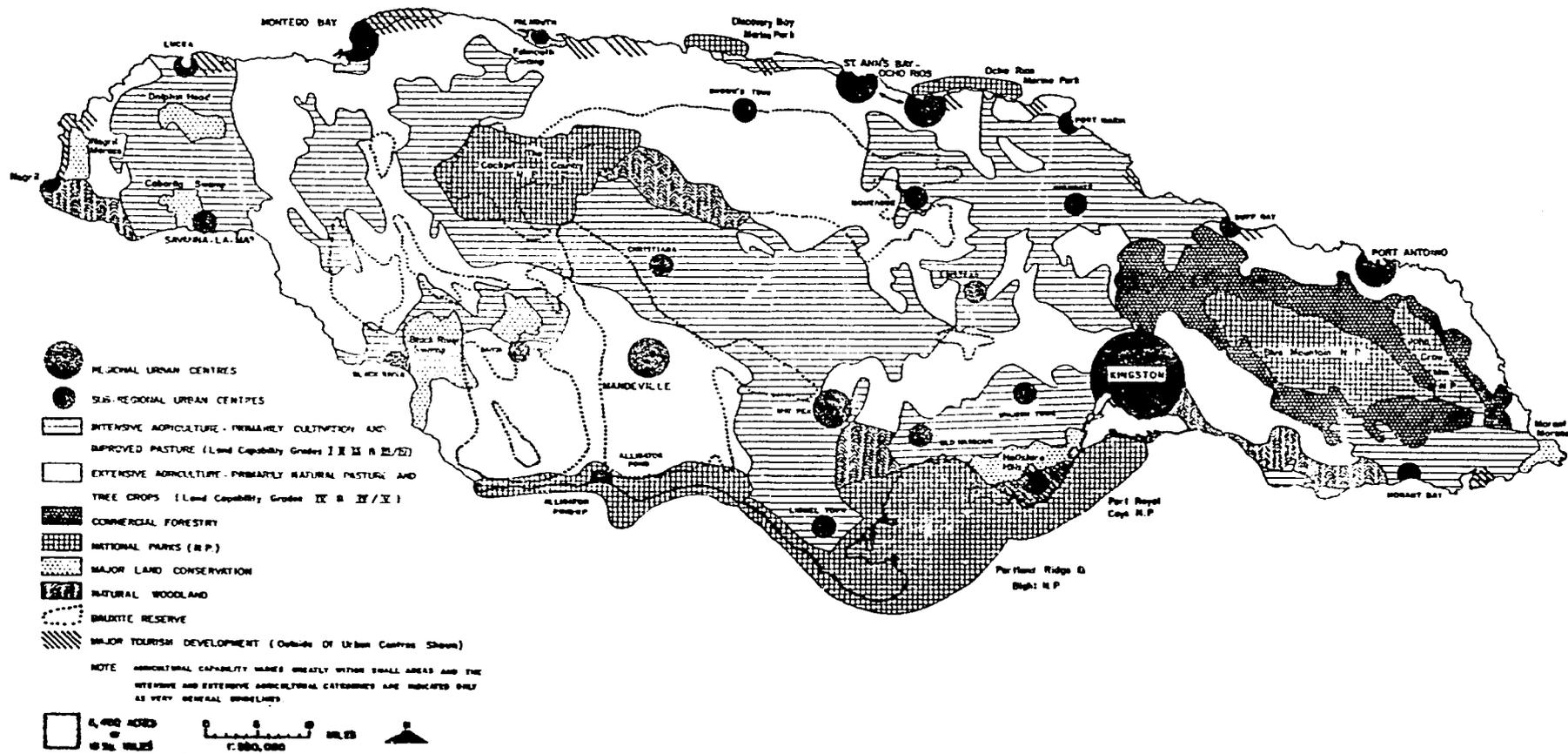
<u>Scale</u>	<u>Responsible Agent</u>	<u>Form</u>
1:50,000	Town Planning Department	Aerial photographs - 1961
1:12,500	Survey Department	Aerial photographs - 1968
{1:12,500-	NASA	Aerial photographs- some infrared
1:50,000		scale differs by area
—	IBRD	Landsat images - 1979 (Forestry Project)

##### 3.1.4 Land Use Planning

In the past, the development of the island has proceeded in a somewhat haphazard manner, resulting in cases of sub-optimal land use. In recognition of existing and potential problems, the GOJ (Ministry of Finance and Planning) and UNDP prepared the National Physical Plan for Jamaica, 1970-1990, which provides a series of guidelines for long-range planning and development of the island. Based on the plans, a land use strategy map (see figure 6 ) was presented in the sister volume, the National Atlas of Jamaica. The map delineates areas

Figure 6

# LAND USE STRATEGY



source: Jamaica. NPA, 1971b

best suited for regional and subregional urban centers, agriculture, forestry, national parks, land conservation areas, natural woodland, bauxite mining, and tourism. Another map provides a system of crop zoning based on ecological suitability, infrastructure development and market accessibility. If implemented, these guidelines will provide a good foundation for rational development of the human and natural resources of Jamaica. At the time the National Physical Plan was presented, Edward Seaga was the Minister of Finance and Planning, so has had a close association with the plan. Seaga claims that no implementation of the Physical Plan was ever undertaken by the Manley government, but that his administration intends to update the plan and begin implementation. Among other things, the government will follow guidelines for rural development and for a system of crop zoning (by introducing crop incentives) (JLP, 1980).

### 3.1.5 Legislation

(Sources: Clarke and Hodgkiss, 1976; Caribook, 1980; Jamaica. NPA, 1979a; Jamaica. Laws, 1973) (See also appendix II)

The Town and Country Planning Act (1958) is the chief means by which general statements about development plans are translated into explicit legal form. Development orders drawn up by the Town and Country Planning Authority contain provisions prohibiting or regulating development of the land. Essentially all physical developments except agriculture may proceed only after recognition of planning constraints specific to each parish. Permission for such activities must be granted from the local planning authority, that is, the Kingston and St. Andrew Council or the appropriate Parish Council. Beginning in the mid-1970s, revision of all Parish Development Orders was initiated. As of May 1980 two revised orders had been officially confirmed. The rest of the Parish Development Orders are scheduled for revision by late 1981. No information was available on the extent to which these new orders will incorporate plans for development as defined by the National Physical Plan, 1970-1990.

The Land Acquisition Law of 1947 provides for compulsory acquisition of private lands when needed for watershed protection, forests, areas of historic, scientific or aesthetic value, land settlements and resettlements.

The Land Valuation Law of 1956 changed the basis for land taxation from improved to unimproved value with the aim of intensifying use of land, especially on ruinate. The law established the Land Valuation Division which has re-valued land in about half the parishes. Assessments made to date have indicated that the difference is too small to significantly affect taxation.

The Land Development and Utilization Law of 1966 (Idle Lands Law) is another law designed to intensify utilization of land. The law is administered by the Land Development and Utilization Commission (LDUC) and applies to holdings over 50 acres. If land is adjudged idle by the Commission, an idle land order is issued to the occupier. Upon review of the land (within 12 months), if it is still not utilized to the satisfaction of the Commission, a notice is served requiring the occupier to submit a land development plan. Those who fail to

submit a plan, revise a rejected plan, or carry out proposed changes, must lease or sell the land to the government. By 1978, 2233 holdings representing 954,761 acres had been inspected and of these 116,168 acres were adjudged idle. Development has subsequently been initiated on most of this land. Only 480 development plans have been required. Since the passing of the law, the government has acquired a total of 14 holdings, most of which have been leased to farmers under Land Lease (see section 3.2.5) (Jamaica. MOA, 1978).

## 3.2 AGRICULTURE

### 3.2.1 The Resource

(Sources: Clarke and Hodgkiss, 1974; Jamaica. MFP, 1971a, 1971b; Jamaica. NPA, 1979a)

Agriculture occupies almost half of the land area of Jamaica. The coastal plains, interior valleys and foothills are used mainly for export crops. Mixed farming on small, individually-owned farms occupies the central upland. Pastures are located in the north-central and western parts of the island.

The pattern of land ownership is a legacy of Jamaica's colonial past in which a dual-society was established. Plantations were located on the best agricultural lands -- the coastal plains and interior valleys. Following emancipation, the freed slaves moved to the uplands and other marginal agricultural lands to set up small farms. The pattern of unequal land distribution remains. About 78 per cent of the total number of farms are less than 5 acres in size and make up only 15 per cent of the total farm acreage, whereas 0.1 per cent of all farms are over 500 acres and account for 43 per cent of agricultural land. The large farms are used almost exclusively for export crops, which occupy about 23 per cent of agricultural acreage. Only 6 per cent of the land is devoted to production of domestic crops, grown primarily by small farmers practicing mixed-cropping on marginal lands. The majority of land in Jamaica is held under a freehold form of tenure. The 1961 Survey of Agriculture showed that 80 per cent of the number of farms were owned by the farmer. During the 1970s the proportion of leased lands increased as the Manley government adopted a policy of leasing public lands.

The principal export crops are sugar, bananas, citrus, cocoa, coffee and spices. The main domestic food crops are coconuts, yams, potatoes, maize and rice. The amount of agricultural land in the principal crops is as follows:

#### Distribution of Land in Farm by Major Types of Use, 1968

<u>Type of Use</u>	<u>Acreage</u>	<u>Percentage of total agricultural land</u>
sugar cane	167,000	11.2
bananas	84,000	5.6
coconuts	100,000	6.7
citrus	25,000	1.7
cocoa	27,000	1.8
coffee	15,000	1.0
pimento	24,000	1.6
tobacco	1,900	0.1
other tree crops	1,000	0.1
domestic food crops	91,000	6.1
other (forest, pasture, suitable but unused agricultural lands)	963,400	64.1

(Source: Jamaica. NPA, 1979b)

### 3.2.2 Sector Performance

(Sources: Jamaica. NPA, 1979b; IBRD, 1977; USAID, 1981)

Agriculture plays an important role in the economy of Jamaica. It provides about 7 percent of the GNP, 35 percent of national employment and 20 percent of income earnings (IBRD, 1979b). Several problems, however, have contributed to stagnating production over the last two decades. As a result of the per-capita decrease in agricultural production, imports have increased steadily, reaching \$120 million in 1975. At the same time, exports have decreased, with negative repercussions on the balance of payments. In addition, as a result of high production costs, sugar and bananas are no longer competitive on open markets.

The poor performance of the agricultural sector has been attributed to many factors, including highly skewed land distribution, poor land use practices, lack of modern equipment and fertilization on small farms, urban migration of rural youth (the average age of farmers is 52 years), inefficient marketing, praedial larceny, the private sector's reluctance to invest in agriculture, under-utilization of land, ineffective extension services, and structural and administrative weaknesses within the Ministry of Agriculture.

The GOJ has taken steps to improve the performance of the sector. In 1973, an agricultural sector study was undertaken with the assistance of the World Bank. Subsequent action included introducing a progressive land tax, reactivating the Land Development and Utilization Commission (which was inactive in the late 1960s and early 1970s), increasing credit availability to farmers, and imposing import restrictions. In 1977, a reorganization of the MOA was initiated. Planned activities include comprehensive rural development projects, increased drainage and irrigation systems, a soil conservation program, and an expansion of the livestock, forest and fisheries industries.

### 3.2.3 Institutional Framework and Activities

(Sources: Caribook Ltd, 1980; Jamaica. NPA, 1977; Jamaica. MOA, 1978)

The principal responsibility for the sector lies with the Ministry of Agriculture (MOA) which oversees the administration of all government-owned property, agricultural production and rural development. The functions of the Ministry are carried out by the MOA administrative departments and technical divisions, in collaboration with 30 statutory boards, authorities, commissions, commodity associations and cooperatives. On the local level, 13 semi-autonomous Land Authorities (relicts of the former Ministry of Rural Land Development which merged with the Ministry of Agriculture and Fisheries in 1972) have the responsibility for agricultural extension and some regulatory functions.

Some agricultural commodities are controlled by statutory boards (eg. the Coffee Industry Board, the Banana Board) which report to the Minister of Agriculture, but are administered independently. In addition, control of important agricultural subsectors is under several different bodies. This fragmentation of authority hinders the MOA from carrying out planning and implementation in an integrated manner. The division of jurisdiction is as follows:

agricultural credit -- Ministry of Finance  
credit dispersed by Agricultural Board, Jamaican  
Development Bank, commercial banks, Commodity  
Marketing Board

irrigation and drainage -- Ministry of Agriculture, Ministry of Utilities,  
Ministry of Mining and Energy

extension -- Ministry of Agriculture, commodity boards

marketing -- Ministry of Commerce and Trade, commodity marketing boards

research -- Ministry of Agriculture, commodity boards

Fragmentation of authority within the MOA and other organizational and administrative problems prompted a reorganization of the Ministry (on-going since 1977) aimed at centralizing planning and policy, and decentralizing program implementation and service functions. For administrative purposes, the island has been divided into three Regions (Northern, Southern and Western), each under the management of a Regional Officer. A Region is composed of a number of Parishes, which are controlled by Parish Officers. The Parishes are in turn divided into Divisions (65 total), and the divisions into Extension Areas (401 total). The responsibility for some centralized services is retained by Headquarters in Kingston, but the administration of agricultural production and rural development activities is carried out by the Regional Directors. (See appendix III for organizational chart.)

### policy

The policy for the 1978-82 Development Plan period is as follows:

- a) maximize production to meet requirements for adequate nutrition of the population, agro-industries, and export markets.
- b) reduce reliance on imports
- c) maximize land utilization
- d) improve the rural standard of living through increased farm incomes, rural amenities, and social infrastructure
- e) increase employment opportunities

The policy of the newly elected Seaga administration is essentially the same. The means of achieving the goals may, however, be considerably different. For example, there appears to be a greater emphasis on increased production of export crops (JLP, 1980) which may indicate a shift in focus from the medium-sized to large land holdings (and perhaps a shift from export substitution to export production).

### extension

Extension falls under the Production and Extension Division (before 1979, the Extension Services Division). The country is divided into 4 parts for the administration of extension services. The main objective of the service is to identify and promote high yielding crop varieties and to encourage improved agricultural practices. In addition to the MOA services, extension is provided by Commodity Boards.

Lack of adequate extension service has always been a problem. The problem is not as severe in the plains and interior valleys, because assistance is offered by Commodity Boards for the large commercial and export crops (sugar, bananas, citrus, coconut). Farmers with small holdings growing domestic crops, however, receive only limited extension service, due to the lack of a sufficient number of government extension agents. There are 479 MOA field agents, or one per 500 farmers. Almost all agents are educated at the Jamaica School of Agriculture, which provides mainly theoretical training. Their effectiveness is limited by lack of applied training and the fact that many agents have a non-rural background (USAID, 1981). In addition, linkages between research and extension are weak.

### research

Research is carried out by the MOA and the Commodity Boards. Commodity Board research is focused on export crops. The MOA research activity is limited, and has historically concentrated on export crops such as bananas, sugar and livestock. There is a need for expanding and coordinating agricultural research. The new administration intends to allocate funds for research on new crops such as sorghum, maize, vegetable oil, spices, and horticultural products (JLP, 1980).

### 3.2.4 Education and Training

(Sources: Jamaica. NPA, 1979a, 1979b)

Education and training in agricultural sciences is offered through agriculture courses at secondary schools, technical/vocational high schools, Jamaica School of Agriculture, the Faculty of Agriculture at U.W.I. (Trinidad), agricultural training centers run by the Training Division of the MOA, and the 4-H program which provides training through its centers and club participation in schools.

technical/vocational schools - Knockalva Agricultural Training Centre, Dint Hill, Vere, Holmwood, St. Elizabeth Technical High School, Elim\*, and Passley\* (combined capacity 4000).

Jamaica School of Agriculture (Ministry of Education) - agricultural education institution, enrollment 344 (1977); offers Diploma in Agriculture (2 years), Associate Science Degree (Agriculture) (3 years), Agricultural Science Teacher Degree

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\* USAID funded, under Rural Education Sector Loan.

Faculty of Agriculture, U.W.I., Trinidad - 4 Jamaicans of 16 graduates in 1977

agricultural training centers - Cape Clear, Chestervale, Cobbla (combined capacity 250 (1977))

4-H centers - 12 centers (combined capacity 600)

The graduates of the technical/vocational schools, JSA, and UWI have traditionally become professional agriculturalists involved in teaching, management and advisory services. The Jamaica School of Agriculture is the only institution on the island offering training at post-secondary school level. The training provided, however, is inadequate to meet the needs of the agricultural sector and is in dire need of upgrading (USAID, 1981). Training of production-oriented farmers is provided by the agricultural training schools and 4-H programs. Low productivity and under-utilized agricultural potential point to the need for increased quantity and quality of training provided for farmers.

### 3.2.5 Agrarian Reform

Land settlement, and later, agrarian reform programs, have long been part of government activity. Prior to 1972, programs were aimed primarily at land distribution, whereas recent programs have focused on agrarian reform, or providing access to agricultural inputs, rural amenities and social infrastructure in addition to land. The major reform programs initiated since 1972 are Project Land Lease, Farm Cooperatives (including Sugar Workers' Cooperatives), Pioneer Farms, the first Rural Development Project, and the Integrated (or Second) Rural Development Project.

#### Project Land Lease (1973)

The government leases land from private owners and rents it to farmers with lenient payment terms. In 1974 it was divided into three phases:

- Phase I: lease of small plot (less than 2 acres) for 5 years; by March 1978 had affected 24,000 farmers
- Phase II: lease of small plot (average 2 acres) for 49 years, with inheritance rights; 9,000 farmers by March 1978
- Phase III: lease of plot (average 4 acres) for 49 years with infrastructure improvements added by the government; 1,000 farmers by March 1978

#### Cooperatives (1971)

Three Sugar Workers' Cooperatives were established in 1971, and by 1977 there were 23 sugar co-ops, averaging 2000 acres each. In addition, some mixed fruit and vegetable co-ops have been set up. Each farm is leased to a group of farmers for management on a cooperative basis. Low interest credit is available, as is extension assistance.

### Pioneer Farms (1977)

Farms, set up on a cooperative basis, are worked mainly by rural youths under a supervisor assigned by the MOA Extension Service. The emphasis is to provide rural youth with employment and agricultural training. As of March 1980, there were 12 pioneer farms.

### First Rural Development Project (1977)\*

Located in the Western Region, the IBRD-supported project involves leasing lands to farmers for 49 years and providing improvements in economic and social infrastructure.

### Integrated (Second) Rural Development Project (1978)\*

Located on two watersheds in the Southern Region, the aim is to establish a model of watershed management for replication in other areas. Economic and social infrastructure improvements are to be provided, in part by a USAID loan.

The Seaga government plans to increase private ownership of land by implementing a modified version of the current Project Land Lease which would permit purchase of land by those who wish to do so. The administration believes that ownership will provide incentive to the farmer to carry out improvements on the land, thus resulting in increased productivity. The government supports the sugar cooperatives and is very firmly committed to rural development, so technical and financial assistance for these programs can be expected (JLP, 1981).

## 3.3 SOILS

### 3.3.1 General Characteristics

(Sources: Asprey and Robbins, 1953; Jamaica. MFP, 1971b)

Jamaica's soils may be classed into three broad categories which reflect differences in geology (see geology map, figure 4 ). These are: highland soils (covering the shale areas, or the Blue, John Crow and Port Royal Mountains in the east and the Dry Harbour Mountains in the central region), alluvial and coastal plain soils (located on flood plains, river terraces, inland valleys and coastal plains), and upland plateaux soils (covering the rest of the island). (See figure 7.)

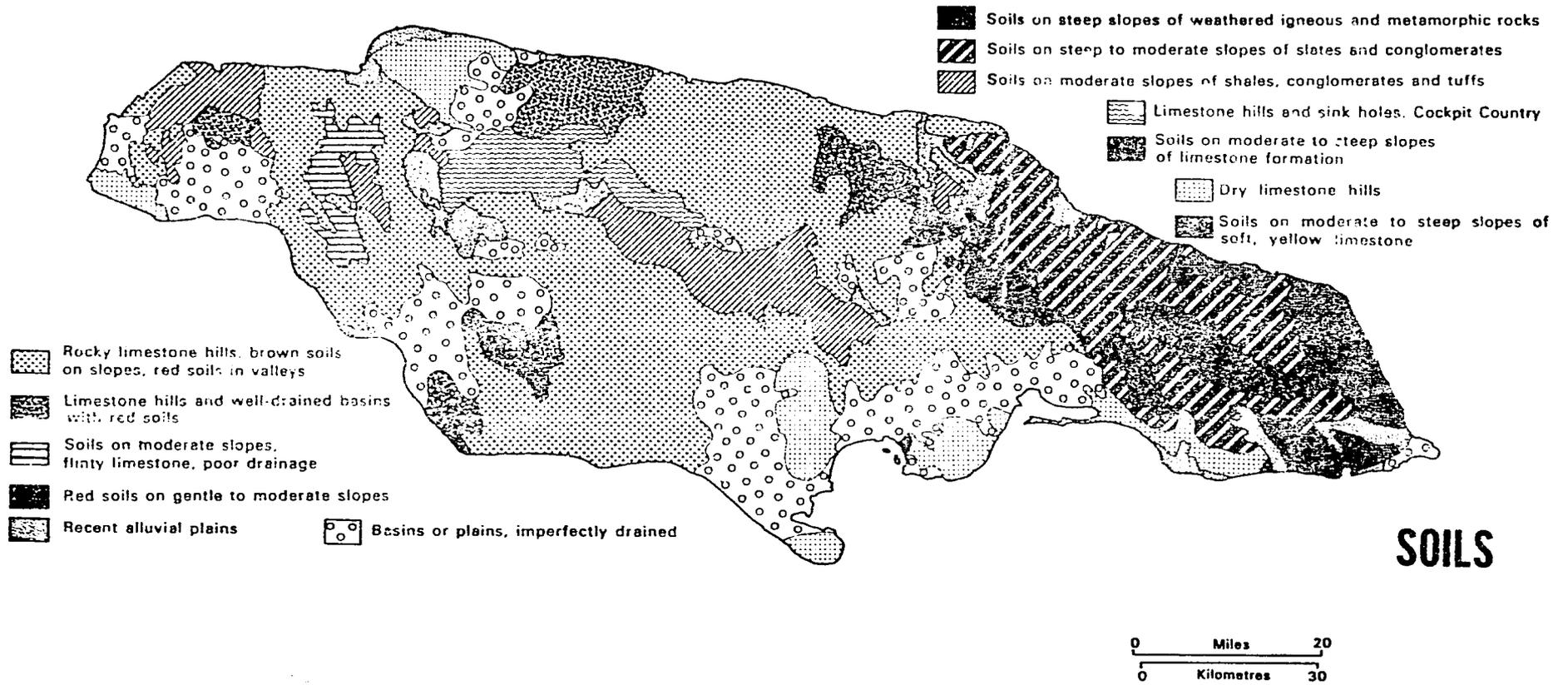
#### highland soils

The soils of the highlands are derived mainly from shales, conglomerates and volcanics, and are exposed to medium or high rainfall. The soils

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\* discussed in more detail in section 3.3.4.

Figure 7



source: Clarke, C.G. and A.G. Hodgkiss. 1974.  
Jamaica in Maps. N.Y., Africana Publishing Co.

in the Blue Mountain area are highly porous and subject to heavy leaching, resulting in low nutrient content and low pH. Under forest vegetation, a generalized profile is of a dark brown, gravelly, sandy loam with a high organic content in the surface layers and an average depth of one meter. Of less widespread occurrence are poorly drained and less acidic clays derived from fine-grained sedimentary rocks. Their upper horizon, a dark brown clay loam with a high humus content, overlies a yellow-red gravelly, sandy clay loam which grades into a lighter, gravelly loam. Both soils are highly erodable. More mature soils occur in scattered locations on top flats or gentle slopes. They have good water retention but low fertility. Soils found in depressions and hollows often are poorly drained, very acidic and of moderate fertility. Since soils in this area are generally highly susceptible to erosion and poor in nutrients, they are best kept under forest cover. The lower slopes, which are not as susceptible to erosion, are being used by subsistence farmers for mixed cropping of cacao, root crops and bananas. With increased population pressure and need for more land, farmers have been clearing steeper land at higher elevations, thus exposing erosion-prone soils.

Lower rainfall and more seasonal climate in the central range, or Dry Harbour Mountains, allows the soils to dry for a few months a year, so they are less highly leached than those of the eastern ranges. The soil is a light brown, heavy clay with moderate fertility. This area is used mainly for mixed cropping.

#### upland plateaux soils

The soils of the upland limestone plateaux are more erosion resistant, have a higher pH (they range from slightly to strongly alkaline), and in general are more fertile than the highland soils. Limitations for agricultural use in certain areas are due to shallow soil depth, stoniness, low availability of water, or iron and aluminum toxicity. The soils are of two main types: terra rossa (red limestone) soils and rendzina (black marl) soils.

The rendzinas, clay soils developed over yellow limestone and marls, have a scattered distribution. The soils are of fine texture and are poorly drained. The red color characteristic of terra rossa soils is absent due to different chemical characteristics and a higher moisture content. Generally the profile has a very dark gray brown upper horizon underlain by a yellow-brown clay. Average depth is 122 cm (48 in). Although low in potassium, these soils have good agricultural potential.

The terra rossa, or residual bauxite soils, are widespread over the upland plateaux, mainly at elevations of 2000-3000 feet (610-915 m) in Manchester and St. Ann. Derived from the solution of hard white limestone, they are characteristically coarse in texture, porous, and well oxygenated. The deep red color throughout the profile is due to high iron content in ferric oxide form. The soils average one meter in depth. These soils are low in nitrogen, phosphorus and potassium, so have poor agricultural potential. They may be used for mining, pasture, or in some areas with fertilization, production of citrus, pimento, bananas and vegetable crops.

#### alluvial soils

Alluvial soils are located on the coastal plains in southern Jamaica, the narrower plains along the north coast, on inland valleys, and flood plains.

These soils, comprised of loam, sand and gravel are among the most productive for agriculture. The coastal plains and interior valleys are used for plantation crops, mainly sugar and bananas. Also included as alluvial soils are heavy, deep (3-4 ft.) clays of marine origin and swamp soils on the southern plains.

### 3.3.2 Status of Information - Soils Classification

#### soil surveys and soils classification

(Source: Hardy and Ahmad, 1974)

There are three main island-wide soil surveys for Jamaica. These are:

- 1) Jamaica volume of the Studies in West Indian Soils, (the Imperial College of Tropical Agriculture (I.C.T.A.), Trinidad (1922-1949)) by Hardy and Croucher (1933)
  - 2) Parish soil and land use surveys done by the Regional Research Centre of the British Caribbean, University of West Indies, Trinidad (1958-1971)
  - 3) FAO/UNESCO Soil Map of the World, Mexico and Central America, 1975
- 1) The Jamaica volume of the ICTA "grey book" series was meant as a preliminary investigation of some Jamaican soils and not intended as a detailed soil survey. Samples from 53 soil pits scattered around the island, mainly in sugar and banana plantation areas, were analyzed for physical and chemical characteristics. Based on this information, some Jamaican soil types were described and mapped on a simple sketch-map showing distribution of rainfall, vegetation and land-forms. This survey had an obvious agricultural bias. The soil classification was provisional, and designed only for local use.
  - 2) The "green book" series of the Regional Research Centre, with technical assistance from FAO and USDA, is made up of 26 soil survey volumes covering Jamaica (by parish) and the former British West Indies. Maps on a scale of 1:12,500 were drawn up using enlargements from 1941 U.S. Army 1:50,000 aerial photographs of the island as base material. For publications and general use, the maps have been reduced to 1:25,000 and 1:50,000.

The soil classification system used was based on the British system, but soil types are often specific to the Commonwealth Caribbean, and in cases to particular islands. The taxonomy consists of classification by parent material (e.g., soils on uplands of shales, conglomerates, and igneous rocks), drainage characteristics and more specific typing of parent material (e.g., well-drained soils on weathered conglomerates, tuffs and hornfels), then finally by a local soil type name (e.g., Linsted Clay Loam). After the soil types were mapped, slope class and degree of erosion were recorded. Land capability classes were drawn up based on soil types, and on limitations imposed by slope and erosion risk, drainage characteristics, soil depth, and climatic factors. In addition to the 1:12,500 maps, each parish soil and land use survey includes a soil profile description for soil types and approximate acreage of soils by slope category and land capability classes. This soil classification system is the one presently in use in Jamaica.

- 3) FAO/UNESCO used the "green book" series as base material for mapping Jamaica on a scale of 1:5,000,000 for the Soil Map of the World series. Although not useful for local soils work, the FAO/UNESCO standardized system enables comparison with other countries.

Although some applied research is carried out by MOA and some agricultural Commodity Boards, from a review of the literature, it appears that relatively little basic research has been done on soils in Jamaica. This is probably explained by the fact that soil research for the British Caribbean is centered in Trinidad, originally at the Imperial College of Tropical Agriculture and now at the Agriculture Faculty of the UWI.

#### land capability classification

The system used in Jamaica is a slight modification of the USDA Soil Conservation Service Land Capability System of the late 1930s (Steel, 1954). Land capability maps have been drawn based on information from the ICTA Soil and Land-Use Surveys of Jamaica (Jamaica. MFP, 1971b). Under this system, the land suitable for agriculture in Jamaica is as follows:

<u>class</u>	<u>acres</u>	<u>% suitable for cultivation</u>	<u>description</u>
I	78,500	4.6	level, with deep, fertile soil
II	280,500	16.9	suitable for cultivation, with some limitation
III	598,800	35.5	suitable for cultivation, with strong limitations
IV	262,800	15.6	marginal for cultivation, suitable for tree crops, improved pasture, commercial forestry
V	461,780	27.4	marginal for cultivation, some areas best in natural vegetation, others for tree crops, pastures and forests
VI	1,517,620	0	unsuitable for cultivation
VII			

(Source: Jamaica. MFP, 1971b)

Since the early 1970s, another system has been recommended, based on work done by UNDP/FAO in the late 1960s (UNDP/FAO, 1977; Sheng, 1972). The classification scheme has been used in trial plots for research on its applicability, and is currently being used in the First and Second Rural Development Projects (see section 3.3.4 and appendix IV).

### 3.3.3 Soil Conservation

#### Institutional Focal Points and Activities

The major responsibility for soil protection lies with the Soil Conservation Unit established within the Agricultural Engineering Unit of the Ministry of Agriculture. The SCU was established in 1972, replacing the Watershed Protection Commission. On the local level 13 Land Authorities have responsibility for soil conservation and watershed protection.

#### legislation

(Source: UNDP/FAO, 1977; Jamaica. MRLD, 1971)

(See also appendix II.)

Soil conservation is covered by two laws, one based on land productivity, the other on water supply. In 1951 the Land Authorities Law was enacted. This established the Yallahs Valley Authority, followed later by the creation of Christiana and 11 other Land Authorities. In 1963 the Watershed Protection Act was passed, under which the Watersheds Protection Commission was established.

The Act and Law are similar. They provide the Government with the power to declare watersheds or other areas for improvement or rehabilitation and to implement compulsory land improvement programs. The Land Authority Law is aimed at the improvement, rehabilitation and development of the land in order to "encourage and secure the proper economic and efficient utilization of all lands in the declared area." The Watershed Protection Act is oriented toward promoting the "conservation of water resources". The Watersheds Protection Commission defined the mandate as:

- a) maintain and if possible increase the quantity of water available
- b) minimize erosion and sediment hazards
- c) reduce flood damage

As of 1980-81, the following 9 watersheds totalling 219,190 acres had been declared under the Watershed Protection Act:

<u>Watershed</u>	<u>Acreage</u>
Lucea/Cabarita (Hanover/Westmoreland)	18,921
Rio Pedro (St. Catherine/St. Andrew)	22,000
Rio Minho (Clarendon/St. Catherine/Manchester)	50,839
Negro Johnson (St. Thomas)	32,614
Cane River (St. Andrew)	6,427
Rio Nuevo (St. Mary)	24,000
Pagee (St. Mary)	35,000
Hermitage (St. Andrew)	3,250
Roaring River (Westmoreland)	26,140

(Jamaica. NRCD, c. 1980)

erosion and land degradation problems

According to a report by UNDP/FAO (1973d), a possible 400,000 acres of cultivated lands in Jamaica are in need of some soil conservation treatments. Erosion in Jamaica results from a combination of cultivation on steep hillsides, high rainfall, rapidly flowing rivers, and a history of poor agricultural practices and deforestation. A well-documented example is the Yallahs Valley in the Blue Mountain area. The Valley had suffered centuries of misuse, when the 1951 hurricane funneled up the valley causing widespread devastation on the denuded slopes. This led to the establishment of the Yallahs Valley Land Authority that same year. A survey carried out in 1952 by the Imperial College of Tropical Agriculture assessed that gully and sheet erosion had resulted in the loss of 75% of the topsoil on over half the valley.

An island-wide reconnaissance survey was carried out the UNDP/FAO in 1973 to assess conditions of the land and degree of disturbance. The findings were that out of a total of 33 watersheds in Jamaica, 18 contain severely disturbed areas, 5 of which are classed as first priority and 6 as second priority for rehabilitation. These are:

<u>Priority</u>	<u>Watershed, sub-watershed or area</u>	<u>estimated acreage</u>
First	Rio Pedro, in Rio Cobre	20,100
	Pindars River, in Rio Minho	19,200
	Hope River	13,000
	Yallahs Valley	30,000
	Two Meetings at Christiana	10,000
Second	Wag Water	47,700
	Upstream area of Rio Minho	41,700
	Lucea River, northwest coast	17,000
	Upstream area of Cabarita	6,000
	Negro River, in Morant River	26,900
	Upper Rio Grande at Alligator Church, in Rio Grande	19,200

(Source: UNDP/FAO, 1977)

land authorities

There are 13 Land Authorities. The Yallahs Valley L.A. was established in 1951, the Christiana Area L.A., in 1959, and the following 11 were established in 1969: Claremont, Santa Cruz, Grange Hill, Morant Bay, Linstead, May Pen, Mandeville, Falmouth, Port Maria, Port Antonio, and Cambridge. The Authorities were established for the purpose of arresting soil erosion, bringing idle land back into production, improving productivity of existing crops, and "rehabilitating" the farmers. The Land Authorities

are patterned on the Yallahs Valley L.A. which is responsible for projects in mechanical and cultural soil conservation techniques, flood control, education, communications, land tenure (issuance of title deeds to leaseholders), and crops research. There is some feeling that lack of experience in the beginning, and more recently, lack of funds and trained personnel have limited the activity and success of the Authorities (UNDP/FAO, 1977).

#### soil conservation unit

(Sources: Jamaica. MOA, 1978; UNDP/FAO. 1977)

The Soil Conservation Unit (SCU) established in 1973, has been concerned primarily with the protection of hilly watersheds through the following major projects:

##### Soil and Water Conservation Demonstration and Training Centers

(6 centers, main one at Smithfield (Hanover))  
crop trials, research on erosion, afforestation program

##### Islandwide Soil Conservation Program - commenced in 1973

soil conservation treatments (on 917 acres between 1973-1978)  
maintenance of forests, building of check dams and waterways

##### Allsides Demonstration Project - commenced in 1977

establishment of 3-acre research demonstration plot, 50 acres of  
on-farm soil conservation work, field studies

Additional work has been carried out in conjunction with the two internationally assisted Rural Development Projects.

### 3.3.4 International Assistance

#### Forestry Development and Watershed Management in the Upland Regions (1967-75)

(Sources: UNDP/FAO, 1973d, 1974c; 1975)

This UNDP/FAO-sponsored project carried out surveys and developed techniques for planning and constructing appropriate soil conservation measures for hilly watersheds, especially in association with small farmers. Early in the project, demonstration and training centers were established in Hanover at Smithfield (Lucea/Cabarita Watershed) and Buxton. A runoff and soil loss study was conducted to determine the effectiveness of four forms of hillside terracing under yellow and Lucea yam (Dioscorea spp.) cultivation (UNDP/FAO, 1973c). These trials indicated that yam production on bench terraces constructed on slopes less than 25 degrees was profitable and had potential for large-scale development in Jamaica.

Another component of the project was research on the applicability of a new agricultural land capability scheme for Jamaica (Sheng, 1972, condensed version in UNDP/FAO, 1977). (See appendix IV .) The scheme was successfully demonstrated at Smithfield and Buxton Watersheds in Hanover, Top Mountain in

Yallahs Valley, Cape Clear Demonstration area in St. Mary, and Serge Island demonstration plot in St. Thomas. Based on permanent limiting factors (slope, soil depth, climate), four main classes of use were suggested -- cultivable land, pasture, fruit trees and forest. The cultivable land has four subclasses, each having particular specifications for conservation treatment. This system has advantages for use in Jamaica, namely, it is well-suited to use on steep slopes, accounts for a potentially high input of labor and is a direct, easily understood system. The system was found to be effective, and is now being implemented in the two rural development projects.

In 1973, in response to expression of the GOJ's intention to initiate a program in watershed rehabilitation, the Project carried out a survey of the country's watersheds (see section 3.3.3). From the five deemed most critical for rehabilitation, the Government chose three, Pindars River, Two Meetings and Hope River for immediate attention. Surveys and development plans were subsequently made by UNDP/FAO in the first two, which are now the sites for the Second Rural Development Project.

#### First Rural Development Project

(Source: IBRD, 1977a)

This 3 1/2 year project came into effect in 1977. It is partially financed through a loan from the World Bank. The three main components are:

- 1) reorganization of the MOA
- 2) settlement of 1400 farm families (under Land Lease III)
- 3) improvement of rural feeder roads, water supply, sanitary facilities, and parish markets.

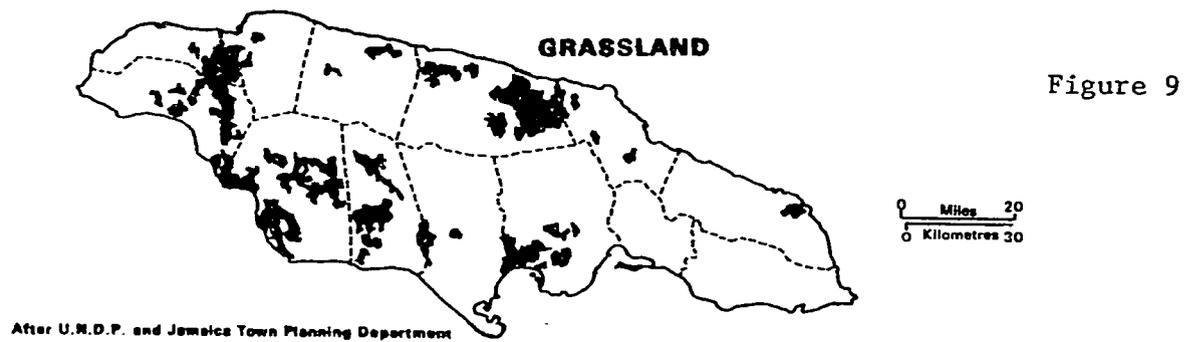
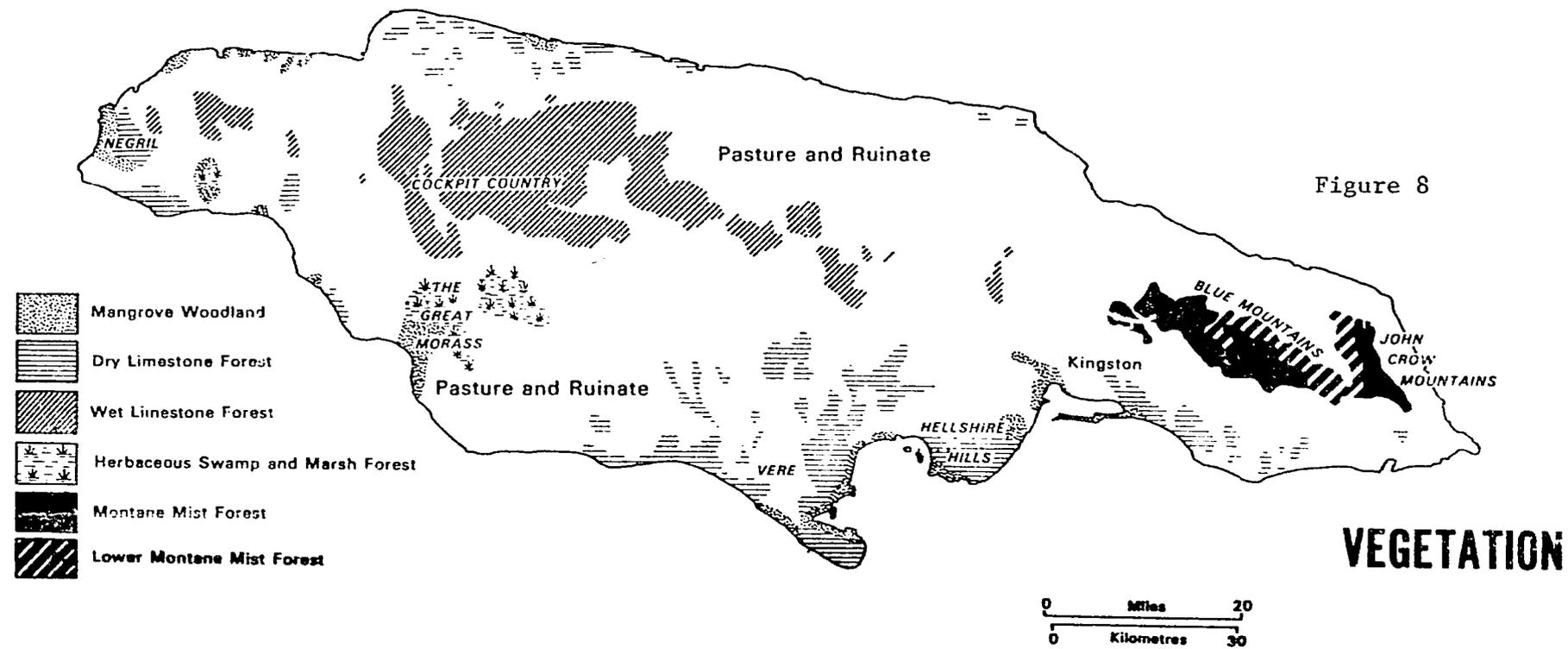
The last two components, aimed at improving the rural economy and standard of living, are being carried out in the Western Region.

The soil and water conservation components include construction of waterways and related works, afforestation of critical areas, and implementation of soil conservation techniques on the cultivated plots. A total of 1000 acres of forest are to be established. These will be planted and maintained by the Forest Department. In addition, one acre of land per farmer will be cleared and prepared for cultivation with the assistance of the settler to familiarize him with good conservation techniques and provide an immediate means of subsistence production. Once established, the farmer is responsible for maintenance of the plot. Assistance is to be provided by Soil Conservation Officers, using guidelines and techniques established by the UNDP/FAO Forestry and Watershed Management Project.

#### Second Rural Development Project, or Integrated Rural Development Project

(Sources: FAO, 1979; Jamaica. NPA, 1979a; UNDP/FAO, 1977)

The project is located in the Southern Region in the Two Meetings Watershed (Manchester) and Pindars River Watershed (Clarendon), with a total combined area of 30,000 acres and population of 25,000. The program, initiated in 1978, is based on plans developed under the UNDP/FAO Forestry Development and



source: Clarke, C.G. and A.G. Hodgkiss. 1974.  
Jamaica in Maps. N.Y., Africana Publishing Co.

Watershed Management Project. Technical and financial assistance is to be supplied by USAID for the first 5 years, after which it is expected that the GOJ will meet the financial requirements, and the Soil Conservation Unit, the technical.

The goal is to improve the standard of living of the small hillside farmer; the means is through implementation of a major soil conservation program, and provision of credit, marketing assistance, improved rural feeder roads, housing, access to domestic water supply and electricity. The hope is to produce an agricultural production model that can be replicated in other watersheds. The project is to be implemented by the Ministry of Agriculture's Southern Region, Forest Department and Ministry of Public Works.

The soil conservation component amounts to almost 50 per cent of the total project cost for uncultivated areas. Three categories of works are needed: i) road erosion control and protection; ii) stream bank erosion control; and iii) landslide and gully stabilization. As for cultivated areas, two major soil conservation treatments are to be implemented on steep, highly erodible slopes. For clean cultivated crops (e.g., yam, ginger, roots, vegetables) bench terraces are to be used. For crops such as banana, citrus, coffee and sugar cane, hillside ditches are required.

### 3.4 VEGETATION

The vegetation of Jamaica, occurring in a wide variety of habitats, is marked by high diversity and high endemism. The estimated number of species of flowering plants is 2,800 and of ferns is 550. More than 20 per cent of the species are endemic, or found only in Jamaica (Sinha, 1972).

Interest in the vegetation of Jamaica has been consistently strong since the collections of Sir Hans Sloane in the late 1600s. A list of plant collectors and their works before 1900 is given by Sinha (1972), while Rundel (1974) provides a bibliography of plant ecology references after 1900. The accepted structural vegetation classification for Jamaica is that of Asprey and Robbins (1953).

During the 1940s the Natural History Division of the Institute of Jamaica was re-established and the Natural History Museum was built. The museum's herbarium is the largest (60,000 specimens) in the Caribbean and one of the best in the Western Hemisphere south of the United States. The Institute periodically publishes monographs on Jamaica flora and fauna, and also supports research at the Mason River Nature Preserve. This 202 acre tract of land was acquired in 1963 by the National Trust and later turned over to the Institute of Jamaica.

Natural vegetation essentially remains only in forest reserves and Crown lands (mainly the Blue Mountains, John Crow Mountains, Hellshire Hills and Portland Ridge) and in small scattered locations that are uncultivable, isolated or inaccessible. In addition to the four main forest types described

in section 3.6.6, there are small areas of mangrove woodland, herbaceous swamp (mainly sedges) and marsh forest (see figure 8 ). The main species of the former are the characteristic mangrove species; red mangrove (Rhizophora mangle), white mangrove (Laguncularia racemosa), black mangrove (Avicennia nitida) and buttonwood (Conocarpus erecta). The marsh forest in the Black River Morass is covered with sedge (Cyperus giganteus), palms (Roystonea princeps) and Calyptranoma occidentalis, Symphonia globulifera and Grias cauliflora. The swamp forests with their rich assortment of species are disappearing through harvesting of wood products, drainage for conversion to cultivation, and more indirectly induced alteration of water dynamics resulting from land use changes. Disappearance of the island's flora species in the last few hundred years is not known, but assumed to be substantial.

### 3.5 RANGELAND

(Sources: Campbell, 1977; Clarke and Hodgkiss, 1974; FAO, 1976; Jamaica. MOA, 1978; Kaplan et. al., 1976)

#### 3.5.1 The Resource

Out of the total 550,000 acres (223,000 ha) of grasslands in Jamaica, about 250,000 (101,000 ha) are in improved pasture, 150,000 (60,000 ha) in unimproved pasture, and about 150,000 in rufinate (degraded secondary growth) and sub-marginal terrain utilized for extensive grazing. Cattle production, coinciding with the most extensive grasslands, is concentrated in the parish of St. Ann and in the southern limestone plateaux (see figure 9 ) in Westmoreland, St. Elizabeth, and Manchester.

#### livestock resource

In the mid-1970s, there were 350,000 cattle -- about 56,000 dairy and the rest beef and dual-purpose. Beef cattle rearing is mainly practiced by large landowners, such as sugar planters and bauxite mining companies. Reynolds Bauxite was the largest beef producer in Jamaica in the mid-1970s. The dairy industry consists of about 4000 farms -- a few large and many small. Most of the milk produced on the island comes from about 200 large farms with 35 or more cattle. The other farms have one or two cows.

The range resource has been assessed as having the capacity to support an average of about 3 head per acre. The stocking density is near that now. No reports of serious rangeland degradation from overstocking were encountered in the course of preparing this profile.

Many cattle breeds are being crossbred. The main ones are Santa Gertrudis, Holstein, Aberdeen, Angus, Zebu and Brahman. The Jamaican Hope, a dairy breed developed in Jamaica during the 1940s, is heat and disease resistant and performs well in Jamaica. Beef breeds that have been developed in the country are Jamaica Red Poll, Jamaica Black and Jamaica Brahman.

While goat meat is considered a delicacy in Jamaica, goats are largely restricted to small plots of land or penned areas. The rangeland is used essentially only for cattle. The Jamaican Labour Party believes that

inadequate attention has been given goats and sheep, particularly in light of the steep topography and higher protein conversion factor as compared with cattle. The JLP has promised strong support for programs to rear sheep and goats, so these livestock may become more important in the future (JLP, 1980).

#### ecological conditions and pasture improvement

Most cattle are grass fed. There is little supplemental feeding of beef cattle, with somewhat more of dairy cattle. Species used in improved pastures are mainly Pangola grass (Digitaria decumbens) but also napier grass, coastal Bermuda grass (Cynodon dactylon) and Guinea grass (Panicum maximum). Grass is abundant during the wet season but shortages occur in the dry seasons. Production of silage or hay is however, rarely done. Fertilizer is usually applied only where irrigation is available or rainfall is fairly high, since in other areas water supply, not soil fertility, is the limiting factor. In general, pasture management is inadequate on most cattle farms.

#### 3.5.2 Institutional Focal Point and Activities

Pasture management and livestock production fall under the jurisdiction of three divisions of the Ministry of Agriculture: Livestock Development Division, Livestock Research Division, and Veterinary Division. The Livestock Research Division deals most directly with the range resource. Its function is to evaluate grass and legume crops for forage production and systems of pasture and animal management.

As far as can be assessed through available literature, there seems to be no direct regulatory control of pasturelands other than what would fall under broad land use and agriculture laws.

#### research

Research recently carried out by the Pasture Research Board falls into three categories: grassland agronomy, grassland utilization and grassland conservation. Research in these areas is relatively limited and should be expanded.

There has been substantial research and development for the dairy industry. Current work includes research at the Serge Factory Limited -- a former sugar estate -- on use of derinded and shredded sugar cane for cattle feed.

#### training

Training for livestock production is obtained through the U.W.I., Trinidad (B.Sc. degree, Animal Science option), or through the Jamaica School of Agriculture which offers courses and practical training in dairy operations. In addition, training is provided at two government-initiated centers, "New Dairy Farms". Courses are given in grassland management, production and economics. Informal training is available through 4-H and commodity groups (e.g., Jamaica Livestock Association). Although these opportunities

exist, as is true of all divisions within the MOA, training facilities are at present inadequate to meet the needs of the country. A shortage of trained personnel in MOA and a lack of technical knowledge at the producer level point to the need for expanding and improving the training facilities.

problems in the sector

Although this sector has advanced fairly rapidly in the last few decades and the GOJ has supported programs especially at the industry level (vs. rangeland management), the potential for livestock production is not fully utilized. At present a large portion of milk and milk products (80%) and beef consumed in the country is imported. Contributing factors to low production are those common to the entire agriculture sector, namely lack of inputs and investment, marketing deficiencies, inadequate education, extension and research.

3.5.3 International Assistance

Information on assistance in the livestock sector related mainly to the dairy industry. Foreign assistance projects are as follows:

USAID -- financing of new dairy farms, improvement of existing farms, settlement of farmers (1965-73)

IDB -- funding for loans to dairy farmers, through Jamaica Development Bank (1971- ) and through MOA self-supporting scheme (1970-76)

-- financing for dairy expansion, strengthening research capacity, upgrading training

DANIDA and FAO -- establishment of Sub-Regional Dairy Training Course at Jamaica School of Agriculture (1975- )

UNDP/FAO -- livestock development project - veterinary emphasis

-- study of dairy development (1975-76); recommendations for new policy and project proposals

Norway -- Crop and Livestock Development Project -- includes expanding livestock at Jamaica School of Agriculture (planned for 1980- )

### 3.6 FORESTS

#### 3.6.1 General Description

Forests, located mainly in the upland regions, cover 659,000 acres, or about 24% of Jamaica's land area. There are three classes of forest: 1) well-stocked natural forest (Dry Limestone Scrub Forest, Wet Limestone Forest, Lower Montane Rain Forest, and Montane Mist Forest); 2) ruinate forests (secondary growth scrub); and 3) plantation forests (mainly Caribbean pine, mahogany, and blue mahoe). The distribution and condition of Jamaican forests today reflect centuries of human activity.

At the time of the Spaniards' arrival in Jamaica in 1494, the island was covered with dense forests and abundant streams, hence the name, "Xamayca," an Arawak word meaning "land of wood and water". While the natural and ruinate forests have been exploited for timber, poles, and fuelwood, the disappearance of large areas of forest cover in the last several centuries is largely attributed to clearing for cultivation. As a consequence of ensuing erosion problems, the forestry practices, initiated in the first half of the nineteenth century, were primarily for purposes of soil and water conservation. It has been only in the last two decades that forestry for commercial exploitation has been practiced, induced by the increasing burden wood product imports are placing on foreign exchange.

In 1976, 90 per cent of the commercial wood products used in Jamaica were imported, with a total value of U.S. \$67.2 million (up from U.S. \$14 million in 1965 and U.S. \$21 million in 1969). This represented 6 per cent of the total merchandise imported that year. Exports of wood products (mostly waste and old paper) in 1972 amounted to only U.S. \$220,000 (IBRD, 1979b).

Plantation development has occurred in the last decade, and probably will be the main direction for forestry in Jamaica in the future. The forestry sector has received substantial foreign assistance. Between 1967 and 1971 an UNDP/FAO project carried out a number of technical studies which contributed to a Forest Development Plan in 1971. Since then forestry projects involving establishment of Caribbean pine plantations have been funded by USAID and the World Bank.

#### 3.6.2 Institutional Framework and Capabilities

(Source: IBRD, 1979b)

The responsibility for development, management, and protection of the forest resources lies within the Ministry of Agriculture. Until 1978, execution of all forest-related activities had been carried out exclusively by the Forest Department (FD), which was established in 1942 as one of the departments within the Ministry.

The final result of a series of reorganizations in 1977 and 1978, aimed at creating a viable commercial forestry subsector, was the establishment in August 1978 of the Forest Industries Development Company (FIDCO). FIDCO has been given the responsibility of operating all forest and forest-industry activities, from establishment and maintenance of plantations, logging, transport, and processing of harvested timber. All FIDCO's shares are held by the Jamaican National Investment Company Ltd. (JNIC) within the Ministry of Finance. FIDCO is therefore accountable to both the Ministers of Finance and Agriculture. The Minister of Agriculture remains responsible for all national forestry policy, provides financial support to FIDCO, and reviews all of FIDCO's activities. Forest reserve land remains under the jurisdiction of the FD but is leased (usually in terms of 49 years) to FIDCO for plantation operations.

The Forest Department remains in charge of non-commercial forestry activities, extension, planning and research (including land acquisition, surveys, inventory and data collection), training, and administration. Although overall administrative direction and the technical and administrative staff are located at the headquarters in Kingston, management of forestry operations takes place at the regional level. The country has been divided into three forestry regions, each of which is managed by a regional officer. The Extension service, although limited, has four divisions: utilization, watershed management, recreation, and resource planning. The overall FD staff is small, consisting of 9 professionals and 49 technicians in 1979 (WWF, 1980). Shortages in trained manpower have been exacerbated by emigration of professional and managerial level staff and the attraction of qualified FD personnel to FIDCO.

#### legislation

(See appendix II)

The Forest Act of 1937 created the Forest Department for the following purposes: developing soil and water conservation measures; encouraging protection and management of forests on private land; developing local timber and forest products industries; and, allowing private landowners to declare their forests as protection areas. In connection with the last point, an amendment in 1941 provides a land tax remittance in compensation for valuable products foregone as a result of having lands declared protection areas. The Forest Act prohibits wood cutting or damaging trees in any way, cattle grazing, cultivation, hunting or kindling fire on forest reserves unless permission is granted by the Minister of Agriculture or a forest officer.

Enforcement of this law could be improved considerably. Also, in light of the recent shift towards production forestry, more legislation is needed to reserve some forests for production and to protect other forests -- both public and private -- from disturbance.

#### policy

Forest policy, stated as follows in the Five-Year Development Plan, 1978-82, reflects the shift in emphasis from watershed protection to commercial forestry

The forest industry 20-year programme aims at establishing 5,000 acres per year. During the Plan period, an additional 31,500 acres of forestry is to be established (20,000 in industrial plantations, 6,500 in private and community plantings, and 5,000 acres of reforestation. . . the activity is labour-intensive, has a high agro-industrial potential and plays an important role in soil conservation and watershed protection, while providing facilities for recreation.

### training

(Source: Jamaica. MOA, 1978)

One of the main problems in implementing current forestry projects is a shortage of skilled manpower. Due to the lack of a forestry tradition, there are no formal forestry training programs in Jamaica or at the U.W.I. There is a two-year diploma course in forestry offered to students of the region at the Eastern Caribbean Institute of Agriculture and Forestry (ECIAF) in Trinidad, but the total capacity is only 10 students per year. Professional and technical foresters in the FD have been trained outside the region, mainly in the U.S. and Canada.

In recognition of the problem, the UNDP/FAO, USAID and World Bank projects have each included a training component. In addition, the FD has proposed initiating Work/Study Training Programs with the island's schools, but is restrained by lack of qualified training officers and support staff. During 1979 bilateral assistance to implement the program was sought.

The obvious need for comprehensive training in forestry may be best provided by a regional training center. (See section 3.8.5).

### research and surveys

(Source: Jamaica. MOA, 1978)

Forestry research has been carried out by the FD and through international assistance projects. Research is limited and focuses on commercial forestry.

The majority of the FD research has been species trials. During the 1940s and 1950s and recently at Bull Head Reserve, a number of species were planted on different sites to assess growth potential (see appendix VI).

Technical studies carried out under UNDP/FAO Forestry Development and Watershed Management Project have formed the basis for many of the forestry projects in the last decade. The Project included inventories, cost/benefit analyses, soil suitability studies, species provenance trials, wood utilization studies, thinning, logging and extraction studies, and industrial development research.

Experiments are currently underway in the Blue Mountains in growing coffee under pines. In addition, a feasibility study of a cement-bonded particle-board mill to use waste sawdust and chips from Twickenham Park sawmill for panels and prefab low cost housing has been carried out with the assistance of the U.K. It was hoped that this mill would be in operation by 1979.

There is a need to expand the quantity and scope of research. One area which has not been explored is use of fast growing species such as Leucaena leucocephala and Albizia falcatta. Their potential for polewood, fuelwood, timber, pulp and paper has not been assessed. Other uses of such species are for erosion control and as shade trees over crops (e.g., for coffee). Forestry research should be expanded to meet the needs of the small farmer. Instead of encouraging pine planting for erosion control, planting of fast growing species for yam poles and fuelwood is better suited to small farmers' immediate needs. Trials on such species as Calliandra calothyrsus is recommended (pers. comm., Michael Bengé, USAID).

### 3.6.3 Status of Information

#### forest ecology

The accepted structural vegetation classification for Jamaica is that of Asprey and Robbins (1953). This work provides species lists and descriptions of Jamaica's natural forest types. Other detailed descriptions of the flora of the montane forests are given by Shreve (1914), Grubb and Tanner (1976), and Tanner (1977), and of the dry limestone forests by Asprey and Loveless (1958). (See also Rundel's (1974) bibliography of West Indian plant ecology.)

#### forest inventory

In the late 1960s Gray and Symes carried out a forest inventory under the UNDP/FAO Forestry Development and Watershed Management Project (UNDP/FAO, 1971). The acreage of different forest types was assessed. Timber reserves were inventoried on government-owned land and qualitatively assessed on private forests. Under the World Bank Forestry Project, mapping and an intensive forest inventory of the existing pine plantations was initiated in 1979.

### 3.6.4 The Forest Resource

#### Forest Land

The distribution of forests in Jamaica is shown below.



figure 10

The extent and ownership pattern for each of the three forest classes is as follows:

	<u>acreage</u>	<u>government-owned</u>	<u>privately-owned</u>
natural forests	190,000	148,000	42,000
ruinate forests	435,300*	101,300**	334,000
plantations (1977)	<u>24,700</u>	<u>24,700</u>	<u>      </u>
	650,000	274,000	376,000

(Sources: USAID, 1973; IBRD, 1979b)

Of the 274,000 acres of government land, 30,000 acres are Crown lands, and the remaining acreage is divided into 92 Forest Reserves. About 67 per cent of state land in natural forests is in three large blocks and the remainder is in small blocks scattered over the island. The privately owned forests are in small, scattered holdings.

#### Timber Supply

(Sources: UNDP/FAO, 1971, 1973b)

The UNDP/FAO survey revealed that forested areas are too inaccessible or that timber volumes in natural or ruinate forests are too low to make harvesting of present timber stock economically worthwhile. The natural forests in Forest Reserves in the Blue Mountains and Cockpit Country (representing the majority of government-owned natural forest) contain sawlog-sized trees, but logging is uneconomic due to steepness of terrain and inaccessibility. Other government land in natural forest has only pole-sized timber of insufficient volume to merit harvesting. Natural forests in private ownership, occurring mainly on limestone soils have low growth potential and are generally in worse condition than Forest Reserves. UNDP/FAO did not conduct a timber survey of these areas, but the potential was deemed low.

Ruinate forests, both government and privately owned, have little present potential for commercial exploitation. Fuelwood collection is considered the only possible use for the near future.

Plantations of Caribbean pine and nine other plantation species were mapped and studied. Caribbean pine was found to have the greatest potential for forestry development. Due to the low timber reserves found in natural and ruinate forests, UNDP/FAO advocated developing plantation forestry.

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\* UNDP/FAO (1971) survey figure (460,000) minus 1977 plantation figure, under assumption that plantations were established on ruinate.

\*\* UNDP/FAO survey figure 126,000 minus 1977 plantation figure under assumption that plantations were established on government land.

## Forest Utilization

### domestic products

Since products for local use, namely fuelwood, yams sticks and fence posts do not enter the commercial stream, it is difficult to obtain harvest figures. A rough estimate made by UNDP/FAO was 25-30 million cubic feet (700,000-850,000 cu. m.) gathered annually (USAID, 1973). Under the World Bank Forestry Project, a study to determine consumption and possible future demand for fuelwood will be undertaken.

### commercial forest products

Most of the hardwood timber harvested in Jamaica comes from private lands and passes through small private sawmills. Although no reliable data on production of hardwood timber from private lands is available, estimates from sawmill volume indicate a range of 42,500-127,000 cu. m. per year (USAID, 1973). Harvests of hardwood from government-owned land (Forest Reserves) is low for both natural forests (4126 cu. m. in 1968/69; UNDP/FAO, 1973b) and hardwood plantations.

Virtually all softwood is produced on government plantations. Planting prior to 1959 was intended for soil and water conservation rather than for commercial exploitation so no significant harvests were expected before 1979. In 1978 the FD extracted 4389 cu. m. (IBRD, 1979b).

### forest industries

Forest industries processing local woods consist of 70 small private sawmills producing 23,000 cu. m. of sawnwood, and the government-run Twickenham Park Sawmill, producing 1,200-2,500 cu. m. annually (IBRD, 1979b).

The private sawmills operate on a part-time basis, milling hardwood from private property. The output is generally of poor quality, and extraction and transport of the logs are labor intensive and marked by lack of modern equipment and techniques. The number of sawmills and output has fallen since 1970. In general, the private sector has chosen not to expand or maintain investment in the forestry sector, so commercial development is largely left up to the government.

Twickenham Park Sawmill was built in 1977 as a training and demonstration facility as part of the UNDP/FAO Forest Development and Watershed Management Project. Plans for the World Bank Forestry Project initiated in 1979 include increasing the yearly capacity of the sawmill from 2500 cu. m. to 12,500 cu. m. and constructing a new pine sawmill on the north coast (probably near Buff Bay) with an eventual capacity of 17,500 cu. m..

### present consumption and future demand

Demand for wood products is concentrated on sawnwood (90 per cent softwood for construction, 10 per cent hardwoods for furniture), utility transmission poles, fence posts, woodpulp and paper products, and fuelwood. Presently

90 per cent of demand for commercial wood products is met by imports. Exports of wood products from Jamaica is negligible by comparison.

Estimates for future demand given below are provided by the study "Forest Industries Development in the CARIFTA Region" by the FAO/ECLA/UNIDO Forest Industries Advisory Group for Latin America (summarized in UNDP/FAO, 1973a)

<u>product</u>	<u>annual growth rate</u>	<u>1971</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>1995</u>
sawnwood (10 <sup>6</sup> cu.ft.)						
softwood	3%	40(8.9)	52(11.6)	61(13.6)	70(15.6)	81(18)
hardwood				7(1.6)		8(1.8)
wood-based panels (10 <sup>6</sup> cu.ft.)	8%	0.62		2.2	3.3	4.8*
pulp and paper: (tons)		48,800				164,500**
roundwood (pieces)						
utility poles	7%	12,000		26,000	26,000	26,000
posts	8%		170,000			470,000

### 3.6.5 Plantation Forests

(Source: Jamaica. F.D., 1967)

#### Background

Virtually all plantations are state-owned and managed. Prior to 1962 the FD had a modest planting program (approximately 400 acres per year), but during the decade of the 1960s an expanded planting program was launched, with goals set in 1962 at 1200 acres and for 1968 at 3000 acres. Planting in the 1940s and 1950s utilized a number of native and exotic species under various site conditions (See appendix VI.). Caribbean pine, assessed as having the greatest potential, was adopted in the late 1960s as the main plantation species. By 1972, according to FD planting records, 10,000 acres of Caribbean pine and 8565 acres of broadleaf hardwoods (mainly mahoe and mahogany) had been planted. (See appendix VI for 1968 acreage of plantation species). Unfortunately planting had been done in scattered locations, making maintenance and harvesting difficult and costly.

\* A figure given by IBRD (1979b) based on a 2.3% annual growth rate, is half this.

\*\* Figure given by IBRD (1979b) based on a 2.3% annual growth rate.

In 1965, the GOJ made a request to FAO for assistance in developing a long-term forestry plan. As a result, in 1967, the UNDP/FAO Forestry Development and Watershed Management Project was initiated. After carrying out inventories, production and economic studies, the Project concluded that the major forestry opportunity in Jamaica was the production of sawnwood from pine plantations. It recommended planting Caribbean pine, which has a high local demand, has a relatively short rotation of 20 years and grows well in the Blue Mountain region where land is relatively available.

The first large-scale plantations were planted with the assistance of USAID in the mid-1970s. Under this project, 7500 acres of Caribbean pine were planted in the Mt. Airy area in the Blue Mountains between 1974-1977. The World Bank Forestry Project, scheduled to have begun in 1979 aims to establish 9250 acres of New Caribbean pine plantations between 1977-1985 in the Blue Mountains.

### Production

The plantations established in the 1950s and 1960s have only recently come of harvestable age, but the yields are small, offsetting the demand for forest products to only a small extent. There will be a need to continue importing wood for at least the next 15 years until the stands planted in the 1970s are ready for harvest.

Based on UNDP/FAO predictions of future demand, in order to become self-sufficient in wood products, the minimum area needed for plantation is:

<u>product</u>	<u>total acreage</u>
1) coniferous ( <u>P. caribaea</u> ) sawn	100,000
2) broadleaf sawn	80,000
3) plywood and veneers	32,800

(Source: UNDP/FAO, 1973b)

### Land availability for plantations

The success of plans for plantation development is clearly contingent on land acquisition. UNDP/FAO calculated the following distribution of ownership of land suitable for Caribbean pine plantations:

	<u>government</u>	<u>private</u>	<u>total</u>
Eastern Division	16,000	83,000	99,000
Central and Western Division	4,000	79,000	83,000
	<hr/> 20,000	<hr/> 162,000	<hr/> 182,000

(Source: USAID, 1973)

In order to reach the target of 100,000 acres in Caribbean pine needed for self-sufficiency in softwoods, at least 80,000 acres of private land must be planted. This land may be bought or leased by the government, or the owners may be persuaded to plant as a private investment. Of the 182,000 acres suitable for pine growth and harvest, it is estimated that all but 50,000 acres are now in agricultural production (USAID, 1973). Questions of competing land uses must be resolved.

### 3.6.6 Natural Forests

(Sources: Symes, 1971; Asprey and Robbins, 1953)

The four main forest types as classified by Asprey and Robbins (1953) are the Dry Limestone Scrub Forest, the Wet Limestone Forest, the Lower Montane Rain Forest, and Montane Mist Forest. (In addition, there are small areas of mangrove woodland and marsh forests.) The relatively intact forests cover 190,000 acres, or about 7 per cent of the total land area of Jamaica. They are located in areas which are inaccessible or undesirable for human use (e.g., Blue Mountains and John Crow Mountains in the east, Cockpit Country in the west, and Hellshire Hills and Portland Ridge on the south coast). Because of their inaccessibility or low timber volumes, they are more important for purposes of scientific study or recreation than for economic exploitation. (Some extraction, however, has been carried out by F.D.). The characteristics of each forest type are discussed below.

#### Dry Limestone Scrub Forest

(Holdridge Life Zone: Tropical Very Dry Forest)

: 0-1250 ft. ASL\*; 79.5 F MAB\*\*; 20-40 in. MAR\*\*\*)

This occurs mainly in the southern limestone hills (from the Hellshire Hills and Portland Ridge to Morant Bay) but also in the Don Figuerero and Santa Cruz Mountains in St. Elizabeth, near Negril, and on the dry limestone hills of Trelawny on the north coast. This is a relatively open, stunted woodland with high species diversity. The thin canopy rarely exceeds 30 feet, but there are some scattered emergents: red birch (Bursera simaruba) and cotton tree (Ceiba pentandra) of over 60 feet. Tecoma stans and T. leucoxydon, logwood and acacia are common. The majority of the vegetation consists of small xerophytic trees and shrubs. Ground vegetation is sparse, and soil and leaf litter are very thin. Although this forest is poor in timber, heavy exploitation for fuelwood and poles has left little of the former canopy and sub-canopy. The fauna of this forest is particularly rich, and includes a variety of reptiles and birds.

#### Wet Limestone Forest

(Holdridge Life Zone: Tropical Moist Forest)

: 0-1250 ft. ASL; 79.5 F MAB; 80-160 in. MAR)

This luxuriant evergreen forest occurs mainly in the Cockpit Country, but also on Mt. Diablo and Dolphin Head Mountain. The canopy at 60 feet is closed but

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\* ASL = above sea level.

\*\* MAB = mean annual biotemperature

\*\*\* MAR = mean annual rainfall

not dense, and is broken by emergents, mainly broadleaf (Terminalia latifolia) and Santa Maria (Calophyllum brasiliense), of 100 feet or more. A sub-story at about 40 feet may often be quite dense. The most common species are breadnut (Brosimum alicastrum), lancewood (Oxandra laurifolia), odor (Xylopia muricata), and timber sweetwood (Nectandra sanguinia). Other important timber trees are broadleaf (Terminalia latifolia), the bullets (Bumelia spp.), and galimenta (Ponteria multifolia). Epiphytes, liana, bromeliads and orchids are present. The species diversity is greater, and ground vegetation and leaf litter is more evident than in the Dry Limestone Scrub Forest. Soil may be deep in valleys but thin or absent on the hillsides. Trees here may attain large diameters, but most of the best trees have been removed. This is especially true of cedar (Cedrela odorata), which is now rare in the Cockpit Country.

#### Lower Montane Rain Forest

(Holdridge Life Zone: Premontane Rain Forest)

: over 1250 ft. ASL; 75.2 F MAB; 40-80 in. MAR

This forest type is found only on the northern slopes of the Blue Mountains and western slopes of the John Crow Mountains up to 4000 feet. This forest is similar in appearance to the Wet Limestone Forest and has many species in common. Stratification here is less well-defined. The canopy is at 60-80 feet and emergents, Psidium montanum, Symphonia globulifera, and Ficus suffocans, grow to 120 feet. The most common species are Santa Maria, the sweetwoods, slugwood (Beilschmiedia pendula), and muskwood (Guarea glabra). The shrub layer, shaded by a generally dense canopy, is usually sparse, but ground cover is quite abundant. The soil is moist and rich in humus and organic litter. In the more accessible places, the forest has been high-graded, especially for cedar which is now extremely rare. Most of this forest, however, is too remote and steep for timber exploitation, so that 35,000 acres remain in a relatively untouched state.

#### Montane Mist Forest

(Holdridge Life Zone: Premontane Wet Forest)

: over 1250 ft. ASL; 75.2 F MAB; 80-160 in. MAR

This evergreen forest is located above 4000 feet in the Blue Mountains. The forest is of no timber value because the constant cloud or mist cover and thin soils limit productivity. The canopy is less than 50 feet high and the trees have poor form and multibranching crowns. Undergrowth shrubs, tree ferns, herbs, mosses and ferns are abundant. The most common tree species are Podocarpus urbanii and Cyrilla racemiflora. The rare indigenous conifer, Juniperus barbadensis, is also present. For the reasons of low economic value and inaccessibility, this forest has suffered very little human disturbance. Its main value is for scientific research and low-impact recreation.

utilization

(Sources: UNDP/FAO, 1973b; USAID, 1973)

While commercial logging in the remaining natural forest areas is generally uneconomical, technically impossible, or undesirable, these forests have potential for recreational or scientific use and are important for resource conservation. Even though use of forests for recreation has been increasing, lack of transportation facilities render most sites inaccessible to the majority of the people. Public awareness of forest conservation is generally very low (AID, 1973). These deficiencies have been recognized by the government, and, with the assistance of multilateral and bilateral agencies, efforts have been made to provide increased recreational and educational facilities in forest reserves.

The existing recreational areas and facilities are:

<u>Location</u>	<u>Number of Visitors</u>	<u>Facilities</u>
Clydesdale	32,065	furnished rest house for weekends, camping, dorm accomodation, bathing pool, scenic beauty, hiking trails, forest roads
Hardwar Gap (Hollywell Forest Park)	23,175	log cabins, picnic shelters, scenic beauty, trails and roads
Blue Mountain Peak	6,000	unfurnished room for shelter, camp sites, picnic facilities, scenic beauty, hiking trails
Bull Head Forest	15,000	picnic shelters, scenic beauty, hiking trails, forest roads
Moneague Nursery	15,000	arboretum, picnic shelter, information kiosk
Gourie Forest	10,000	log cabins, picnic shelters, scenic beauty, hiking trails, forest roads
Williams Field Nursery	n.a.	picnic shelters, information kiosk
Lover's Leap	10,000	
Mount Diablo	abandoned 1972	picnic shelters

(Source: Jamaica. DOS, 1978)

### 3.7 WATER RESOURCES

#### 3.7.1 Surface Water Resources

(Sources: Caribook, Ltd., 1980; USAID, 1979; Jamaica. DOS, 1973a; Chin, 1979)

Jamaica has numerous rivers, most of which originate in the interior highlands then flow north or south toward the coast. Due to the permeability of the limestone areas, stream density is high only in the eastern region (Blue Mountain area), in the central and western regions where shale inliers outcrop, and on interior basins and coastal embayments. (See figure 11.) Most of the rivers are narrow and fast flowing, but in general, those running south are longer, slower, and fed by more tributaries than those flowing north.

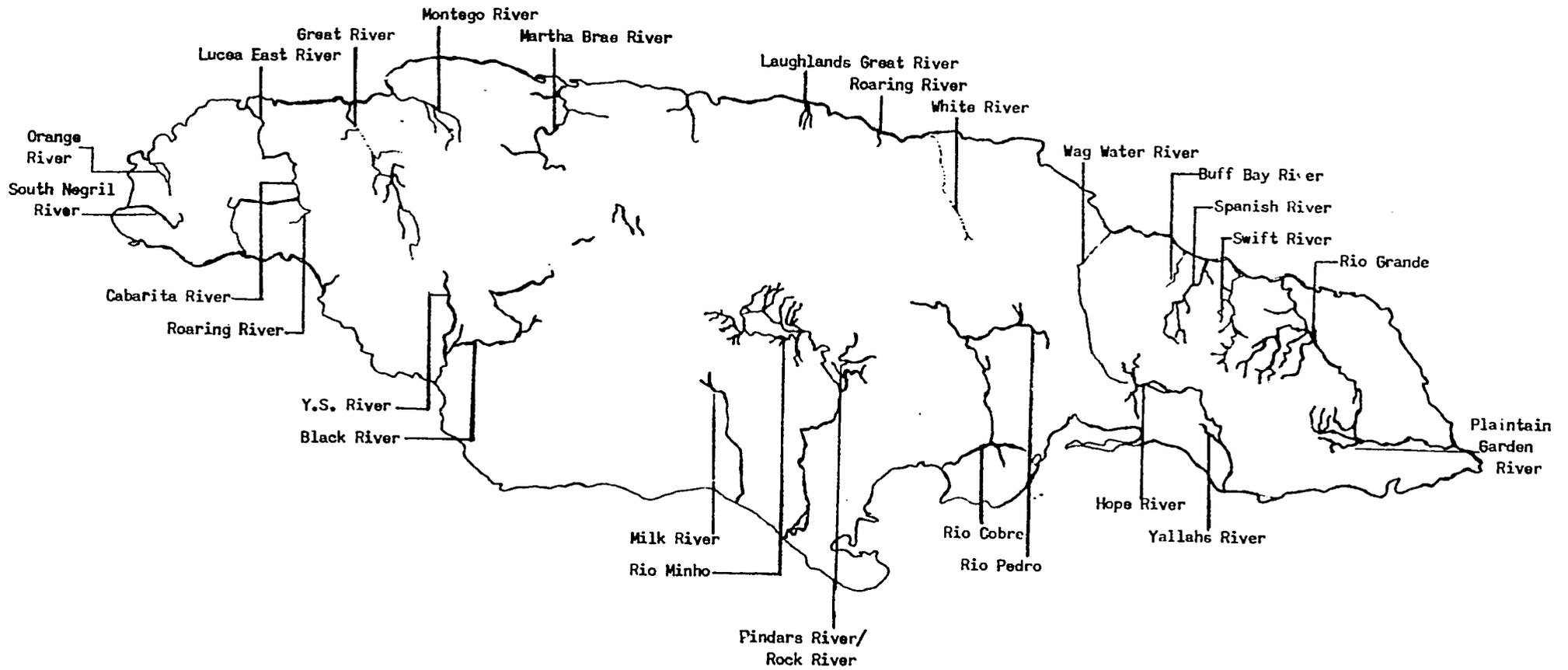
The Blue Mountains, a high rainfall area underlain by impermeable bedrock give rise to numerous rivers since streamflow is derived largely from direct runoff. The rivers are permanent but highly irregular. In the rainy season these rivers are subject to flash flooding and severe bank erosion. The nature of these rivers renders them unnavigable and of little potential for hydroelectric generation.

In the limestone regions, large areas are devoid of surface runoff. Rivers draining these areas appear only intermittently and generally rise within a few miles of the coast. The major exception is the Rio Minho which originates in the central shale inlier and flows to the south coast. The flow of rivers from limestone catchment areas is less variable than in the Cretaceous areas (Blue Mountains and inliers) because the large groundwater aquifers tend to equalize discharge.

Of a total 120 streams and rivers in Jamaica, 36 are perennial. The following table lists the largest (by length or volume):

Figure 11

RIVERS OF JAMAICA



(from Chin, 1979)

PRINCIPLE RIVERS OF JAMAICA

	<u>Period of record</u>	<u>Length (mi) *</u>	<u>Drainage area (sq mi)</u>	<u>Mean daily discharge (IMGD)</u>	<u>Minimum 14-day flow (IMGD)</u>
<b>NORTHERN REGION</b>					
<u>Great River-Lethe</u>	1955-76	28.6	85.4	248	21.0
<u>Montego River-Montego Bay</u>	1968-76	15.0	45.2	30	4.9
<u>Martha Brae River-M. Brae</u>	1955-76	20.2	-	272	49.0
<u>Rio Bueno</u>	1970-75	-	-	177	67.0
<u>Laughlands Gt. River</u>	1972-75	-	-	79	0.2
<u>Roaring River-Ocho Rios</u>	1955-71	-	1.5	52	37.0
<u>White River</u>	7 months	17.0	-	48	30.0
<u>Buff Bay River</u>	1956-76	13.8	20.3	67	7.1
<u>Spanish River</u>	1970-75	-	13.7	96	5.5
<u>Swift River</u>	1969-75	-	18.6	106	8.8
<u>Rio Grande-Fellowship</u>	1955-75	21.3	82.9	431	36.0
<u>Wagwater</u>	-	22.5	-	14	-
				<hr/>	<hr/>
<b>SOUTHERN REGION</b>					
<u>Yallahs River-Llandewey</u>	1971-75	22.9	-	80	22.0
<u>Hope River</u>	1956-75	12.2	15.9	12	1.7
<u>Rio Cobre-Spanish Town</u>	1955-75	31.6	-	104	47.0
<u>Pindars River-Rock River</u>	1968-76	-	32.3	22	0.9
<u>Rio Minho-Danks</u>	1968-73,75	57.5	83.4	73	5.8
<u>Black River-Lacovia</u>	1963-75	33.2	-	383	128.0
<u>Y.S. River</u>	1955-75	-	-	97	10.0
<u>Roaring River-Petersfield</u>	1965-76	-	44.8	91	10.0
<u>Cabarita River</u>	1968-75	24.7	-	39	3.1
<u>Milk River</u>	1970-75	22.6	-	7	0.6
<u>Plaintain Garden River</u>	-	21.7	-	-	-
				<hr/>	<hr/>
				908	228.7

(sources: Chin, 1977; Hardware, 1973 \* )

The Black River has been described as the finest river on the island. It is navigable for boats of considerable size for about 25 miles from its mouth. The Milk River is the only other river that is navigable, for about 2 miles of its lower reaches. Recreational uses of the rivers include rafting on the Rio Grande and Martha Brae. Use of surface water for water supply, irrigation, and hydro-power will be discussed in later sections.

### 3.7.2 Groundwater Resources

(Source: White, 1979)

The main aquifers of Jamaica are the White Limestone Formation and unconsolidated alluvium deposits mainly associated with the rivers draining to the south coast. Although well yields may be higher in certain limestone areas, demand is greater in the vicinity of alluvium deposits (Kingston and the prime agricultural areas of the southern coastal plains) so the alluvium aquifers have been utilized to a greater extent.

The highest yield of water from the limestone aquifers comes from underground rivers running along joints or fault lines. Water in the channels flows rapidly along a steep gradient, so that wells drilled into these areas produce a high 1-3 million imperial gallons per day (IMGD). In other areas where there are no developed underground river systems, well yields are often more constant but lower (about 1.0 IMGD). Limestone ground water basins occurring as inland and coastal basins provide a fairly constant supply of water. The inland basins are closed depressions with no significant direct hydrologic connection with the sea. Coastal basins which are hydrologically linked to the sea are susceptible to salt water intrusion.

The majority of deep wells and boreholes in Jamaica have been sunk in the alluvium aquifers of the southern coastal plains. These sands, gravels, and loams contain a considerable volume of water, supporting well yields of up to 1.5 IMGD. As with coastal limestone basins, there is risk of salt water intrusion, which is already occurring in parts of the Clarendon (Rio Minho-Milk River Basin) and St. Catherine (Lower Rio Cobre Basin) Plains and in the Montego River Basin.

### 3.7.3 Administration and Legislation

#### administrative structure

There are three main entities involved in production and distribution of water. Prior to January 1977 each fell under the jurisdiction of a different ministry, but at that time they were all placed under the jurisdiction of the Ministry of Local Government. Since the change of government in October, 1981, they have fallen under different ministries (L.O. Evans, pers. comm.).

#### a) The Water Commission

(Ministry of Public Utilities and Transport)

The Water Commission is responsible for production, treatment, and distribution of water, and for sewage disposal services within the 55 sq. mi. corporate area of Kingston and St. Andrew.

#### b) The National Water Authority

(Ministry of Public Utilities and Transport)

The NWA is responsible for the island's domestic water supply systems other than in the Kingston and St. Andrew Corporate Area. The Authority studies and recommends water supply systems to the Minister and has the

responsibility to design and construct all approved schemes. It operates domestic water systems, sells the water in bulk to Parish Councils, and advises the councils on matters relating to the management of water systems. The Authority must keep water quality under constant surveillance, for which purpose it operates a Water Quality Laboratory in Montego Bay. Since 1973, the NWA has also been empowered to undertake major irrigation projects (Laskin, 1977).

c) The Parish Councils  
(under Ministry of Local Government)

The Parish Councils supply water on a parish basis. They purchase water from the NWA to distribute to customers. The Councils also operate minor production systems. In order to more effectively carry out water resource management and planning, a long discussed merger between the Water Commission and NWA to form the National Water Commission was scheduled for 1980. No information was available to confirm completion of the merger.

In addition to the three principal water bodies, the following agencies are also involved in the sector:

d) Water Resources Division  
(within the Ministry of Mining and Energy)

The WRD monitors existing wells, conducts exploration, and collects data on quality and quantity of potential surface and ground water supplies.

e) Underground Water Authority  
(comprised of Director of Geological Surveys (as Chairman) and 5 members)  
(Ministry of Public Utilities and Transport)

The UWA controls use of ground water for irrigation and water supply. The main concern is overutilization in places defined as critical in terms of underground water availability. Currently the designated critical areas include the Montego Bay River Basin, the Pedro Plains, the Clarendon Plains, and Yallahs Valley (Wedderburn, 1974).

f) Environmental Control Division and Parish Health Department  
(both within Ministry of Health and Environmental Control)

MOHEC conducts a program in drinking water quality control. Water Quality Inspectors supervise the operation of production facilities and sample water to be analyzed for bacteriologic content by the Montego Bay Water Laboratory or the Government Medical Laboratory.

g) Natural Resources Conservation Department  
(within the Ministry of Mining and Energy)

NRCDC operates a network of monitoring stations of the island's major rivers and streams. Its concern is that an adequate standard of water quality be met for the protection of fish and wildlife and general environmental protection.

h) Irrigation Authorities  
(within Ministry of Local Government)

An Irrigation Authority is responsible for supplying water to an Irrigation District (a sub-parish unit) for agriculture at the time and of the quality and quantity needed. Each Authority establishes and manages irrigation works and distribution systems. The Authorities also offer extension services to irrigators.

i) Irrigation and Drainage Section  
(within Ministry of Local Government)

The Irrigation and Drainage Section is responsible for major irrigation drainage and micro-dam projects.

Legislation

(Source: Harza and Chin, 1971; Jamaica. 1973. Laws.)(see also appendix II)

The body of law dealing with water resources is complex and the statutes are often conflicting. The doctrine underlying surface water laws is that of riparian rights as derived from English law; basically that each land owner bordering a water body is entitled to use that water, undiminished in quality and quantity. This doctrine has been modified to make provision for reasonable use, to specify priorities of use and vest rights through appropriation. There has been little litigation involving water rights, and in some cases noncompliance and budgetary constraints have rendered ineffective the objectives of the legislation. Laws governing groundwater are not as comprehensive as those governing surface water use even though the majority of water used is derived from underground sources. No clear definition of ownership of this resource is found in Jamaican legislation, although the implication is that landowners have the right to abstract water freely from the subsoil. The laws give the government jurisdiction over all water other than private water.

Laws relating to water rights and use are listed below.

water laws

(Sources: Valls, 1971; Jamaica. Laws. 1973))

The Parishes Water Supply Law - 1889 (Cap. 270)

- right to construct and operate waterworks for water supply vested in Parish Councils excepting the Kingston and St. Andrews Corporate Areas.

The Kingston and St. Andrew Water Supply Law - 1911 (Cap. 195)

- entitles the Kingston and St. Andrew Water Commission to utilize local surface waters to supply waterworks for Kingston and St. Andrew

The Water Law - 1922 (Cap. 410)

- deals with rights of use for different purposes, establishment of Irrigation Boards to manage irrigation schemes, establishment of Water Courts, and acquisition of servitudes.

The Kingston and St. Andrew Water Commission Law - 1937 (Cap. 194)

- establishes The Water Commission.

The Black River (Upper Morass) Reclamation Law - 1941 (Cap. 43)

- establishes the Black River Drainage and Irrigation Board responsible for keeping Black River clean and navigable, making regulations, and executing reclamation, irrigation and drainage works.

The Wild Life Protection Law -1945 (Cap. 413)

- prohibits taking of immature fish, use of dynamite or other noxious materials with intent to injure, take, or kill fish, and input of trade effluents or industrial wastes into waters containing fish.

The Mining Law - 1947 (Cap. 253)

- regulates water use for mining operations; prohibits discharge of any poisonous or noxious matter into any public water in such quantity as to be injurious to animal, fish or vegetable life.

The Irrigation Law - 1949 (Cap. 168)

- creates Irrigation Authorities

The Water Supply Law - 1958 (Cap. 17)

- provides for joint undertakings by two or more statutory bodies (NWA, Water Commission, Parish Councils)

The Flood Water Control Law - 1958 (Cap. 28)

- authorizes Minister to declare flood water control areas and appoint undertakers (government department or statutory body to prepare and undertake flood control schemes)

The Town and County Planning Act - 1958 (Cap. 42)

- provides for issuance, development orders which controls the development of land with the purpose of providing public services, protecting and extending amenities, and conserving and developing the resources of defined areas; includes provisions for control of water supply, drainage, sewage disposal, pollution of surface waters and seashores.

The Underground Water Control Law - 1959 (Cap. 57)

- establishes the Underground Water Authority to promote proper groundwater use. Gives the government the power to declare an area a Critical Area and make withdrawals from aquifers within the area subject to licences. By 1977, 5 areas covering a total of 2000 sq. mi. (45 per cent of Jamaica) had been designated Critical Areas. These include Kingston Metropolitan area SE Westmoreland, an area east of Montego Bay, and virtually all of St. Elizabeth, Manchester, Clarendon and St. Catherine.

The National Water Authority Act - 1963 (Cap. 10)

- establishes the National Water Authority

The Watersheds Protection Act - 1963 (Cap. 4)

- establishes the Watersheds Protection Committee vested with the duty to institute proper, efficient and economic land use in watershed areas with purpose of promoting conservation of water resources; includes regulation of land use and of agricultural practices

The Public Health Act - 1974

- gives the Minister of Health the authority to develop regulations on water quality control.

Revision of existing legislation

(Source : Reid, 1980)

Revision of the existing legislation is now in progress. A draft Water Resources Act was prepared in the mid-1970s (with the assistance of UNDP/FAO). The draft provides for regulation of water use and quality, for water planning,

and for the administration and organization of institutions for water resources development. It appears to be generally acceptable, but despite the obvious need for such revision of existing legislation, the Act had not been passed as of March 1980 (Wright, 1979).

The draft provides for the appointment of a Commissioner for Water Resources and a Water Resources Council by the Minister of Mining and Energy. The Council's main responsibility would be to regulate use of all water in the public interest. Its duties would include: i) controlling withdrawal and use of water by issuance of licences; ii) controlling water quality; iii) formulating and reviewing plans for water resource development; and iv) making regulations for the administration of the Act. The existing Water Resource Division would be the executive arm of the Council. It would collect and interpret water resource data, issue licences, enforce regulations formulated by the Council, and advise the Council on individual water projects and the administration and implementation of a National Water Plan (see section 3.7.6).

#### 3.7.4 Information and Surveys

(Sources: Wedderburn, 1974; Chin, 1979)

No systematic investigation of Jamaica's water resources was made until the 1950s. In 1952 and 1953 the U.S. Corps of Engineers and U.S. Geological Survey carried out surface and ground water studies on the island and in 1956 Prescott (USGS) and Versey (Geological Survey Department of Jamaica) presented a report on the groundwater of the Clarendon Plains.

A water program initiated in 1954 included setting up 25 streamflow gauging stations. Systematic collection of streamflow data has continued since that time, although most of the stations in the existing network have been established since 1965. In 1977 there were 110 stations providing fairly good geographic coverage of the island.

With the assistance of USAID and CIDA, the NWA carried out water feasibility studies for Montego Bay, Spanish Town, Mandeville, Ocho Rios and 4 small communities in the 1960s (IBRD, 1977). Between 1965-1973 an UNDP/FAO/GOJ project carried out ground and surface water investigations of the major basins in the island, presenting detailed development plans for a few. As of 1974 more than half of the island had been examined, including the following areas: Negril, Discovery Bay/Dry Harbour Mountains, Bull Savannah, Clarendon/Rio Minho, St. Catherine/Rio Cobre. In 1977 the Water Resources Division, which has assumed responsibility for continuing the project, was investigating resources in the Hope River, Upper Rio Cobre and Yallahs River Basins (White, 1979).

#### 3.7.5 Water Utilization

(Source: White, 1979)

##### groundwater

About 300-330 IMGD, or 67 per cent of the total water produced in Jamaica, comes from underground sources. Of the two main aquifers (limestone and alluvium

deposits), the limestone is the more extensive and has the higher yield, but the greatest demand is in the alluvium areas. As of 1977 there were 675 working wells on the island, ranging in depth from 15-1000 feet. The greatest concentration of wells (78 per cent of the total) is in the alluvium deposits of Clarendon and St. Catherine coastal plains where there is a high demand for water for irrigation and for domestic use in the Kingston Metropolitan Area. In some places on the plains these resources have been overutilized, resulting in salt water intrusion. Although the greatest potential for water production exists in the limestone regions of central and western Jamaica, these underground resources are relatively underdeveloped.

surface water

(Source: Chin, 1979)

Surface water development has received increased attention in the last decade and a half with the view of utilizing hydro-power potential and implementing groundwater use. Investigations have focused mainly on the Kingston-St. Andrews area (and to some extent the southern coastal plains) where surface resources are most concentrated, groundwater has been almost fully tapped, and a combination of rapid population growth and serious droughts (1968-69; 1975-76) have necessitated rationing during the dry season and have clearly established the need for developing new resources. There are two major obstacles to developing surface water resources. One is the variable streamflow; the other is the unfavorable geographic location of available resources relative to the area of greatest demand. This necessitates the construction of large storage reservoirs to compensate for variable flow and long conveyance systems to distribute water from locations of ample supply and low demand to areas of high demand. Both require large capital investment. Another problem is that the frequently high sediment load in the river systems due to the watersheds' susceptibility to erosion causes rapid siltation of reservoirs. The resulting continual reduction of their holding capacity imposes a severe constraint on the economics of any such schemes.

#### 3.7.5.1 domestic water supply

(Source: Jamaica. NPA, 1979a)

In 1977 82 per cent of Jamaicans had easy access to water supplies through house connection or standpipes. Coverage is much better in urban areas. Essentially 100 per cent of urban dwellers are served (97-99 per cent through house connections) compared with 74 per cent of rural dwellers (only 34 per cent through house connections) (Reid, 1979). Per capita daily consumption in urban areas averages 60 imperial gallons compared with 9 IG in rural areas (Harza and Chin, 1971). The following figures represent the water sold in 1978-79 by the controlling water bodies:

	<u>IMG*</u>	<u>IMGD*</u>	<u>note:</u>
Water Commission	10,500	28.8	-66,920 paying customers supplied
National Water Authority	16,609	45.5	-14,606 IMG sold to Parish Councils, 2000 sold directly to customers
Parish Councils	n.a.	---	in Montego Bay and Portmore

(Jamaica. NPA, 1979a)

### National Water Authority

Most of the water supplied by the NWA comes from wells with small volume reservoirs. The approach recently taken by the NWA for increasing supplies has been improvement and expansion of existing water schemes rather than construction of new ones. Construction of new facilities will, however, be necessary, and two new projects have recently been started with financial assistance from IDB. One project in Montego Bay/Falmouth involves 4 new wells which will add 1 IMBD to the existing supply. The second is construction of a water scheme for Mandeville, the funding for which was secured from IDB in 1979. In addition to these major projects in the late 1970s, the Inter-American Development Bank partly funded a rural water study which recommended extending or improving 129 existing water systems covering over 200 communities.

### Parish Councils

Little information was available on supplies provided by the Councils. During the financial year 1979-80 the work of the Councils (under a program entitled "Minor Water Supplies Programme") mainly involved maintenance and extension of existing domestic water supply schemes in rural areas.

### Water Commission

The Kingston-St. Andrew Metropolitan Area is served by both surface and ground-water supplies. The surface water supply is from rivers fed mainly by direct runoff, necessitating storage facilities to compensate for flow variability. Two reservoir systems serve Kingston: Mona Reservoir (capacity 825 IMG, reliable for 12 months) which derives its water from the Hope River, and the Hermitage Dam (393 IMG capacity, reliable for 3 months), fed by the Wagwater, Moresham and Ginger Rivers. Underground water supplies are available from limestone wells in Kingston and St. Catherine and alluvial wells in Kingston. Water supplies for the years 1976-1979 and projected demand are:

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\* IMG = million imperial gallons

\*\* IMGD = million imperial gallons per day

Kingston Metropolitan Area Water Supply (1976-1979)

	<u>Volumes (IMGD)</u>		
	<u>1977</u>	<u>1978</u>	<u>1979</u>
<u>Surface Supplies</u>			
Hermitage Reservoir	12.0	12.0	19.0
Mona Reservoir	4.5	4.5	8.5
total	<u>16.5</u>	<u>16.5</u>	<u>27.5</u>
<u>Underground Supplies</u>			
limestone wells	16.1	13.6	14.0
alluvial wells	3.1	3.1	-
Tulloch Springs	-	6.0	2.0
total	<u>19.2</u>	<u>22.7</u>	<u>16.0</u>
<u>Total Supplies</u>	35.7	39.2	43.5*

(Jamaica. NPA, 1979a)

Future Demand of Kingston Metropolitan Area and Nearby Communities

	<u>1975</u>	<u>1980</u>	<u>1982</u>	<u>1989</u>	<u>2000</u>
K.S.A., incl. Portmore/ Hellshire	41.6	51.7	55.7	70.8	97.9
Spanish Town	4.3	5.9	6.6	9.3	14.1
Bull Bay/Yallahs	0.7	1.2	1.4	2.3	3.8
total	<u>46.6</u>	<u>58.8</u>	<u>63.7</u>	<u>82.4</u>	<u>115.8</u>

(Chin, 1979)

The combined capacity of the existing resources (Hermitage and Mona Reservoirs and underground sources) is about 50.5 IMGD (Marston, 1979). These resources are being utilized near their capacity, yet demand still exceeds the available supply. Shortages have been exacerbated by droughts in the late 1960s and mid-1970s, resulting in rationing of water use for non-essential purposes during most dry seasons of the last decade. The need for developing new water resources is clear.

Short-term needs will be met by small, untapped sources now being developed. The World Bank has provided financial assistance for two water supply projects during the 1970s. The first (Kingston Water Supply Project or Rio Cobre Scheme), executed between 1969 and 1976, increased groundwater production

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\* increase in volume used directly attributable to greater rainfall increasing the supply.

by 7.5 IMGD by developing wells (Headwork Wells) and springs (Tulloch Springs). A current project (Kingston Sewerage and Water Supply) will include construction of wells near Tulloch Springs, in the Linstead Basin and in the Liguanea Plains, and intake works at Hall's Green. These works will have a combined capacity of 11 IMGD (IBRD, 1975).

Long-term sources of water are being studied and developed. A portion of the IBRD Kingston Sewerage and Water Supply Loan was allocated to a comparative evaluation of major water projects which had been proposed for the Metropolitan Area (including the Blue Mountain (study conducted by Harza Engineering Company), Rosemont Dam, Konigsbert Dam, Mahogany Vale, Devon Pen-Castleton Supply, Linstead Basin Groundwater Supply Schemes). In 1977 the consulting firm Tippetts-Abbott-McCarthy-Stratton (TAMS) in association with the local consultants Mattis, Demain, Beckford and Associates carried out this study. Based on the results, they recommended a long-term Water Supply Plan for the region. The majority of water would be imported from the northern slopes of the Blue Mountains by tunnels and long conveyance systems and stored in a large reservoir (also the general plan of the Harza Engineering Company's Blue Mountain Scheme proposed in the 1970s). The total cost was estimated at \$U.S. 29-37 million (1977 prices). The water supplied would meet the demands of the Metropolitan Area until the year 2000. Although it is not clear which water supply scheme the Jamaica Labor Party endorses (probably the Blue Mountain or TAMS scheme), the present government has indicated a commitment to implementing a large and costly water supply plan for Kingston (JLP, 1980).

### 3.7.5.2 Irrigation - present and proposed schemes

Irrigation accounts for the greatest portion (50-70 per cent) of water used in Jamaica (Wedderburn, 1974; Chin, 1979). Irrigation is practiced mainly on the island's prime agricultural land: the southern coastal plains of St. Catherine, Clarendon, and St. Elizabeth. Some irrigation water is supplied by private wells operated by the larger land owners, but most is provided by government-operated irrigation schemes. Most of the irrigation works are managed by Irrigation Authorities, with the exception of the Rio Cobre Irrigation Scheme which is operated directly by the Ministry of Agriculture. The four major schemes on the island are:

#### Major Irrigation Schemes

<u>Irrigation Scheme</u>	<u>Sources</u>	<u>Volume (IMGD)*</u>
1) Rio Cobre (35,000 ac)	Rio Cobre groundwater	76.1-112.1** 58.6
St. Dorothy (4,000 ac)	groundwater	n.a.

\* calculated from acre-feet using conversion: (ac. ft. x .0007423 = IMGD)

\*\* extraction in normal rainfall years is 76.1; 112.1 is maximum in high rainfall years.

Major Irrigation Schemes (cont.)

<u>Irrigation Scheme</u>	<u>Sources</u>	<u>Volume(IMGD)</u>
2) Cockpit River	Cockpit River	23.7
3) Mid-Clarendon	Rio Minho	11.1
	Milk River	8.9
	groundwater	178.0
	return flows	7.4
		<hr/>
		205.4
4) Yallahs River	Yallahs River	11.8*

(Chin, 1979; UNDP/FAO - GOJ, 1974c)

Studies carried out in the 1970s indicated that additional acreage could be brought into agricultural production if irrigated. Proposals aimed at developing additional water resources for this purpose have been presented. The needs and three major schemes suggested to meet these needs are discussed below.

- The UNDP/FAO study of the irrigation requirements of the Rio Cobre Basin (St. Catherine Plains) estimates that 20 per cent of the basin's land suffers from water shortages in most years. In addition, there are an estimated 11,452 cultivable acres now idle due to lack of irrigation. To meet irrigation needs, it is recommended that irrigation efficiency be increased to 60 per cent from the present low level of 40 per cent (caused by inadequate control of water diversions and inefficient application and use of water) and that an additional 30.6 IMGD of groundwater resources from the Linstead Basin be developed (UNDP/FAO - GOJ, 1974a)
- About 16,400 more acres in the Clarendon Plains could be brought into production if an additional 30.5 IMGD of water were supplied for irrigation. It is proposed that this be done by damming the Rio Minho and Pindars Rivers (mid Clarendon, Pindars Dam Scheme) and increasing irrigation efficiency to 60 per cent (Chin, 1979; UNDP/FAO, - GOJ, 1974a; JLP, 1980).

The new government has announced intentions of examining a proposal to collect, treat and distribute waste water from Kingston to the St. Catherine and Clarendon Plains to satisfy irrigation needs (JLP, 1980). The combined benefits of waste disposal, nutrient re-cycling and provision of needed irrigation water could be very effective, provided adequate safeguards against aquifer contamination are taken.

- The Black River Drainage and Irrigation Scheme would involve flood control, irrigation and drainage on about 11,500 acres in the central part of the

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\* (1 cfs. = 0.59 IMGD)

Upper Black River Morass. Irrigation water would be supplied by diversions of the Black, North Elim and South Elim Rivers (Chin, 1977; Harza and Chin, 1976). Indications are that drainage on some areas of the Morass has already taken place, but no specific information on this was encountered in the preparation of the profile. The Seaga government has expressed an interest in diverting the Black River into southeast St. Elizabeth, thus draining 30,000 acres to be put into intensive agriculture (JLP, 1980). The ecological implications are enormous, and adequate assessments of the possible environmental impacts should be made.

### 3.7.5.3 Industrial Water Use

(Sources: Chin, 1979; UNDP/FAO - GOJ, 1974a, 1974b, 1974c)

Figures for the total industrial water use for the island were not available. The UNDP/FAO/GOJ studies on the major water basins carried out between 1965-1973 provide some data on industrial water consumption. Figures were available for St. Catherine, Clarendon, and Negril Basin, so only a partial view of industrial water consumption in Jamaica can be provided. Although it represents only part of the island, this information, given below, is useful in that it illustrates industrial use in relation to other uses:

#### Water Use (IMGD)\*

	<u>Clarendon</u>		<u>St. Catherine</u>		<u>Negril Basin</u>	
	<u>1971-72</u>	<u>2000</u>	<u>1972</u>	<u>2000</u>	<u>1973</u>	<u>2000</u>
agricultural	193.7	224.2	183.1	213.8	nil	0.2
municipal	7.0	17.4	7.6	38.0	0.4	5.2
industrial	37.0	56.9	33.4	37.5	nil	nil

Funds from the World Bank Loan (Kingston Sewerage and Water Supply Project) have been allocated for a survey of industrial water use on the island. When the report has been completed, a more precise island-wide picture of industrial water consumption will be available.

The largest industrial users in Jamaica are the bauxite operations. In 1972 the Alcan operation at Ewarton, St. Catherine consumed 3 IMGD. Sugar factories require a large volume of cooling water but the use is mainly non-consumptive as the water is returned to the fields for irrigation. Secondary industries, such as those heavily concentrated east of Spanish Town in the Twickenham Park area of St. Catherine are the other main users.

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\* calculated from acre-feet

### 3.7.5.4 Hydro-Power Generation

(Sources: Boyne, 1979; Hay, 1979)

Currently there are 5 hydro-power plants in Jamaica. They are located on rivers draining the White Limestone Formation, which provide a fairly high sustainable flow. Characteristics of these hydro plants are:

<u>River</u>	<u>Design Discharge - cfs</u>	<u>Installed Capacity - MW*</u>
Roaring River	100	4.0
Upper White River	225	3.2
Lower White River	180	4.5
Rio Bueno	170	2.4
Black River	300	6.0
		<u>20.1</u>

(Chin, 1979)

A steep increase in oil prices has prompted the investigation of alternative sources of hydroelectric generation. In 1976 the National Energy Commission contracted Motor-Columbus Consulting Engineers to do a general hydro-power survey of the middle and western regions of the island and a prefeasibility study of potential hydroelectric development in the Blue Mountain Region.

The survey in the middle and western regions indicated that the following 5 major rivers have a potential for 20 MW installed capacity and the capability to generate about 100 GWh annually:

<u>River</u>	<u>Installed Capacity (MW)</u>
Rio Cobre River	1.4
Martha Brae River	3.2
Great River	7.0
Y.S. River	1.7
Rio Minho	7.0
	<u>20.3</u>

(Hay, 1979)

Further studies are needed to more accurately assess their hydro-power potential and evaluate the economic feasibility of development. The Seaga government supports development of the energy potential of these rivers (JLP, 1980).

\* MW = mega watts

The prefeasibility study in the Blue Mountains in eastern Jamaica initially identified 31 possible schemes, of which 5 -- Mahogany Vale, Northern, Durham, Alligator Church, and Shot-Over -- were subsequently evaluated. The first two, also the largest, are mutually exclusive, but an economic evaluation concluded that Mahogany Vale would provide the greatest long-term benefit as it can supply both electricity (equivalent to 20 per cent of public energy generation) and sufficient water (95 IMGD) to supply the domestic water needs of the Kingston-St. Andrew Corporate Area until the year 2000. Details on Mahogany Vale and the other three schemes are:

	<u>Installed Capacity (MW)</u>	<u>Average Energy (GWh/yr)*</u>	<u>Investment Cost (\$10<sup>6</sup>)</u>	<u>Unit Cost ¢/KWh**(1979)</u>
Mahogany Vale	60	252	177.3	7.5
Durham	20	77	80.0	10.4
Alligator Church	6	33	24.0	6.7
Shot-Over	2	8	5.4	8.4

(Chin, 1979.)

Although in comparison with energy generating costs, none of the schemes are economically feasible, the Mahogany Vale Scheme is economically attractive when the additional benefit derived from water supply is considered. This scheme would involve building a 45000 acre-foot volume reservoir impounding the Yallahs River. Potential problems might arise from crossing the Blue Mountain Fault with tunnels and expected siltation of the reservoir.

In a pre-election statement of JLP policy, the present administration announced the intension to develop a 50 MW hydro-powered scheme in the Blue Mountains. (JLP, 1980). Although it is not clear, it is assumed that the reference is to the Mahogany Vale Scheme.

### 3.7.6 Need for a National Water Plan

In light of the facts that the demand for drinking water in the Kingston Metropolitan area has outstripped supply, there is full or over-utilization of some water supplies in some areas to the extent that it has resulted in salt-water intrusion, while in other places the groundwater resources are greatly under-utilized, there is growing demand for water for industrial use, increased agricultural production through irrigation, and revived attention on hydro-power; and the jurisdiction over water resource management is fragmented, there is an urgent need for the preparation and implemen-

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\* GWh = giga-watt-hours (10<sup>6</sup> Kilowatt hours)

\*\* KWh = Kilowatt hours

tation of a National Water Plan. In addition to providing a strategy for development of the resource to meet short and long-term needs, the plan would provide guidelines for siting new industries and locating new population centers to control the distribution of demand. The Water Resources Division has prepared a proposal for a study leading to a "National Water Resources Plan and has applied to USAID and IDB for assistance (Reid, 1980). This is clearly a priority need for the country and must be given adequate attention and support.

### 3.8 NATURAL AREAS AND WILDLIFE RESOURCES

#### 3.8.1 Overview of Natural and Scenic Areas Resources

(Source: Worthington, 1971; Jamaica. MFP, 1971a, 1971b)

Despite the long history of interest in Jamaica's flora and fauna, there has been little emphasis on natural areas conservation or management.

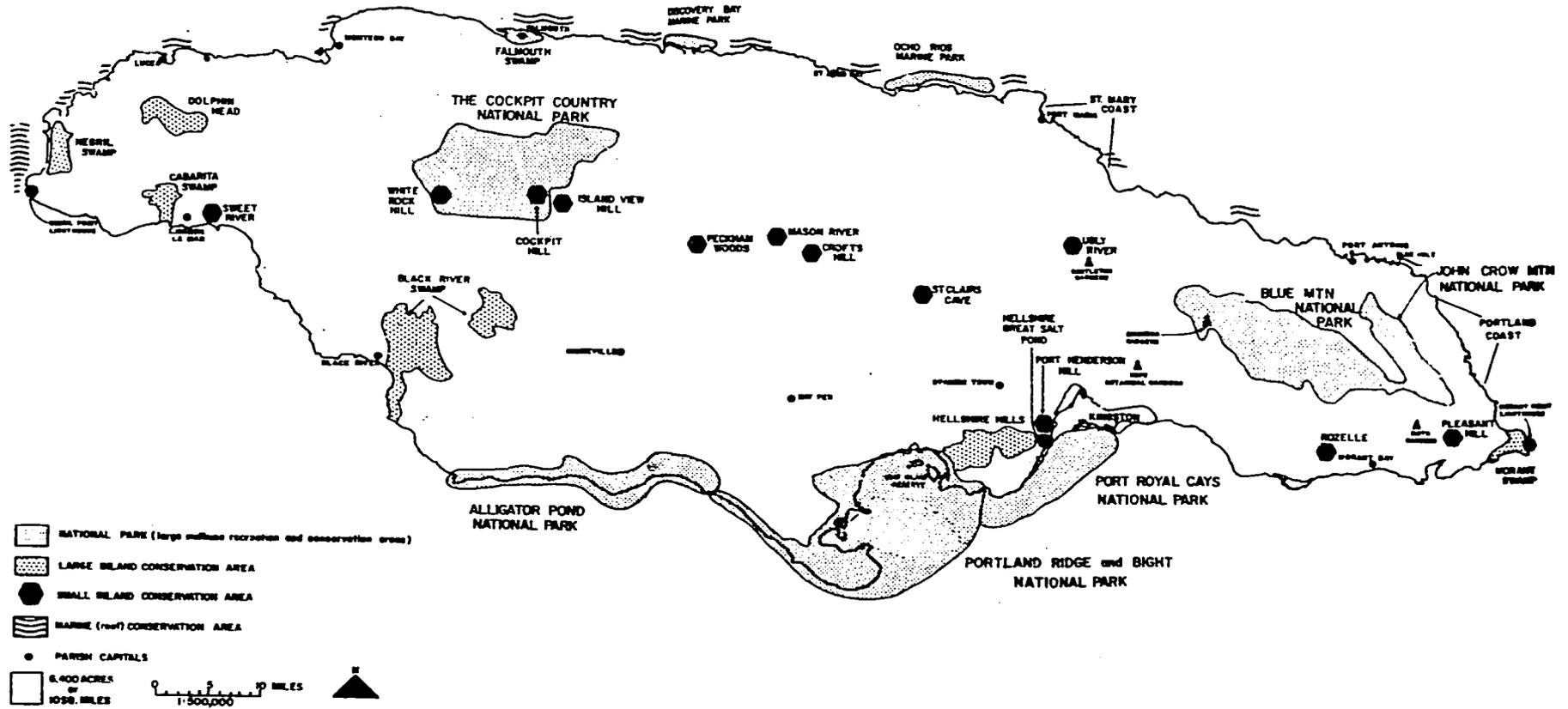
The natural history interest has translated into the establishment of four botanic gardens, a zoo and museums. The botanical gardens are at Bath, Hope, Castleton and Cinchona Hill; the zoological garden is at Hope. Proposals have been made for aquaria, one at Ocho Rios Marine Park or Discovery Bay, the other in the Kingston Area, in association with either Hope Botanic Gardens or the Port Royal Marine Laboratory. The major natural history museum has been developed in connection with the Institute of Jamaica. In addition to the museum and outstanding herbarium in Kingston, the Institute operates a small botanical field station at the Mason River Nature Preserve.

As for natural area conservation, besides the Mason River Preserve, the areas of Jamaica currently under some form of protection include Forest Reserves, which double as game sanctuaries under the Wild Life Protection Act, Crown Land and three marine parks. There are, however, many other sites of high recreational, scientific or aesthetic value. There is a need to extend protection and wise management to these areas as well as provide better protection for the existing Forest Reserves.

In the last decade and a half the government has been involved in work to assess the wildland resource (UNDP-sponsored study in 1968), has presented plans for natural areas preservation, set up an administrative body (Natural Resources Conservation Department), and revised laws to support protection of resources. These steps have been highly significant, but the financial and political commitments needed to ensure the successful maturing of these efforts are still insufficient (Jamaica. NPA, 1979a).

Figure 12

NATIONAL PARKS and CONSERVATION AREAS



source: Jamaica. NPA, 1971b

### 3.8.2 Sources of Information

#### existing information on natural areas

In 1968 an UNDP-sponsored team of resource planners, headed by Dr. C. Carlozzi, carried out a study of the needs and capability of Jamaica regarding establishment of recreational areas and national parks. The report produced was incorporated into the final report of the UNDP Physical Development Planning Team which became the basis for planning in the National Physical Plan 1970-1990. The Carlozzi report made full use of extensive knowledge about areas of scenic and ecological importance from people in government departments, U.W.I., the Institute of Jamaica, and existing literature. The National Physical Plan, therefore, provides an excellent foundation for establishing a system of protected areas.

#### existing information on wildlife

A succession of visiting and native naturalists have provided information on the natural history of Jamaica. These include Sloane (1687-88), Browne (1756), Long (1774), and Gosse (1844-5). The Institute of Jamaica houses a collection of fauna in its museum and periodically publishes treatises on Jamaican fauna. In this series, comprehensive coverage of herpetology (Grant and Lynn, 1940) and of marine and freshwater fishes (Caldwell, 1966) is provided. A substantial amount of research on Jamaican avifauna has been carried out by Bond (1971), Lack (1976), and Cruz (bibliography in Cruz and Fairbairn, 1980). Current research is mainly carried out through the Zoology Department at U.W.I., Jamaica. Marine biological research is conducted at the University's Port Royal Marine Laboratory on the Palisadoes and also at the Discovery Bay Marine Laboratory on the North Coast (St. Ann.)

### 3.8.3 Administration

(Source: Jamaica. NPA, 1979a)

The responsibility for environmental planning, management and control lies with the Natural Resources Conservation Authority (NRCA) and its service arm, the Natural Resources Conservation Department (NRCD). These were established in 1975 within the Ministry of Mining and Natural Resources, partly as an amalgamation of existing government bodies -- Beach Control Authority, Watershed Protection Committee, Wildlife Protection Committee, Kingston Harbour Quality Monitoring Committee, Marine Advisory Committee, Resource Planning Unit -- and partly by adding new functions, particularly in ecological research, information and natural areas management.

The Authority, made up of a 9-member board, advises the Minister on policy and also defines priorities to guide the activities of NRCD. The Department is made up of 5 divisions and is staffed by 11 professionals and 27 technicians (W.W.F., 1980). (See organizational chart, appendix III). While the responsibility for natural areas management falls to the Recreation and Conservation Division, activities of the different divisions are closely related and should be closely coordinated. The divisions and their areas of jurisdiction are:

- 1) Recreation and Conservation Division (Beaches Branch, National Parks Branch)  
 purposes: to plan, develop and manage national parks, beaches, unique scenic areas and ecological preserves; responsible for conservation of land, animals and plant resources and for provision of recreational facilities.
  
- 2) Watersheds Engineering Division (Watershed Branch, Engineering Branch)  
 purpose: to plan, design and maintain water management projects which include upland watershed management, river, flood and sea control.
  
- 3) Aquatic Resources Division (Water Quality Branch, Wetlands Branch, Oceanography Branch)  
 purpose: to survey, investigate, and monitor water quality, beaches, sea beds and wetlands.
  
- 4) Resource Management Division (Ecology Branch, Data Branch, Wildlife Branch)
  - i) Ecology Branch: to provide ecological input to planning and development process by working closely with the physical planning division and local authorities.
  
  - ii) Data Branch: to store, process, and distribute natural resource data, maintain a library of national and international references, and develop a public education program.
  
  - iii) Wildlife Branch.
  
- 5) Administration Division (Finance Branch, Personnel Branch)  
 purpose: to administer financial, personnel and training matters of NRCA/NRCD.

The fledgling NRCD has encountered many problems. Since to date much of the work has been done on a project basis, staff has been hired for limited periods. The rapid turnover creates management problems and hinders training programs. In addition, funding restraints have reduced the Department's effectiveness. Funding figures for the years 1978-81 illustrate both the financial constraints under which NRCD is operating and the relative priorities of NRCD and the government:

Capital Budget - NRCD: 1978-81 (in J\$ '000)

<u>Capital Programme</u>	<u>1978-79</u>		<u>1979-80</u>		<u>1980-81</u>	
	<u>requested</u>	<u>received</u>	<u>requested</u>	<u>received</u>	<u>requested</u>	<u>received</u>
Ecological Research	—	—	190	10	67	67
Watershed Conservation	1025	255	1364	560	1500	375
Beach Development	120	16	136	15	50	50
National Parks Development	18	7	130	—	—	—
TOTAL	1163	278	1820	585	1617	492

### 3.8.4 Legislation

(Sources: Jamaica. NPA, 1979a; Jamaica. Laws. 1973.) (see also appendix II)

The Parish Development order embodied in the Town and Country Planning Act is the legal means of controlling development so to provide for optimal land use (See also 3.1.5). The revised Orders, due to be completed by the end of 1981, include the following two paragraphs under the heading, "Conservation of Natural Resources":

"The Natural Resources Conservation Authority has indicated areas which are to be the subject of controlled management of development. These are areas of high natural productivity such as wetlands; areas of outstanding landscape beauty; areas of outdoor recreational potential; areas of special scientific interest due to the presence within them of unique flora or fauna; areas with vulnerable watersheds; flood plain areas; areas to be secured for public beaches, national parks, seaside parks, or access along coastlines and all coral reefs within the territorial waters.

These areas are shown on the accompanying map\* (with exception of submarine resources) and only developments which are in harmony with the policies of the Natural Resources Conservation Authority or such other Authority which Government may from time to time nominate will be permitted."

(Jamaica. NPA, 1979a)

The NRCDC recommends that areas given special attention should include not only the most pristine or scenic areas as described above, but also the most degraded.

Another legal change directed at protection of natural areas is the planned revision of the Town and Country Planning Act which will include a provision enabling the NRCDC to declare National Park Orders.

Presently the NRCDC works within the legal bounds set by the Beach Control Act, Watershed Protection Act and Wild Life Act. Work has commenced on amalgamating these into one comprehensive law. Until such work is completed, these laws will be in effect, but subject to revision by the NRCDC.

The Wild Life Protection Act (1945) established the Wildlife Protection Committee (whose duties now lie with NRCDC) to advise the government on protection and preservation of wildlife and to enforce the Law. All Forest Reserves were designated game sanctuaries, affording protection to all animals in these areas. In addition, the Law prohibits killing the manatee, monk seal, iguana, hutia, crocodile and all non-game birds except for a few pest species. A hunting season may be called annually for specific game birds, but this option hasn't been exercised since 1974. (Plotkin, pers. comm). Turtle and fish also

\* Map not available.

are afforded some protection under this law. Adherence to and enforcement of the Law is slack; illegal hunting continues. At one time the Wildlife Protection Committee had a limited field staff of Game Wardens; however, they were unable to enforce the Law (Bryan, c. 1970; unpubl. paper). The NRCD is presently establishing a system of Conservation Wardens (NRCD, c. 1980). Habitat modification in Forest Reserves by forestry and other uses may require that some areas now in reserves be designated wildlife sanctuaries in their own right. In addition, this protection should be afforded to valuable wildlands not within a Forest Reserve. There are needs to update the Law so to include endangered species not now given special protection.

The Beach Control Act (1956) empowered the Beach Control Authority (now the NRCD) to control and regulate the use of the sea floor, overlying waters, foreshore and beaches. The Authority could declare any part of the foreshore and sea floor a protected area, where controls would be put on fishing, use of motor boats, disposal of waste matter, dredging or disturbance of the sea floor, and removal of sedentary marine life. As for enforcement, control of fishing, motorboating and sand removal needs to be strengthened.

The Watersheds Protection Act (1963) established the Watersheds Protection Committee, whose powers are now vested in the NRCD. The Committee was given the duties of promoting soil and water conservation programs, providing assistance and building soil and water conservation structures, and regulating land use practices (especially agriculture) within watersheds particularly those most seriously degraded watersheds subsequently "declared" under the Law (see also 3.3.3).

### 3.8.5 Training

#### professional training

(Source: WWF, 1980)

Professional training in wildland resources is available at U.W.I., through B.Sc. and occasionally M.Sc. degrees in zoology (Mona, Jamaica), biology (Cave Hill, Barbados), and biological sciences (St. Augustine, Trinidad). Courses available through these departments are:

zoology: animal ecology, marine ecology, coastal management, fisheries, aquatic sciences

biology and biological sciences: ecology, marine biology, applied ecology, environmental studies

U.W.I., Barbados planned to offer B.Sc. courses in fisheries biology and aquaculture in 1980-81. In September 1981 U.W.I., Jamaica is to start a M.Sc. Fisheries degree program which will train 15 people annually. The courses offered will include marine fisheries, inland fisheries and water bodies management.

The capability of U.W.I. to train professionals in fisheries is quite adequate. The 12 professionals in Jamaica's fisheries division were trained at U.W.I., Jamaica. There is a need, however, to strengthen training in park,

wildlife, watershed, and soil management. The courses currently available provide a basic foundation for resource management but no specialized training. Two suggested approaches to meeting these needs are providing short, specialized post graduate training, or establishing a regional Natural Resources Management at U.W.I. (Trinidad) (Jackson, 1980).

#### In-services technical training

Due to the lack of past activity in the natural resource management/conservation fields, internal in-service training by NRCDC is weak, and at this point is perhaps best provided, although limited and sporadic, through international assistance projects with training components. On the short-term, until formal education programs are set up, this is an effective way of providing training. Requests should be made by Jamaica for assistance in natural resources training, and bilateral and multilateral programs should include training components to strengthen Jamaican capabilities. One project which was planned for the late 1970s (no information was available on whether it did take place) was an 18 month training project in park development and management to have been provided by Parks Canada (through CIDA funding) to the Parks Branch of NRCDC's Recreation and Conservation Division. This exercise was to have taken place in 1977-78 in the Negril Swamps (Cotterell, 1977).

To encourage and coordinate regional and subregional efforts, the World Wildlife Fund (under USAID sponsorship) carried out a study of the training facilities and needs in Latin America and the Caribbean in the natural resource and environmental field, which proposed the initiation of a Regional Training Project (WWF, 1980). The Project would, on regional, sub-regional and national levels, assess training needs, stimulate and sponsor training-related activities, coordinate efforts among national entities, and bring together potential donor and recipient institutions.

#### 3.8.6 Information and Public Environmental Education

(Source: Jamaica. NPA, 1979a)

At present there is a need for generating public interest and involvement in environmental issues. This need is being addressed by NRCDC. Each division has a public environmental education strategy. The Data Branch of the Resource Management Division has the responsibility of developing a public education program on an island-wide basis and a library information system.

NRCDC has been designated by UNEP to be the Jamaican focal point for the International Environmental Information Network. NRCDC is therefore responsible for identifying, registering, and supplying information to all environmentally involved organizations on the island.

#### 3.8.7 Ecological Research and Monitoring Activities

In the last several years, the NRCDC has been involved in several ecological research and monitoring activities, many with international assistance. CIDA has provided funds for a study of the biology and water quality of the

Negril and Black River Lower Morasses carried out between 1977-79. Training and equipment provided form the basis of NRCD's present water quality and ecology laboratory work. There is currently a feasibility study being done to assess the ecological effects of peat mining in these two swamps. This study is funded by the Jamaica Pre-Investment Programme and the Petroleum Corporation of Jamaica.

NRCD has also been involved in the Javemex (now Jamaica Bauxite Mining) Ecological Study, largely funded by UNEP. This study involves an ecological impact assessment of proposed alumina works in southern Manchester. Publication of the report was scheduled for 1980.

Two other current projects are concerned with protected animals: the manatee and the crocodile. The Organization of American States is funding the manatee conservation project, in which several of the animals are to be confined to the Alligator Hole River in south Manchester for purposes of scientific study and public education. The crocodile project, funded by the GOJ, involves establishment of a national conservation area in southern St. Elizabeth for the species.

### 3.8.8 Wildlife Resources

As consistent with the theory of island biogeography, Jamaica is low in faunal diversity but high in endemism. Species lists include 6000 insects and 280 native terrestrial or freshwater invertebrates. The vertebrates include 10 freshwater fish, 15 frogs, 30 reptiles, 200 birds, and 24 mammals (the hutia and manatee -- both endangered -- and 22 bats) (Woodley, 1968). The endemics include 27 bird species, 18 (of the 133) butterflies, and many of the bats, frogs and reptiles (NRCD, c. 1980).

The wildlife resources of Jamaica have been under constant pressure due to habitat destruction associated with land clearing for cultivation. This has resulted in limiting the distribution of many species to the most remote or un-hospitable areas of the island such as the Cockpit Country and Hellshire Hills. Some species have been so heavily utilized for food, such as the hutia, manatee and certain birds, that they are now endangered. Other species (e.g., black-billed parrot) have fallen prey to the pet trade. Snakes are often killed on sight under the faulty impression that they are dangerous. (There are no poisonous snakes on Jamaica.) Another threat to wildlife in Jamaica has been harvesting for commercial products as with the hawkbill turtle shells and crocodile skins.

Perhaps the most destructive event in terms of Jamaican wildlife diversity was the introduction of the mongoose (Herpestes griseus) to the island in 1872. The mongoose was brought to Jamaica to control the rat population on sugar plantations, but has had a tremendous impact on much of the island's fauna. At least 5 endemic species have gone extinct or are endangered as a result of predation by the mongoose, and many others have undergone population and behavior changes.

The species listed as endangered by the IUCN Red Data Book (1972) or by Mittermeier (1972) are:

THREATENED AND ENDANGERED SPECIES OF JAMAICA

<u>name</u>	<u>local name</u>	<u>scientific name</u>	<u>status</u> *
hutia	coney	<u>Geocapromys brownii</u>	V
manatee	sea cow	<u>Trichechus manatus</u>	V
Caribbean monk seal	Pedro seal	<u>Monachus tropicalis</u>	N,X
American crocodile	alligator	<u>Crocodylus acutus</u>	CN
Jamaican iguana	guana	<u>Cyclura collei</u>	N,X
lizard	galliwasp;gully asp;yellow wasp	<u>Celestus(Diploglossus)occiduus</u>	N,X
skink	snake waiting boy;wood slaves	<u>Mabuya spilonotus</u>	N,X
snake	black snake	<u>Alsophis ater</u>	N,X
Jamaican boa	yellow snake;nanka	<u>Epicrater subflavus</u>	N,X
Hawkbill turtle	— —	<u>Eretmochelys imbricata</u>	V
Jamaican plain pigeon	blue pigeon	<u>Columba inornata exigua</u>	I
Jamaican golden swallow	— —	<u>Kalochelidon euchrysea</u>	I
West Indian tree duck	whistling duck	<u>Dendrocygna arborea</u>	V
tundra peregrine falcon	— —	<u>Falco peregrinus tundrius</u>	N

- V = vulnerable
- N,X = endangered or extinct
- CN = critically endangered
- I = indeterminate
- N = endangered

(see appendix VII for details)

Of these species, the monk seal, snake, skink, lizard and iguana are probably extinct. The whistling duck and golden swallow, although critically endangered, have recently been sighted (Plotkin, pers. comm.). The hutia and boa appear to be slowly coming back.

In addition to the species listed above, the following have been named as species which may in the foreseeable future be endangered (Smith, 1968; Cruz and Fairbairn, 1980):

ring-tailed pigeon	- <u>Columba caribea</u>	- Portland hills	- shot for food
black-billed parrot	- <u>Amazona agilis</u>	- Cockpit Country	- crop damage, pet trade
'Jabbering Crow'	- <u>Corvus jamaicensis</u>	- Cockpit Country and Portland hills	- shot because of crop damage
masked duck	- <u>Omyura dominica</u>	- fresh water swamps	- swamp destruction
Caribbean coot	- <u>Fulica caribaea</u>	- fresh water swamps	- swamp destruction
glossy ibis	- <u>Plegadis falcinellus</u>	- mangrove areas of Kingston Harbour	- swamp destruction
white ibis	- <u>Eudocimus albus</u>	- mangrove areas of Kingston Harbour	- swamp destruction
terns	- <u>Sterna fuscata</u>	- Morant and Pedro Cays	- collection of eggs
	- <u>Anous stolidus</u>	- Morant and Pedro Cays	- collection of eggs

Whereas in the past, the mongoose posed the greatest threat to species, habitat destruction is probably the greatest direct threat today. The government has the power to provide increased protection of species and their habitat by passing (and enforcing) more comprehensive laws, and by considering wildlife habitats in drawing up development plans.

### 3.8.9 National Parks and Conservation Areas

(Source: Cruz and Fairbairn, 1980)

As already mentioned (section 3.8.2) Jamaica's National Physical Plan 1970-1990 provides guidelines for the establishment of a system of national parks and conservation areas (see figure 12). Each area is placed into one of two categories: 1) low intensity use areas and wildlands (national parks) and 2) nature reserves and archeological sites (nature preserves). A brief discussion of the major areas, their ecological importance and competitive uses facing them will be given.

#### upland areas

The upland regions recommended for protection include the Cockpit Country, Blue Mountains, John Crow Mountains and the smaller areas of Hellshire Hills, Portland Ridge and Dolphin Head Mountains. These areas are mainly covered by indigenous hardwoods. (See section 3.6.6)

Both the Blue Mountains (100 sq. mi.) and John Crow Mountains (26 sq. mi.) are watershed areas for many rivers, are important areas for wildlife protection and scientific study, and (especially true of the Blue Mountains) have high scenic value. The vegetation in both areas is of the Lower Montane Rain Forest type, except the highest areas of the Blue Mountain which are covered with Montane Mist Forest. The John Crow Mountains provide habitat for the endangered hutia and may be the last refuge of the plain pigeon. Forestry operations are now being carried out on the lower slopes of both mountain ranges. At the higher elevations productivity is low, soils thin, and the steep and rugged conditions render any forestry operations

in either the Blue Mountains (UNDP/FAO, 1971) or John Crow Mountains (Roy Jones, pers. comm.) uneconomic. The National Physical Plan 1970-1990 recommends designating both areas as national parks.

The Cockpit Country (118 sq. mi.), a severely karsted region covered with dense wet limestone forest, is an important refuge for birds (including possibly the endangered or extinct golden swallow) and the Jamaican boa. The area has low recreational potential, but is of value for wildlife and scientific study, hence UNDP/FAO recommends it be designated as a nature preserve. However, fuelwood collection has been taking place on the margins, roads have been extended into the area, and extensive tracts in southern Cockpit Country have been leased to bauxite companies.

The Dry Limestone Scrub Forests of the Hellshire Hills and Portland Ridge have in the past been protected from human disturbance by their aridity. They are important wildlife areas. Portland Point is the last place in which the skink might still be found. The Hellshire Hills is one of the few places in which the Jamaican boa and hutia are still living and may be the last stronghold of the iguana and lizard. Both areas also contain interesting caves and Arawak archeological sites. The eastern Hellshires are now being developed as an extension of Kingston. The Hellshire Hills Development Project includes the establishment of two new towns with main road connections to Kingston. Associated activity will certainly have a large effect on the ecological conditions of the area.

#### wetland regions

There are approximately 70 square miles of wetlands or swamps in Jamaica. The major areas are the Negril, Cabarita, Black River, Falmouth, and Morant Swamps. The vegetation consists largely of reeds, mangrove species, and logwood (Haemotoxylum compechranum). These areas are important habitats for fish, in some places crocodiles, and birds, such as the endangered West Indian tree duck and the increasingly rare masked duck and Caribbean coot. These swamps have come under increasing pressure. The Black and Negril Morasses have been extensively drained for agriculture (rice and cattle raising) and the feasibility of mining peat for fuel from these areas is being studied (see section 2.2.2). No equally thorough assessment of the possibility of utilizing these areas as wetlands for wetland food culture (fish and shrimp), fiber production (reed or thatch palm), and recreational activities has been done.

The famous phosphorescent Rock Bay east of Falmouth has been destroyed by filling in the nearby mangrove for resort development. The development of Portmore, a large housing scheme to the west of Kingston, and the building of the causeway and bridge connecting this new area to the capital has destroyed much of the surrounding mangrove swamp. The filling of mangroves in Kingston Harbour is threatening Jamaica's largest known egret and heron

colony, including the only group of white ibis and largest group of glossy ibis on the island. South of Portmore, the development of the Hellshire Hills will make the Great Salt Pond, a coastal mangrove lagoon, more accessible and inevitably more susceptible to human disturbance. The Great Salt Pond is important as a nurseryground for fish and shrimp and an area of scientific interest (Reeson, 1970).

#### beaches and marine parks

Jamaica's irregular coastline provides many bays and beaches of commercial and recreational value. The north coast beaches are well protected by fringing reefs. The south coast is less protected by reefs but has numerous spits, bars and dunes. Half of Jamaica's 554 mile-long shoreline is considered usable. Only a small portion of this (14.2 miles) is accessible to the public through 128 public bathing beaches and 22 seaside parks (Jamaica. DOS, 1978). Some of these have changing and bathroom facilities, while others are in the process of being developed. In addition, there are many hotel beaches, most of which are available to the general public on a fee basis. There is also a total of 7 miles of fishing beaches. The development, management, and protection of beaches are the responsibilities of the individual Parish Councils. The Beaches Branch of the NRCD has only the power to inspect and advise.

There are three marine parks, all on the north coast. The Cornwall and Ocho Rios Marine Parks are protected under the Beach Control Act. Both are currently being developed as parks. As of 1977, the Discovery Bay Marine Park had not yet been protected under law (Gutterell, 1977).

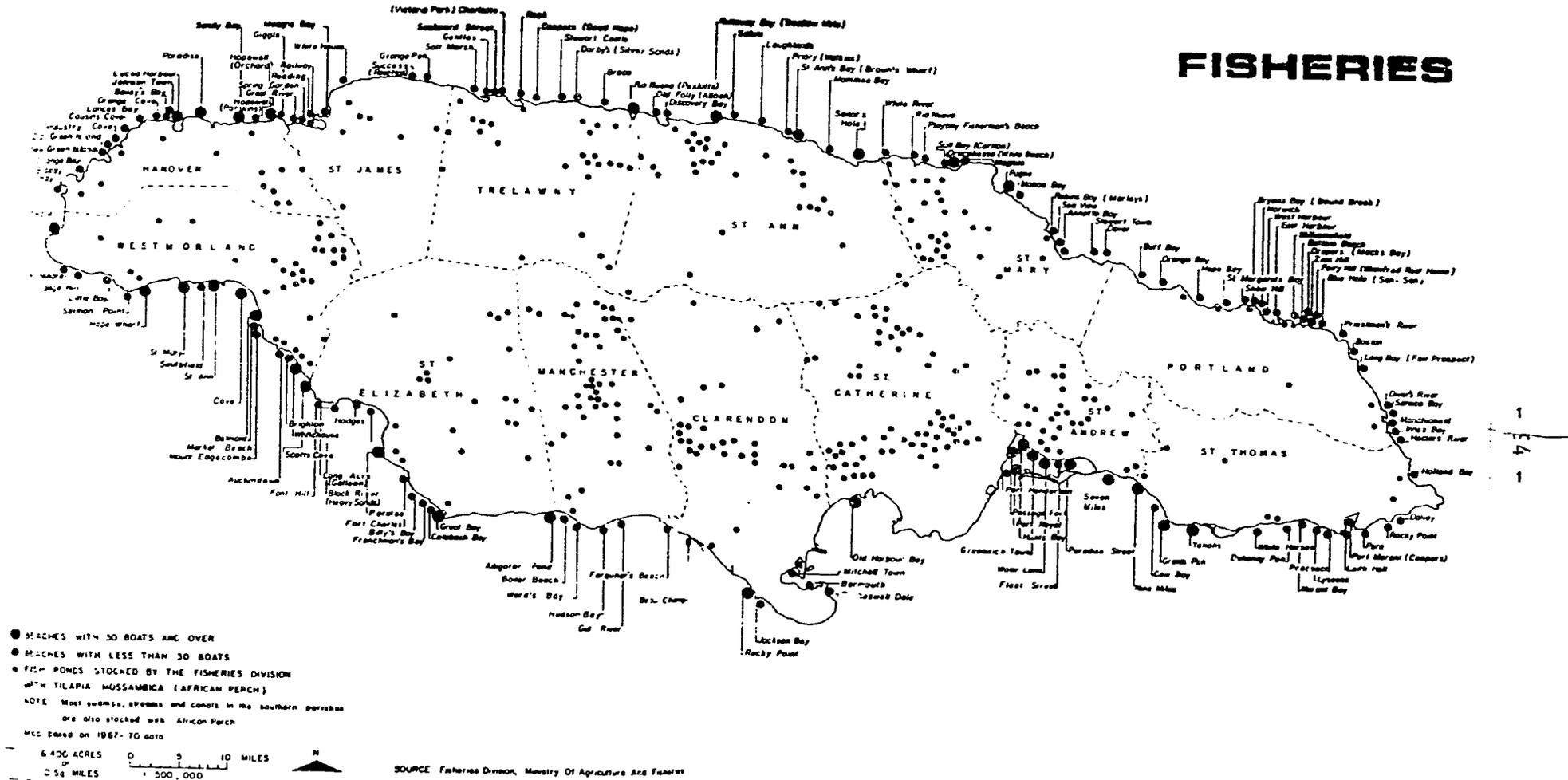
Protection of the beach and marine resources needs to be strengthened for ecologic and recreational reasons. Along the south coast the Port Royal and Portland Ridge Cays (including Goat Island, perhaps still a habitat of the iguana and boa) have been recognized as important areas to be set aside as national parks. On the north coast, the coral reefs are important in protecting the shoreline and in providing habitat to inshore fish on which the local fishery depends. Currently problems exist with illegal removal of sand, coastal pollution, and illegal collection of increasingly rare species (e.g., black coral). Another problem, which illustrates that in a small island ecosystem the management of coastal resources is inextricably tied to management of inland areas, is the destructive impact of high sediment load of rivers draining to the coast. Soil erosion control and controlled land use is critical not only to the inland areas but also the marine resources. Enforced protection must be guaranteed to several threatened species. Collection of hawksbill turtles which breed on the beaches, black coral, and the eggs of noddy and sooty terns from the Pedro and Morant Cays, have threatened the survival of these species (Cruz and Fairbairn, 1980; NRCD, c. 1980).

#### 3.8.10 Fishery Resources

Jamaica's fishing industry consists of marine fishery operations (inshore, offshore and cays fisheries) and very limited production from fresh water fish ponds. Jamaica produces only half the fish products it consumes. In 1976 an estimated 10,100 metric tons (MT) of fish were caught in Jamaica, and an additional 13,180 MT of fish valued at U.S. \$ 14 million were imported (FAO, 1978a and b). The same year only 4 metric tons (\$U.S. 7,000) were exported. Fish imports obviously represent a significant drain on foreign exchange.

Figure 13

# FISHERIES



source: Jamaica. NPA, 1971b

### marine fisheries

(Source: Munro, 1969)

Most of Jamaica's fishermen fish the narrow strip of coastal water surrounding the island. The fish resource has been depleted in these areas, but the fishermen are not equipped to venture further from shore. The offshore banks are four times as large but only a small portion, mainly the Pedro and Morant Cays, is exploited, and only to a small extent.

The fishing industry is largely dependent upon dugout and fiberglass canoes equipped with outboard motors. In 1978 there were about 12,000 fishermen operating 4,000 canoes from 160 beaches (Jamaica. DOS, 1978). (See figure 13). Half of the south shore and all the north shore canoes have outboard motors (Jamaica. DOS, 1977). Fishermen may range 60 miles from the coast in these boats, but generally stay much closer to land. In addition, there are about 150-200 canoes based on the Pedro and Morant Cays and Baja Nueva Bank (Jamaica. DOS, 1977). Ferry boats transport fish from there to the Kingston markets.

There are two main fishing techniques used in Jamaica. The most common method is trapping, done in shallow waters (20-130 ft. deep). The other method is handlining, mainly on the island shelf edge (about 360 ft. deep) but also in the shallower bay waters. Some trolling for large pelagic fish (barracuda, tuna, and kingfish), and net fishing with seine or gill-nets for small pelagic fish in shallow, sheltered areas are also practiced.

The most important economic species taken by hand-lining are the silk snapper (Lutjanus vivanus), black fin snapper (L. vivanus), black snapper (Apsilius dentatus), misty grouper (Ephinephelus mystacinus) and great amberjack (Seriola dumerili). From shallower waters the Nassau grouper (E. stratus), yellow fin grouper (Myceteroperca venenosa), little red hind (Ephinephelus guttatus), yellow butterfly (Cephalopholis fulva), and yellowtail snapper (Ocyurus chrysurus) are the principal species caught. The trap fishermen catch a greater variety of fish, including several species of grunts, parrot fish, small snappers, jacks, groupers, "welchmen", trigger fish, surgeon fish and butterfly fish.

Presently the nearshore fishing grounds, especially along the north coast, are overfished. There has been a successive decrease in the size of fish caught and fishermen have been forced to go further away to be ensured a profitable catch. The major problem is lack of regulation of trap fishing. Traps are quite commonly left unattended, trap mesh sizes are too small for the high intensity of fishing, and dynamiting is illegally practiced. There should be enforcement of minimum marketable sizes for individual species, restriction of the number of traps used or numbers of licensed fishermen, restriction of mesh size, enforcement of the law against dynamiting, and protection afforded to known nursery grounds such as the Port Royal Cays.

The resources of deep water seem to be the most promising for future development of the offshore fishery. The UNDP/FAO Caribbean Fisheries Development Project which undertook a study of the Caribbean's fishery resource and the industry's development during the 1960s and 1970s collected data suggesting that the deep water around the edges of the oceanic banks have large untapped potential.

These areas are out of reach of the shore fisherman, so utilization of this resource is possible only with larger boats. Fishing cooperatives have been formed in Jamaica, a few of which have acquired large, modern vessels equipped for hand-lining on distant banks.

Some other marine resources which need further development or management are the spiny lobster (Panulirus argus), the mangrove oyster (Crassostrea rhizophorae) and mussel (Perna perna).

#### freshwater fisheries

There are few desirable freshwater fish on the island. Introduced food fish include tilapia or African perch (Tilapia mossambica), carp and brown trout, but the tilapia is the only one which contributes significantly to the fishery (Caldwell, 1966).

Production through fish farming was apparently more active in the past. A consultant contracted by USAID to survey the freshwater fisheries of Jamaica in 1974 reported that the Fisheries Division had on file over 700 ponds and lakes covering an estimated 3500 acres (Pratner, 1974). (See figure 13.) These ponds had been stocked by fisheries officers but production was very limited. (FAO, 1978a). To revitalize the fisheries, the GOJ/USAID Inland Fisheries Project was initiated in 1976. In 1978 there was a total of 38 acres of active fish ponds, 12.5 acres of which were privately operated by 25 farmers. It was hoped that by April 1979 the production of the ponds between 1976-79 would have totalled 103 MT. (Jamaica. NPA, 1978). In 1979 it was reported that under the Project the Mitchell Town Pond System at the Moreland Food Farm in Southern Clarendon had been expanded to 80 acres. The production of tilapia fingerlings for distribution to privately-owned fish ponds is centered there. The pond system at the old inland fisheries center at Twickenham Park has been renovated as a demonstration and research facility. Work with three new species, Nile perch (Tilapia nilotica), grass carp (Carpus idellus), and mirror carp has been initiated.

#### administration and research activities

(Source: Jamaica. MOA, 1978)

The fishery industry is the responsibility of the Fisheries Division of the Ministry of Agriculture. The Division's duties include exploratory and experimental fishing, training fishermen, constructing modern shore facilities, encouraging and assisting fishermen's cooperatives, selling motors to fishermen through the Outboard Motor Scheme, and developing inland freshwater fisheries.

The training activities of the Division include limited training for fishermen to be deep-sea fishing captains. The three vessels owned by GOJ are used for this purpose. Training is also provided through the UNDP/Jamaica Commercial Fisheries Training Programme. These two programs involved a total of 24 fishermen in 1977-78.

Several research projects have been undertaken recently. Studies of the life cycle and harvesting of the spiny lobster were carried out with the assistance of UNDP/FAO. The studies concluded that although the lobster resource has good potential for economic development, presently it is being over-utilized, and conservation measures should be implemented. The Division has also been involved in a project to use tires to create an artificial reef at South Cay Lagoon. Expansion of this project to establish other artificial reefs along the north and south coasts has been proposed.

Another project has been an on-going beach landing study involving data collection on fish catch. In addition, other resource inventory work has been carried out on the off-shore fisheries. Under the Cuba-Jamaica Cooperative Fishing Research Programme which began in 1977, a Cuban vessel has made investigations of fish and lobster resources and oceanographic conditions. Three research cruises have been made to the south shelf, the eastern Pedro Banks, and the western coastal waters and southwest Pedro Banks. Also funded through this program is the Oyster Culture Project which involves a feasibility study of commercial production of local oysters.

## 4.0 ENVIRONMENTAL QUALITY

### 4.1 ADMINISTRATION

(Sources: Reid, 1979; CCS, 1978; Jamaica. NPA, 1979a)

The agencies with primary responsibility for environmental management in Jamaica are the Environmental Control Division of the Ministry of Health (professional staff of 20) and the Natural Resources and Conservation Department of the Ministry of Mining and Energy (professional staff of 11). In addition, there are many other agencies which provide supporting roles such as the Scientific Research Council (research on environmental sciences and technology), the National Planning Agency, the different water bodies, and the Ministry of Local Government. Jamaica is unusual in the Caribbean in that as of 1978, the ECD was the only government body in the region with sole responsibility for environmental control.

The ECD's jurisdiction is over quality control of drinking water and beaches, domestic sewage and industrial waste water control, solid waste disposal, and occupational health programs. The NRCDC is responsible for water quality in relation to conservation, beach control, development of national parks, and protection of wildlife, wetlands and watersheds. Both agencies operate under laws which are fragmented, often conflicting and unenforceable (see sections 3.7.3, 3.8.4, and appendix II). Standards for environmental quality, notably of water, are ill-defined or non-existent. Due to trained manpower shortages and financial constraints, monitoring activities are limited.

Action required for the future includes establishment of standards and criteria for water quality and the design of water, waste water and solid waste disposal systems; improved monitoring to ensure compliance with standards; revision of existing legislation and drafting of new laws; and implementation of development and training programs for environmental health workers.

The major environmental quality issues discussed below are water quality, sewage treatment, solid waste disposal, industrial waste (water and air pollution), occupational health, and coastal zone environmental quality.

### 4.2 WATER QUALITY

(Source: Jamaica. NPA, 1979a)

In 1979 roughly half of the total number of 1152 water supplies on the island were treated with chlorine. About 72 per cent of the population received treated water, 16 per cent untreated, and 12 per cent were not connected to an organized system (Jamaica. NPA, 1979a). The drinking water quality in Kingston is considered acceptable by WHO International Standards, but in rural areas the general standard of drinking water is considerably lower. In 1975 26 per cent of samples collected outside the Kingston area showed bacterial contamination (Reid, 1980). The areas with the highest percentage of positive samples were Portland, St. Catherine, St. Thomas and Clarendon. This was positively correlated with inadequate chlorination; 28 per cent of samples tested were either not treated or were inadequately treated with chlorine.

Due to the community settlement patterns in Jamaica, in all but a few remote areas, the streams are susceptible to pollution from domestic sewage, garbage, and in some areas, industrial wastes. Effluent from factories are commonly discharged untreated into nearby rivers (Le Bosquet, 1972). In addition, inadequately treated effluent from sewage treatment plants near Kingston is frequently discharged into storm water channels and gullies with little or no diluting water. There is evidence that stream quality is declining in Jamaica. Monitoring of coastal area streams has revealed a high proportion of streams with excess nutrient loading, high biological oxygen demand (BOD) resulting in oxygen depletion in the water, excess algal growth, turbidity, discoloration, and bacterial contamination (Varma, 1972; Jamaica. NPA, 1979a).

Sources of groundwater contamination include inadequately treated domestic sewage, industrial wastes, salt water intrusion, and bauxite red mud waste. High nitrate contamination in groundwater in the Kingston and St. Andrew region is attributed to the high number of septic tanks, absorption pits, and latrines. A high nitrate concentration has rendered certain groundwater sources from the Liguanea Basin unsafe to drink. Three wells (combined capacity of 3 MGD) were taken out of service in 1974 because of excessive nitrate concentration (IBRD, 1975). Increased levels of contamination were found in four wells which are now being closely monitored. The combined capacity of these 7 wells was 19 per cent of total 1975 water production in the Kingston area, representing a considerable threat to the metropolitan water supply, which is already being outstripped by demand.

#### 4.3 SEWAGE TREATMENT

(Source: IBRD, 1975)

In Jamaica there is a total of 80 sewage treatment plants (almost all secondary treatment) for domestic sewage and industrial waste water. About 21 percent of the urban population, but only 7 percent of the total population is served by sewage systems. Kingston and Montego Bay have limited sewage systems, while the rest of the urban and rural communities use septic tanks, absorption pits and pit privies. About 91 percent of the rural population is served by disposal systems in the form of individual septic tanks or privies, but sewer systems are practically non-existent in the rural areas.

In the Kingston Metropolitan Area there are about 20 sewage treatment plants, 10 of which handle industrial wastes. About 20 per cent of the population of Kingston is served by sewage treatment plants, two of which provide most of the domestic treatment. Considerable improvement and expansion of these facilities are needed. Other facilities in the KMA include small installations serving residential developments. Regulations require that sewerage systems are provided for urban subdivisions with the result that there are a number of scattered systems, mostly discharging into drainage channels, with little prospect of being integrated in a comprehensive manner. (Reid, 1979).

Outside the Kingston area, sewage systems are largely restricted to Montego Bay (1 plant) and resort areas. Many resort hotels are served by individual "package" sewage treatment plants. These facilities are often either overloaded or improperly operated and maintained. The result is inadequate treatment of sewage, which is usually discharged into the nearby coastal waters.

Sewage treatment capability in Jamaica is obviously inadequate. There is a need to improve and expand services throughout the island. Existing problems resulting from insufficient sewage treatment include contamination of aquifers and surface waters, serious pollution of Kingston Harbour (see section 4.7) and health problems. An indication of the seriousness of the deficiencies in quality is the continuing high incidence of water-borne diseases (65 cases of typhoid and 97 cases of gastroenteritis reported in 1977) (CCS, 1978).

In 1975 a World Bank Loan was made to Jamaica to begin a long-range sewage program in two areas of Kingston (IBRD, 1975). Recently, efforts have been made to promote re-use of treated water. In 1979 several government agencies studied the possibility of reclaiming treated wastewater in the Kingston area for irrigation of agricultural land in St. Catherine. In addition, one industrial operation used treated effluent for fish production (Jamaica. NPA, 1979a).

#### administration and legislation

(Source: Reid, 1980)

(See also section 3.7.3)

Authority for governing general water quality is fragmented. The National Water Authority, Water Commission and Parish Councils are responsible for provision of water supplies and sewage treatment for domestic and some industrial use. The NWA operates a water quality laboratory in Montego Bay. The Water Resources Division of the Ministry of Mining and Energy and the Parish Health Department carry out some monitoring of drinking water quality. In addition, the Ministry of Mining and Energy has jurisdiction over mining pollution and (through NRCDD) monitors surface waters in the interest of general environmental quality, and the Ministry of Agriculture has an interest in water quality from the standpoint of fisheries and irrigation.

The main responsibility, however, for water quality control of drinking water lies with the Environmental Control Division of the Ministry of Health and Environmental Control. The ECD administers the Drinking Water Quality Program in which 14 inspectors, operating in collaboration with the Parish Health Departments and Local Water Authorities, collect and evaluate water sample data, recommend necessary improvements of the systems and report any suspected cases of water pollution to the Director of Environmental Control.

Although the new Public Health Act (1974) makes provision for the Minister of Health to develop regulations on water quality control, this has not yet been done. Jamaica has informally adopted WHO International Standards for Drinking Water as a guideline for water quality criteria.

#### 4.4 SOLID WASTE DISPOSAL

(Source: Wright, 1972; Jamaica. NPA, 1979a)

Although for Jamaica as a whole, the storage, collection and disposal of solid waste is considered satisfactory, it is estimated that less than 25 per cent of the 340,000 tons of domestic and trade wastes generated annually in the Kingston Metropolitan Area are satisfactorily controlled (NPA, 1979). Much uncontrolled dumping occurs in gullies, drains, yards, empty lots, public places, streets and water bodies. The solid waste problem poses a major health risk and constitutes a source of pollution of water courses and coastal waters.

The refuse problem has in the past received only limited attention in Jamaica. Administration of services is generally deficient, collection and disposal unsatisfactory, and urban planners have largely ignored solid waste disposal as an aspect of planning. In response to the now obvious need for planning and careful management, in 1979 the GOJ examined the status of waste disposal in the KMA. A plan for solid waste management for the Kingston Metropolitan Area is presently being developed (Reid, 1980). The problem is greatest in the KMA, but a national policy should be developed to meet national needs. Means of disposal and appropriate sites must be decided upon and integrated with national and regional land use policy. In addition to better planning, increased technical expertise at the Ministry level and provision of an adequate number of vehicles and equipment are required.

#### 4.5 INDUSTRIAL WASTES

##### 4.5.1 Water Pollution

The principal waste-producing factories in Jamaica in 1972 were sugar and rum (16 factories), bauxite (5 alumina plants), citrus (2 factories), coffee (1 factory) and food (4 factories including 1 milk condensery) and, in the Kingston area, oil refining, brewery, meat packing and tannery factories (Le Bosquet, 1972).

The numerous cane sugar and rum factories are serious polluters. The discharge of "dunder" waste from rum manufacturing into streams and rivers is the most significant problem associated with the industry. The dunder, originating from molasses fermentation after the distillation of rum, is high in sugar, alcohols and yeast. It can impart bad odor and taste to the water, and its high BOD can cause anoxic conditions. Another method of disposal is using the waste water for irrigation, which has the potential to contaminate ground or surface water. The milk condensing, citrus and coffee factories discharge their untreated industrial effluents into nearby rivers (Varma, 1972). The problem of red mud waste has already been discussed (see section 2.1.2).

#### 4.5.2 Air Pollution

(Source: Campbell, 1974)

Since the 1960s air pollution has increased with growth of the industrial sector. Most of the gaseous and some of the particulate pollutants are related to the use of fossil fuels, mainly for power generation, but also for automobile transport. There has also been some problem with dust from the bauxite mining operations. The major sources of air pollution are:

Source	Location	Major Air Contaminants
Alumina Plants	Several (Rural)	a, b, c, e, f
Asphalt Plants	Ferry, White Marl	a, b, c, e, f
Vehicles	General	a, b, c, e
Battery Manufacturing	Kingston	Lead, acid aerosols
Cement Manufacturing	Kingston	a, b, e, f
Cement-Asbestos Plant	St. James	Asbestos particles
Garbage Dumps	Several	b, c, d, f
Gypsum Crushing	Kingston	f
Electricity Generating Plants	Kingston, Old Harbour	a, b, c, e, f
Oil Refinery	Kingston	a, b, e, f, H <sub>2</sub> S
Sugar Manufacturing	Several	a, b, c, d, e, f

a) Sulphur oxides                      d) Carbon dioxide  
b) Nitrogen oxides                    e) Hydrocarbons  
c) Carbon monoxide                    f) Particulates

There has been only limited research done on air pollution in Jamaica. There is a need for more data as well as a strengthening of legislation. Presently, the Clean Air Law (1961) does not provide an adequate basis for setting air quality standards. The law states that an owner of an operation discharging noxious or offensive air pollutants must use the "best practicable means" of controlling the discharge. Neither strict standards nor an adequate regulatory structure has been established.

#### 4.6 OCCUPATIONAL HEALTH

(Sources: Reid, 1980; Jamaica. MOH, 1978)

Satisfactory control of occupational health conditions is generally lacking; evidence is that the vast majority of Jamaican workers are regularly exposed to varying degrees of heat, noise, inorganic and organic dusts, fumes and inadequate sanitation. Surveys carried out by the ECD in 1978 and 1979 estimated that less than 10 per cent of the susceptible labor force is covered by adequate programs to protect the working environment and monitor worker's health (Jamaica. NPA, 1979a). Although cases of lead poisoning and other occupational diseases have been noted and industrial accidents are common, other than those provided by the recent ECD surveys, little specific

data exist on the prevalence of detrimental conditions associated with working environments. There is a need to define the scope and magnitude of occupational health problems and to implement adequate safety measures in working environments.

#### 4.7 COASTAL ZONE ENVIRONMENTAL QUALITY

Deterioration of coastal environmental quality results from disposal of inadequately treated wastes into coastal waters (through short sewage outfalls or into protected areas where dispersal is inadequate), physical alteration of the coastline, and oil spills.

##### waste disposal

The concentration of Jamaica's population along the coastline has resulted in wide-scale use of coastal water for waste disposal. Kingston and Montego Bay have municipal coastal outfalls of primary and secondary treated sewage effluent. In addition, sewage discharged into nearby coastal recreation waters by the package treatment plants of resort hotels along the north coast poses a potential health hazard. Increased industrialization especially in Kingston, St. Catherine and St. James, accompanied by lax restrictions on effluent quality have resulted in the deterioration of coastal water quality. Effluent discharge may pose a serious health problem through pathogenic pollution. Although WHO has recommended standards for bathing water quality, neither these standards nor adequate regulations have been adopted in Jamaica. Bacterial contamination exceeding WHO standards is particularly high near Kingston. Domestic and industrial discharges have also caused considerable organic pollution. The high BOD (resulting in oxygen depletion of the water), production of a soft sludge which covers the sea floor, and eutrophication (nutrient enrichment leading to floral blooms which may be toxic to marine organisms and which cause oxygen depletion) are detrimental to marine life and aesthetically distasteful.

##### physical alteration of the coastline

Waterfront housing development, especially in Kingston, Ocho Rios and Montego Bay, has involved dredge and fill operations. Physical alteration of the coastline by dredging, filling, bulkheading and river training may cause siltation, erosion, or current alteration. In Jamaica such activity has affected shipping lanes, fish nursery grounds and recreational beaches.

##### oil pollution

(Source: Wade, 1980)

Another form of pollution which is increasing in severity throughout the Caribbean is oil, often in the form of "tar balls." The principal origin of this pollution is discharge of bilge water from tankers and merchant ships. Tank cleaning is done at sea or (illegally) within harbors. Jamaica's most severe spill was the Portland Bight spill off the Clarendon and St. Catherine coasts in May, 1974, probably caused by a tanker cleaning its tanks after leaving port. The precise quantity of the spill is unknown, but is assessed at 300-3,000 barrels. The oil, contaminating an area of about 15 sq. mi., severely

damaged six miles of red mangroves and virtually eliminated the associated mangrove oysters and sessile organisms, resulted in the death of fish, shellfish, birds, and some intertidal and subtidal benthic organisms (e.g., turtle grass communities), severely fouled fishing and recreational beaches, and coated fishing and pleasure boats, necessitating that they be cleaned and repainted. Less severe but significant oil spills have occurred in Kingston Harbour, including two in 1979, one in April (less than 100 gallons) and one in October (several hundred gallons).

The responsibility for cleaning up oil spills rests with the Oil Control Committee, a joint venture set up in 1971 by the three oil companies on the island to handle operations in the event of an oil spill. There is an arrangement with the harbour master, water police and coast guard whereby a fleet of boats with trained crews is ready for rapid deployment to the area of a spill. The capabilities of the Committee are geared toward moderately sized local spills rather than larger spills in the open sea. If the Committee had been called to action in the Portland Bight spill (the spill was not reported to government authorities for at least a week), the facilities at the Committee's disposal would have been insufficient to contain and recover the majority of the spilled oil. Since that time, oil pollution surveillance, an alert network, oil clean-up methods and logistical support have not been significantly up-graded. There is a need to establish an effective national plan with trained personnel, adequate facilities and specialized services and to link it with sub-regional plans for preparedness and action against spills. In response to the recognized need for regional coordination and action for control of oil pollution, in 1979 the O.A.S. appointed Task Force of representatives from Caribbean countries met in Trinidad to draw up a contingency action plan for oil spills occurring in the Caribbean.

#### Kingston Harbour

(Source: Wade, 1972)

As the Kingston Harbour is the most intensively used of Jamaica's coastal bodies, the effects of pollution are greater here than anywhere along the coastline. In order to assess the degree of pollution, the Zoology Department of U.W.I., the Scientific Research Council and Beach Control Authority collaborated on the Kingston Harbour Research Project, based at the Port Royal Marine Laboratory. The results of the Kingston Harbour Study showed serious environmental degradation of the harbour and potential health threats (Wade, 1976).

While natural fresh water runoff by rivers and gullies is a major source of organic and nutrient input to the harbor, more than half of the input is from domestic and industrial wastes. Other pollution is derived from solid waste dumping and oil discharged by merchant ships using the harbor. About 15 sewage treatment plants discharging primary treated wastes a few feet from shore, illegal dumping by cesspool emptiers, and gully discharges of domestic wastes contribute to organic and nutrient pollution. Bacterial contamination substantially higher than WHO standards has been found in certain areas such as along the north shore of the harbor and the Port Royal waterfront. Serious oxygen depletion in most of the harbor water, but especially in the eastern portions where diffusion is worst, has been caused by high organic pollution and phytoplankton. Coincident with oxygen depletion, anaerobic sludge

beds have formed over large areas of the harbor bottom. The pollution has been responsible for documented declines in fish and invertebrate populations in parts of the harbor. By 1971 most of the bottom waters of the eastern end of the harbor (or almost a third of the total harbor area) was devoid of marine life.

Filling of swamp lands and the construction of the Kingston-Portmore causeway have altered currents in the western portion of the harbor, leading to siltation of shipping lanes and reduction of water circulation in Hunts Bay. This has exacerbated the oxygen depletion problem in the harbor and increased eutrophication of Hunts Bay which receives a high input of sewage waste. Solid waste dumping along the causeway and elsewhere has increased the amount of floating debris in the water. The other major problem is the fouling of beaches and boats, and destruction of marine habitats and organisms by oil pollution from frequent discharge of ships' bilge water within the port. Although this is illegal, powers of arrest and prosecution are ineffective.

The legislation to control coastal pollution is weak because the existing laws are vague and in many cases, unenforceable. Four of the most important laws relating to coastal pollution are: 1) The Public Health Law (1974), 2) The Harbour Law, 3) The Beach Control Law, and 4) The Wild Life Protection Law. The Public Health Law charges that discharge of a liquid or solid that is injurious to health is illegal. Since a major offender is sewage discharge, and the government is responsible for much of the discharge in the Kingston area, the law is seldom enforced. Monitoring of private outfalls is irregular so that sufficient data to support charges are seldom obtained. Under the Harbour Law, disposal of rubbish or oil into a harbor is prohibited. However, there is little or no patrolling at night, when most of the offenses are committed. It is difficult to provide tangible evidence to identify particular offenders, and the penalty is so small that it serves as little deterrent. As for the Beach Control Law, in the past it has been ineffective because the Beach Control Authority did not have research capabilities to develop objective criteria and standards for issuing licences, and once licenses were issued, monitoring of activities was seldom done. Perhaps now that the NRCD is the body responsible for the enforcement of the law, controls will be more effectively implemented. The provision in the Wild Life Protection Law which prohibits industrial waste discharge into any water body containing fish has seldom if ever been enforced. Effluents are not regularly monitored, and the small penalty is an insufficient deterrent.

The first major step in protecting the coastal environment is the establishment of objective criteria and standards on which regulatory bodies can base their control of waste discharge into waters and physical alteration of the coastal edge. Enforcement of these standards must be supported by effective legislation and effective enforcement bodies. In addition, the water bodies should be classed by priority needs to avoid conflict in use.

### Regional Environmental Programs

--(sources: UNEP, 1980a; 1980b; 1980c; 1980d; IUCN, 1979, 1980a)

Jamaica is involved in two regional coastal programs, one organized by the United Nations Environment Programme (UNEP) and Economic Commission for Latin America (ECLA), the other by the International Union for Conservation of Nature and Natural Resources (IUCN). The principal objectives of UNEP/ECLA's Caribbean Environment Programme are to ensure sound environmental management of the marine and coastal area and resources of the wider Caribbean region, to provide a framework for regional cooperation, and to affect policy-making so that it takes into account rational utilization of available natural resources. The vehicle for achieving these goals is the Caribbean Action Plan (CAP), the preparation of which has been in progress since 1975.

The CAP concentrates on coastal areas but makes reference to interactions between terrestrial, coastal and marine environments. The plan has two main purposes: 1) to provide basic background information on the natural resources (through development of a resource inventory and monitoring program) and 2) implementing projects. The Draft Action Plan includes projects in the categories of : protected natural areas, pollution control, coastal areas, fisheries, watersheds, natural disasters, energy, human settlements, tourism and environmental health.

The projects to be chosen for implementation will be financed through contributions made by Caribbean States and Territories participating in the Caribbean Action Plan, United Nations organizations and other international or regional organizations. The responsibility for disbursement of funds and coordination of the plan will lie with a Regional Co-ordinating Unit which will maintain links with the National Focal Point of each participating country. At the Intergovernmental Meeting on the Caribbean Action Plan in April, 1981, it was decided that the Regional Co-ordinating Unit would be located in Jamaica.

The second regional project is the IUCN's Strategy for the Conservation of Living Marine Resources and Processes in the Caribbean Region, initiated in 1978. IUCN's efforts and goals are complementary to the UNEP/ECLA Caribbean Action Plan, and efforts are being made to integrate both programs. The goals of IUCN are to support the management of living marine and coastal resources of the Caribbean for sustainable yields and to serve as a model for other areas or regions. In association with the project, data on the marine resources, which have been gathered since 1977, have been stored as a Data Base and graphically presented in a Data Atlas. The information will serve as guidelines for field projects to be implemented.

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ACRONYMSJamaican Entities

DOS	-	Department of Statistics
FD	-	Forest Department
ECD	-	Environmental Control Division
GOJ	-	Government of Jamaica
JLP	-	Jamaica Labour Party
MFP	-	Ministry of Finance and Planning
MME	-	Ministry of Mining and Energy
MOA	-	Ministry of Agriculture
MOE	-	Ministry of Energy
MOH	-	Ministry of Health
MOHEC	-	Ministry of Health and Environmental Control
MRLD	-	Ministry of Rural Land Development
NAC	-	Nutrition Advisory Council
NPA	-	National Planning Authority
NRCA	-	National Resource Conservation Authority
NRCDD	-	National Resource Conservation Department
NWA	-	National Water Authority
PNP	-	People's National Party
UWA	-	Underground Water Authority
UWI	-	University of the West Indies

International Entities

CCA	-	Caribbean Conservation Association
CCS	-	Caribbean Commonwealth Secretariat
CDB	-	Commonwealth Development Bank
CDC	-	Commonwealth Development Corporation
CFNI	-	Caribbean Food and Nutrition Institute
CFTC	-	Commonwealth Fund for Technical Cooperation
CIDA	-	Canadian International Development Agency
DANIDA	-	Danish International Development Agency
DEG	-	W. German international assistance agency
ECLA	-	Economic Commission for Latin America
EDC	-	Export Development Corporation
EDF	-	European Development Fund
EDI	-	Economic Development Institute (of the World Bank)
EEC	-	European Economic Community
EIB	-	European Investment Bank
FAO	-	Food and Agriculture Organization (U.N.)
GTZ	-	German Technical Assistance Corporation
IBA	-	International Bauxite Association

IBRD - International Bank for Reconstruction and Development (World Bank)  
IDB - Inter-American Development Bank  
IUCN - International Union for the Conservation of Nature  
NASA - National Aeronautics and Space Administration (U.S.)  
NORAD - Norwegian Agency for International Development  
OAS - Organization of American States  
ODA - Overseas Development Administration  
OPEC - Organization of Petroleum-Exporting Countries  
OPIC - Organization of Petroleum  
PAHO - Pan-American Health Organization (of W.H.O.)  
SAREC - Swedish Agency for Research Cooperation with Developing Countries  
SIDA - Swedish International Development Authority  
UNCTAD - United Nations Department of Technical Cooperation for Development  
UNDP - United Nations Development Programme  
UNEP - United Nations Environment Programme  
UNIDO - United Nations International Development Organization  
USAID - United States Agency for International Development  
WHO - World Health Organization (U.N.)  
WWF - World Wildlife Fund

ENVIRONMENTALLY RELATED LEGISLATION

Beach Control Act - June 1, 1956

(Laws: 63 of 1955; 11 of 1957; 12 of 1958; 5 of 1959; 25 of 1960)  
 (Acts: 14 of 64; 42 of 1969)

rights and restrictions

- rights to foreshore and sea floor vested in the Crown
- owner or occupier of land adjoining foreshore has rights of access and use for private domestic purposes (bathing, fishing, recreation)
- use of foreshore and sea floor for any public purpose or commercial enterprise prohibited unless licenced

protection areas

- the Minister, on recommendation of Beach Control Authority, may declare by order any part of the foreshore and sea floor protected, prohibiting except where licenced the following activities in the area:
  - i) fishing by any means specified in the order
  - ii) use of motor boats for certain purposes
  - iii) water skiing
  - iv) disposal of waste matter
  - v) dredging or disturbance of sea floor
  - vi) destruction or removal of coral, seafans and sedentary marine animals
  - vii) searching for or removal of any treasure or artifact from sea floor

Beach Control Authority established and given power to:

- i) grant licences for use of foreshore and sea floor
- ii) acquire land through lease or purchase (power of eminent domain provide)
- iii) maintain, use and develop beaches for benefit of the public
- iv) declare and make regulations governing use of public recreation beaches

Bauxite and Alumina Industries ( Encouragement Act)

(Cap. 37)  
 (Act 37 of 1967)

- requires bauxite or alumina producer to conform to specifications made by the Minister ensuring that the fertility and productivity of the land available in Jamaica for agricultural and pastoral purposes shall not be diminished to any greater extent than can, in the opinion of the Commissioner of Mines, be economically avoided.
- the Minister, on behalf of the government, may make agreements to encourage the alumina industry in Jamaica.
- important import and excise duty concessions given to recognized bauxite and alumina producers
- income taxes will be based on a fair assessment of the value of the alumina, based on current market conditions (note: this "fair assessment of value" was redefined with the Bauxite Levy in 1974)

Black River (Upper Morass) Reclamation Act

(Cap. 43, 1941)

- Black River Drainage and Irrigation Board established and empowered to:
  - i) prepare, execute and maintain within area any necessary reclamation, irrigation or drainage works
  - ii) keep clean, clear and navigable the water of the Black River
  - iii) purchase, lease and dispose of property for the purposes of the Act
  - iv) enter and inspect lands, and carry out works authorized by the Act
  - v) require land owners to clean watercourses
- illegal to damage works, obstruct water courses, damage banks of watercourse

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Clean Air Act - July 1, 1964

(Law 32 of 1961)

- administered by Central Board of Health  
Board may issue published order requiring owner of affected works to conform to law (improve quantity or quality of discharge)
- Minister appoints inspectors with power to enter and inspect  
Minister may alter list of noxious and offensive gases\*
- owner of every affected premises shall use best practicable means (defined in context of local conditions, financial circumstances, and current state of technical knowledge) for:
  - a) preventing escape of any noxious or offensive gas
  - b) preventing discharge of any such gas into the air
  - c) rendering such gas, where discharged, harmless or inoffensive

\* noxious or offensive gases (including particulates) defined as discharges from alumina, cement, lime, gypsum, petroleum (sulfur compound), electrical generating or sugar works

Country Fires Act - March 5, 1942

(Cap. 81)

(Law 46 of 1955)

(Act 6 of 1968)

- Act deems it illegal to set fire to any crop (excluding sugar cane) or trash unless notice served to occupiers of adjoining land and officer in charge of nearest police station and a space at least 15 feet wide is cleared of inflammable material; burning may be done only during daylight hours
- Minister may during specified periods and places prohibit all trash burning without a permit.

Factories Act - August 1, 1943

(Cap. 124)

(Laws 68 of 1956; 71 of 1958; 5 of 1968)

- Governor-General may appoint a Chief Factory Inspector (CFI) to supervise all factories and inspectors to carry out the Act
- all factories must be registered with CFI, and CFI must approve plans for construction of any factory or associated building
- regulations given concerning safety and sanitary conditions around and within factory; CFI may enter factory premises for inspection and medical examination; notification of accidents and industrial diseases must be reported to CFI which may conduct a formal investigation

Flood-Water Control Act - March 13, 1958

(Laws 28 of 1958; 4 of 1961)

- the Minister may designate an area as a flood-water control area and appoint an undertaker (government or statutory body) for land improvement works for flood-control if the power to do so is not vested in that body by any other law. The appointed body is responsible for submitting a flood-water scheme to the Minister and upon approval of the plans, carrying out the works of the scheme

The Forest Act - December 30, 1937

(Cap. 134)

- Minister given power to declare any Crown lands as forest preserves or prohibited areas and certain private lands as protective areas.  
Minister also has power to regulate transport of all timber, make regulations and require permits with regard to trees growing on Crown lands (including the preservation of trees of remarkable beauty or rarity)
- Authority for carrying out provisions of Act given to forest officials (under directives of Minister) (officials given power of arrest)

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Prohibited on forest reserves unless permission granted by Minister, forest officer, or through Commissioner of Lands:

- i) felling or damaging trees in any way
- ii) kindling or carrying fire
- iii) subjecting to any manufacturing process, conveying or removing any forest product
- iv) clearing or cultivating any land
- v) killing, wounding or capturing or attempting to do same, of any wild bird or animal
- vi) carrying or being in possession of any gun, rifle, or firearm (in exception given)
- vii) allowing trespassing or grazing of cattle
- viii) damaging, removing, or altering any landmark, wall, fence, etc.
- ix) carrying any saw, axe, adze or cutlass

Prohibited in prohibited areas:

- i) entering area without written permission by authorized officer
- ii) cattle trespassing
- iii) posting any advertising matter

Prohibited in protective areas:

- i) breaking up or clearing of lands for cultivation
- ii) pasturing of cattle
- iii) firing or clearing of the vegetation

- A forest officer may, with the sanction of the Minister, carry out work on the private land designated a protective area, and with the Director of Surveys carry out inspection and survey of the land.
- The owner of a protective area is compensated by remission of property tax and may also be entitled to compensation for annual revenue forgone as a result of restricting use of the land.
- If the owner fails to comply with regulations, the Government may assume control of the land or purchase.
- An owner may request that his lands be managed as a forest reserve on such terms as may be agreed upon.

Harbours Act - January 1, 1874

(Cap. 145)  
(Acts 1 of 1963; 42 of 1969)

- empowers Marine Board to regulate use and activity within harbors
- prohibits ships to deposit rubbish, mud, oil or any oil residues into the harbor or any channel leading to the harbor except where specifically permitted.

Irrigation Act - November 23, 1949

(Cap. 168)  
(Laws 40 of 1955; 72 of 1956)

- Minister has authority to declare an irrigation area or restricted area
- an Irrigation Authority is to administer an irrigation area
  - duties: i) carry out studies to propose irrigation schemes to the Minister
    - ii) establish, manage, operate and control irrigation works
    - iii) distribute water under irrigation schemes
  - powers: i) drain land
    - ii) abstract, divert, impound any water in any public stream or underground water
    - iii) enter any land within Ministry's boundaries; inspect and work on land under any irrigation scheme
    - iv) require owner within the irrigation area to clear drains
    - v) impose annual irrigation rates
- prohibits obstruction of or damage to irrigation works, waste water conserved by works, or resell water without Authority's permission

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- abstraction is controlled within irrigation or restricted area; licence must be obtained from Authority to construct or extend works for underground water for anything but domestic use.

Kingston and St. Andrew's Water Commission Act - January 8, 1937

(Cap. 194)  
 (Laws 33 of 1956; 59 of 1956; 14 of 1958; 10 of 1959)  
 (Acts 55 of 1964; 28 of 1965; 10 of 1968; 42 of 1969)

- established the Water Commission, given power to maintain, control and supervise watersheds and sewerage within the Kingston and St. Andrew Corporate Area

Kingston and St. Andrew Water Supply Act - March 20, 1941

(Cap. 195)

- Kingston and St. Andrew Water Commission given rights to use of water and construction of water works on Ferry River system, Wag Water River, Iron, Plantain and Ginger Rivers. Provisions made for land or easement acquisition and compensation paid for damage sustained as result of powers exercised under the Act.

Land Acquisition Act - May 22, 1947

(Cap. 204)  
 (Law 48 of 1955)  
 (Acts 3 of 1968; 42 of 1969)

- power of eminent domain vested in government for lands needed for public purposes.

Land Authorities Law - November 1951

(Cap. 205)  
 (Act 19 of 1969)

Land Authorities established (Yallahs Valley, 1951; Christiana, 1959; 11 others (1969)) and each entrusted with following functions and power:

- i) encourage efficient utilization of land within area of jurisdiction
- ii) encourage, assist, or participate in improvement work by private sector
- iii) prepare provisional compulsory improvement schemes (local basis)
- iv) prepare and submit to the Minister plans for afforestation, rehabilitation and development of relevant improvement area on a regional basis
- v) make by-laws (to be approved by Minister) for ensuring proper, efficient and economic utilization of and by prohibiting, restricting, or regulating planning and cultivation of specific crops in certain areas
- vi) power of inspection of private lands

Enquiries and appeals to be directed to the Arbitration Board for the particular Authority

Land Clauses Act - June 27, 1872

(Cap. 207)  
 (Act 33 of 1965)

covering land transactions by purchase or lease and stipulations for compensation.

d Development and Utilization Act (Idle Lands Law)

(Act 22, 1966)

- "agriculture" defined as fruit, seed and vegetable production, horticulture, forestry, livestock production
- law applied to land holdings over 50 acres
- Land Development and Utilization Commission established and empowered to inspect private agricultural lands; acquire, hold and dispose of underutilized land

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- arable land not used for an agricultural purpose for two years or more is considered "idle". The Commission may issue an idle lands order and within 12 months review farming practices on the land. The Commission can then serve notice on the occupier requiring him to prepare and submit a farming development plan for the land. The plan must be submitted and approved by the Committee, or if rejected resubmitted with modifications. If the occupier fails to comply with the idle lands notice, submit a revised plan, or carry out the work proposed in the plan, the Minister has the power to acquire the land through purchase or lease. Appeals during the process are directed to the Minister.

Land Valuation Act - January 18, 1957

(Laws 73 of 1956; 41 of 1957; 23 of 1959; 15 of 1962)  
(Acts 44 of 1964; 29 of 1971)

- Commissioner of Valuations (appointed by Governor-General) administers Act; Commission shall make a valuation of unimproved and improved value of every land holding. The land is then taxed generally on unimproved value.

Mining Act - October 13, 1947

(Cap. 253)  
(Laws 38 of 1957; 39 of 1958; 43 of 1960)

- Act covers prospecting rights, licences, mining regulations, use of water, inspections and accidents, possession and purchase of minerals
- Governor-General may appoint a Commissioner of Mines and other officers to carry out Act
- restrictions given on mining sites; including restriction on mining on lands set apart for public purpose except where authorized by Commissioner
- unless licenced, Commissioner has power to close area to prospecting or mining for any specified mineral. Commissioner or person appointed by Commissioner may inspect mining operation and if found dangerous or defective the site may be temporarily closed.
- Mining leases may be obtained from Minister. Leases provide rights and restrictions on mining procedures and water use. (Special mining lease is granted for bauxite or laterite mining.)
- Water use:
  - i) illegal to dam or divert public water without Minister's consent
  - ii) illegal to in the course of prospecting or mining permit any poisonous or noxious matter to be discharged into any public water in such a quantity to be injurious to animal, fish or vegetable life
  - iii) a "water right" may be granted by Minister for use of water for proper working of operation, processing or transporting minerals mined therein.

National Water Supply Act - November 28, 1889

(Cap. 270)  
(Laws 36 of 1937; 68 of 1958; 17 of 1959; 27 of 1959; 34 of 1959; 16 of 1972)

- applies all but Kingston and St. Andrew Metropolitan area
- Parish Councils empowered to:
  - i) apply to Minister to authorize construction, enlargement or improvement of water works
  - ii) acquire land (under Land Clauses Act), rights or easements, and sell Lands not needed
  - iii) alter roads for water supply purposes
  - iv) enter premises for inspection purposes

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Town and Country Planning Act

(Law 42 of 1957)  
(Act 42 of 1969)

- Advisory Planning Committee established to carry out provisions of the Act and advise Minister
- Town and Country Planning Authority made responsible for preparation and notification of provisional development orders
- object of provisional development order is to control development (defined as building, engineering, mining or other operations in, on or under lands) on specified lands

Each order:

- 1) defines clearly the area to which it relates
  - ii) contains provisions for prohibiting or regulating development of land
  - iii) provides for granting permission from local planning authority (Kingston and St. Andrew Council or appropriate Parish Council) for developing land
- provision made for compensation of land owners under some circumstances brought about by enforcement of the law

Underground Water Control Act - April 3, 1962

(Law 57 of 1959)  
(Act 42 of 1969)

Under Water Authority established and empowered to promote conservation and proper use of underground water, control water exploitation, gather or request hydrological data on wells, boreholes and other works, inspect private works, and issue licences

- the Minister may declare an area to be critical, so that special conservation measures are observed; the order comes into operation only after approved by both Houses of Parliament.
- critical area restrictions
  - no person shall in a critical area construct or extend a work for the purpose of abstracting underground water from other than domestic use unless he has obtained a licence from the Authority. (Experimental boring is permitted but notice must be given to the Authority)
  - abstraction of water in the critical area is controlled under certain condition and at certain times by the Authority
- anyone drilling a well over 50 feet deep must notify the Authority of the intention and keep records which will be accessible to the Authority

The Water Act - July 31, 1922

(Cap. 410)

- definitions: primary use - for domestic use and watering of stock necessary for ordinary farm and pen-keeping purposes
- secondary use - irrigation, watering of stock greater than ordinary purposes
- tertiary use - mechanical and industrial purposes
- riparian land - land through which or along which a public stream flows
- rights:
  - sole and exclusive use of private water belongs to proprietor of land on which is found
  - all water other than private water is vested in the Crown and subject to supervision by the Minister
  - use of public waters for primary use allowed where lawfully accessed, and for tertiary use if authorized by the Minister and quality is not diminished

- rights granted to riparian proprietors to use, divert, and impound public waters for primary, secondary and tertiary use (under certain conditions and in regard to upper and lower proprietors)
  - water used for secondary and tertiary purposes, if used in same watershed, must be returned to stream at nearest convenient point without diminution in quality, serve such as is caused by such use, so as not to interfere with primary or secondary use by other proprietors
- a petition may be transmitted to the Minister by two or more proprietors to authorize a combined irrigation scheme for a defined area
- provision given for water not used by riparian landowners to be taken onto non-riparian lands
- Minister may appoint an Irrigation Board for area of combined irrigation schemes or a number of irrigation schemes
- Minister may appoint one or more Water Courts to hear and determine disputes in connection with use, diversion and appropriation of water (membership, duties, and procedures for water courts given)
- Minister may construct or acquire any irrigation works and levy rates on beneficiaries

Water Supply Act - March 6, 1968

(Law 17 of 1958)  
(Act 10 of 1963)

- covers joint water supplies and transfer of undertakings by agreement between NWA, Water Commission, Kingston and St. Andrew Corporation or Parish Councils

Watersheds Protection Act - April 1, 1963

(Act 4 of 1963)

- Watersheds Protection Committee established with duty to:
  - i) promote and institute measures of proper, efficient and economic land use in watershed areas to promote conservation of water resources
  - ii) recommend to the Minister soil conservation programs within and adjoining watershed areas

WPC powers:

  - i) make regulations
    - a) promoting, regulating or restricting planting or cultivation of any specified crop;
    - b) prohibiting, regulating or restricting use of land for specified purpose
    - c) felling, barking or destruction of any trees or clearing or vegetation
  - ii) enter into agreements with land owners concerning improvement works on their lands
  - iii) acquire, hold and dispose of property
  - iv) authorize inspection of land within watershed
- Minister (upon Committee's recommendation) may declare watershed area, approve appointment of WPC and compulsory improvement schemes
- where owner of the land to be improved fails to enter into an agreement proposed by the Commission, Commission may prepare a compulsory improvement scheme whereby the improvements are carried out by the landowner or the WPC.

The Wildlife Protection Act - September 20, 1945

(Cap. 413)  
(Law 56 of 1960)

The Governor-General has power to appoint Game Wardens, Fishery Inspectors and other officers necessary for carrying out the provisions of the Act. These officers have the power to enter

The Minister has the power to:

- 1) make regulations to better carry out provision of the Act (regulations specified)
- 1i) designate Game Reserves upon written application of the owners or occupiers of any lands.
- 1ii) declare open hunting season for game birds\*\* and designate hunting days within the season.

restrictions: illegal to:

- 1) hunt or intend to hunt any animal or bird in Game Sanctuary\*
- 2) take or intend to take any egg or nest of any bird in a Sanctuary
- 3) take or permit entrance of a dog into a Sanctuary
- 4) carry in a Sanctuary any hunting weapon
- 5) hunt any protection animal\*\*\* or protection bird\*\*\*\*
- 6) hunt any game bird out of the shooting season or on days within the open season when hunting is prohibited
- 7) take, attempt to take or sell turtle eggs
- 8) take or kill or attempt to do so, buy or sell an immature fish
- 9) use dynamite and other noxious materials with intent to kill or injure any fish
- 10) add trade effluent or industrial waste into any fresh water or sheltered marine water body containing fish
- 11) obstruct or assault any Game Warden or Fishery Inspector

First Schedule

\* Game Sanctuaries

All Forest Reserves except Peak Bay Forest Reserve

Second Schedule

First Part

\*\* Game birds (56/1960)

Long-tailed peadove	<u>Zenaida macro ra</u>
ground dove	<u>Colmbigallina passerina</u>
whitewing	<u>Zenaida asiatica</u>
baldpate	<u>Colmba leucocephala</u>
whitebelly	<u>Leptotila jamaicensis</u>
Caribbean coot	<u>Fulica caribaea</u>
American coot	<u>Fulica americana</u>
Snipe	<u>Charadrius wilsonia</u>
plover or lapwing	<u>Squatarola Squatarolo</u>
ducks	all migratory species

Second Part (L.N. 308/1968)

(Note: these birds are defined as pest species and are not subject to any hunting regulation)

Jabbering crow	<u>Corvus jamaicensis</u>
pigeon hawk	<u>Falco columbarius</u>
chicken hawk	<u>Buteo jamaicensis</u>
Guiana parrotlet	<u>Forpus passerinus</u>
paroquet	<u>Aratinga nana</u>
petchary	<u>Tyrannus dominicensis</u>
starling	<u>Sturnus vulgaris</u>
kling-kling	<u>Quiscalus niger</u>
peadove	<u>Zenaida aurita</u>
water hen	<u>Gallinula chloropus</u>

Third Schedule (L.N. 24/1971)

\*\*\* protected animals

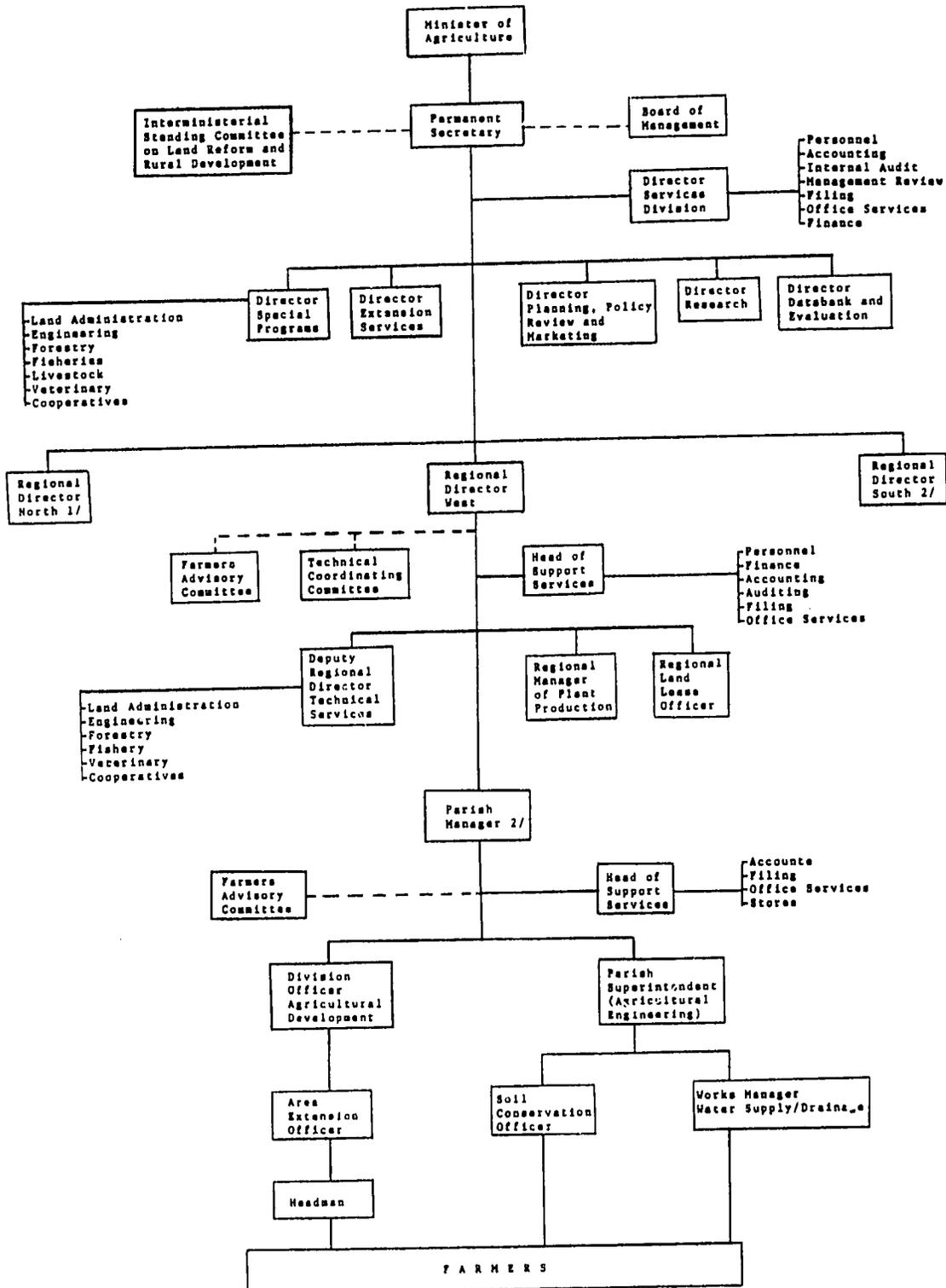
- coney
- crocodile
- iguana
- manatee
- Pedro seal

\*\*\*\* protected birds - defined as all those birds other than those in Second Schedule.

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ORGANIZATIONAL CHARTS

PROPOSED ORGANIZATION OF THE MINISTRY OF AGRICULTURE



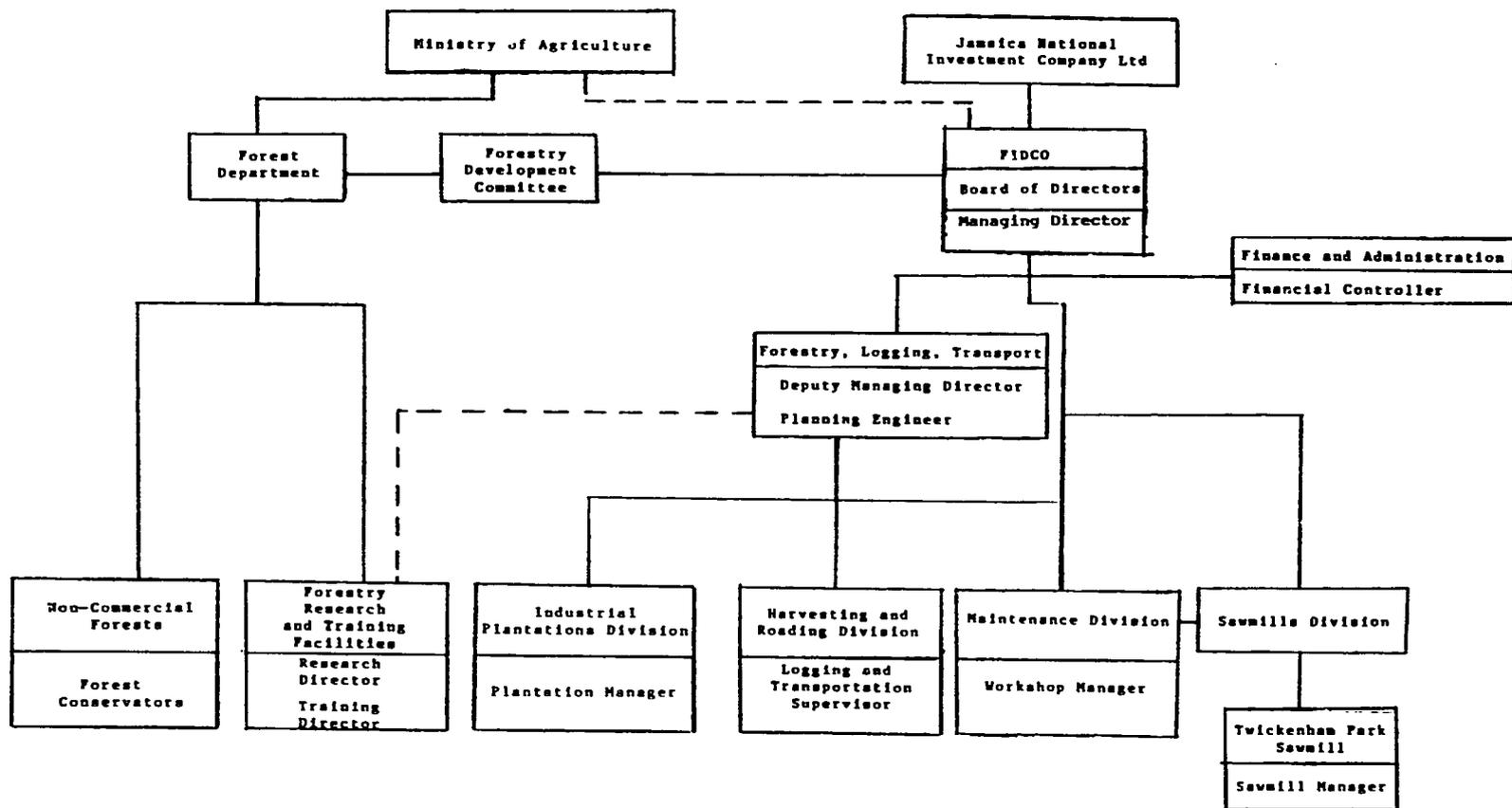
1/ With organisations similar to that of the Western Region  
 2/ There are five parishes in the Western Region and eight in the remainder of the country with similar organisations.

from IBRD, 1977  
 note that it is the proposed organisation for MOA, modifications may be expected

Best Available Document

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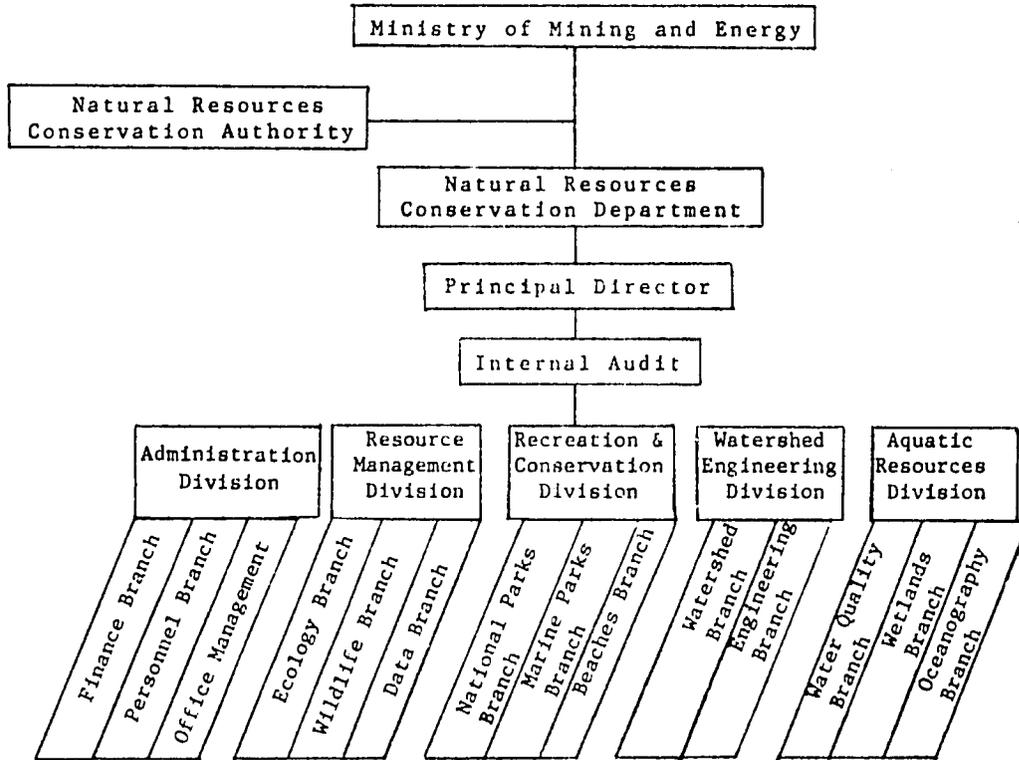
ORGANIZATION OF FORESTRY INSTITUTIONS



from IBRD, 1979b

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NATURAL RESOURCES CONSERVATION DEPARTMENT



from: Jamaica. NRCD, c. 1980

New Scheme of Land Capability Classification

A Treatment-oriented Scheme for Hilly Marginal Lands -

Slope \ Soil Depth	1. Gentle Sloping < 7°	2. Moderate Sloping 7° - 15°	3. Strongly Sloping 15° - 20°	4. Very Strongly Sloping 20° - 25°	5. Steep 25° - 30°	6. Very Steep > 30°
Deep (D) > 36 in. ( > 90 cm.)	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>	FT	F
Moderately Deep (MD) 20 - 36 in. (50-90 cm.)	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub> P	FT P	F
Shallow (S) 8 - 20 in. (20-50 cm.)	C <sub>1</sub>	C <sub>2</sub> P	C <sub>3</sub> P	P	F	P
Very Shallow (VS) < 8 in. ( < 20 cm.)	C <sub>1</sub> P	P	P	P	F	F

1. Symbols for most intensive tillage or uses:

- C<sub>1</sub> : Cultivable land 1, up to 7° slope, requiring no or few intensive conservation measures, e.g. contour cultivation, strip cropping, vegetative barriers, rock barriers and in larger farms, broadbase terraces.
- C<sub>2</sub> : Cultivable land 2, on slopes between 7° and 15°, with moderately deep soils, needing more intensive conservation e.g. bench-terracing, hexagons, mini-convertible terracing for the convenience of four wheel tractor farming. The conservation treatments can be done by medium sized machines such as Bulldozer D5 or D6.
- C<sub>3</sub> : Cultivable land 3, 15° to 20°, needing bench-terracing, hexagons and mini-convertible terracing on deep soil and hillside ditching, individual basins on less deep soil. Mechanization : limited to small tractor or walking tractor because of the steepness of the slope. Terracing can be done by a smaller machine such as a D4.
- C<sub>4</sub> : Cultivable land 4, 20° to 25°, all the necessary treatments are likely to be done by manual labour. Cultivation is to be practised by walking tractor and hand labour.
- P : Pasture, improved and managed. Where the slope is approaching 25° and when the land is too wet, zero grazing should be practised. Rotational grazing is recommended for all kinds of slopes.
- FT : Food trees or fruit trees. On slopes of 25° to 30° orchard terracing is the main treatment supplemented with contour planting, diversion ditching and mulching. Because of steepness of the slopes, interspaces should be kept in permanent grass cover.
- F : Forest land, slopes over 30°, or over 25° where the soil is too shallow for any of the soil conservation treatment..

(from Sheng, 1972)

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FOREST RESERVESLIST OF EXISTING AND PROPOSED FOREST RESERVES  
(from UNDP/FAO, 1973b)Eastern Division

<u>Forest Reserves</u>	<u>Acreage</u>	<u>Forest Reserves</u>	<u>Acreage</u>
Blue Mountain	73	Citron Valley	12
Lloyds	146	Kildare	21
Chepstowe	370	Windsor and Seaman's Valley	88
Norris	603	Caenwood	126
Dallas Mt. (Elletson's Run)	150	Grange Hill	2
Haycock Hill	363	Cambridge Back Lands	1,062
Blue Mountain	103,632	Spring Estate (Silver Hill)	149
Rockfort	1,812	Blue Mountain (Chestervale Plantation)	511
Ecclesdown	87	Fellowship	49
Orchard	350	Trumpet Tree	400
Water Commission Lands (Blue Mt. area)	4,499	Flamstead	61
Hope River Stream	57	Good Hope	55
Petersfield	300	Hope	72
Rock Spring	119	Wallenford and Cedar Valley	372
		Spring Pen	413
			<hr/>
			115,954

Area to be reserved

* Bellevue	223
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Central Division

<u>Forest Reserves</u>	<u>Acreage</u>	<u>Forest Reserves</u>	<u>Acreage</u>
Teak Pen	1,687	St. Faith's	136
Pennants (Douces)	78	Treadways	65
Pennants	564	Ballintoy	2,014
Armadale	72	Kellets-Camperdown	3,701
Peak Bay	1,275	Bull Head	543
Greenock	122	Stephney-John's Vale	16,587
Fergis-Ramsey	297	*Litchfield-Matheson's Run	11,082
Peckham	175	Troja	46
Kellits Stream	20	Fort Stewart	193
Harker's Hall	16	Dover	62
Industry Field-Rowcamp	236	Nutfield	24
Hellshire Hills	12,000	Richmond Pen	225
Cedar Valley	600	New Ground	14
Mount Diablo	3,325	Fort George	1,327
		Peace River	288
			<hr/>
			56,819

Camperdown  
Mt. Diablo (Schwallenberg)  
Industry Field (Providence)

\* Falls in two Divisions

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Western Division

<u>Forest Reserves</u>	<u>Acreage</u>
Lover's Leap	434
Pike and Ravens	201
Hyde Hall Mountain	1,635
Bianheim	50
Ramble	119
Spring Vale	141
Spring Garden	47
Virginia	32
New Forest	997
Hyde	1,253
Dromilly	142
Balfont	155
Windsor Lodge	91
Petersville	422
Bottom Hampden	293
Jericho	892
Chatsworth	926
Fyffe and Rankine's	2,387
Cockpit Country	55,170
Shuna	1,132
Ruthven	473
Burnt Savannah	197
Dolphin Head	565
Discovery	368
Dean's Valley	1,100
Troy	1,279
Cockpit Country (Peru Mtn. Addn)	666
Chesterfield	14
Garlands	342
Bog	29
Content II	139
Bogue	276
Cook's Bottom	488
Denham Farm	56
Raglan Mountain	250
Geneva Mountain	344
Allsides	40
Llandaff	312
Stonehenge	983
Windsor	1,307
Belmont	91
Forest Mountain	332
Baron Hill/Hopewell	370
St. Jago	568
	<hr/>
	76,509

Cockpit Country Area  
Calculated by dot grid - 67,002 acres

Areas to be reserved

* Pike and Ravens (Lowe River)	272
Hudson's Bottom	
John Anderson	
* Gourie	157
* Oxford	
Hyde Hall Mt. (Brislington)	
Muirhead	
* Raglan Mt. (Retirement)	123

\* Falls in two Divisions

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Plantation Species

During the 1940s and 1950s the Forest Department planted a number of species to assess their growth potential. In 1968 the areas of FD plantations were:

		<u>acres</u>
<u>Pinus caribaea</u>	Caribbean pine	3932
<u>Pinus patula</u>	Patula pine	444
<u>Pinus massoniana</u>	masson's pine	155
<u>Hibiscus elatus</u>	blue mahoe	3375
<u>Terminalia latifolia</u>	broadleaf	487
<u>Tectona grandis</u>	teak	335
<u>Eucalyptus saligna</u>	eucalyptus	322
<u>Eucalyptus robusta</u>	eucalyptus	210
<u>Callophyllum brasiliense</u>	Santa Maria	108
<u>Swietenia macrophylla</u>	Honduras mahogany	685
other species		154
<u>S. mahagoni</u>	mahogany	
<u>Cedrella odorata</u>	West Indies Cedar	
<u>Simamba glauca</u>	bitter damson	
<u>Piscidia piscipula</u>	dogwood	
		<u>10207</u>

(from: Jamaica, FD. 1967, UNDP/FAO. 1971)

During the 1970s at Bull Head Forest Reserve, the following species were planted as trials:

Leucaena glauca  
Brazil macca  
castor oil  
roseapple  
Cassia siamea  
yacca  
silky oak

(from: Jamaica. MOA, 1978)

12/8

ENDANGERED SPECIES OF JAMAICA

(Sources: Mittermeier, 1972; Woodley, 1968; Plotkin, pers. comm.)

Hutia - Geocapromys brownii

The hutia, a rodent about the size of a rabbit, is mainly nocturnal and inhabits rock crevices in wooded hills. Judging by quantity of hutia remains in Arawak middens, the animal was a staple in the Indians' diet. At that time it was abundant throughout much of southern Jamaica and St. Ann in the north. Predation by man for food, feral dogs and the mongoose has restricted its distribution to the south-east of the island, especially the John Crow Mountains and Hellshire Hills. Since about 1900, the hutia population seems to have reached a balance with the mongoose and appears to be coming back, particularly in the Hellshire Hills and near Worthy Park. Although now totally protected by law, the hutia is still used for food in the John Crow Mountains and occasionally may be killed by hog hunters in the Hellshire Hills.

Manatee - Trichechus manatus

A large aquatic mammal valuable as food, the manatee has been severely over-hunted in the past few hundred years. The animal requires shallow, secluded waters for breeding and are sensitive to disturbance of all kinds. Population decline has been due to habitat destruction, continuous hunting, injuries from boat propellers, and poisoning from herbicides. Scarcely 100 are left in Jamaica. They are most common near river mouths along the south coast, but there have been confirmed sightings of one manatee in three different places in the north (Rio Nuevo, Priory, and near Port Antonio) (Plotkin, pers. comm). The OAS project in south Manchester will confine a few manatee to a relatively undisturbed wetland for scientific and public educational purposes.

Caribbean monk seal - Monachus tropicalis

The monk seal was the basis of a profitable fishery in the 17th and 18th centuries, so that by the 19th century the seal hunters had almost exterminated the populations. Since that time, the seal had often been killed on sight by fishermen to protect the fish resource. The last recorded seal taken in Jamaica waters was in 1952 (Woodley, 1967).

American crocodile - Crocodylus acutus

The preferred habitat of the crocodile is mangrove swamp. It used to be abundant in the swamps and lagoons of southern Jamaica, but development adjacent or within wetlands has seriously reduced the extent and quality of habitat. Although protected by law since 1971, killing for sport and the export trade continue to be factors in the crocodile's population decline. Crocodiles were reported to still be at Portland Point, the Black River, in a few other isolated sites and until recently in the Great Salt Pond (Mittermeier, 1972). Near Palmouth a commercial operation called "Jamaican Swamp Safaris" reportedly had 2000 crocodiles kept as a tourist attraction and for breeding purposes. The population size was at best only a very rough estimate and breeding attempts appear to have been weak, but in 1977-78 on the order of 200 animals were illegally exported from the Safari to Florida (Plotkin, pers. comm). Recently the Safari's management was transferred to the state-owned Jamaica Tourist Attractions Development Corporation (JADCO), which will be supervised by the NRCDC.

Jamaican iguana - Cyclura collei

Extinction or near extinction of this iguana is due to predation by man, and loss of eggs and young to the mongoose. Quickly eliminated by the mongoose on most of the mainland, the iguana was found in the early 1900s only on Goat Island and in the Hellshire Hills. Subsequent introduction of the mongoose onto Goat Island reduced the population to a few by the mid-1940s. No sightings of live iguana have been reported since that time. Rumors that they still survive in the Hellshire Hills have not been confirmed.

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Lizard - Diploglossus occiduus

The natural habitat of the lizard is debated to be either in swamps or among rocks. In any event the lizard is thought to be another victim of the mongoose and has probably been extinct for over a century. The only area where the lizard might still survive is the Hellshire Hills.

Skink - Mabuya spilonotus

The skink was once present throughout the lowlands, but by 1940 was found in abundance only at Portland Point. Here the pitted limestone provided protection from the mongoose, feral cats and rats which had devastated the population. By now it is probably extinct.

Snake - Alsophis ater

This species is presumed to be extinct. Decimation of its population is attributed to the mongoose and man. As with all snakes, it is commonly shot on sight.

Jamaican boa - Epicrates subflavus

The habitat of the boa is rocky scrublands. This snake is also killed on sight by man, but is also preyed upon by feral cats and to some extent by the mongoose. It is now found in limited numbers in a restricted range, namely on Goat Island, Hellshire Hills, the Cockpit Country, and areas of St. Thomas, Trelawny, Portland, and also in Montego Bay and Kingston (Plotkin, pers. comm). Several specimens are now housed in the Hope Garden Zoo.

Hawksbill turtle - Eretmochelys imbricata

Up until a couple decades ago hawksbill turtles were abundant, found breeding on most beaches in Jamaica. Continued rapid decline in population is attributable to increased harvesting pressure by man as the value of the hawksbill shell rises. The shell brings up to U.S. \$150 per pound on the export market.

Jamaica plain pigeon - Columba inornata exigua

The pigeon was once common, but its numbers rapidly declined between the middle and the end of the 19th century, perhaps as a result of excessive hunting and habitat destruction. Recent sightings in the highlands southeast of Mandeville, on Mt. Diablo, in Fern Gully and on the Mabess River may indicate that the species is coming back.

Jamaican golden swallow - Kalochelidon euchrysea

Once found throughout the interior uplands, the golden swallow has for almost fifty years been confined to the Cockpit Country. The cause of the decline is unknown.

West Indian whistling duck - Dendrocygna arborea

Draining and destruction of swamps have threatened the survival of this species. Although the Red Data Book (1972) indicates that the bird is now gone from the island, recently flocks have been seen in the Black River and Negril Morasses.

Tundra peregrine falcon - Falco peregrinus tundrius

This migrant bird from near the Arctic Circle overwinters in Latin America and the Caribbean. Its decline is attributed to the accumulation of chlorinated hydrocarbons ingested while overwintering, which results in the laying of thin, easily broken shells. Sightings have been reported at Hunt's Bay, near Treasure Beach in St. Elizabeth and at Rockland's Bird Sanctuary in St. James.

AGRICULTURE/RURAL DEVELOPMENT PROJECTS

Project title: Centralization of Jamaica Agricultural Research

Location: St. Catherine, St. James

Duration: 1979-84

Executing agencies: Ministry of Agriculture

Total estimated cost: U.S. \$8.58 million

External financing: \$7.0 million

Financing agencies: IDB

Description and objectives: to build 3 regional research stations at Bodles (Central Station), Montpelier, and 4 sites in Northern Region so to centralize agricultural research planning within MOA in order to maximize use of scarce human and financial resources available for these purposes and make results of research immediately available to farmers.

Status: loan approved April 1979, agreement expected to be signed May 1979, completion date expected mid-1984

References: Jamaica. MFP, 1979

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Project title: Charlemont Development

Location: St. Catherine

Duration: NI

Executing agencies: Ministry of Agriculture

Total estimated cost: U.S. \$0.7 million

External financing: U.S. \$0.2 million

Financing agencies: CIDA

Description and objectives: Rural community development project which aims at developing Charlemont, a 790 acre property in St. Catherine, into a nucleus and small farmers' scheme. Development of a dairy herd, production of vegetables and tree crops and the provision of agricultural support services. Loan is for purchase of farm tools and equipment.

Status: implementation

References: Jamaica. MFP, 1979

Project title: Cornwall Youth and Community Development Project

Location: County of Cornwall

Duration: NI

Executing agencies: Social Development Commission

Total estimated cost: U.S. \$3,838 million

External financing: U.S. \$1.918 million

Financing agencies: Netherlands

Description and objectives: Envisages development of 5352 acres of arable lands in the Cornwall Area for cultivation of crops, vegetables and fruits. A further 3270 acres will be devoted to cattle production and 3400 acres for forestry projects. Proposes to settle 910 young farmers on a lease-hold basis on a minimum of 5 acres. Construction and expansion of houses and health centers planned.

Status: preparation or implementation

References: Jamaica. MFP, 1979

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Project title: First Rural Development

Location: Cornwall

Duration: NI

Executing agencies: Ministry of Agriculture

Total estimated cost: U.S. \$31.4 million

External financing: U.S. \$15 million

Financing agencies: IBRD

Description and objectives: Designed to complement government's program to strengthen the rural economy and improve living conditions of rural population. Intended to achieve a narrowing of rural-urban disparities and also to reduce rural-urban migration. Project consists of reorganization of MOA; establishment of agricultural settlements in the Western Region for landless families and farm families with insufficient lands; improvement of economic and social infrastructure in the Western Region.

Status : preparation or implementation (started in 1977)

References: Jamaica. MFP, 1979

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Project title: Forestry Development and Watershed Management in the Upland Regions  
UNDP/FAO: see under Forestry Foreign Assistance Projects

Project title: Rural Community Development

Location: Clarendon

Duration: NI

Executing agencies: Ministry of Youth and Sports

Total estimated cost: U.S. \$3.8 million

External financing: U.S. \$1.0 million (loan at 3.75% interest, 8 years grace, 30 years repayment)

Financing agencies: Netherlands

Description and objectives: Training and settling 275 families over 4.5 year period in Ebony Park area of Clarendon. Seen as a pioneering project in rural settlement based on concept of community self-help. There will be agricultural production, mainly of vegetables and field crops; construction of houses, community buildings and infrastructure facilities.

Status: implementation

References: Jamaica. MFP, 1979

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Project title: Rural Settlement Project  
OAS: see appendix

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Project title: Second Integrated Rural Development

Location: Clarendon

Duration: NI

Executing agencies: Ministry of Agriculture

Total estimated cost: U.S. \$22 million

External financing: U.S. \$13 million

Financing agencies: USAID

Description and objectives: To improve status of living of small hillside farmers. The project involves soil conservation works, construction of rural roads, afforestation, provision of credit and marketing services

Status: implementation

References: Jamaica. MFP, 1979

note: see also USAID Projects: appendix

Project title: Settlement Planning Project  
OAS: see appendix

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Project title: Soil Conservation and Watershed Management

Location: Islandwide

Duration: NI

Executing agencies: Ministry of Agriculture

Total estimated cost: U.S. \$60 million

External financing: NI

Financing agencies: NI

Description and objectives: To treat, over a 5-year period, an average of 13,000 acres per year. Project will help increase agricultural productivity by promoting proper land practices, generate employment and raise living standards of the rural population.

Status: Studies being prepared.

References: Jamaica. MFP, 1979

## FORESTRY PROJECTS

Project title: Cement Bonded Particle Board

Location: Twickenham Park, St. Catherine

Duration: NI

Executing agencies: FIDCO

Total estimated cost: U.S. \$11.5 million

External financing: U.S. \$10 million

Financing agencies: (possibly) IBD; DEG (Germany); EIB

Description and objectives: One of three forest-based industries identified by a UNDP/FAO Forest Industries Identification Mission, 1976-77. Intended to provide low-cost building materials. Proposal is to build and equip a factory to be commercially operated to produce particle board and pre-fabricated components.

Status: appraisal documents in preparation

References: Jamaica. MFP, 1979

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Project title: Hardwood Sawmill

Location: near Port Antonio

Duration: NI

Executing agencies: Ministry of Agriculture/FIDCO

Total estimated cost: U.S. \$3.5 million

External financing: U.S. \$2.1 million

Financing agencies: NI

Description and objectives: To establish a hardwood sawmill to utilize accessible indigenous resources to the John Crow Mountains Area and produce about 4.7 million board feet of sawnwood annually

Status: feasibility study carried out in 1979 with assistance from Sweden

References: Jamaica. MFP, 1979

14/6

Project title: Forestry Development and Watershed Management in the Upland Regions -  
Project JAM 67/505

Location: islandwide

Duration: 1967-75

Executing agencies: Ministry of Agriculture, FD, UNDP/FAO

Total estimated cost: NI

External financing: NI

Financing agencies: UNDP/FAO

Description and objectives:

FORESTRY

1967-72: Phase I (U.N. - U.S. \$857,600; GOJ - U.S. \$872,000)

- prepared 38 publications, including land use surveys, forest inventories, mapping, cost/benefit analyses, studies of forestry potential such as soil suitability and forest growth rates. Wrote Forestry Development Plan for Jamaica.
- established pilot forestry demonstration project and watershed demonstration center
- prepared land use strategy for Jamaica
- initiated guidelines and plans for establishing a forest road system

1972-73: Bridging Operation

- analyzed information collected for recommendation of policies to GOJ
- did training, harvesting, extraction studies

1973-75: Phase II

- prepared demonstration of logging techniques
- set up demonstration sawmill (Twickenham) (Using Caribbean pine from mature stands) near Kingston

WATERSHED MANAGEMENT

- set up demonstration and training centers in Hancver at Smithfield and Buxton for soil conservation measures
- carried out studies on different soil conservation techniques for the small hillside farmer
- studied runoff and soil loss under different forms of terracing for yam cultivation
- recommended different agricultural land capability scheme for Jamaica
- developed plans for Integrated Rural Development Project (Two Meetings-Pindars River)

14/4

Project title: Forestry Industrial Plantation

Location: Portland/St. Andrew

Duration: NI

VIII - 7

Executing agencies: FIDCO

Total estimated cost: U.S. \$31.7 million

External financing: U.S. \$25.0 million

Financing agencies: IBRD, CDC, ODM -- IBRD - U.S. \$12.0 million; CDC U.S. \$11.5 million (both loans, 7% interest, 6 years grace, 25 years. ODM - U.S. \$15. million grant.

Description and objectives: Is second phase of industrial plantation program, consists of i) dedication to FIDCO's use of about 20,000 ha of public and private land for plantation; ii) establishment of 9,250 ha new pine plantations and replanting; iii) maintenance of 7,200 ha pine plantations; iv) improvement of Twickenham Park Sawmill; v) construction of new pine sawmill; vi) establishment of logging and timber transport units and a maintenance unit for the equipment; vii) infrastructure improvements, mainly forest roads; viii) institutional strengthening of FIDCO and FD; ix) technical assistance on engineering for present projects and studies for future development

Status: being implemented

References: Jamaica. MFP, 1979

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Project title: Jamaica Forestry Development Project  
USAID: see appendix

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Project title: Jamaica Forestry Project

Location: Blue Mountain region, eastern Jamaica

Duration: 1979-84

Executing agencies: FD, FIDCO

Total estimated cost: U.S. \$31.7 million

External financing: U.S. \$12.2 million

Financing agencies: ODM: finance technical assistance related to forestry development  
CDC: finance most of local-currency requirements of the industrial plantation  
IBRD: assist in financing a small portion of the forestry development and most of the related activities -- roading, harvesting, sawmills, institution-building, studies for future projects -- which have a relatively high foreign-exchange content

Description and objectives: country's first cohesive step toward the ultimate goal of self-sufficiency in wood products. While the program is concerned with long-term development of pine plantations and downstream activities over a 25-year period, the project focuses on bringing forestry activities to economic efficiency. The principal purpose of the pine-plantation program is to transform forestry-related activities in Jamaica from demonstration, training or pilot schemes into a commercial undertaking. While the program does not involve direct investments in other forestry activities other than pine plantations, training and research components might lead to other forestry development and help the country define future roles for Jamaican forestry.

- between 1979-84 9250 ha of new pine planting
- between 1985-2004 (post-project planting) an additional 19,500 ac.
- improvement of Twickenham Park sawmill
- construction of new sawmill (possible at Buff Bay)
- establishment of logging and timber transport units associated with the two sawmills
- infrastructure improvements, mainly forest roads
- institution strengthening (including research and training)
- technical assistance (inventions, engineering)

Status: being implemented

References: IBRD, 1979

Project title: Black River Upper Morass - Drainage and Irrigation

Location: St. Elizabeth

Duration: NI

Executing agencies: Black River Upper Morass Development Company

Total estimated cost: U.S. \$18.5 million

External financing: U.S. \$15.5 million (IDB signed loan agreement in 1977 for \$12.5 million) (5)

Financing agencies: IDB, OPEC funds

Description and objectives: Involves drainage of about 8,800 ac. and irrigation works for about 3,000 ac. with aim to bring the 11,800 ac into production; also includes building of feeder road system within the project area, technical acquisition and installation of pumping equipment; execution of a program for institutional strengthening of executing until

Status: implementation behind schedule

References: Jamaica. MFP, 1979; IDB, 1977

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Project title: Castleton Water Supply

Location: St. Mary for Kingston/St. Andrew supplies

Duration: NI

Executing agencies: Water Commission

Total estimated cost: U.S. \$5.3 million

External financing: U.S. \$3.5 million

Financing agencies: CDB

Description and objectives: Construction of pumping station situated at Castleton to provide 6 IMGD water to Golden Spring filter plant. Use of facility only when Hermitage Dam is overflowing. Scheme is therefore aimed at improving supply to Hermitage and quality of water produced and supplied to Kingston.

Status: appraisal presented to CDB Board in June 1979

References: Jamaica. MFP, 1979

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Project title: Economic Rehabilitation of the Vere Area

Location: Clarendon

Duration: NI

Executing agencies: Ministry of Agriculture

Total estimated cost: U.S. \$3.6 million

External financing: U.S. \$1.4 million

Financing agencies: CIDA

Description and objectives: To diversify economic options of people of Vere who depend on sugar cane growing and suffer when crop fails. Proposals for construction of check dams, reservoirs and settling basins to provide irrigation to facilitate growing of legumes, root crops, and livestock fodder

Status: preliminary discussions held with Canadian Government

References: Jamaica. MFP, 1979

14/6

Project title: Hague, Mayersfield Drainage  
Location: Trelawny/Westmoreland  
Duration: NI  
Executing agencies: Minister of Agriculture  
Total estimated cost: U.S. \$3.45 million  
External financing: U.S. \$1.10 million  
Financing agencies: Netherlands government  
Description and objectives: Involves the reclamation and improvement by drainage on approximately 2,900 acres to be used for rice cultivation by small farmers

Status: preparation or implementation

References: Jamaica. MFP, 1979

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Project title: Kingston Sewerage I and Water Supply

Location: Kingston and St. Andrew

Duration: NI

Executing agencies: Water Commission

Total estimated cost: U.S. \$31.0 million

External financing: U.S. \$15.0 million

Financing agencies: IBRD (#1146-JM)

Description and objectives: i) sewerage collection and treatment (largest component); ii) additional water supply and distribution facilities; iii) studies to aid the choice of the next major water supply scheme; iv) technical assistance designed to strengthen the Commission's management capability.

Status: completion expected in 1981

References: Jamaica. MFP, 1979

Note: This project builds upon Kingston Water Supply Project (Loan 598-JM) executed by the Water Commission between 1969-76. Total cost was U.S. \$11.8 million, of which IBRD supplied \$4.8 million.

Project title: Mandeville Water Supply

Location: St. Elizabeth

Duration: NI

Executing agencies: National Water Authority

Total estimated cost: U.S. \$15.8 million

External financing: U.S. \$10.8 million

Financing agencies: ICB

Description and objectives: To provide safe and adequate supply of potable water to Mandeville and environs. (Presently Mandeville is forced to depend on rainfall collected in storage tanks to supply basic needs.) Main use of water is domestic, but allowance made for commercial, industrial, public use in urban areas, small scale livestock and rural domestic agriculture.

Status: Loan to be signed in May 1979.

References: Jamaica. MFP, 1979; IDB, 1978

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Project title: Micro Dams

Location: islandwide

Duration: NI

Executing agencies: Ministry of Agriculture

Total estimated cost: U.S. \$13.52 million

External financing: U.S. \$ 5.87 million

Financing agencies: Netherlands

Description and objectives: Involves the construction of micro dams, and the supply and installation of irrigation equipment to serve some 15,000 acres of agricultural development in the parishes of Clarendon, Manchester, St. Catherine, St. Elizabeth, St. James, St. Mary, St. Thomas, and Trelawny.

Status: implementation rescheduled to mid-1979

References: Jamaica. MFP, 1979

Project title: Montego Bay/Falmouth Water Supply

Location: Montego Bay/Falmouth

Duration: C. 1975-1985

Executing agencies: National Water Authority

Total estimated cost: U.S. \$18.3 million

External financing: U.S. \$13.7 million

Financing agencies: IDB, Venezuela Investment Fund

Description and objectives: Designed to improve water supply system of Montego Bay and Falmouth. Involves utilization of well fields in Queen of Spain Valley in Trelawny. Construction of two reservoirs at Bounty Hall and Montego Bay is planned.

Status: implementation (loans signed in 1976) (IDB loan equals U.S. \$12 million)

References: Jamaica. MFP, 1979; IDB, 1979

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Project title: Pedro Plains Irrigation

Location: St. Elizabeth

Duration: NI

Executing agencies: Ministry of Agriculture

Total estimated cost: U.S. \$7.395 million

External financing: U.S. \$3.08 million

Financing agencies: Netherlands government

Description and objectives: To provide irrigation water for about 4600 acres of land for agriculture in the Pedro Plains.

Status: Preparation or implementation

References: Jamaica. MFP, 1979

14/8

Project title: St. Ann's Bay Water Scheme

Location: St. Ann's Bay area

Duration: NI

Executing agencies: National Water Authority

Total estimated cost: U.S. \$10.0 million

External financing: U.S. \$8.0 million

Financing agencies: IBD (probably)

Description and objectives: To provide St. Ann's Bay area with a water supply that will satisfy both the commercial and domestic demand of the area up to the year 1995. Expected to increase current extraction of 2 IMGD to 7.9 IMGD. Includes intake works and treatment plant at Roaring River

Status: Selected for further feasibility studies. Financing not yet finalized.

References: Jamaica. MFP, 1979

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Project title: Tank Building

Location: islandwide

Duration: NI

Executing agencies: Ministry of Agriculture

Total estimated cost: U.S. \$5.3 million

External financing: U.S. \$2.6 million

Financing agencies: Netherlands and EDF

Description and objectives: To build water tanks to provide domestic water to farmers in very dry parishes where community catchments have proven inadequate and where trucking of water is uneconomical and unreliable.

Status: . Loan agreement under negotiation.

References: Jamaica. MFP, 1979

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Project title: Yallahs River Water Scheme

Location: St. Thomas

Duration: NI

Executing agencies: Water Commission

Total estimated cost: U.S. \$50.0 million

External financing: U.S. \$30.0 million

Financing agencies: IBRD (probably)

Description and objectives: Envisage diversion of Yallahs River at Middleton Abbey to supply a maintainable yield of 16.4 IBGD to be conveyed to treatment plant on Long Mountain Range. Construction of dam, conveyance system and treatment plant (capacity 30 IMGD). Water will satisfy incremental demands for the expanded Water Commission area (Hellshire, Portmore, Bull Bay, etc.) for 1981-86.

Status: feasibility studies being made.

References: Jamaica. MFP, 1979

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## WILDLIFE MANAGEMENT/FISHERIES PROJECTS

Project title: Black Coral

Location: St. Mary

Duration: NI

Executing agencies: Jamaica National Institute of Craft

Total estimated cost: J \$249,000

External financing: NI

Financing agencies: NI

Description and objectives: To establish commercial/craft operation to harvest, process and manufacture; and to carry out research to catalogue the resource and identify a program for long term development and conservation. Aimed to nationalized management of this resource and protection from illegal and uncontrolled harvesting on the North Coast.

Status: studies to be undertaken.

References: Jamaica. MFP, 1979

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Project title: Wildlife Management Recreation Areas Public Education  
OAS: see appendix

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Project title: Fish Production System Development  
USAID: see appendix

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Project title: Fisheries Development

Location: NI

Duration: NI

Executing agencies: Ministry of Agriculture

Total estimated cost: U.S. \$11.0 million

External financing: U.S. \$ 8.8 million

Financing agencies: NI

Description and objectives: To establish an investment plan to encourage integrated development of industrial subsistence fishing.

Status: IDB/FAO report completed, further studies, especially on availability of fishing grounds needed

References: Jamaica. MFP, 1979; IDB, 1978

Project title: Fisheries Terminal

Location: Kingston

Duration: NI

Executing agencies: Ministry of Agriculture

Total estimated cost: U.S. \$5.2 million

External financing: U.S. 1.96 million

Financing agencies: Federal Republic of Germany

Description and objectives: Involves construction of fisheries terminal for Kingston to provide for a larger fishing fleet.

Status: preparation or implementation

References: Jamaica. MFP, 1979

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Project title: Fishing Vessels

Location:

Duration: NI

Executing agencies: Ministry of Agriculture

Total estimated cost: U.S. \$6.7 million

External financing: U.S. \$4.5 million

Financing agencies: NI

Description and objectives: To improve the fishing fleet; assuming new fishing grounds are realized, will increase the size and nature of the local fishing industry.

Status: Studies to be undertaken

References: Jamaica. MFP, 1979

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Project title: Inland Fisheries Development  
USAID: see appendix

## ENERGY PROJECTS

Project title: Biogas Research and Development

Location:

Duration: NI

Executing agencies: Ministry of Agriculture (and MME)

Total estimated cost: NI

External financing: U.S. \$500,000

Financing agencies: USAID

Description and objectives: To quantify the total potential for biogas (survey of sources and economic analysis).

Status: MOA is collecting data from government-owned farms and institutions. MME is surveying data on privately owned farms.

References: IDB, 1980

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Project title: Blue Mountain Hydroelectric Power

Location: eastern Jamaica

Duration: 2 years

Executing agencies: Ministry of Finance

Total estimated cost: U.S. \$800,000

External financing: U.S. \$800,000

Financing agencies: Swedish government

Description and objectives: To supply hydropower and water to the Kingston Metropolitan area; collection of several sources of surface water in the Blue Mts. for combined hydro-power and water supply

Status: analysis completed and prefeasibility study being initiated by consulting firm.

References: IDB, 1980

Project title: Energy Conservation

Location: islandwide

Duration: NI

Executing agencies: NI

Total estimated cost: NI

External financing: U.S. \$5-6 million

Financing agencies: NI

Description and objectives: To conserve energy through educational programs and advertisements and to improve energy efficiency in industry and building construction. External financing required for short-term experts in energy conservation. The U.K. is providing 2 of them and UNDP has some commitments also. Capital investment required to improve standards of energy conservation. A feasibility study on energy conservation has been proposed and is under consideration.

Status: NI

References: IDB, 1980

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Project title: Energy Planning and Development Program (JM/77/007)

Location: islandwide

Duration: 2 years

Executing agencies: UNCTAD

Total estimated cost: NI

External financing: U.S. \$152,0934

Financing agencies: UNDP

Description and objectives: To establish comprehensive policy for planned development of energy in Jamaica; involves: i) training of personnel to prepare energy development plans and to gather, process and disseminate energy information; ii) establishing appropriate systems for monitoring, forecasting and accounting; iii) updating petroleum legislation; and iv) preparing technical reports and studies.

Status: Being implemented.

References: IDB, 1980

Project title: Hydroelectric Development in Central and Western Jamaica

Location: central and western Jamaica

Duration: 3 years

Executing agencies: JPSC

Total estimated cost: U.S. \$27 million

External financing: U.S. \$12 million

Financing agencies: IDB

Description and objectives: Development of alternative energy source; to determine feasibility of constructing two hydroelectric plants.

Status: feasibility studies completed; projects not considered feasible at Dec. 1978 oil prices.

References: IDB, 1980

Project title: Preliminary energy assessments

Location:

Duration: August-November 1979

Executing agencies: Ministry of Mining and Energy

Total estimated cost: U.S. \$250,000

External financing: NI

Financing agencies: USAID

Description and objectives: To carry out a series of short-term energy studies in a variety of areas to assist the GOJ in determining what projects it should launch in the energy sector. A nine-man U.S. team of experts working with Jamaican counterparts in the MMNR, Scientific Research Council and the U.W.I. prepared series of reports providing recommendations to the government. The studies covered the feasibility of obtaining energy from urban waste, biomass, solar and coal as well as an analysis of the utility rate structure of the JPSC.

Status: completed

References: IDB, 1980

Project title: Production, transmission and distribution  
Location: islandwide  
Duration: NI  
Executing agencies: Jamaica Public Services Co. Ltd. (JPSC)  
Total estimated cost: U.S. \$118.4 million  
External financing: U.S. \$ 70.7 million requested  
Financing agencies: IBRD (20 mil.), ECD (31 mil.), Supplier's Credit, OPEC  
Description and objectives: To provide for the increased demand of energy to year 1985 by a) increasing generation capacity; b) ensuring reliability and flexibility in the system, c) extending transmission and distribution systems.  
Status: being implemented  
References: IDB, 1980

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Project title: Non-Conventional Sources of Energy  
Location:  
Duration: NI  
Executing agencies: NI  
Total estimated cost: NI  
External financing: U.S. \$350,000  
Financing agencies: IDB  
Description and objectives: To prepare a study of non-conventional sources of energy; a firm will be hired to prepare study which will be closely correlated with USAID general energy study  
Status: no action taken yet, pending receipt of request from GOJ  
References: IDB, 1980

Project title: Science and Technology-Energy (532-0065)

Location:

Duration: 1980-85

Executing agencies: Ministry of Mining and Energy

Total estimated cost: U.S. \$3 million

External financing: U.S. \$3 million

Financing agencies: USAID

Description and objectives: In support of Jamaica's 5-year National Energy Plan, this project assists the GOJ to develop economically viable energy conservation programs and alternative energy sources. These areas of priority are development of local energy resources, including non-conventional sources, energy conservation and establishment of institutional support for effective implementation of the energy program. Technical assistance and training will be provided for the development of prototype energy systems. It is anticipated that the results of these studies will partially promote the development of biomass and solar energy systems. Project draws upon USAID/W and RDO/C Training for Development projects to prepare Jamaicans to implement activities and strengthen institutional capacity of energy related organizations.

Status: NI

References: IDB, 1980

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Project title: Survey of Energy Use in Industry

Location:

Duration: NI

Executing agencies: NI

Total estimated cost: U.S. \$60,000

External financing: U.S. \$60,000

Financing agencies: IDB

Description and objectives: To prepare a feasibility study on energy use in industry

Status: No action taken yet.

References: IDB, 1980

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Project title: Rural Electrification, I, II and III

Location: islandwide

Duration: 1975-82

Executing agencies: Rural Electrification Programme Limited

Total estimated cost: U.S. \$30.2 million

External financing: U.S. \$20.9 million (Programmes I, II and III)

Financing agencies: IDB

Description and objectives: To extend electricity services to rural areas through construction of extension's loans made in November 1975 and February 1978 and expect third to be approved May 1979.

Status: Being implemented

References: Jamaica. MFP, 1979

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**ENVIRONMENTAL HEALTH PROJECTS****PAN-AMERICAN HEALTH ORGANIZATION/WORLD HEALTH ORGANIZATION (PAHO/WHO)****JAMAICA-2000 (-2100). Water Supplies and Environmental Sanitation**

Purpose: Improvement of environmental conditions by developing adequate programming for water supply, sewerage, solid waste disposal, food sanitation, occupational health, and air, water and soil pollution.

Probable duration: 1968-1977

Assistance provided: 1 sanitary engineer, 2 short-term consultants, and advisory services by staff of projects AMRO-2101 and -2070; equipment and supplies.

Work done: The Environmental Control Division became a reality within the Ministry of Health. The Division and the Natural Resources Conservation Authority, both recently established, are the 2 main arms of the Government dealing with growing problems of environmental management (100% of target). An organization plan was developed for the Division's operation (100%), and job descriptions were prepared for various types of personnel (80%). Closer attention was given to waste treatment management in the corporate area, and performance evaluation of treatment plants was carried out (80%). Specific pollution problems were investigated in connection with bauxite-alumina waste and hotels (100%). Terms of reference were prepared in order to commission a study to look at the overall wastewater management and Kingston Harbor pollution (75%). Supervision was provided to the first phase of the Institutional Development Program in the National Water Authority (100%), and training courses were implemented in occupational health (100%) and waterworks operations (100%).

PAHO/RB

**JAMAICA 2100 (-2204). Water and Sewerage Administration**

Purpose: Development of policies, procedures, and manuals that will enable the National Water Authority (NWA) to be effective and efficient in meeting its legal, institutional, financial, engineering, and coverage objectives for providing water and sewerage services.

Probable duration: 1973-1977

Assistance provided: 1 sanitary engineer (project manager), 3 short-term consultants, and advisory services of staff of project AMRO-2100; equipment and supplies.

Work done: The initial phases of the project were concerned with the preparation of a work execution plan and the organization of the administrative aspects.

Short term consultants completed their studies in management (100%) and supply and stores procedures (100%). Studies in project management were underway (30%).

The Authority accepted an interim organization plan and its related job descriptions (100%). Progress in implementation was limited to 50% as only the Kingston office was reorganized. The remaining 50% was scheduled for 1976 when 3 regional offices were to be established.

PAHO/CWSF, WHO/RB  
Community Water Supply Fund

CIDA/NWA

**JAMAICA-6400. Sanitary Engineering Education**

Purpose: Development of comprehensive and intensive training programs for professional, technical, and auxiliary personnel in sanitary engineering and environmental health.

Probable duration: 1971-1978

Assistance provided: 3 short-term consultants and advisory services by staff of Headquarters, Zone I Office, and project Jamaica-2000; course costs.

Work done: The course on principles of operations and maintenance of water systems was able to provide 28 participants with the necessary technical and practical information to improve their skills in water-works operation and supervision (100%) and another course was planned for 1976. Plans were made to hold an oil spill control seminar in 1976.

WHO/RB

(from Caribbean Working Group, 1977)

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Inter-American Development Bank (IDB): Loans to Jamaica

<u>loans</u>	<u>estimated total cost (U.S.\$ '000)</u>	<u>dates loan signed-expiring</u>	<u>project</u>
<u>Agriculture and Fisheries</u>			
269	11,800	1970-75	-
317	5,735	1972-76	-
359	16,000	1973-78	-
516	9,000	1977-82	-
538	18,500	1978-82	Black River Upper Morass
580	9,400	1979-83	Centralization of Jamaica Agr.
588	10,000	1980-84	- Research
<u>Education, Science and Technology</u>			
283	8,000	1970-76	-
466	9,300	1976-80	-
<u>Energy</u>			
444	13,700	1975-81	Rural Electrification I
512	3,500	1977-81	Rural Electrification II
581	13,200	1979-92	Rural Electrification III
638	29,500	NI	-
<u>Environmental and Public Health</u>			
451	10,167	1975-81	Montego Bay/Falmouth Water Supply
573	15,800	1978-83	Mandeville Water Supply
<u>Industry, Mining and Tourism</u>			
210	7,854	1971-76	-
254	10,146	1973-78	-
289	11,003	1971-76	-
371	12,902	1973-78	-

- = information on nature of project not available

(Source, IBB, 1979)

Organization of American States (OAS): Environmental Projects in JamaicaProjects executed with 1980 appropriated funds:Regional Scientific and Technological Development Program

(in U.S.\$ '000)

			appropriations 1980	dispersed
52B	515	JM1 : Wildlife Management Recreation Areas Public Ed.	23.3	none
52B	515	JM2 : Solar Energy	19.0	none
52B	670	JM1 : Solar Energy	23.0	none
52C	500	JM1 : Fuel from Fermentation	NI	

Regional Cultural Development Program

53E	682	JM2 : Development of an Integrated Information System	46.5	0.6
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Executive Secretariat for Economic and Social AffairsRural Development

44A	300	JM1 : OASIS	23.6	4.9
44A	300	JM2 : Settlement Planning Project	23.0	0.4

Social Development

48A	300	JM1 : OASIS	55.8	none
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Projects executed in 1980 with funds appropriated in previous years

Solar Energy  
Sugar Cane By-Products  
OASIS  
Forestry Industry Development  
Regional Infrastructure

Rural Development Program1. Settlement Planning Project - U.S. \$23,000

objective: to strengthen participation at local government level in settlement planning and project implementation as a means of achieving a more balanced and efficient level of development for the country as a whole

2. Rural Settlement Project (OASIS) - U.S. \$23,000

objective: reduce rural migration in the area by creating new sources of employment, by establishing a model rural settlement using the self-help system through training, community development, agricultural production and infrastructure

The objective is to cooperate with the GOJ in implementation of the First Rural Development Project that GOJ is carrying out with IBRD. Technical assistance requested from the OAS is oriented mainly to areas of regional planning and supervision of secondary road construction. Also, with the Forestry Development Project (IBRD), OAS assists FIDCO in implementation of a forestry development program at the national level. The technical assistance requested from OAS is oriented to planning and forestry development, clearing and transportation of woods and development of forestry industries.

Regional Scientific and Technological Development Program1. Wildlife Management Recreation Areas Public Education

objective: to confine several manatee in Alligator Hole River in South Manchester for purposes of scientific study and public education

(source: OAS, 1980)

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U.S.A.I.D. Environmental Projects in Jamaica

<u>Project Number</u>	<u>project title</u>	<u>Initial FY</u>	<u>Final FY</u>	<u>Expenditures</u>	
<u>COMPLETED PROJECTS</u>					
5320010	Health Plan Services	1956	1965	307	
5320001	Agricultural and Rural Development	1960	1967	950	
5320012	Water Supply Study	1960	1962	20	
5320019	Community Water Supply	1962	1972	2735	
5320025	Community Water Supply	1962	1972	1500	
5320017	Low-Cost Housing and Redevelopment	1963	1970	3130	
5320023	Agricultural Production and Marketing	1963	1970	763	
5320023	Dairy Development Loan	1965	1973	2460	
5320035	Rural Feeder Roads and Secondary Roads	1971	1977	9989	
5320043	Rural Nutrition and Income Improvement	1977	1980	83	
<u>ACTIVE PROJECTS</u>					
5320009	Rural Education Sector	1975	1980	11200	L
5320030	Family Planning	1966	1980	3309	G
5320038 (00)	Forestry Development	1976	1980	4893	L 4400
5320038 (01)	Inland Fisheries Development	1976	1980		G 493
5320040	Health Improvement for Young Children	1976	1980	275	G
5320041	Family Planning Services	1976	1981	4676	G
5320045	Rural Community Nutrition - Income Improvement	1977	1981	154	G
5320046	Integrated Regional Rural Development	1977	1982	15000	{ L 13000
5320047	Manpower Planning Training and Employment	1978	1981	806	{ G 2000
5320059	Fish Production System Development	1979	1983	4107	{ L 2740
5320060	Agricultural Marketing Development	1980	1986	4700	{ G 1367
5320061	Agricultural Planning	1979	1984	1166	L
5320070	Vocational Skills Training PVO OPC	1979	1982	270	G
<u>PLANNED PROJECTS</u>					
5320062	Agricultural Education, Research Extension	1979	1983	7000	L
5320064	Energy Sector Development	1978	1978	280	G
5320065	Energy Management	1980	1981	10400	{ L 10200
					{ G 200

(from: USAID. 1981. Project Design Information; USAID. 1981. Evaluation Documentation; USAID. 1981. DIS Project LAC List (Planned and Active Projects); USAID. 6/8/81. DIS Databases 1 & 2 )

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 \* COUNTRY/BUREAU: JAMAICA PROJECT: 5320038 SUB-PROJECT: 01 \*  
 \* TITLE: INLAND FISHERIES DEVELOPMENT INITIAL FY: 76 FINAL FY: 80 \*  
 \* ESTIMATED AMOUNT AUTHORIZED(\$000): 4,893 \*  
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**PROBLEM:**  
 FRESHWATER FISH PRODUCTION IN JAMAICA REMAINS UNEXPLOITED AS A SOURCE OF HIGH QUALITY PROTEIN. ALTHOUGH FISH ARE A RECOGNIZED STAPLE, JAMAICANS HAVE A LOW CONSUMPTION OF FISH DUE TO LIMITED SUPPLIES AND HIGH PRICES. GOJ CURRENTLY LACKS TECHNICAL PERSONNEL, ADEQUATE LABORATORY AND FIELD FACILITIES TO OFFER TRAINING AND EXTENSION SERVICES AND THUS BOLSTER PRIVATE FISH FARMING INDUSTRY.

**STRATEGY:**  
 THREE-YEAR PROJECT CONSISTS OF GRANT TECHNICAL ADVISORY ASSISTANCE AND PARTICIPANT TRAINING TO ESTABLISH INLAND FISHERIES DEVELOPMENT PROGRAM IN JAMAICA. USAID ALSO PROVIDES COMMODITIES. HOST-COUNTRY WILL PROVIDE FINANCIAL, ADMINISTRATIVE AND OPERATIONAL SUPPORT. PEACE CORPS ALSO PROVIDES TECHNICAL ASSISTANCE.

**SUMMARY:**  
 THIS IS NOT A BASKET PROJ IN THE USUAL SENSE. OI WAS DESIGNED AFTER, AND INDEPENDENTLY OF 532003800, BUT WAS ASSIGNED THE SAME NO GRANT. TECH ASSISTANCE IS PROVIDED TO JAMAICA TO ESTABLISH INLAND FISHERIES DEVEL PROGRAM. FISHERIES DIVISION WITHIN MINISTRY OF AGRICULTURE WILL ADMINISTER PROJ. FULL-TIME US FISHERIES ADVISOR WILL DEVELOP PROG STRATEGY & ACTIVELY PARTICIPATE IN ITS IMPLEMENTATION. SHORT-TERM CONSULTANTS WILL BE PROVIDED FOR SPECIALTY FIELDS SUCH AS POND DESIGN, POND CONSTRUCTION, HATCHERY MGMT, FISH NUTRITION, FISH DISEASE AND FISH ECON & MARKETING. CONSULTANTS WILL WORK ON SPECIAL PROBLEMS & CONDUCT IN-COUNTRY TRNG COURSES. A POND SURVEY & EXTENSION PROG FOR SMALL FARMERS/PRODUCERS WILL BE INTRODUCED IN JAMAICA'S SOUTHEASTERN REGION. 175 FARMER/PRODUCERS WILL BE SURVEYED TO COLLECT INFO ON POND SIZES, LOCATIONS, OWNERSHIP, ACCESSIBILITY, WORK QUALITY & AVAILABILITY, CONDITION OF POND BOTTOMS, POSSIBILITY OF MULTI-PURPOSE USE OF WATER AND RENOVATION REQUIRED FOR INTENSIVE FISH CULTURE DEVEL. 4 PEACE CORPS VOLUNTEERS WILL ASSIST WITH SURVEY. NEW FISH FARM CONSISTING OF 14 PRODUCTION PONDS (2 ACRES EACH) WILL BE BUILT AT GOJ-OWNED MORELAND FOOD FARM. THIS & OTHER GOVT FOOD PRODUCTION & PROCESSING FACILITIES WILL BE USED TO DEMONSTRATE PRACTICAL FISH FARMING TECH. TWICKENHAM PARK FISHERIES STATION WILL BE RENOVATED. NEW FISH STORAGE AREAS & PONDS WILL BE BUILT & THEIR RESEARCH LABS EQUIPPED. RENOVATION WILL INCLUDE NEW RESIDENCES FOR STATION MANAGERS. 3 PARTICIPANTS WILL RECEIVE MS DEGREE TRNG IN AQUACULTURE AT US UNIVERSITIES BEFORE ASSUMING RESPONSIBILITY FOR PROG. SPECIAL STUDY TOURS WILL BE PROVIDED TO FISHERIES PERSONNEL TO OBSERVE FISH CULTURE PROJS IN US & 3RD COUNTRIES. PROJ WILL PROVIDE ASSISTANCE TO JAMAICAN SCHOOL OF AGRICULTURE TO DEVELOP FISHERIES CURRIC. 1 STAFF MEMBR WILL RECEIVE ADVANCED TRNG IN AQUACULTURE PRODUCTION & PONDS WILL BE BUILT FOR USE AS FIELD LABS. PRIMARY BENEFICIARIES ARE POOR MAJORITY FOR WHOM INCREASED AMOUNTS OF LOW-COST FISH WILL BE AVAILABLE. USAID WILL ALSO FINANCE LAB EQUIPMENT & 6 VEHICLES. GOJ WILL FINANCE TWICKENHAM PARK RENOVATION AND PROVIDE ADMIN & OPERATING SUPPORT.

**GOAL:** ASSIST IN MEETING JAMAICA'S FOOD AND NUTRITION OBJECTIVES BY INCREASING PRODUCTION OF INLAND FISH.

**PURPOSE:** CREATE WITHIN GOJ FISHERIES DIVISION THE INSTITUTIONAL CAPABILITY AND TECHNICAL EXPERTISE TO DESIGN AND IMPLEMENT AN INLAND FISHERIES PROGRAM INVOLVING APPLIED RESEARCH, EXPERIMENTATION AND AN INLAND FISHERIES EXTENSION PROGRAM.

**OUTPUTS:** 1. PERSONNEL TRAINED IN INLAND FISHERIES DEVELOPMENT. 2. SURVEY OF PONDS COMPLETED AND EXTENSION PROGRAM OPERATIONAL. 3. UPGRADED PHYSICAL FACILITIES OF TWICKENHAM PARK. 4. PRODUCTION CAPACITY EXPANDED AT MORELANDS AND JAMAICAN INDUSTRIAL DEVELOPMENT CORPORATION (JIDC).

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* COUNTRY/BUREAU: JAMAICA PROJECT: 5320046 SUB-PROJECT: 00 *
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* TITLE: INTEGRATED REGIONAL RURAL DEVELOPMENT INITIAL FY: 77 FINAL FY: 82 *
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* ESTIMATED AMOUNT AUTHORIZED($000): 15,000 *
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**PROBLEM:** IN THE TWO MEETINGS/PINDARS RIVER PROJECT AREA OF JAMAICA, THERE ARE 4,000 SMALL, HILLSIDE FARMERS. THEY TYPICALLY HOLD 2.9 ACRES OF LAND, MOSTLY ON 5 TO 30 DEGREE SLOPES, YIELDING A PER CAPITA INCOME ON LESS THAN \$200/YR. BECAUSE SUCH SOIL CONSERVATION MEASURES AS TERRACING, DITCHING, & FORESTATION HAVE NOT BEEN INSTITUTED, THE PROJECT'S WATERSHLD AREAS HAVE BECOME SEVERELY ERODED AND CROP YIELDS REMAIN LOW. ALSO, CREDIT, MARKETING, & FARM INPUT SYSTEMS ARE DISJOINTED & INADEQUATE. W/ FEW INCENTIVES FOR FARMERS, IDLE LAND INCREASES.

**STRATEGY:** 5-YEAR PROJECT PROVIDES A) A GRANT FOR CONTRACT TECHNICAL ASSISTANCE, IN-COUNTRY, AND PARTICIPANT TRAINING, AND B) A LOAN FOR CAPITAL EXPENSES, COMMODITIES, AND OPERATING COSTS TO SUPPORT INTEGRATED RURAL DEVELOPMENT IN JAMAICA. HOST COUNTRY PROVIDES PROJECT MANAGEMENT AND A PORTION OF THE CAPITAL AND OPERATING COSTS.

**SUMMARY:**

GRANT AND LOAN FOR INTEGRATED RURAL DEVELOPMENT PROGRAM IN THE PINDARS RIVER AND TWO MEETINGS WATERSHED AREAS OF JAMAICA. PROJECT HAS 5 COMPONENTS:

- 1) EROSION CONTROL: A) SOIL CONSERVATION MEASURES, INCLUDING TERRACING, DITCHING, WATERWAYS, AND PASTURELAND ON 17,700 ACRES; B) FORESTATION ON 5,000 ACRES; AND C) ENGINEERING WORKS, INCLUDING 22 MILES OF ROAD CONSTRUCTION/REHABILITATION, AND RIVER AND STREAM CONTROL (CHECK DAMS AND EMBANKMENT PROTECTION).
- 2) DEMONSTRATION AND TRAINING CENTERS: 5 CENTERS WILL BE ESTABLISHED TO TEST AND DEMONSTRATE THE ADVANTAGES OF TERRACED FARMING AND OF MULTIPLE AND CONTINUOUS CROPPING TECHNIQUES. 50 SUBCENTERS, OWNED AND OPERATED BY NEARBY FARMERS, WILL FUNCTION AS PRACTICAL APPLICATIONS OF THE MODEL DEMONSTRATION CENTERS.
- 3) FARMER ORGANIZATIONS AND SERVICES: THE JAMAICAN AGRICULTURAL SOCIETY (LOCAL FARMER GROUPS) THE PEOPLE'S COOPERATIVE BANKS, AND COOPERATIVES IN THE PROJECT AREA WILL BE ENCOURAGED TO PROVIDE IMPROVED CREDIT, INPUTS, AND MARKETING SERVICES TO SMALL FARMER MEMBERS. THESE ORGANIZATIONS WILL BE PROVIDED WITH TECHNICAL ASSISTANCE, TRAINING, AND SEED CAPITAL.
- 4) AGRICULTURAL EXTENSION: TECHNICAL ADVISORS WILL TRAIN 20 AGENTS AND OTHER MINISTRY OF AGRICULTURE PERSONNEL. THE AGENTS WILL PROMOTE THE PROJECT'S SOIL CONSERVATION MEASURES AND THE SERVICES OF THE FARMER ORGANIZATIONS AMONG AREA FARMERS. THEY WILL ALSO ADVISE FARMERS ON APPROPRIATE CULTIVATION TECHNIQUES, AND ON THE USE OF INPUTS, CREDIT, AND MARKETING SERVICES.
- 5) RURAL INFRASTRUCTURE: THE GOJ WILL FINANCE RURAL ELECTRIFICATION, POTABLE WATER, AND HOUSING CONSTRUCTION/REFURBISHING PROGRAMS IN THE PROJECT AREA.

30 JAMAICANS WILL RECEIVE UNDERGRADUATE AND GRADUATE TRAINING IN THE US IN VARIOUS FIELDS OF AGRICULTURE PROJECT WILL BE IMPLEMENTED BY JAMAICA'S MINISTRY OF AGRICULTURE - SOUTHERN REGION IN CONJUNCTION WITH THE FORESTRY DEPARTMENT AND THE MINISTRY OF PUBLIC WORKS. PROJECT ACTIVITIES WILL INCREASE EMPLOYMENT OPPORTUNITIES IN THE AREA.

**GOAL:** TO IMPROVE STANDARD OF LIVING OF FARMERS IN JAMAICA BY INCREASING INCOME & PROVIDING IMPROVED ROADS, HOUSING, ELECTRICITY, WATER. SUBGOAL: TO ESTAB AN AGRIC PRODUCTION MODEL THAT CAN BE REPLICATED ON SMALL HILLSIDE FARMS.

**PURPOSE:** A) INCREASE AGRICULTURAL PRODUCTION ON SMALL HILLSIDE FARMS IN THE PINDARS/TWO MEETINGS WATERSHEDS. B) CONTROL SOIL EROSION IN WATERSHEDS C) STRENGTHEN THE HUMAN RESOURCE CAPABILITY OF THE MIN AG.

**OUTPUTS:** 1) SOIL CONSERVATION MEASURES ON 17700 ACRES 2) REFORESTATION OF 5000 ACRES NOT SUITABLE FOR AGRIC 3) 22 MI OF ACCESS ROADS CONSTRUCTED OR REHABILITATED 4) 1.1 MIL M/D OF SHORT-TERM EMPLOYMENT GENERATED 5) IMPROVED, INTENSIFIED FARMING SYSTEM INTRODUCED ON 10000 ACRES 6) 30 TECHNICIANS TRAINED 7) 55 TRNG & DEMO CTRS 8) SMALL FARMER ORGANIZATIONS DEVELOPED 9) SMALL FARMER CREDIT SYS ESTAB. 10. IMPROVED POTABLE WATER SUPPLY SYS. 11) RURAL ELECTRIFICATION 12) 235 RURAL HOUSES CONST OR REHAB.

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PROJECT DESIGN INFORMATION

\* COUNTRY/BUREAU: JAMAICA PROJECT: 5320059 SUB-PROJECT: 00  
 \* PROJECT TITLE: FISH PRODUCTION SYSTEM DEVELOPMENT INITIAL FY: 79 FINAL FY: 83  
 \* EST. FUNDS(000): \$4,107

**PROBLEM:** JAMAICA'S CURRENT AGRICULTURAL OUTPUT DOES NOT ADEQUATELY PROVIDE FOR THE NATION'S NUTRITIONAL NEEDS. OF 1.5 MILLION ACRES DESIGNATED AS FARMLAND IN THE 1978 GOJ AGRICULTURAL PLAN, ONE-THIRD WAS CLASSIFIED AS MARGINAL OR UNUSED. ALTHOUGH FRESHWATER FISH PRODUCTION WOULD PUT TO USE SUCH MARGINAL OR RUINATE LANDS, THE GOJ CURRENTLY LACKS TRAINED MANPOWER AND FACILITIES TO PROMOTE THE EXPANSION OF THIS INDUSTRY. AS A RESULT, AN IMPORTANT SOURCE OF NUTRITION, COMMERCE, AND EMPLOYEMENT REMAINS UNEXPLOITED.

**STRATEGY:** FIVE-YEAR PROJECT CONSISTS OF GRANT, LOAN, TECHNICAL ASSISTANCE, PARTICIPANT TRAINING, AND COMMODITIES TO THE GOVT OF JAMAICA TO INCREASE THE NATION'S FRESHWATER FISH PRODUCTION. HOST-COUNTRY WILL PROVIDE INSTITUTIONAL AND FINANCIAL SUPPORT.

**SUMMARY:** GRANT, LOAN, TECH ASSIST, PARTICIPANT TRNG, AND COMMODITIES ARE PROVIDED TO THE GOVT OF JAMAICA'S INLAND FISHERIES UNIT (IFU) TO INCREASE THE NATION'S FRESHWATER FISH PRODUCTION. AN IFU HATCHERY/DEMONSTRATION FACILITY CONSISTING OF 20 ACRES OF PONDS WILL BE CONSTRUCTED AT FERRIS CROSS & WILL BE EXPECTED TO PRODUCE 13 MIL FINGERLINGS YELY RESEARCH FACILITIES AT TWICKENHAM PARK WILL BE EXPANDED TO PERMIT IFU TO INVESTIGATE NEW SPECIES & CONDUCT PRACTICAL RESEARCH ON FEEDING & STOCKING RATES, MIXED SEX CULTURE, AND POLYCULTURE. IFU STAFF WILL BE EXPANDED FROM 44 TO 100 BY 1982, AND WILL INCLUDE 36 PROFESSIONAL FISHERIES OFFICERS AND 124 LABORERS, CLERICAL STAFF, POND OPERATORS, AND DRIVERS. USAID WILL ASSIGN A SENIOR TECH ADVISOR TO SERVE AS COUNTERPART TO THE DIRECTOR OF IFU & TWO EXTENSION ADVISORS TO SERVE AS COUNTERPARTS TO FISHERIES EXTENSION OFFICERS IN THE EASTERN & WESTERN REGIONS. SHORT-TERM SPECIALISTS WILL ALSO BE PROVIDED TO TRAIN IFU STAFF IN FINGERLING PRODUCTION & EXTENSION WORK. IN ADDITION TO THEIR OTHER DUTIES, IFU STAFF & LONG-TERM US ADVISORS WILL INSTRUCT FARMERS IN POND MGMT & PRODUCTION TECHNIQUES. ONE-WK COURSES WILL BE OFFERED ON A QUARTERLY BASIS AT THE TWICKENHAM FACILITY. ALL INTERESTED FARMERS WILL BE ENCOURAGED TO ATTEND AT LEAST ONE OF THE COURSES. THE US PARTICIPANT TRNG COMPONENT WILL INCLUDE 12-MOS OF AQUACULTURE TRNG FOR ONE IFU RESEARCH TRNG OFFICER, 14 MOS OF TRNG FOR TWO REGIONAL EXTENSION SPECIALISTS AND 24 MOS OF TRNG FOR A REGIONAL PRODUCTION/EXTENSION OFFICER. TWELVE FISHERY EXTENSION AGENTS WILL BE SENT TO A 15-WK AQUACULTURE TRNG PROG AT AUBURN UNIVERSITY. IN ADDITION TWO USA (JAMAICA SCHOOL OF AGRICULTURE) FACULTY MEMBERS WILL PARTICIPATE IN A 15-MOS OUT-OF-COUNTRY TRNG PROG IN AQUACULTURE, FISHERIES EXTENSION, AND ECONOMICS; AND ONE UWI (UNIVERSITY OF WEST INDIES) PARTICIPANT WILL RECEIVE NINE-MOS OF POST-DOCTORAL TRNG IN FRESHWATER FISH CULTURE IN THE US. USAID WILL PROVIDE COMMODITIES INCLUDING VEHICLES, TRAILBIKES, BULLDOZERS, FEED, FERTILIZER, AND OTHER SUPPLIES. TWENTY-FIVE PEACE CORP VOLUNTEERS WILL TRAIN COUNTERPARTS AS EXTENSION AGENTS AND HATCHERY MANAGERS.

**GOAL:** A. INCREASE FOOD PRODUCTION. B. REDUCE FOREIGN EXCHANGE DRAIN OF FOREIGN IMPORTS. C. INCREASE INCOME AND EMPLOYMENT AND IMPROVE NUTRITION IN RURAL AREAS. D. ESTABLISH THE FOUNDATION FOR A REGIONAL TRAINING PROGRAM IN FISH PRODUCTION.

**PURPOSE:** 1. TO DEVELOP THE CAPACITY OF THE GOVT OF JAMAICA INSTITUTIONS TO INCREASE FISH PRODUCTION THROUGHOUT THE COUNTRY. 2. TO ESTABLISH FRESHWATER FISH FARMING AS A VIABLE FARMING ACTIVITY ISLANDWIDE. 1

**OUTPUTS:** 1. FARMERS TRAINED. 2. IFU (INLAND FISHERIES UNIT) PERSONNEL TRAINED. 3. REGIONAL PERSONNEL TRAINED. 4. FISH PRODUCED. 1

DESIGN AND EVALUATION DOCUMENTS IN DEVELOPMENT INFORMATION CENTER

DOCUMENT TYPE	DATE	DOCUMENT TITLE	PAGES	DIC CALL NO	FUN NO
PROJECT PAPER	06/27/79	FISH PRODUCTION SYSTEM DEVELOPMENT	127P		

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* COUNTRY/BUREAU: JAMAICA PROJECT: 5326038 SUB-PROJECT: 00 *
* TITLE: JAMAICA-FORESTRY DEVELOPMENT INITIAL FY: 76 FINAL FY: 80 *
* ESTIMATED AMOUNT AUTHORIZED($000): 4.893 *
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**PROBLEM:** JAMAICAN FOREST RESOURCES UNDERDEVELOPED BECAUSE FOREST DEPARTMENT UNDERSTAFFED AND UNDERTRAINED. IF JAMAICA IS TO SUCCESSFULLY ACHIEVE RESOURCES DEVELOPMENT GOALS IT MUST UPGRADE ITS CONTROL OVER FOREST RESOURCES.

**STRATEGY:** PROVIDE FINANCIAL AND TECHNICAL ASSISTANCE TO STRENGTHEN FOREST DEPARTMENT.

**SUMMARY:** ASSISTANCE TO DEVELOP TIMBER RESOURCE BASE AND ESTABLISH FORESTRY DEPARTMENT WITH TECHNICAL AND MANAGERIAL CAPABILITY TO ADMINISTER RESOURCE DEVELOPMENT PROGRAMS. INCREASE STAFF, TRAIN TECHNICAL AND PROFESSIONAL PERSONNEL, DILINEATE STAFF FUNCTIONS, IMPROVE MOBILITY AND COMMUNICATION BETWEEN HEADQUARTERS AND FIELD OFFICES. CARIBBEAN PLANTATION SUPPLIES RAW MATERIAL BASE ON GOVERNMENT LAND, ENCOURAGING PRIVATE LAND OWNERS TO ALSO PLANT PINE. TECHNICAL ASSISTANCE PROVIDED TO SAW MILL OPERATIONS.

**GOAL:** INCREASE JAMAICA'S FORESTRY CONTRIBUTION TO NATIONAL ECONOMY. I

**PURPOSE:** DEVELOP PUBLIC FORESTRY INSTITUTION WITH TECHNICAL AND MANAGEMENT CAPABILITY TO ESTABLISH ECONOMICALLY VIABLE TIMBER RESOURCE PROGRAM THAT INCREASES EMPLOYMENT AND SUPPLIES WOOD DEMANDS I

**OUTPUTS:** FORESTRY DEPARTMENT REORGANIZED; CARIBBEAN PINE PLANTATION ESTABLISHED; FOREST ACCESS ROADS CONSTRUCTED AND MAINTAINED; PINE SEED PRODUCTION INCREASED; WOOD PROCESSING AND TIMBER SALES DEMONSTRATION PROJECTS IMPLEMENTED; FORESTRY DEPARTMENT OFFICE FACILITIES CONSTRUCTED; FORESTRY DEPARTMENT TECHNICAL AND PROFESSIONAL PERSONNEL TRAINED. I

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