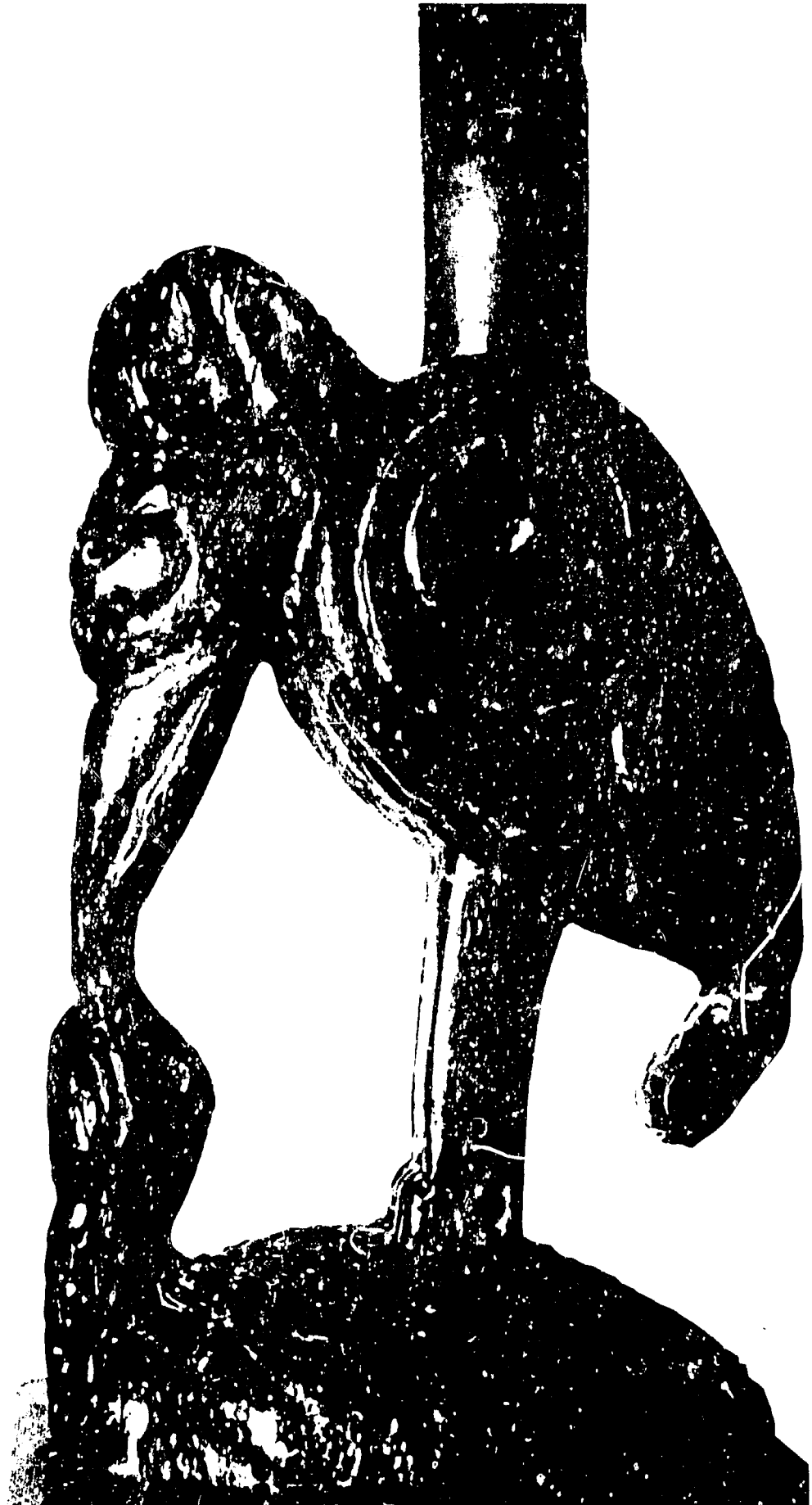


- PN-ABC-274 -

COUNTRY  
ENVIRONMENTAL PROFILE

J  
A  
M  
A  
I  
C  
A



J  
A  
M  
A  
I  
C  
A

COUNTRY  
ENVIRONMENTAL PROFILE

Prepared By:

**Government of Jamaica, Ministry of Agriculture,  
Natural Resources Conservation Division**

And

**Ralph M. Field Associates, Inc.**

On Behalf Of:

**International Institute For Environment And Development**

## PREFACE

This Country Environmental Profile (CEP) of Jamaica is one of a series of environmental profiles funded by the U.S. Agency for International Development (USAID). Financial support was received both from the USAID mission to Jamaica, and the Bureau for Latin America and the Caribbean (LAC), Office of Development Resources (DR). The Scope of Work for this CEP was jointly prepared by Dennis McCaffrey of the International Institute for Environment and Development (IIED) in Washington, D.C., and Ralph M. Field, President of Ralph M. Field Associates (RMFA) of Westport, Connecticut. The views and opinions expressed in this document are those of the authors, and not necessarily those of the U.S. Agency for International Development.

Preparation of the various sections comprising this document is entirely the work of Jamaican governmental agencies, consulting firms and individual consultants retained by the Natural Resources Conservation Division (NRCD). In the evolution of the Country Environmental Profile, sector drafts prepared by various contributors went through an iterative, and unavoidably time-consuming process in order to involve a broad spectrum of reviewers in critiquing the work. The role of RMFA during this process has been to co-ordinate the work with NRCD, edit the successive drafts, offer constructive criticism where appropriate, and organize the many individual contributions into a single cohesive document.

It would be presumptuous to claim that this Profile incorporates a definitive set of policy recommendations with respect to Jamaica's environment, or that it is encyclopedic in its coverage of the individual sectors. This is not that type of document. It is, however, an important milestone in assembling a broad information base on Jamaica's environment and natural resources, thus providing a further basis for making policy and program determinations. Hopefully, this Profile will contribute to the on-going dialogue of how best to reconcile the protection and enhancement of Jamaica's natural environment with the country's pressing need for sustained economic growth and development.

## ACKNOWLEDGEMENTS

Technical guidance in preparation of the CEP was the responsibility of Ralph M. Field Associates, Inc., working under a subcontract from IIED. Coordination of local consultants and review of sector reports was the responsibility of the Natural Resources Conservation Division.

Co-team leaders in this effort were successive directors of NRCD and Ralph M. Field, who was assisted throughout this two-year effort by Julie E. Troy, Senior Analyst at RMFA.

Jaime Correa of USAID was instrumental in laying the groundwork for initiation of the CEP, together with Beverly Miller, former Director of NRCD. Dr. S.C. Sinha, current Director of NRCD, deserves credit for helping with the many tasks that arose during the final phase of the project, as does Dr. Marcel Anderson, who coordinated many of the agency reviews of the individual sector reports.

Numerous other individuals and organizations provided valuable and much appreciated assistance during the course of this project. Particular recognition is due to those cited below.

## **Science, Technology and Research Department, Ministry of Agriculture**

Dr. H.I.C. Lowe	- Executive Director
Dr. Marcel Anderson	- Director, Technical Coordinator
Ms. Vilma McClenan	- Director
Mrs. Joyce Annakie	- Secretary

The Natural Resources Conservation Division is indebted to Dr. Lloyd Rankine, Head, Department of Agricultural Economics and Farm Management, University of the West Indies, St. Augustine Campus, Trinidad for his assistance in the preparation and editing of various sections of the document.

## **Natural Resources Conservation Division (NRCD) Staff**

Mr. Philemon Hoilett	- Acting Principal Director
Miss Claire Forrester	- Acting Principal Director
Mr. Paul Carroll	- Acting Principal Director
Dr. C. Sinha	- Principal Director
Mrs. Elizabeth Ross	- Acting Director, Aquatic Resources
Miss Ann Haynes	- Ecology and Wildlife
Miss Karen Harvey	- Peace Corp Volunteer - National Parks
Mr. Learie Miller	- Beach Control Division
Miss N. Plunkett	- Technical Assistant
Mr. L. Gardner	- Technical Assistant
Mr. Fitzroy Gregory	- Draughtsman
Mr. Lancelot Anderson	- Draughtsman
Miss L. Clato-Day	- Secretary Stenographer
Miss G. Clarke	- Secretary Stenographer

## **Consultants**

### Project Management

International Institute for Environment and Development	- Prime Contractor
Ralph M. Field Associates	- Principal Consultant

### Sector Contributors

Charles V. Carnegie	- African-Caribbean Institute, ISER, UWI
Lloyd A. Donaldson	- Underground Water Authority, Ministry of Agriculture
Conrad Douglas & Associates	- 14 Carvalho Ave., Kingston 10
Fred Hanley	- Master Blend Feeds Ltd.
Franklin McDonald	- Office of Disaster Preparedness, Ministry of Construction
Beverly Miller	- Imeru Environmental Consultants

## **Interagency Advisory Committee**

The CEP team was assisted by an Interagency Advisory Committee which provided input on policy and project recommendations. Members of the Committee are listed in Appendix A. Many other individuals provided valuable information through interviews.

## **U.S. Agency for International Development (USAID)**

The JCEP has benefited greatly from the participation of Jim Talbot, Caribbean Regional Environmental Specialist for the USAID, and Leland Voth and Mark Nolan of the Agriculture and Rural Development Office and Charles Matthews of the Office of Engineering, Energy and the Environment of the USAID mission to Jamaica. These individuals carefully reviewed drafts, attended numerous meetings, provided input, and generally helped to facilitate the production of this CEP.



## CONTENTS

	<u>Page</u>
Preface	i
Acknowledgements	i
List of Figures	vii
List of Tables	ix
<b>INTRODUCTION</b>	<b>1</b>
<b>Purposes of a Country Environmental Profile</b>	
<b>Process of CEP Preparation for Jamaica</b>	1
<b>Objectives of the CEP for Jamaica</b>	2
<b>Organization of the Report</b>	2
<b>PART I: CONTEXT</b>	<b>3</b>
<b>Physical, Demographic and Economic Context</b>	5
<b>Institutional Overview</b>	21
<b>PART II: ISSUES, POLICIES AND RECOMMENDATIONS</b>	<b>31</b>
<b>Problems and Issues</b>	33
<b>Framework for Environmental Management</b>	37
<b>Policy and Project Recommendations</b>	41
<b>PART III: SECTOR ANALYSES</b>	<b>47</b>
<u><b>The People</b></u>	49
<b>Human Resources and Culture</b>	49
<b>Environmental Education</b>	69
<u><b>The Resource Base</b></u>	83
<b>Coastal Resources</b>	83
<b>Water Resources</b>	113
<b>Wildlife</b>	133
<b>National Parks and Protected Areas</b>	161

	<u>Page</u>
<b><u>Environment and the Economy</u></b>	173
<b>Fisheries Resources</b>	173
<b>Forestry</b>	197
<b>Tourism and Recreation</b>	211
<b>Minerals and Mining</b>	229
<b>Energy Resources</b>	243
<b>Agricultural Resources</b>	259
<b><u>The Built Environment</u></b>	291
<b>Urban and Rural Infrastructure</b>	291
<b>Industry and Industrial Pollution</b>	307
<b>Environmental Hazards</b>	329
<b>APPENDICES</b>	349
A. Interagency Advisory Committee Members	350
B. Bibliography	351



## LIST OF FIGURES

	<u>Page</u>
<b><u>Physical &amp; Cultural Context</u></b>	
1: Regional Context	6
2: Island of Jamaica	7
3: Topography	8
4: Climate	10
5: Geology	11
6: Soils	12
7: Land Use	15
8: Bauxite and Alumina Exports	19
9: GOJ Agencies with Functions Related to Environmental Management	25
<b><u>Human Resources &amp; Culture</u></b>	
10: Population Densities and Distribution by Parish	52
11: Growth of the KMA	55
12: Total Fertility Rate, Jamaica	57
13: Settlement Strategy	61
<b><u>Coastal Resources</u></b>	
14: Coastal Area Boundaries and Management Units	84
15: Shoreline Configuration	86
16: Kingston Harbour and Environs	92
17: Distribution of Stranded Tar	103
18: Areas of Critical Beach Erosion	105
<b><u>Water Resources</u></b>	
19: Jamaica - Mean Thirty Year Rainfall (1931-1960)	114
20: Jamaica - Location of Main Surface Water Features	116
21: Jamaica - Location of Significant Groundwater Features	117
22: Jamaica - Hydrologic Basins and Watersheds	119
23: Jamaica - Location of Water Supply Systems	120
<b><u>Wildlife</u></b>	
24: Vegetation Map of Jamaica Showing the Distribution of Forests and Plantation Crops	135
25: Comparison of the Number of Species of Flowering Plants and Ferns in Jamaica, Sri Lanka and the British Isles	138
<b><u>National Parks</u></b>	
26: Existing and Proposed Parks and Protected Areas	163
<b><u>Fisheries</u></b>	
27: Schematic Outline of Jamaican Fishery Resources	174
28: Inshore and Offshore Fishing Areas	175
29: Potential Shrimp Trawling Areas on the South Coast	176
30: Coastal Areas Under Development Pressure	179
31: Aquaculture Development Plan - Location of Fish Farms	181
32: National Aquaculture Development Plan	186
<b><u>Forestry</u></b>	
33: Forest Vegetation	198
34: Areas Suitable for Pine Development in Eastern Region	202
35: Forest Administrative Units and Infrastructure	205
36: Proposed Formal Institutional Organization Structure	207

	<u>Page</u>
<b><u>Tourism</u></b>	
37: Total Visitor Arrivals to Jamaica, 1971-1985	212
38: Jamaica - Hotel Beds Sold by Region (1985)	213
39: Offshore Islands and Cays, Mineral Springs, Waterfalls and Botanical Gardens	218
<b><u>Minerals and Mining</u></b>	
40: Jamaican Bauxite Resources	230
41: Metallic Minerals	233
42: Petroleum Exploration Status	235
43: Non-Metallic Minerals	236
<b><u>Energy</u></b>	
44: Major and Minor Peat Deposits	246
45: Jamaica Public Service Power Stations	248
46: Jamaica Public Service Co. Major Transmission Lines - Distribution	249
47: Small-Scale Hydropower Sites	254
<b><u>Agriculture</u></b>	
48: Land Use Map of Jamaica	265
49: Agricultural Land Capability	266
50: Contaminated Groundwater Aquifers of Jamaica	287
<b><u>Infrastructure</u></b>	
51: Areas Classified as Urban	292
52: J.P.S. Rural Distribution	293
53: Kingston Harbour, Showing Major Freshwater and Waste Discharges	294
54: Post-Primary Schools	295
55: Health Services	296
56: Clinics	297
57: Public Housing Distribution	298
58: Public Housing Projects in Pipeline	304
<b><u>Industry &amp; Industrial Pollution</u></b>	
59: Sugar Production in Jamaica	310
60: Bauxite and Alumina Operations in Jamaica	311
61: Section Across Red Mud Pond	312
62: Simplified Geological Map of Jamaica showing Red Mud Disposal Sites	313
63: Essex Valley Location of Wells and Contaminated Areas	315
64: Distribution of Manufacturing Establishments	316
65: Location of Treatment Plants	321
<b><u>Environmental Hazards</u></b>	
66: Preliminary Map of High Risk Areas - Jamaica	331
67: Projected Surge & Wave Heights, Kingston Harbour	332
68: Major Hurricanes Affecting Jamaica 1880-1970	333
69: Fault Zones in the Caribbean	334
70: Number of Earthquakes of Intensity VI, 1874-1978	335
71: Modified Mercalli Intensity Map of 1907 Earthquake	335
72: Geology of the Kingston Waterfront	337
73: Geology of Portmore	338
74: Areas Having Priority for Mitigation in the KMR	341

## LIST OF TABLES

	<u>Page</u>
<b><u>Physical and Cultural Context</u></b>	
1: Interpreted Land Cover/Use Category Totals	14
2: Population Change in Jamaica, 1975-1983	16
3: Gross Domestic Product, 1984/85, 1985/86	18
<b><u>Human Resources and Culture</u></b>	
4: Population Density in Selected Countries of the Circum-Caribbean	51
5: Estimates of Net Migration, 1960-1984	53
6: Distribution of Emigrants to North America, 1970-80	53
7: Population by Age Group and Number of Parishes lived in Between June 1969 and June 1974	54
8: Degree of Dependency of Communities in the KMR on KMA	56
9: Level of Housing Construction, 1974-1984	57
10: Percentage Employed Labour Force by Industry Group	58
11: Percentage Employed Labour Force by Occupation	59
12: Unemployment Rate, Jamaica	59
13: Adjusted School Enrollment Ratio	59
14: A Profile of Community Based Organizations and Institutions in Jamaica	66
15: PVO's Concerned with Environmental Conservation	67
<b><u>Environmental Education</u></b>	
16: Major Events in the Development of Environmental Education in Jamaica	71
17: CAST's Extra Curricular Involvement in Environmental Education	75
18: Tertiary Institutions Offering Environmentally Related Courses and Programmes	78
19: Major Public Sector and Non-Governmental Organizations in Jamaica which Provide Aspects of Environmental Education	79
<b><u>Coastal Resources</u></b>	
20: Dominant Plant Species in Jamaican Wetlands	88
21: Number of Species in Plant Communities, Negril Morass	90
22: Number of Species in Plant Communities, Black River Lower Morass	91
23: Summary of Coastal Zone Management Recommendations for the Kingston Region	98
<b><u>Water Resources</u></b>	
24: Average Annual Distribution of Water Types	115
25: Distribution of Demand and Supply	121
26: Distribution of Irrigated and Irrigable Land and Unit Demands	122
27: Hydropower Facilities	123
28: Government Institutions and Agencies in the Water Resources Sector	124
29: Data on Main Water Supply Systems	126
30: Problems Related to Inadequate Source Evaluation	127
31: Programs Required to Improve Management of the Water Sector	129
32: Recommended Projects	130
<b><u>Wildlife Resources</u></b>	
33: Some Examples of Levels of Endemism in Various Groups of Plants and Animals	134
34: Some Proposed Sites of Scientific Interest for Wildlife	137

	<u>Page</u>
35: Critically Endangered/Extinct Species of Wildlife	139
36: Endangered Species of Wildlife	140
37: Some Threatened Species	141
38: Some Examples of Rare Species	143
39: Endangered, Threatened & Rare Plants	144
40: Summary of Institutional Responsibilities for Wildlife Resources	148
 <b><u>National Parks and Protected Areas</u></b>	
41: Description of Proposed Reserve Categories and Some Proposed Jamaica Areas	164
42: Institutions Related to National Parks and Protected Areas	167
 <b><u>Fisheries</u></b>	
43: Species of Fish Comprising More than 80% by Weight of Those Caught by Traps in Demersal Fishery	176
44: Estimates of Fish Production from Jamaican Insular Shelf Only, 1945-1981	177
45: Artisanal Fishery: Estimated Annual Catch by Type of Fish and Fishing Ground	178
46: Major Projects Undergoing Expansion in the Aquaculture Industry	185
47: Development Pressures Affecting Fisheries Resources	187
48: Fishery Resources of Jamaican Waters	194
 <b><u>Forestry</u></b>	
49: Distribution of Forest Resources in Government and Private Hands, by Parish	199
50: Climatic Characteristics of Jamaica's Natural Habitats	199
51: Jamaica's Life Zones	200
52: Extent and Ownership of Forest	201
53: Estimated Forest Plantations on Forest Reserves by Species	202
54: Pine Lumber Imports and Local Production to Satisfy Local Demand	203
55: New Scheme of Land Capability Classification for Jamaica	208
 <b><u>Tourism and Recreation</u></b>	
56: Jamaica, Spatial Distribution of Hotel Rooms	213
57: Jamaica, Hotel Bed-Nights Sold	214
58: Commercial and Recreational Usage of Jamaica's Coastline	215
59: Schedule of Public Bathing Beaches	216
60: Mineral Springs in Jamaica	219
 <b><u>Minerals and Mining</u></b>	
61: Jamaica's Bauxite Production, 1972-1985	231
62: Gypsum Production, 1980-1985	232
63: Estimate of Marble Reserves	232
64: Silica Sand Production	234
 <b><u>Energy</u></b>	
65: Petroleum Consumption by Product, 1985	244
66: Petroleum Consumption by Sector, 1985	245
67: Electric Generating Capacity, 1981-1984	247
68: Location, Type and Rating of JPSCo. Generating Facilities	248
69: Jamaica's Petroleum Demand Forecast, 1985-1989	250
70: Proposed Hydropower Projects	253

	<u>Page</u>
<b><u>Agriculture</u></b>	
71: Agricultural Employment (as of Oct. 1982)	260
72: GDP at Current and Constant Prices (Annual Percentage Change)	261
73: Change in GDP at Constant Prices (Annual Percentage Change)	261
74: Land Use Distribution, 1978-79	262
75: Jamaica's Agricultural Capability Classes	263
76: Number of Farms by Income-Earning Activity	263
77: Number and Acreage of Farms by Size Groups	267
78: Value of Selected Agricultural Exports, 1980-1984	267
79: Volume of Major Agricultural Commodities Produced, 1980-1985	268
80: Total Number of Farms by Size and Acreage, By Legal Status Holder	269
81: Acreage of Farms by Tenure of Land, By Size Group	270
82: Total Number of Farms by Major Income Earning Agricultural Activity, By Size Group of Farm by Legal Status Holder	271
83: Total Acreage of Farms by Major Income Earning Agricultural Activity by Size Group of Farm by Legal Status Holder	272
84: Total Number of Farms with Farm Machinery and Equipment Available by Size Group of the Farm	273
85: Number of Farms with Specified Crops and Size Utilizing Fertilizer and Pesticides	274
86: Domestic Food and Livestock Production, 1981-1985	276
87: Total Meat and Fish Consumed, Meat Production and Imports of All Types of Meat, 1975-1985	278
88: Imports of Main Milk Products	279
89: Imports of Selected Foodstuffs, 1981-1985	279
90: Selected Traditional Export Crops, 1981-1985	280
<b><u>Industry and Industrial Pollution</u></b>	
91: Sugar Production, 1963-1985	308
92: Jamaica: Gross Foreign Exchange Earnings 1981-85	309
93: Composition of Red Mud	314
94: Cement Production in Jamaica, 1981-1985	317
<b><u>Environmental Hazards</u></b>	
95: Recorded Instances of Coastal Flooding due to Storm Surge	330
96: Return Periods for Modified Mercalli Intensities and Anticipated Effects	336
97: Major Risk Areas Vulnerable to Multiple Hazards	340
98: Key Government Agencies and Private Organizations with Programs and Activities Affecting Natural Hazards Management	342



Plate 2 - Duna's River Falls, St. Ann.

## INTRODUCTION

---

### **Purposes of a Country Environmental Profile**

Preparation of a Country Environmental Profile (CEP) is intended to serve multiple purposes. For the U.S. Agency for International Development (AID), the CEP offers an opportunity to systematically review the environmental and natural resource base of a particular country or region. This information provides a context for identifying and ranking environmental problems and opportunities, thereby strengthening programming capabilities and providing a framework for project implementation.

For the host country, the CEP can become an effective instrument for establishing a consensus on national environmental policy. It does this by gathering together the relevant information on key resource sectors, and by reviewing the findings with public agencies, private voluntary organizations, and interested citizen groups. The aim is to establish a consensus on key resource problems and how the country may proceed to resolve these problems within the constraints of budget, manpower, technology, and jurisdictional authority.

Thus far, full Environmental Profiles have been prepared for 15 countries, principally in Latin America and the Caribbean. Desk-type profiles, based almost entirely on library research, have been prepared for an additional 23 countries.

These profiles have been used widely by AID, host countries, development banks, and other bilateral agencies for briefing and reference. Profiles have helped set the stage for major investments in natural resource management and have served an institution-building function. Typically, they have provided a compendium of useful information on the natural resource base of each country and have identified major existing and potential problems associated with environmental and natural resource management.

### **Process of CEP Preparation for Jamaica**

In 1981, a "desk-type" Environmental Profile for Jamaica was prepared under a contract between U.S. AID, Office of Forestry, Environment, and Natural Resources and the U.S. Man and the Biosphere Program.\* A full CEP project was initiated in 1985 through a contract between AID and the International Institute for Environment and Development (IIED). Ralph M. Field Associates, Inc. (RMFA) was retained by IIED as principal consultant for the CEP, to work with the Jamaica Natural Resources Conservation Division (NRCD), the counterpart agency for the Government of Jamaica (GOJ).

\* Susan Braatz. Draft Environmental Profile on Jamaica. 1981.

It was jointly agreed that 16 environmental and resource sectors would be examined. These included: Agriculture, Coastal Resources, Energy Resources, Fisheries, Forestry, Human Resources and Culture, Industry and Industrial Pollution, Mining and Minerals, National Parks, Natural Hazards, Private Voluntary Organizations, Recreation and Tourism, Training, Urban and Rural Infrastructure, Water and Hydrology, and Wildlife. Using NRC staff, a short Reconnaissance Phase was initiated to compile and summarize readily available information on each of the sectors.

After an intensive staff effort in searching files and conducting interviews, initial reconnaissance reports were prepared according to a uniform format. A decision was then made as to which sectors required additional consulting assistance. Once the consultants were selected, the reconnaissance reports became the starting point for further in-depth research by experts in the particular fields. Throughout the effort, emphasis was on insuring factual accuracy, highlighting the key issues in each sector, and formulating recommendations for policy and future programming.

Synopses of the Sector Reports were later reviewed by a specially-appointed Advisory Group in an attempt to reach broad consensus on policy recommendations to be submitted to Government. The recommendations in this CEP Report are based on the results of the Advisory Group's review and deliberations, supported by the findings of the sectoral studies.

### **Objectives of the CEP for Jamaica**

The goal of the Jamaica Country Environmental Profile (CEP) is to contribute to sustained economic development. The approach has been to develop a national overview of Jamaica's environment, with the aim of identifying opportunities for significantly improving resource-conservation and environmental management.

The specific terms of reference of the Jamaica CEP were as follows:

1. To prepare a report that documents Jamaica's natural resource base and the condition of the natural environment.
2. To describe and analyze the existing institutional framework as it affects resource sectors and areas of environmental concern.

3. To identify key governmental policies, programmes, and investment priorities affecting resource and environmental management.
4. To identify the areas of congruity and conflict between economic development and environmental protection in key sectors and activities.
5. To prepare a draft environmental policy statement for Jamaica.
6. To identify programmes and projects that further both environmental and development objectives that could be financed by the Government of Jamaica and/or the private sector with financial and technical assistance from AID and other donors.

### **Organization of the Report**

This CEP for Jamaica includes three parts:

- o **Part I:** describes the physical and cultural context and provides an institutional overview.
- o **Part II:** identifies key issues and problems facing Jamaica in attempts to balance an overwhelming need for economic development and the essential need to manage and conserve the resource base on which this development depends, and makes policy and project recommendations to further the objectives of the CEP.
- o **Part III:** includes, for each of the individual sectors, a summary of existing conditions and institutional responsibilities, identifies plans and programmes affecting the sector, identifies major issues and problems within each sector, and discusses directions for future work.



## PART I: CONTEXT

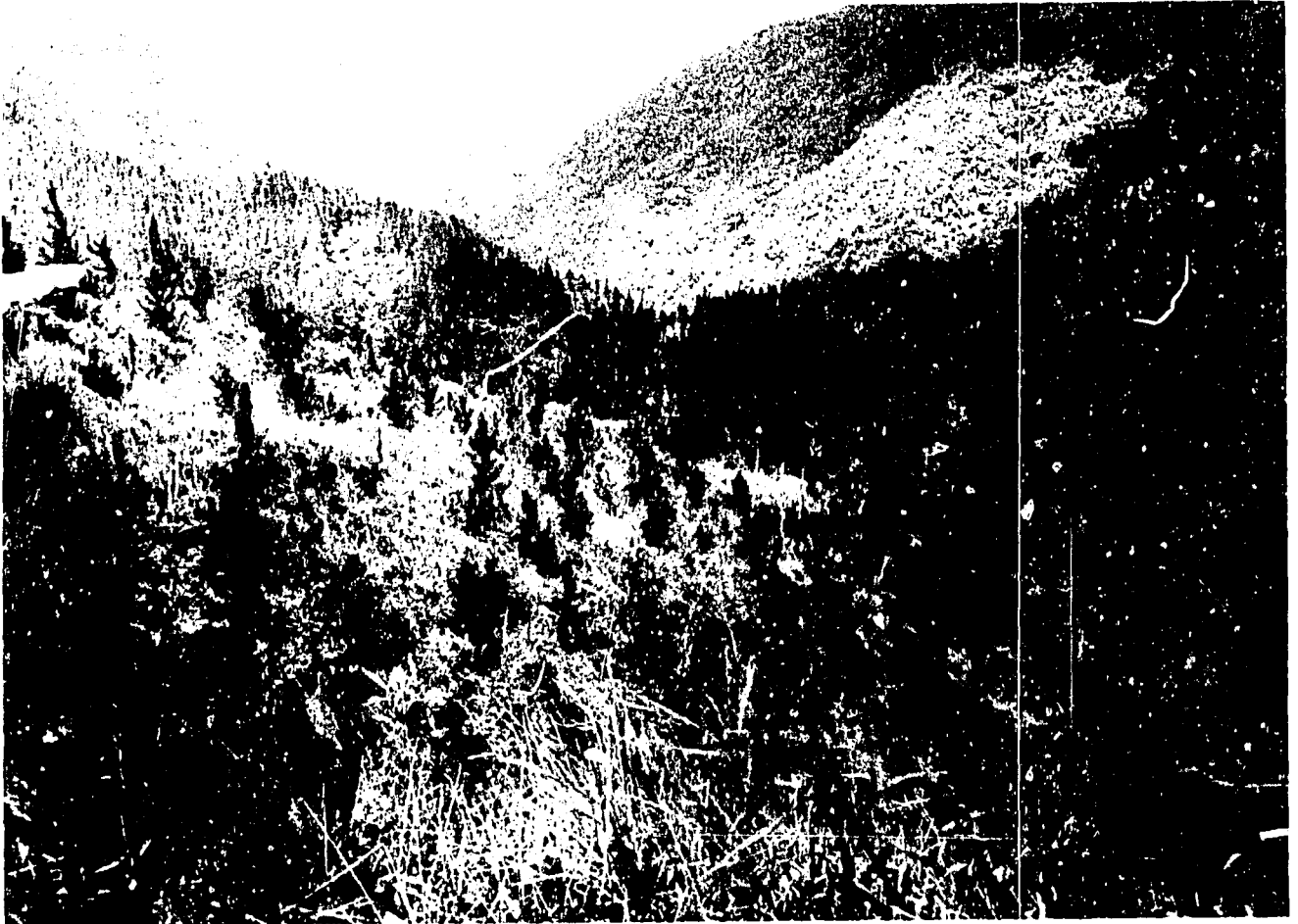


Plate 3 - Pine Trees on the Slopes of the Blue Mountains.



Plate 4 - House at Irish Town.



Plate 5 - Section of Road along Negril Beach (1967).

## PHYSICAL, DEMOGRAPHIC, AND ECONOMIC CONTEXT

---

### GEOGRAPHY

Jamaica is located in the Greater Antilles, approximately 90 miles (145 km.) south of Cuba and 100 miles (161 km.) west of Haiti. (See Figure 1.) It is the third largest island in the Caribbean with a total land area of 4,411 square miles (10,939.7 sq. km.). Jamaica is 146 miles (236 km.) long and between 22 and 51 miles (35 and 82 km.) wide. (See Figure 2.)

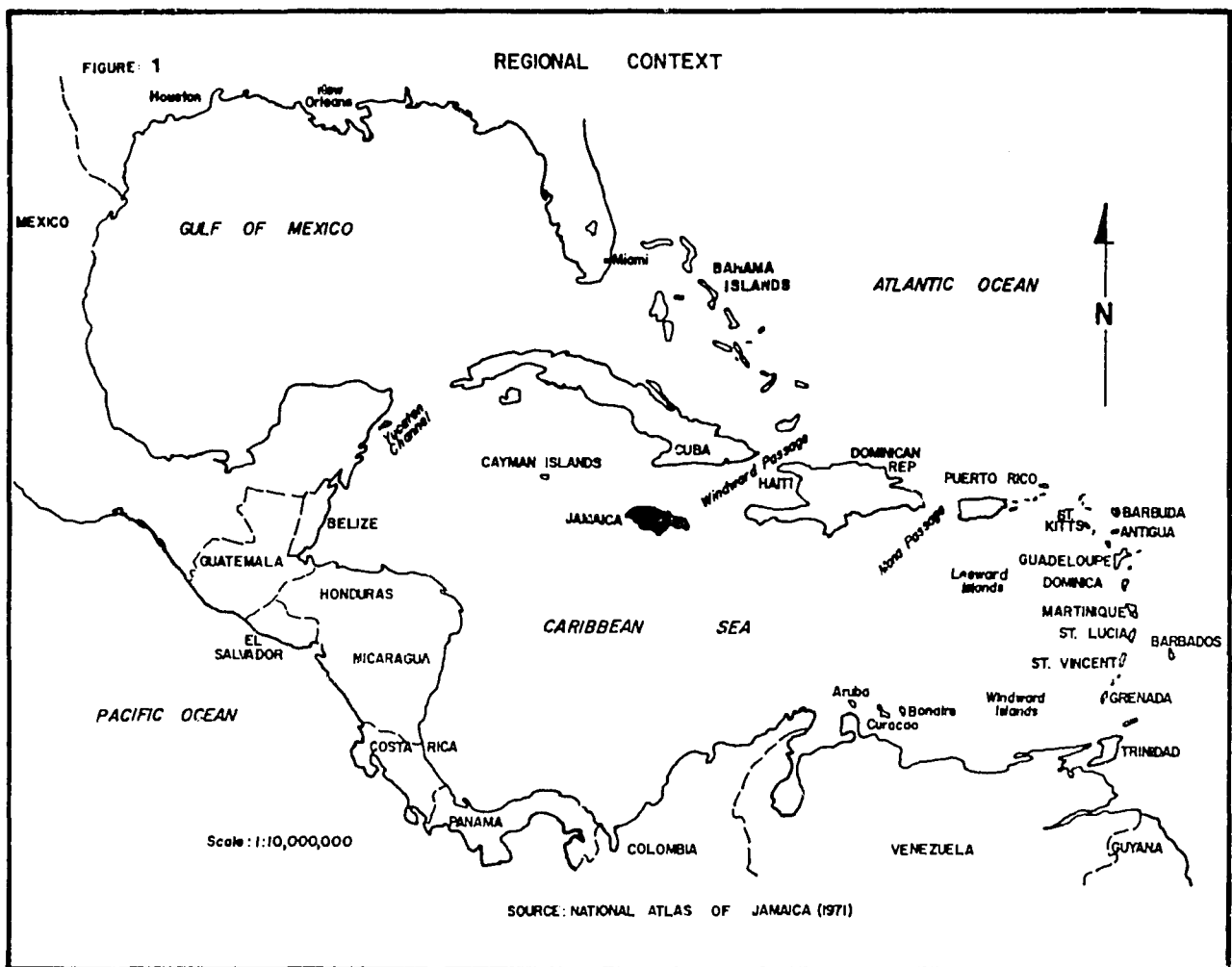
### Topography

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. (See Figure 3.) Over half the island lies more than 1,000 ft. (1,609 km.) 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 the coastal plains with 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-mile (16 km.) long NW-SE oriented range of peaks exceeding 6,000 ft. (1,829 m.) and reaching a

maximum height of 7,402 ft. (2,256 m.) at Blue Mountain Peak. Long spurs run north and south from the central ridge to the coastal plain, in some areas only 10 miles (16 km.) 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 4,000 ft. (1,219 m.) high, known as the Queensbury Ridge.

Limestone Plateaux and Hills. Flanking the interior mountain ranges are hills and plateaux, which occupy the central and western two-thirds of the island. Within this region, the highest areas — the Dry Harbour, Santa Cruz and May Day Mountains — lie between 2,000-3,000 ft. (1,610 - 914 km.), while the majority of the plateaux lies between 1,000-2,000 ft. (305 - 610 m.). 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 hummocks 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 caves have been located and registered.



**Coastal Plains.** The coastal plain is less than two miles (3.2 km.) 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 Valley in the north and Horse Savannah in the south form partially enclosed embayments. In addition to coastal lowlands, there are three major interior valleys — St. Thomas in Ye Vale, the Queen of Spain Valley and the Nassau Valley. The coastal plains and interior valleys are the prime agricultural lands.

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

**Coastline.** Jamaica's 550-mile (885 km.) long coastline is varied. The south shoreline is edged by long, straight cliffs, mangrove swamps and black sand beaches. The north coast is very rugged, with several white sand beaches, the finest of which stretches for four miles (6.4 km.) along the west coast at Negril. Around the entire island the coastline is irregular, indented with bays and extended by sand pits and bars. Sixteen of the bays are utilized as commercial harbours. Kingston Harbour, sheltered by the eight-mile long Palisadoes sand spit, has 8 square miles (20 km.<sup>2</sup>) of navigable water and 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 feet (36.6 m.) deep extends offshore for 5 to 20 miles (8-32 km.). The south coast has some barrier reefs and numerous sand cays, the most well-known being just off Kingston. Much further offshore lie the larger

FIGURE: 2

ISLAND OF JAMAICA: PARISHES & MAIN TOWNS

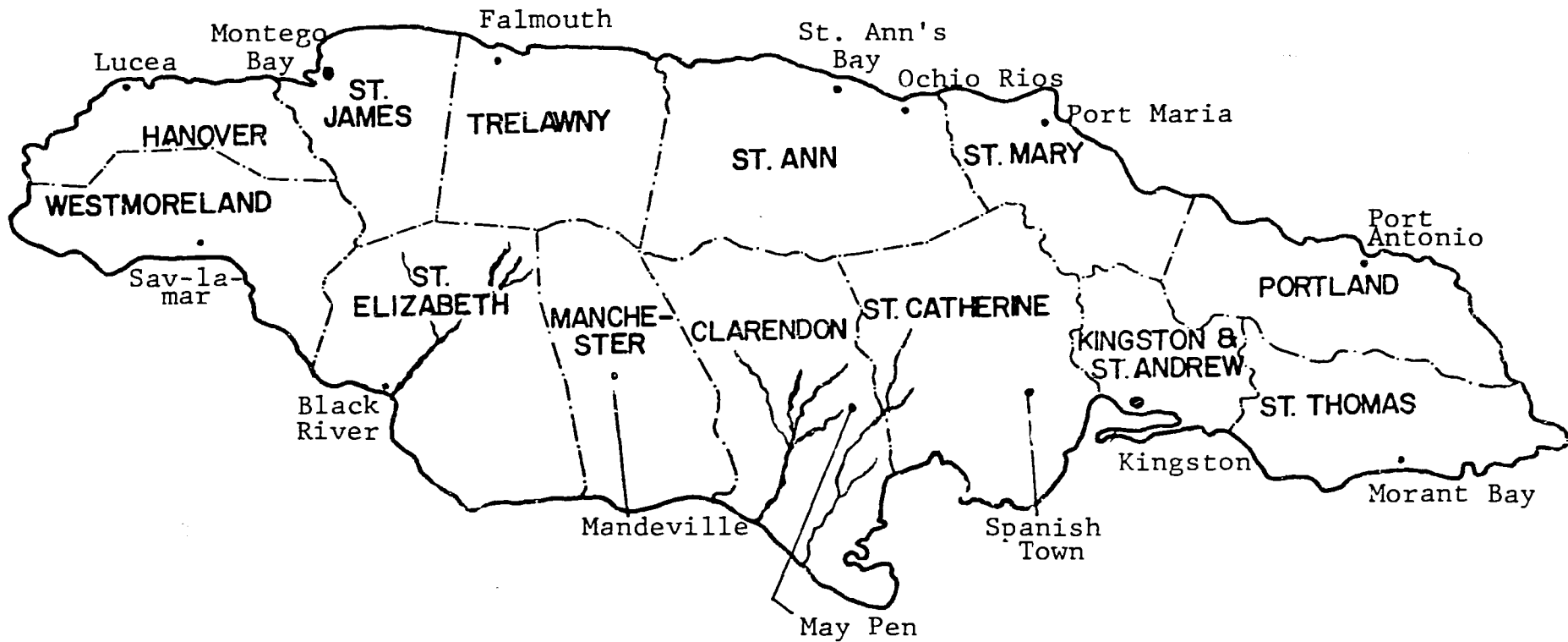
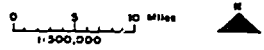
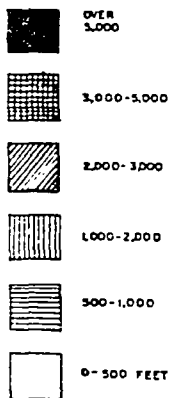
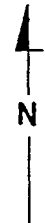
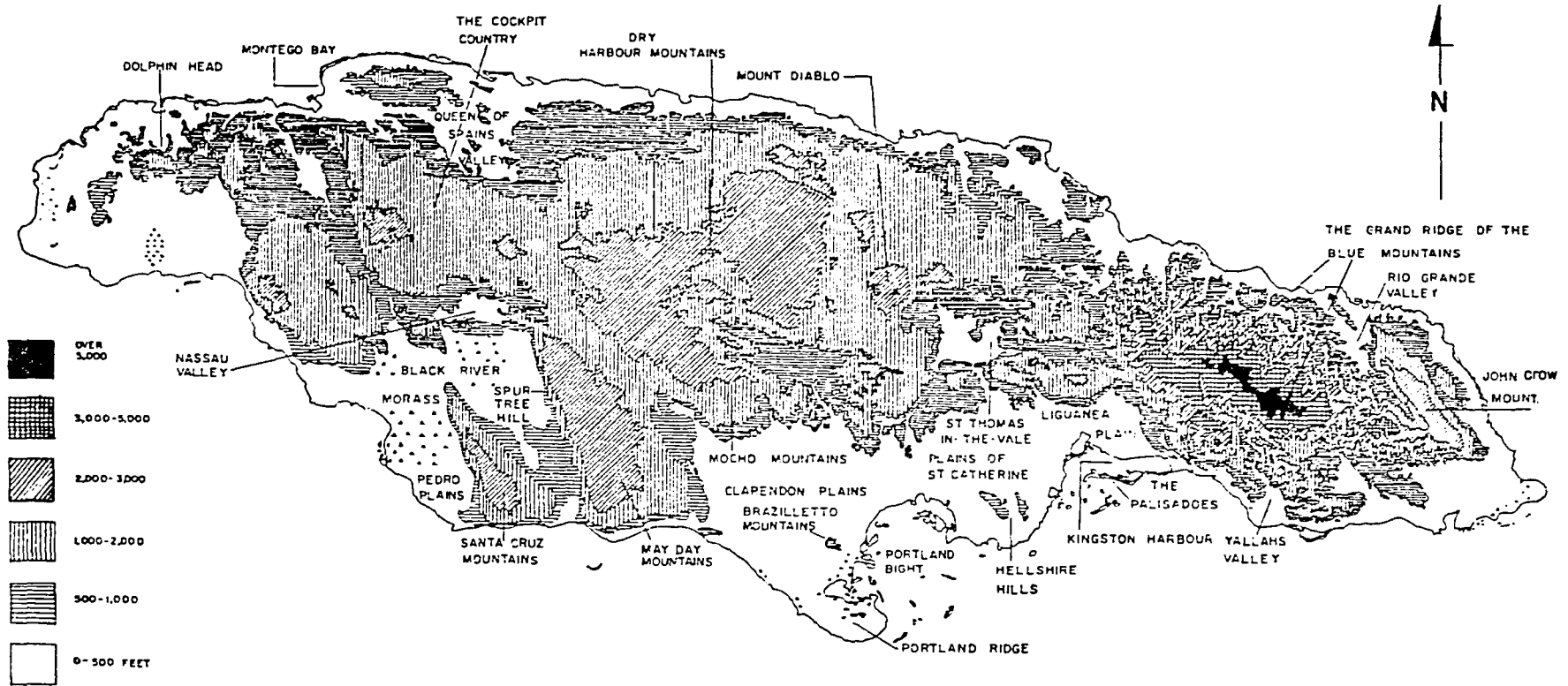


FIGURE: 3

# TOPOGRAPHY



SOURCE: National Atlas of Jamaica (1971)

Morant Cays (33 mi. SE of Morant Point) and the 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 5,000-30,000 ft. (1,500-9,000 m) in the Bartlett Trough. Fringing reefs have developed in places along the north and northeast shorelines. The south coast has relatively few reefs.

Volcanoes and Seismicity. Lava cones in the Blue Mountains and hot springs on the east and south coasts are vestiges of volcanic activity. Earthquakes are experienced in Jamaica due to the proximity of the plate boundary separating the small Caribbean Plate from the North American Plate. The two largest earthquakes to impact Jamaica in historic times were those of 1692 (the Port Royal Event) and 1907 (the Kingston Event). Because it is built on unconsolidated alluvial sands and gravels (the Liguanea Plain), Kingston is more susceptible to tremors than other areas of the island.

## **Climate**

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 4 shows islandwide climate patterns.

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 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 spatial 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 130 in. (330 cm). Kingston, in the lee of the range, receives less than 50 in. (127 cm.) annually. 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. Damaging rains are associated with hurricanes and "northers", cold winter air waves which mainly affect Jamaica's northern side.

Droughts. Since 1870, Jamaica has experienced island-wide droughts in 1871-77, 1880-85, 1920, 1922-23, 1946-47, and 1975-76. Droughts in the late 1960's and mid 1970's resulted in domestic water shortages and serious agricultural losses.

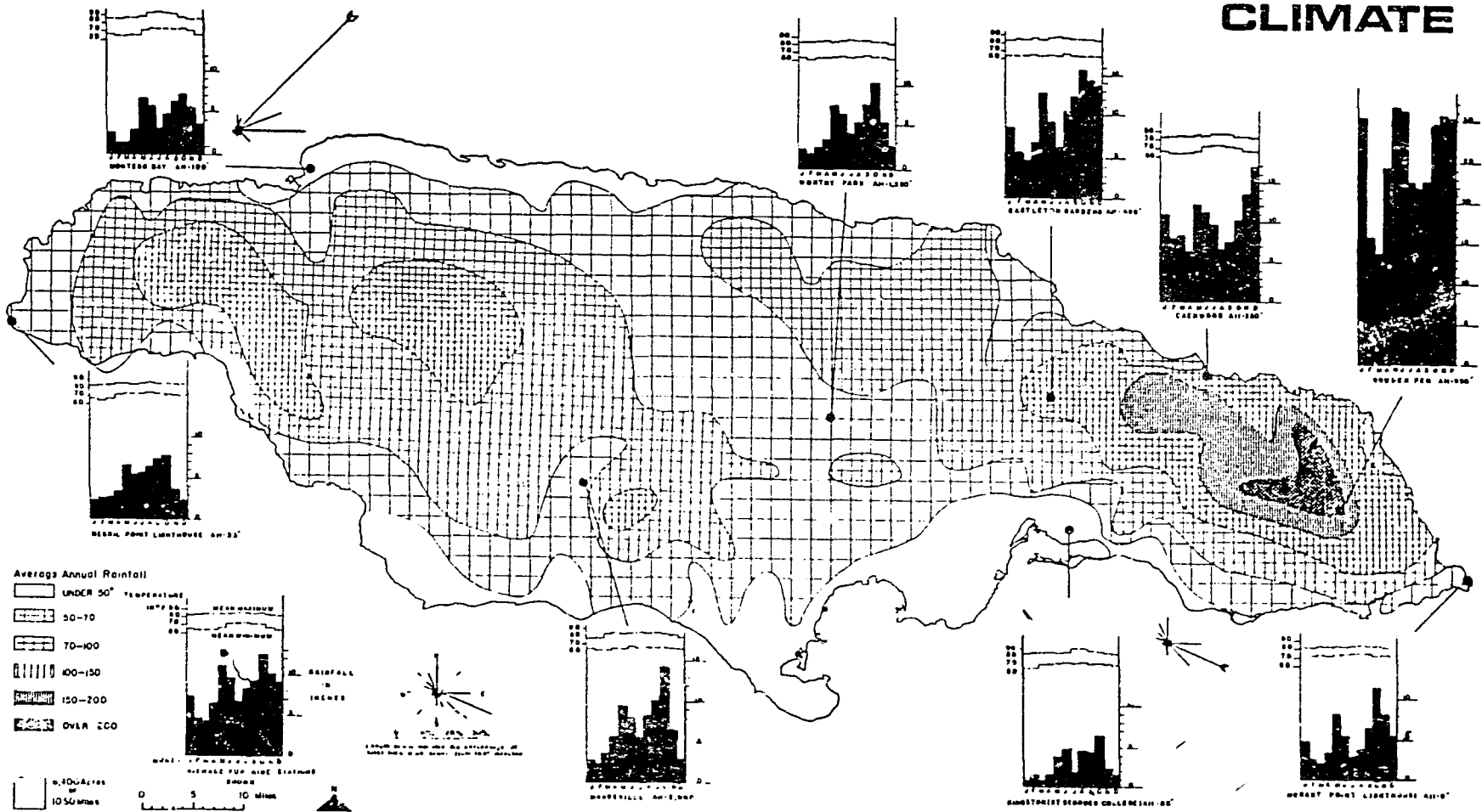
Hurricanes. Jamaica is under considerable threat from hurricanes, especially during the hurricane season which extends from July to November. Between 1886 and 1967, 19 hurricanes and tropical storms directly hit Jamaica, and 98 (48 of which were hurricane force) had centres within 150 miles of the island. Approximately one-third of these storms caused flooding and damage resulting from the forces of intense rains, extremely high winds and high waves.

## **Geology and Soils**

The geological history of Jamaica consists basically of alternating periods of igneous and metamorphic activity and submergence beneath the sea. 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, concentrated in the central and western parts of the island, and the other third by igneous and metamorphic rocks, shales and alluvium. (See Figure 5.)

Jamaica's soils may be classified into several categories which reflect differences in geology. The soils of the upland plateaux, formed from weathered limestone, constitute approximately 64% of the island's soils, while alluvial soils located on flood plains, river terraces, inland valleys and coastal plains constitute approximately 14%. The highland soils (covering the shale areas of the Blue, John Crow and Port Royal Mountains in the east and the Dry Harbour Mountains in the central region) constitute 11% of the island's total soils. The remainder of the island's soils are formed from calcareous

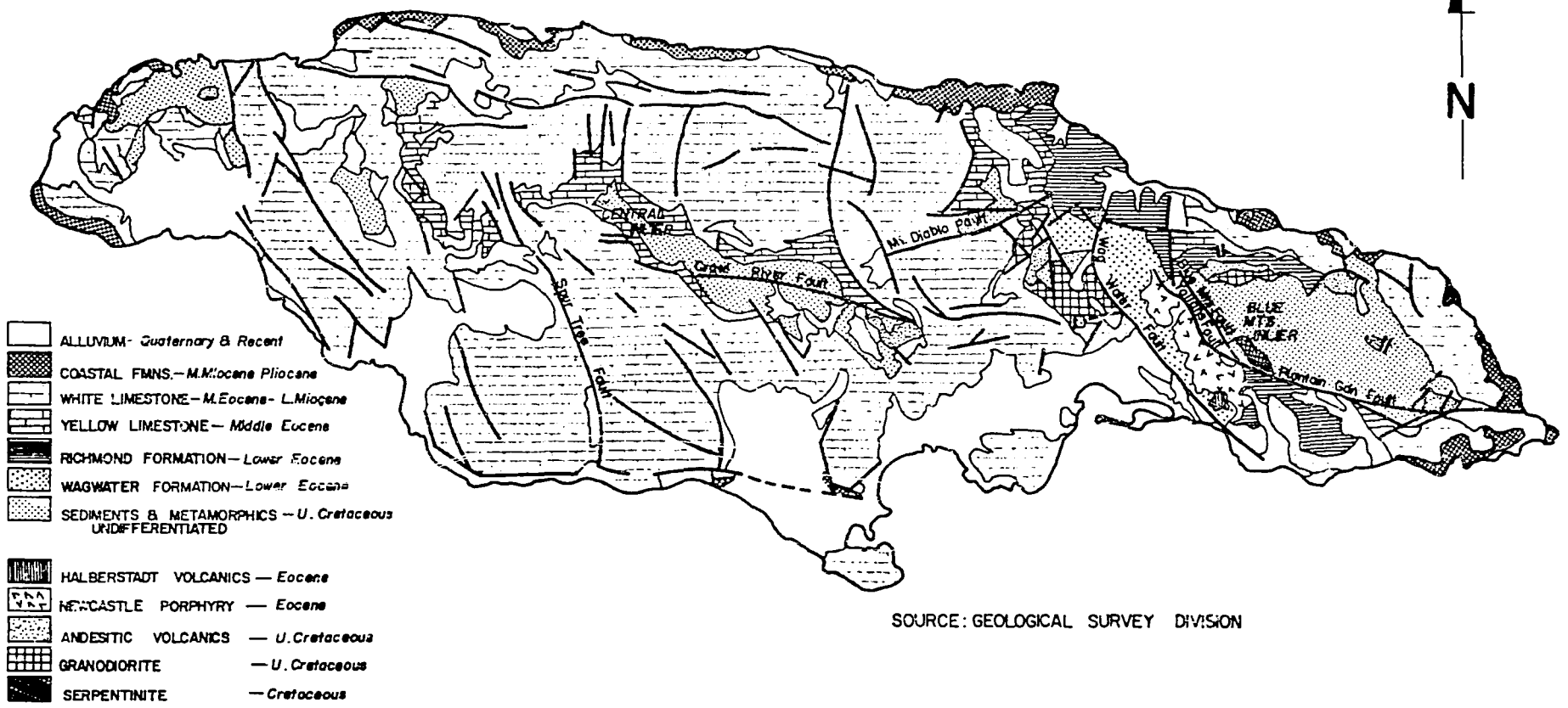
FIGURE 4  
**CLIMATE**



Source: National Atlas of Jamaica, 1971



FIGURE: 5 JAMAICA - GEOLOGY



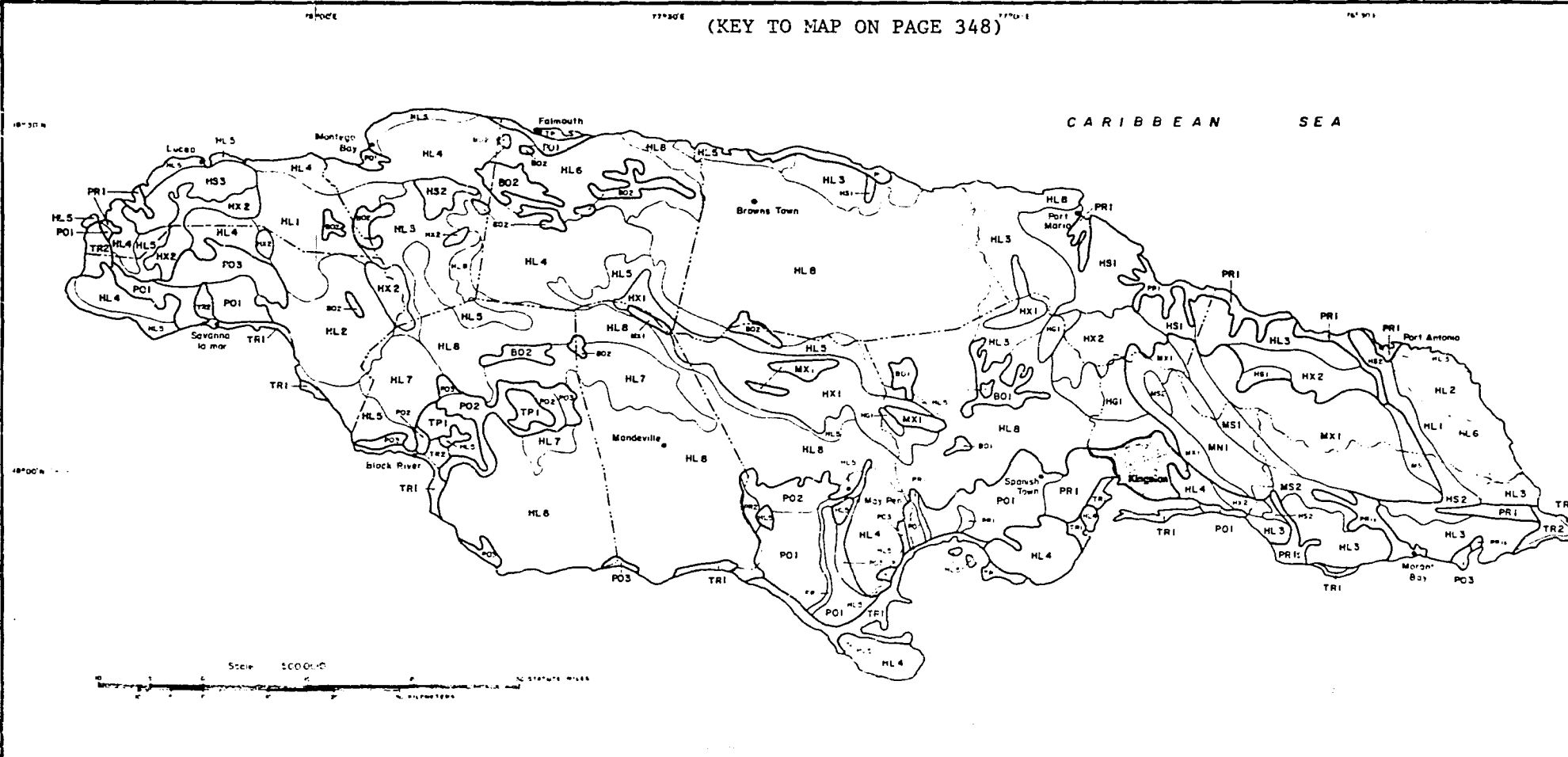
SOURCE: GEOLOGICAL SURVEY DIVISION

FIGURE: 6 EXPLORATORY SOIL MAP OF JAMAICA

MINISTRY OF AGRICULTURE  
RURAL PHYSICAL PLANNING UNIT  
CENTRAL REGION

SCALE 1:500000

(KEY TO MAP ON PAGE 348)



shale or weathered from igneous and metamorphic rock, limestone and shale. (See Figure 6.)

Upland Plateaux Soils. The soils of the upland limestone plateaux are more erosion resistant, have a higher pH (ranging 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, which are clay soils developed over yellow limestone and marls, have a scattered distribution. 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 2,000-3,000 feet (610-915 m) in Manchester and St. Ann. These soils are low in nitrogen, phosphorus and potassium, so have poor agricultural potential. They may be used for pasture, or, in some areas with fertilization, for 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 floodplains. 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 sugarcane and bananas. Also included as alluvial soils are the heavy, 3-4 feet deep clays of marine origin and swamp soils on the southern plains.

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 in the Blue Mountain area are highly porous and subject to heavy leaching, resulting in low nutrient content and low pH. 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. This area is used mainly for mixed cropping.

The main islandwide soil surveys for Jamaica are:

- 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);
- Jamaica Resource Assessment, CRIES, 1982;
- Parish soil and land use surveys done by the Regional Research Centre of the British Caribbean, University of West Indies, Trinidad (1958-1971); and
- FAO/UNESCO Soil Map of the World, Mexico and Central America, 1975.

### **Land Use and Capability**

Land Use. Forestry and agriculture are the predominant forms of land use in Jamaica. (See Table 1 and Figure 7.) Forestry and other woodlands cover approximately 45 percent of the country, mostly areas of rugged terrain such as the Blue Mountains and the Cockpit Country and dry, hilly uplands of poor soils in the southern, western and northwestern parts of Jamaica. Few large areas of virgin forest exist in Jamaica, and most of the forest or other woodlands are comprised of rinate or second growth.

Agriculture in Jamaica extends over almost one-half of the land area (42%). The three principal types of agricultural use are plantation crops grown mostly for export, mixed farming of food crops for domestic consumption and export, and pasture for beef and dairy cattle for local consumption. Other land use includes urban areas and mining (mostly bauxite).

Land Capability. Historically, the land capability classification system used in Jamaica was based on physical factors such as soil type, rainfall and drainage. The present land suitability classification system is based on parallel physical and socio-economic surveys and includes considerations of infrastructure, markets, and labour force characteristics. The updated land suitability classification system presently being used gives suitability ratings for specific crops.

**Table 1:**  
**Interpreted Land Cover/Use Category Totals In Jamaica**

	Percent of Total
Urban Residential	1.70
Rural Residential	3.33
Industrial, Commercial, and Institutional	.39
Resort Development	.10
Sugar Cane	8.11
Bananas	.94
Coconuts	1.43
Mixed Bananas/Coconuts	.09
Orchards	.14
Tobacco	.06
Mixed Coconuts/Forest	1.99
Mixed Bananas/Forest	.05
Intensive Mixed	3.77
Extensive Mixed	2.37
Improved Pasture	11.31
Unimproved Pasture	11.33
Unimproved Pasture Limited by Slope	1.99
Coniferous	.33
Deciduous	45.90
Brush	2.13
Lakes	.19
Rivers	.25
Wetlands Coastal	1.27
Wetlands Noncoastal	.16
Surface Mining	.44
Bare Sand or Rock	.12

Source: Jamaica Resource Assessment, CRIES (1982)

## DEMOGRAPHY

### Population Size and Density

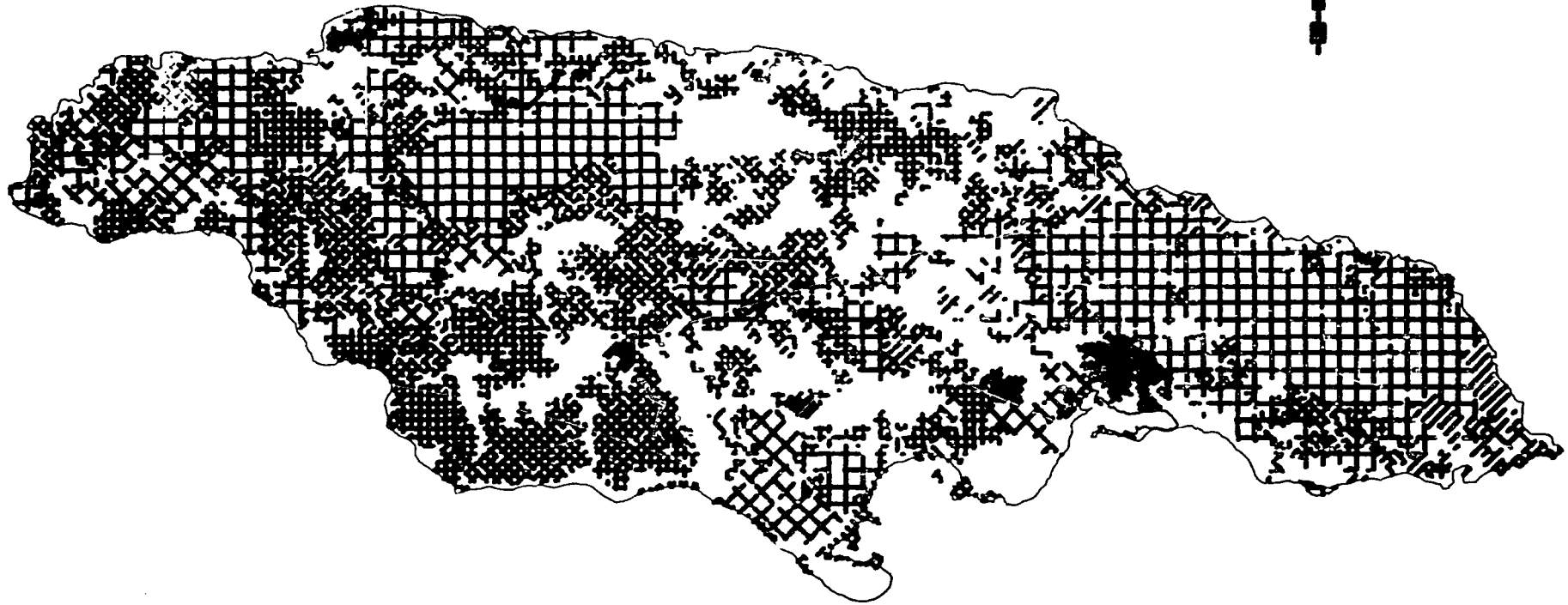
Jamaica's population at the 1982 census was 2,190,357. Slightly less than half of the population was classified as urban, while 52.2 percent were rural dwellers. Geographical features significantly affect settlement patterns: settlement is considerably restricted in those areas of steep and rugged terrain in the centre of the island and in regions of swamp around certain sections of the coast. Based on the provisional count of the 1982 census, Jamaica's population density was 205 per sq. km. (as compared to 130 per sq. km. for the Caribbean region as a whole, 40 per sq. km. in Central America and 12 per sq. km. in North America).

### Population Distribution

Between the 1920's and the 1960's, the Kingston Metropolitan Area (KMA) experienced a very high rate of population growth, both through natural increase and by net migration from rural areas. The population in the metropolitan area almost doubled from 238,300 to 419,400 between 1943 and 1960. Between 1960 and 1980 this growth in population led to the development of large settlements around the perimeter of the old metropolitan area. The population of the Portmore region, for example, grew from just over 2,000 in 1970 to over 66,000 in 1982. However, the spread of the urban population in spatial terms has not been matched by the growth of municipal services and infra-struct-

FIGURE: 7

JAMAICA LANDUSE 1985/86



SCALE - 1:200,000

78 30 78 15 78 00 77 45 77 30 77 15 77 00 76 45 76 30 76 15 76

LEGEND



URBAN



FOREST



MIXED CROPPING



WETLANDS



SUGAR CANE



OTHER USES



PASTURE



PERMANENT CROPS

	RURAL PHYSICAL PLANNING DIVISION
	MINISTRY OF AGRICULTURE
	HOPE GARDENS
	KINGSTON 6 JAMAICA

ture. Also, the Urban Growth and Management Study, conducted in the mid-1970's, found that residents in outlying 'suburbs' were dependent to a very high degree on jobs and services within the Kingston Metropolitan Area (KMA).

### Population Projections

Jamaica's annual rate of population increase, 1.4%, places it among those countries which have reduced their rate of population growth to a relatively moderate level.

Population trends for the island as a whole have looked promising since the decline in the fertility rate and the rate of population increase which began in the early 1970's. Projections made in the early 1980's suggest that the fertility rate will continue to decline to replacement level by 1995-2000 under the moderate projection (as of 1984 the number of children per woman had fallen to 3.3). It is anticipated that the island's population will be approximately 3 million in the year 2000.

### Ethnic Groups

Although a multi-ethnic society, ethnic groups, other than those of African origin, comprise a very small minority of the population. According to the Statistical Yearbook of Jamaica (1980), the total of those classified as East Indian, White, and Chinese comprised 3.1% of the total population; blacks accounted for 90.9%; 5.9% were listed as of "other races"; and no race was given for 0.1%. Yet the impact of minorities cannot be gauged solely by their numbers. Jamaica was a slave society for over 150 years and a colony for over 300. During this lengthy period, the society was controlled by a small minority of European origin. The powerful position of this minority has exerted considerable influence on culture, values and the local evaluation of phenotypic features. (Jamaica's population patterns and cultural features are discussed more fully in the Human Resources and Culture Sector in Part III.)

Table 2: Population Change In Jamaica, 1975-1983

Year	Population at 31st Dec.	X Population	Crude Birth Rate	Crude Death Rate Per 1,000	Rate of Natural Increase	Infant Mortality Per 1,000
1975	2,060,300	2,042,700	30.1	6.9	23.2	23.5
1976	2,084,400	2,072,300	29.3	7.1	22.2	20.3
1977	2,109,400	2,096,800	28.9	6.8	22.1	15.1
1978	2,140,500	2,124,900	27.4	5.7	21.7	14.9
1979	2,164,500	2,152,500	27.5	6.2	21.3	12.4
1980	2,186,100	2,175,700	26.9	5.8	21.1	-
1981	2,226,400	2,206,300	26.9	6.0	20.9	-
1982	2,265,400	2,245,900	27.3	5.6	21.1	-
1983	2,309,900	2,287,700	26.8	5.5	21.3	-

Source: Department of Statistics, 1982

## ECONOMY

### Overview of Trends

Historically, agriculture has provided employment for the largest number of people in Jamaica, although production has not kept pace with population growth. Major export crops are sugarcane, bananas, citrus, cocoa and coffee.

Sugarcane, the first commercial crop grown in the country and the basis of its economy, continues to be grown on large sugar plantations as well as by small farmers. Banana, the second leading export crop, is grown mainly by small farmers. Many food crops are grown by small hillside farmers primarily for domestic consumption.

In the last several decades, bauxite mining, manufacturing and tourism have become dominant sectors in the economy. Between 1952, when bauxite was first mined, and the 1970's, Jamaica had become the world's second leading producer of bauxite ore, and mining had become the leading source of revenue of the Jamaica government. Several types of manufacturing are well established in Jamaica. These include food processing (vegetable, cocoa, spice, etc), textiles and leather products, furniture, ceramics and glassware, and electronics. Tourism is currently the most important source of foreign exchange earnings and a stimulant to other domestic industries (e.g., construction).

During the 1970's, the country experienced serious fiscal problems, with seven consecutive years of economic decline resulting from a rapid rise in the price of oil and stagnating productivity in most sectors. Unemployment increased from 22.5% in 1972 to 26.8% in 1980.

With the change of administration in October 1980, measures were taken to stimulate the private sector and encourage foreign investment. At the same time austere fiscal management measures were adopted by Government. Negotiations with the International Monetary Fund were renewed. Loans from several Western countries as well as from international banks were pursued to provide capital for imports needed in the manufacturing and agricultural sectors.

In 1981, the GOJ initiated the Structural Adjustment Programme, which was geared toward achieving sustainable economic growth. The Programme's objective was to transform the economy through the correction of structural

defects and the promotion of export-oriented development.

The policies designed to achieve these goals were:

- o Promoting the private sector as the main engine of growth, and creating the appropriate economic structure and climate to enhance increased private sector investment and output in key sectors of the economy; and
- o Rationalising the operations and management of all public enterprises to establish their viability, generating profits, and thus, eliminate their dependence on the fiscal budget.

At present, the programme for the Jamaica economy is focused on five broad areas: balance of payments management; industrial policy rationalisation; agricultural policy rationalisation; public sector savings and investment; and public sector administration. Within this framework, planners have developed a programme of research and planning activities designed to provide a scientific basis for the formulation of policy measures to achieve the objectives of structural adjustment. Aspects of the Programme which have already been implemented include:

- devaluation of the Jamaican dollar to enhance export competitiveness;
- implementation of a crop diversification programme and adjustment of prices of export crops;
- provision of export development funds and technical assistance funds;
- preparation of a Comparative Advantage and Incentives Study (CAIS) focused on four critical policy areas: trade policy, industrial growth policy, credit and foreign exchange policy, and employment and distribution policy.

The overall purpose of the CAIS is to redesign Jamaica's trade and industrial policies in order to foster a more rational use of resources, accelerate economic growth and a higher employment level. Special attention has been given to the industrial incentive system, particularly as it affects export industries, and as it operates within the broader CARICOM incentive structure.

According to preliminary indications, real Gross Domestic Product (GDP) is estimated to have

declined by approximately 0.7% in fiscal year 1984/85. (See Table 3.) The outlook for FY 1985/86 is for further contraction in output, a consequence of the crisis in the domestic bauxite/alumina sector (see below), which has necessitated additional fiscal measures to extract \$239 million from the domestic economy to make up for the fall in the bauxite levy.

### Sectoral Performance

Agriculture. The major domestic crops include legumes, vegetables, condiments, fruits, cereals and butter. The major livestock production in Jamaica includes cattle, hogs, goats, sheep, fish and dairy products. The major export crops produced by Jamaica are sugar cane, bananas, citrus, coffee and cocoa. Major non-traditional exports include vegetables, fruits, tubers and horticulture.

Under the Structural Adjustment Programme, an agricultural modernization programme is designed to increase the potential of the sector as a net earner of foreign exchange. The programme involves all categories of farmers and provides for the restructuring of institutional arrangements for production and market-

ing. One of the major mechanisms for achieving these objectives is the AGRO 21 Programme, which is targeted to generate employment for approximately 109,000 persons and to generate foreign exchange. Thus far, it is estimated to have provided employment for over 6,000 persons and foreign exchange earnings/ savings of approximately US\$5.3M.

Mining. The bauxite/alumina industry represents over 90 percent of the total product value of the mining sector, while the non-metallic mineral industries comprise the balance. Between 1952 when bauxite was first mined and the 1970's, Jamaica had become the world's second leading producer of bauxite ore and mining was the major source of revenue of the Jamaica Government.

During 1983, Jamaica's bauxite output fell to 7.7 million tonnes, the lowest level since the 1930's. Of this amount, 25% was exported as alumina. A 13.7% increase in total bauxite exports in 1984 resulted from increases in the export of the crude ore. However, the situation reversed itself rapidly in 1985, when total bauxite exports fell to 6 million tonnes, of which approximately 60% was crude bauxite.

**Table 3:**  
**Gross Domestic Product, 1984/85, 1985/86**  
**(J\$Millions)**

	1984/85	1985/86
Gross Domestic Product (current prices)	9,460.9	11,123.8
Private Consumption	6,163.3	7,357.5
Public Consumption	1,635.3	1,910.0
Investment	2,089.8	2,488.0
Central Government	453.0	750.0
Net Exports	-427.5	-631.7
Exports of goods	3,148.1	3,914.7
Imports of goods	-5,328.1	-6,883.8
Net NFS*	1,752.6	2,337.4
GDP at 1974 (constant) prices	1,927.6	1,850/1,860
Real growth rate	-0.7	-4/-3
*Net factor services		
Source: PIOJ Staff Estimates. Planning Institute of Jamaica. Quarterly Economic Report. Vol.1, No.4. June 1985.		



The decline in the Jamaican industry, in spite of recovery in the world primary aluminium industry, was due to several factors: an over-supply on the world market resulting in a supply/demand imbalance; decline in prices; high local energy costs; and net reduction in operating capacities. This situation forced the closure of Alcoa, Alpart (a conglomerate of Kaiser, Reynolds and Arco) and Reynolds Jamaica Mines. Kaiser and Alcan are presently operating in the island. The Alcoa Plant has since been reopened as the Clarendon Alumina Production Ltd. and is operating under the ownership of the Jamaican Government.

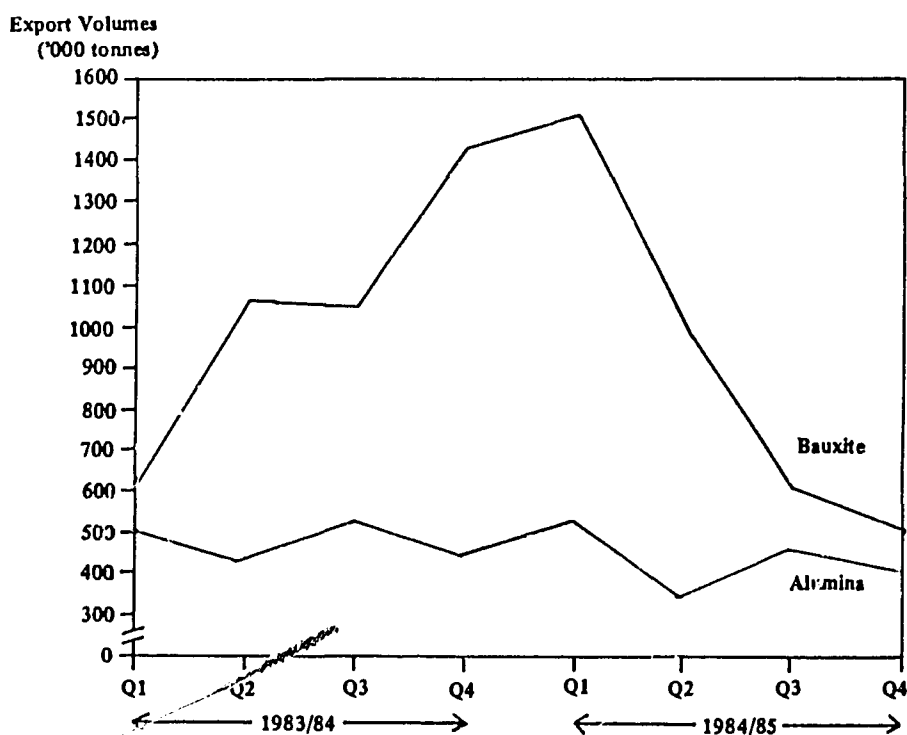
Jamaica's bauxite industry faces continuing problems of increased competition from areas such as Guinea and Brazil, high local energy costs, the disadvantage of small-scale operations, and the use of "take or pay" contracts by some competitors. In response, a number of measures

to stabilize the industry are being considered, including: energy conversion from oil to coal; utilization of idle capacity created by the closures of Reynolds and Alcoa; introduction of new marketing strategies; and restructuring the bauxite levy with incentives for improving plant efficiency and output.

In 1984, the industrial minerals subsector showed increases in the output of gypsum and marble, which totalled 180,200 tonnes and 370 tonnes respectively. Other commercially-mined minerals include silica sand, industrial lime, marl and sand and gravel.

Manufacturing. The performance of the manufacturing sector has been mixed over the past few years. In 1983, half of 62 selected commodities registered increased production, while the other half showed decreased production. In 1984, apparel and sewn products, processed food

**Figure 8:**  
**Bauxite and Alumina Exports by Quarters**  
**1983/84, 1984/85**



Source: Planning Institute of Jamaica. Quarterly Economic Report. Vol.1, No.4. June 1985. Based on Data from the Jamaica Bauxite Institute.

and chemicals and chemical products experienced strong growth, while beverages, tobacco, sugar, rum, molasses, shoe and leather products and non-metallic minerals and metallic products registered declines. Generally, declines in production were caused by difficulties and delays in obtaining raw material due to the unavailability of foreign exchange and of credit lines.

Capital investment grew in three subsectors in the period 1982-1984 — food processing (324%), textiles and clothing (1794%), chemical and chemical products (770%). Of the total employed labour force, 12.8 percent was employed in the manufacturing sector in 1984.

The GOJ has taken several steps to combat problems in the manufacturing sector:

- deregulation of imports of raw materials and capital goods;
- changes in the parity rate of the Jamaican dollar to increase competitiveness of Jamaican goods;
- allocation of foreign exchange for the purchase of raw materials and spare parts for certain manufacturing enterprises; and
- expanded production drives through the JNEC and JETC.

Tourism. The tourism industry has continued its positive growth trend, with visitor arrivals reaching a level of 846,716 in 1985. Over 67% were stop-over guests; the remainder were cruise ship passengers and armed forces personnel. Gross visitor expenditure amounted to US\$406.8 million in 1985. Direct employment in the tourism sector was 13,619 in the same year.

## **INSTITUTIONAL OVERVIEW**

---

### **GOVERNMENT ORGANIZATION**

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, along with the Prime Minister, make up the Cabinet. 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, who is a civil servant in charge of the general administration of the Ministry. In 1986 there were 15 ministers with responsibilities for 16 ministries. 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 Appeals.

Jamaica is divided into three counties (Cornwall, Middlesex, Surrey), which are in turn divided into 14 parishes for purposes of local government. 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 Councils. 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.

### **HISTORICAL DEVELOPMENT OF ENVIRONMENTAL MANAGEMENT**

Xaymaca, the Awarak name for Jamaica, means the land of wood and water and indeed, this was an apt description of the island prior to the advent of European domination. Large rivers roared through the island's countryside, and numerous wildlife species were supported by the island's unique topography and microclimates. The advent of "development" has changed this picture markedly, exerting severe stress on the carrying capacity of the environment.

The Jamaican legislature has exhibited concern for environmental management since 1874, when the Harbours Act, which prohibits the pollution of selected marine waters by solid and liquid wastes, was passed. However, an examination

of the historical situation reveals that the institutional capabilities to administer this and other related laws have been slow in evolving in Jamaica.

Historically, the protection and management of resources was vested in the Crown, and operated through various government and statutory organizations. Forestry, which remains the largest resource sector of the island, was the responsibility of the Conservator of Forests, while mineable resources were the responsibility of the Commissioner of Mines. Up to the period immediately preceding independence, environmental management in Jamaica was geared towards resource exploitation. During this period, several pieces of environmental legislation were put in place, including the Public Health Act (1926); the Forestry Act (1937); the Country Fires Act (1942); the Mining Act (1944); the Wildlife Protection Act (1945); the Irrigation Act (1949); the Beach Control Act (1956); the Quarries Control Act (1958); and the Water Supply Act (1958). As the consequences of environmental degradation in Jamaica became more widely felt, the legislature responded by enacting the Town and Country Planning Act, in 1958, and the Clean Air Act, in 1961.

Following independence in 1962, the pattern of management of resources, which had been aimed specifically at resource exploitation, began to change. During the 1960's, the movement towards resource enhancement was strengthened. In January 1969, the Ministry of Agriculture and Lands was divided into two separate ministries — the Ministry of Agriculture and Fisheries, and the Ministry of Rural Land Development.

Coupled with the changing institutional arrangements, was the enactment of new legislation, such as the Underground Water Control Act, (1962) and the Watershed Protection Act (1963). Major additions to the legislative framework since 1970 include: the Ports Authority Act (1972); the Revised Public Health Act (1974); the Fishing Industry Act (1976); and the Litter Act (1985).

However, despite the passage of this legislation, a review of the institutional framework that existed during the 1960's to early 1970's reveals a fragmented approach to environmental management, with numerous agencies and committees sharing responsibility for the administration of various environmental laws. These included:

- The Beach Control Authority

- Watershed Protection Commission
- Wildlife Protection Committee
- Natural Resource Planning Unit (Ministry of Mining)
- Marine Advisory Committee
- Kingston Harbour Quality Monitoring Committee
- Public Health Division, Ministry of Health

The major weakness of this network was the lack of coordination between the various components and the chronic shortage of technical staff.

During the 1970's, three major events sparked a concerted effort toward the development of a coordinated approach to environmental management. These were: the Stockholm Conference on the Environment, 1972; the establishment of the Ministry of Mining and Natural Resources; and the proposal to site a major petrochemical complex in Jamaica.

At the Stockholm Conference on the Environment, Jamaica played a major role in establishing a worldwide mandate for environmental management through His Excellency Keith Johnson, who was elected Rapporteur General of the meeting. During this conference, Jamaica also voiced its commitment to the development of a sound institutional base for environmental management. The country's active participation in the conference placed it in the forefront of the international environmental management movement. As a result of its stated commitment to environmental protection, Jamaica was elected to sit on the First Governing Council of the United Nations Environment Programme, in 1975.

The second major step leading to a more coordinated approach to environmental management was the creation of the Ministry of Mining and Natural Resources in 1974. The Ministry had responsibility for:

- Mineral resources mining, including bauxite;
- Geological mapping and mineral resource exploration;
- Development and conservation of water resources (Watershed Protection Commission, Water Resources Surveys and Planning, and Underground Water Authority);
- Distribution of water (Mid-Clarendon Irrigation Authority, St. Dorothy Plains Irrigation Authority, Black River Drainage and Irrigation Board, and Hounslow Irrigation Authority);
- Land planning, development and registration (Town Planning, Negril Area Land Authority, and Land Valuation);

- Beach Control Authority
- Kingston Harbour Monitoring Committee
- Scientific Research Council
- Seismographic Research Unit
- Development of Public Recreational Facilities
- National Parks and Wildlife Committee.

As can be seen from this list of the Ministry's responsibilities, a concerted effort was being made to coordinate the management of natural resources.

In 1973, the Ministry of Public Services initiated a Management Development Programme, which involved a comprehensive management training exercise for middle and senior level management personnel within Government. Candidates from the Ministry of Mining and Natural Resources were exposed to several areas of management, including organizational development. As part of the exercise, a concept for the development of an environmental management agency was conceived and partially developed.

At the same time as the institutional framework for environmental management was evolving, the country's economy was rapidly expanding. In 1974, the Government was approached by a major U.S. developer to use the island as the site for a large petro-chemical complex. The components of this proposed development were a refinery (25,000 B.C.D.), a marine terminal and transshipment port, a dry cargo pier, power station (380 MW), caustic/chlorine plant (300,000 tons per annum of caustic), ethylene storage, and a water treatment plant. This project, with its potentially deleterious environmental effects, underlined the need for a coordinated institutional approach to environmental management. The proposal for industrial development, coupled with the commitments from the Stockholm Conference and the management development exercises, were the catalysts for the formation of the Natural Resources Conservation Department (NRC D) and the Environmental Control Division (E C D) in 1975.

#### **ENVIRONMENTAL MANAGEMENT MACHINERY**

Environmental management in Jamaica is currently dependent on the coordinated actions of several agencies. These include resource management institutions, such as the Town and Country Planning Department (TPD), the Town and Country Planning Authority (TPA), the Natural Resources Conservation Division (NRC D), and the Environmental Control Division

(E C D); as well as development agencies, such as the Ministries of Agriculture (including Fisheries and Forestry), Construction (Housing and Works), Public Utilities, Local Government and others.

The creation of the Natural Resources Conservation Department (NRC D) and the Environmental Control Division (E C D) was the most significant legacy of the post-Stockholm environmental movement in Jamaica. In 1975, the Natural Resources Conservation Authority (NRCA), a nine-member board of overseers, was formed to direct the workings of the NRC D. The new entity was intended to unite existing bodies — the Beach Control Authority, Watersheds Protection Commission, Wildlife Protection Committee, Natural Resource Planning Unit, Marine Authority Committee and Kingston Harbour Quality Monitoring Committee. In addition, new functions pertaining to ecological research and natural areas management were assigned to the NRC D.

In the past year, the NRC D has been reorganized, and reduced to Divisional status. The NRCA is no longer functioning, while the Beach Control Authority and Watershed Protection Commission continue to operate.

The NRC D is expected to perform in four areas: policy and law, information and public education, ecological research and monitoring, and environmental management. Specific objectives include:

- To increase public understanding of the island's ecological systems and promote methods for the conservation and development of its natural resources;
- To raise the quality of life by increasing public awareness of the natural beauty of the island, and the availability and accessibility of outdoor recreational facilities;
- To determine policy to be followed and standards to be maintained in the management of the island's resources of land, water, air, flora and fauna in the interest of the present and future generations of Jamaica;
- To promote and ensure the wise use of the nation's natural resources by the establishment of an ecological review procedure for all relevant development proposals;
- To implement programmes for the conservation and development of natural resources; and,

- To collect, store and distribute data and information on the development and conservation of the island's natural resources.

The Environmental Control Division (ECD) is responsible for the development and application of environmental standards and appropriate technology geared towards the protection of public health, livestock, crops and natural resources. ECD is also mandated to carry out monitoring and assessments with regard to the control of water quality, sewage, industrial waste water, solid waste, industrial working environments, air pollution and noise.

The Town and Country Planning Department (TPD) is the agency which deals with physical planning, and serves as the secretariat of the Town and Country Planning Authority. This Authority administers the Town and Country Planning Act, which regulates all development activities. The Authority, by virtue of its membership, also serves as the principal coordinating body for environmental management. It is chaired by the Government Town Planner, and has representation from the NRCD, the ECD and the Planning Institute of Jamaica (PIOJ), as well as the development agencies, all of whose projects must receive the Authority's approval. In addition, the NRCD and the ECD have independent refusal authority over projects by virtue of their respective authorizing legislation.

Physical plans produced by the Town and Country Planning Department are intended to integrate policies of the NRCD and the development agencies as well. These physical plans provide a basis for development plans produced by the Planning Institute of Jamaica. Following is a list of the agencies involved:

#### Development Control and Coordination

- Town and Country Planning Authority<sup>1</sup>
- Town and Country Planning Department<sup>2</sup> (Physical Planning Secretariat of the Authority)

#### Natural Resources Conservation

- Natural Resources Conservation Department<sup>3,4</sup> (Resource Management, Ecological Research, and Information Secretariat of the Authority)

<sup>1</sup> Administers the Town and Country Planning Act.

<sup>2</sup> Denotes membership on the Town and Country Planning Authority.

#### Environmental Control

- Environmental Control Division<sup>2,4</sup> (Research and Regulation in Matters related to Public Health)

#### Resource Development

- Ministry of Agriculture<sup>2</sup>
- Ministry of Construction<sup>2</sup>
- Ministry of Public Utilities and Transport<sup>2</sup>
- Ministry of Local Government<sup>2</sup>
- Ministry of Mining, Energy and Tourism<sup>2</sup>
- Ministry of Education<sup>2</sup>
- Urban Development Corporation<sup>2</sup>

#### Economic Planning

- Planning Institute of Jamaica<sup>2</sup>

The broad titles of the NRCD and ECD suggest an overlapping of functions which, in reality, are quite separate. The ECD, in the Ministry of Health, serves the Ministry's own legislation, notably the Public Health Act. Consequently, the ECD is concerned with pollution sources, standards, and controls. By contrast, the NRCD is concerned with ambient levels of pollution, rather than with point source emissions.

### **FUNCTIONS OF MAJOR GOJ INSTITUTIONS**

As noted above, numerous GOJ ministries and/or their affiliated public corporations play some role in environmental regulation or natural resource management. (See Figure 9.) Other institutions are significant to environmental management due to their development promotion functions.

Brief functional descriptions of all the agencies that conduct some environmentally-related activities are included below. Specific agency activities are described, as appropriate, in the individual sector analyses in Part III. Institutional barriers to effective environmental management are included in the discussion of issues and problems in Part II.

<sup>3</sup> Administers the Beach Control Act, Watersheds Protection Act, and Wildlife Protection Act.

<sup>4</sup> Administers the Public Health Act.

**Figure 9: List of GOJ Agencies with Functions  
Related to Environmental Management**

**Key Regulatory & Management  
Agencies**

Natural Resources Conservation Division  
(M. of Agriculture)

Environmental Control Division  
(M. of Health)

Town Planning Department /Town  
Planning Authority  
(M. of Finance & Planning)

**Key Economic Planning  
& Investment Agencies**

Planning Institute of Jamaica

Urban Development Corporation

Petroleum Corporation of Jamaica

Jamaica National Investments  
Promotion/Jamaica National  
Investments Co.

Jamaica Industrial Development  
Corporation

**Supporting Resource Management and Protection Agencies**

Fisheries Division (M. of Agriculture)

Inland Fisheries Unit (M. of Agriculture)

Port Authority of Jamaica

Mines & Quarries Division (M. of Mining, Energy & Tourism)

Office of Disaster Preparedness (M. of Construction)

Water Resources Division (M. of Local Government)

Underground Water Authority

Watershed Engineering Division (NRCD, M. of Agriculture)

Meteorological Office (M. of Public Utilities & Transport)

Survey Department (M. of Agriculture)

Forest Department (M. of Agriculture)

Metropolitan Parks & Markets Co. (UDC affiliate)

Bureau of Standards

**Supporting Investment & Development Agencies**

Energy Division (M. Mining, Energy & Tourism)

Jamaica Public Service Co.

M. of Construction (Works)

National Water Commission

Jamaica Bauxite Institute

AGRO-21 Corp. Ltd.

Agricultural Development Corp.

Forest Industry Development Co.

Coffee Industry Development Co.

Jamaica National Export Corp.

M. Mining, Energy & Tourism

Jamaica Tourist Board

## **Key Regulatory and Management Agencies**

Natural Resources Conservation Division (NRCD). NRCD, in the M. of Agriculture, is Jamaica's chief resource management and conservation agency. NRCD administers several pieces of key environmental legislation, including the Beach Control Act (1955), the Wildlife Protection Act (1945), and the Watershed Protection Act (1963). NRCD's functions include:

- Resource management and policy formulation for wildlife species, watersheds and coastal zone management;
- Research and monitoring of inland and nearshore aquatic resources, including surveys and investigations on water quality, aquatic ecology and nearshore physical dynamics;
- Planning and development of national parks, both marine and terrestrial, as well as the conservation and protection of unique natural areas;
- Development control, including the performances of environmental impact assessment; and
- Execution of a Public Education Programme aimed at increasing public awareness for all areas of environmental management.

Environmental Control Division (ECD). The ECD, in the M. of Health, seeks to develop and ensure the application of environmental standards and appropriate technology geared towards the protection of public health, livestock, crops, and natural resources. It also carries out monitoring and assessments with regard to the control of water quality, sewage, industrial wastewater, solid waste, industrial working environments, air pollution and noise.

Town Planning Department (TPD). The role of TPD, which is within the M. of Finance and Planning, is to carry out comprehensive and balanced development of land throughout the island along the national/regional and urban development policy guidelines of the Government. Inherent in these functions is the vital role of development control with respect to the orderly and progressive development of cities, towns and their necessary amenities, as well as education of the public regarding the role of the planning process as a critical aspect of community life. The Town Planning Department is represented on the Town and Country Planning Authority. The TPD is responsible

for: preparation of the National Physical Plan; recommendations for public policies on land use and development; preparation of land use studies, plans, and regulations; preparation of Development Orders; coordination of interagency review of subdivision applications; and the preparation of development suitability maps and studies.

## **Key Economic Planning and Investment Agencies**

Planning Institute of Jamaica (PIOJ). The PIOJ initiates and coordinates planning for the economic, financial, social, cultural and physical development of the country, monitors the implementation of these plans, and manages technical cooperation agreements and programmes. In addition, the PIOJ carries out research, training and provides consultant services to government ministries, agencies and statutory bodies.

Urban Development Corporation (UDC). The UDC, a statutory corporation reporting to the M. of Finance and Planning, is legally empowered, within designated UDC areas, to act as its own planning authority and to design and construct development projects and to implement conservation elements of its projects. UDC also prepares physical plans for designated areas, and supervises and coordinates implementation of the Comprehensive Rural Townships Development Plan.

Petroleum Corporation of Jamaica (PCJ). The PCJ, a statutory body established under the Petroleum Act (1979), reports to the M. of Mining, Energy and Tourism. PCJ is empowered to conduct a broad range of activities for the development of the country's energy resources. PCJ's operations include petroleum exploration, operation of the Petrojam Refinery, and investigation of the potential uses of Jamaica's peat resources.

Jamaica National Investment Promotion, Ltd. (JNIP). The JNIP, along with the Jamaica National Investment Co. Ltd. (JNIC), is a statutory corporation reporting to the M. of Finance and Planning. JNIP and JNIC provide local or foreign private investors with advice, information and assistance regarding investment opportunities.

Jamaica Industrial Development Corporation (JIDC). JIDC, a statutory body under the M. of Industry and Commerce, is the principal agency charged with ensuring that the GOJ's industrial development objectives are fulfilled.



JIDC plans for and implements public sector industrial projects, promotes both public and private industrial development projects, and operates industrial estates throughout the island. Recently merged with the National Industrial Development Company, the "new" JIDC is responsible for the development and implementation of a Comprehensive National Industrial Plan and is specifically responsible for upgrading the performance of the manufacturing sector.

### **Supporting Resource Management and Protection Agencies**

Fisheries Division. The Fisheries Division of the M. of Agriculture is responsible for promoting fisheries development through research, administration of fisheries laws, training and credit services to fishermen, and monitoring of offshore fishery reserves.

Inland Fisheries Unit (IFU). The IFU, within the M. of Agriculture, is responsible for maintaining an islandwide programme to encourage small farmers to take up fish farming. IFU's programme concentrates on extension, production, training, research, and marketing coordination.

Port Authority of Jamaica. The Port Authority regulates coastal structures on or over water, provides aids to navigation, monitors oil spills, provides information on ship traffic, and is responsible for the review, approval, construction and leasing of buildings on the foreshore in areas under its jurisdiction.

Mines and Quarries Division (MQD). The MQD, within the M. of Mining, Energy, and Tourism, collects and disseminates information on the geological resource base of the country, for example, geological mapping to identify mineral deposits, potential geological hazards, assessment of slope stability, drainage and other physical factors in reviewing development and subdivision applications. The MQD also provides technical assistance in matters relating to prospecting, mining and quarrying.

Office of Disaster Preparedness (ODP). ODP, within the M. of Construction, coordinates disaster response and post-disaster recovery activities, makes recommendations on public policies for the avoidance of risk areas, maintains a system for monitoring and forecasting environmental events, and reviews development and subdivision proposals in high risk areas.

Water Resources Division (WRD). The WRD of the M. of Local Government collects data and provides technical information and support to other GOJ agencies on water resources (e.g., streamflow and tidal data, critical water levels, etc.)

Underground Water Authority (UWA). The UWA is a statutory body which was established under the Underground Water Authority Act (1962) to provide for the conservation and proper use of underground water resources and to control the exploitation of such resources. To this end, the UWA is empowered to issue licences for groundwater extraction.

Watershed Engineering Division (WED). The WED, part of NRCDC, is involved in water conservation through the implementation of various watershed management projects (e.g., for the reduction of soil erosion, river bank stabilization, etc.).

Meteorological Office. The Met Office of the M. of Public Utilities and Transport provides technical support to other agencies through the collection of data on weather (rainfall, winds, etc.) and issues warnings of severe weather conditions.

Survey Department. The Survey Dept. of the M. of Agriculture prepares, updates, and maintains a central depository of islandwide maps (including topographic maps) and aerial photos.

Forest Department. The Forest Department of the M. of Agriculture is responsible for non-commercial forestry activities, extension, planning and research, training, and administration. The Forest Department leases forest reserve lands to FIDCO for commercial forestry operations.

Metropolitan Parks and Market Company (MPM Co.). MPM Co., an affiliate of the UDC, is responsible for administration of metropolitan parks and refuse collection in the Kingston Metropolitan Area.

Bureau of Standards. The Bureau of Standards administers legislation and regulations related to the establishment and enforcement of uniform standards: the Standards Act (1968); the Processed Food Act (1959); and the Weights and Measures Act (1976). The Bureau makes recommendations with respect to the formulation and application of standards and specifications and provides for the examination and testing of commodities and processes.

## **Supporting Investment and Development Agencies**

Energy Division. The Energy Division, within the M. of Mining, Energy and Tourism, is responsible for the development and monitoring of a National Energy Policy and the gathering and analysis of information in regard to petroleum products and energy conservation.

Jamaica Public Service Co. (JPSCo). JPSCo is responsible for developing and maintaining the country's public electricity distribution network.

Ministry of Construction (Works) The Works Division of the M. Construction has a principal role in constructing and repairing flood and erosion control facilities and other public facilities and infrastructure (e.g., roads and bridges). The Works Division also reviews large private development proposals for conformance with construction standards.

National Water Commission (NWC). The NWC is responsible for water supply and most of the sewerage works in the Kingston/St. Andrew corporate area.

Jamaica Bauxite Institute (JBI). The JBI, a limited liability company, is involved in the research and development of bauxite reserves and bauxite conversion processes, allocation of mining sites, establishment of bauxite levies, and monitoring the safety of mining operations, alumina production, and reclamation of mined lands.

AGRO-21 Corp. Ltd. Agro-21 is a statutory body, jointly funded by the Government of Jamaica and USAID. Its primary objective is to restructure the country's agriculture by employing improved technology and a programme of crop diversification. Under this programme, private investors have been encouraged to become involved in development of non-traditional export crops.

Agricultural Development Corp. (ADC). The ADC is a statutory body under the M. of Agriculture whose purpose is to improve and/or maintain the quality of Jamaica's produce, particularly livestock production.

Forest Industry Development Co. (FIDCO). FIDCO is responsible for all commercial forestry activities, establishment and maintenance of forestry plantations, and logging, transport and processing of harvested timber. FIDCO is accountable to both the Ministry of Finance

and the Ministry of Agriculture.

Coffee Industry Development Co. (CIDCO). CIDCO is responsible for establishment and maintenance of major coffee plantations.

Jamaica National Export Corporation (JNEC). The JNEC is responsible for development, promotion and expansion of Jamaica's non-traditional export products.

Ministry of Mining, Energy & Tourism (MMET). The MMET is responsible for the formulation and implementation of Government policies relating to mineral resource development and mining and energy management and for the overall development of tourism, including policy formulation, promotion, marketing and all other aspects of the tourism industry.

Jamaica Tourist Board. The Jamaica Tourist Board, a statutory organization, is responsible for promoting tourism locally and overseas and for developing and maintaining tourism industry standards. Two subdivisions of the Jamaica Board are the Jamaica Attractions Development Co. (JADCo), which is charged with developing new sites and attractions for tourism and enhancing existing sites, and the Rafting Authority which is responsible for the development and regulation of river rafting.

## **OTHER INSTITUTIONS**

A number of private voluntary organizations (PVO's) and research institutions also play a role in environmental management. These include:

Institute of Jamaica. The Institute of Jamaica was established to encourage and develop knowledge in the areas of literature, science, arts, culture and history, and the conservation of monuments for the public benefit. This is accomplished via the delivery of lectures, the compilation and publication of literature of historical, scientific or artistic interest and the establishment and maintenance of schools, museums, galleries, halls and other places reserved for the dissemination and development of literature, science and the arts.

Scientific Research Council (SRC). The SRC, a statutory body within the M. of Agriculture, was established in 1960. Its role is to foster and coordinate scientific research and to encourage the application of such research to the exploitation and development of the island's

resources. The Food Technology Institute, which has responsibility for technical assistance, product development and training in the area of food research and development has been a part of the SRC since 1968.

Sugar Industry Research Institute. The Sugar Industry Research Institute is responsible for the research and development of sugar production techniques and improved sugar cane varieties.

University of the West Indies (UWI). The UWI is a tertiary institution providing certificate, diploma, degree, and graduate courses in the arts, natural sciences, social sciences and medicine to students, mainly from the Caribbean region. In addition, it carries out research in social and human development, and the economic, scientific and medical aspects of environmental management through the Faculties of Education, Social Studies, Natural Sciences and Medicine.

Caribbean Agricultural Research and Development Institute (CARDI). Financed and directed by CARICOM member countries, this organization responds to Caribbean needs for agricultural research and development. Particular areas of interest include pesticides and pest control, species research and development and researching of agricultural equipment suitable for small farms.

Hope Zoo Trust. The Hope Zoo Trust is a non-profit organization, whose activities are geared toward upgrading the facilities of the Hope Zoo.

Natural History Society of Jamaica. The Natural History Society of Jamaica is a non-profit organization, whose objectives include the study and conservation of the Jamaican environment and the promotion of public environmental education.

Jamaica Junior Naturalists. The Jamaica Junior Naturalists, a non-profit organization for young people between the ages of 6 and 18 years, provides opportunities for the study of the flora, fauna and other natural resources of the island, and encourages an appreciation of the need for conservation of the Jamaican environment.

Jamaica Agricultural Society. This organization assists Jamaica's small-scale farmers by providing marketing, agricultural credit, education and training services. Several federations have been formed under its auspices, including the Jamaica Coffee Growers Cooperative Federa-

tion, the Cocoa Growers Cooperative Federation, and the JAS Cattle Insurance Cooperative Society.

All-Island Jamaica Banana Farmers Association. Funded by the M. of Agriculture, the responsibilities of the Association include public education and the distribution of pesticides, fertilizers and sleeves to farmers at subsidized rates. Since 1983, materials have been available to farmers on credit.

The All-Island Cane Farmers Association. The largest commodity association in the island, this Association is involved in the replanting of sugar cane where sugar cane production has been abandoned.

Coconut Industry Board. The Coconut Industry Board carries out the production and distribution of seedlings, the provision of reinsurance funds against crop losses, research and development of species varieties, and provides advice to farmers on methods and techniques.

Jamaica Livestock Association Ltd. The Jamaica Livestock Association is a limited liability company involved in the production of cattle and small livestock.



**Plate 6 - Beach Erosion (Trelawny) resulting from illegal removal of sand.**

## PART II: ISSUES, POLICIES AND RECOMMENDATIONS



Plate 7 - Crowd Demonstration.



Plate 8 - Garbage in Kingston Harbour.



Plate 9 - Cement Company, Kingston.

## PROBLEMS AND ISSUES

---

A principal reason for preparing the Country Environmental Profile is to identify the major environmental problems and issues that confront Jamaica. The approach that was used called for an examination of 15 subject areas that include Jamaica's major resource sectors. Each of the 15 component areas was examined in considerable detail, and resulting "sectoral needs" were identified. The detailed sectoral reports are included in Part III of this document. However, before turning to the individual sectors, it may be useful to summarize some of the principal findings and conclusions that emerged from this two-year effort.

### MAJOR PROBLEMS RELATED TO QUALITY OF THE ENVIRONMENT

Jamaica faces major environmental problems with respect to air pollution, surface and ground water pollution, deforestation, soil and shoreline erosion, destruction of wildlife and wildlife habitat, and serious deficiencies in urban infrastructure. Each of these is discussed briefly below.

#### Air Pollution

Although the island is blessed with a constant sea breeze that acts to disperse airborne pollutants, poor air quality is a persistent problem

in areas of high population concentration, particularly in the dense urban settlements of Kingston, Spanish Town, and at scattered centres elsewhere on the island. The primary causes of air pollution are industrial effluents from oil refineries and power stations in the urban areas, and bauxite plants, sugar factories and processing plants in scattered rural locations. In urban areas, the burning of garbage at municipal dumps, and vehicle exhaust fumes aggravate the problem. At present, the known impacts of air pollution are visual and aesthetic — impaired visibility and offensive odors due to high levels of particulate matter and hydrocarbons. In some cases, however, airborne toxins, such as lead, have had discernable effects on those living in close proximity to the emitting industrial sources.

#### Water Pollution

Jamaica's interior and coastal water bodies are being adversely affected by the discharge of sewage and industrial effluents. Kingston Harbour is subject to pollution from at least ten documented point sources. The restricted water circulation within the Harbour, coupled with the high nutrient load of the effluents, has resulted in a drastic reduction of dissolved oxygen, and the almost total destruction of benthic life. In addition, plumes of nutrient-rich water emanating from the Harbour have encouraged the proliferation of algae, smother-

ing corals for miles along the south coast of the island. In the rural areas, much of the surface water pollution can be attributed to the release of untreated effluents from food processing plants. Particularly acute examples include the pollution of the Cabarita River by sugar cane "dunder", and of the Rio Cobre by effluent from beverage and citrus processing plants at Bog Walk.

Ground water pollution occurs as a result of sewage infiltration, saline intrusion and the leakage of caustic residues from red mud disposal sites. In Kingston and St. Andrew, there has been extensive aquifer contamination by sewage, while much of the south coast suffers from salt water intrusion, a consequence of over-abstraction of ground water. This has resulted in the closure of many wells. Caustic pollution from the Mt. Rosser red pond at Schwallenburg has led to the contamination of five square miles of the aquifer in the Linstead and Moneague sub-basins. Ground water in the Kingston Metropolitan Area is subject to infiltration from thousands of individual household sewage units. The long-awaited plan for centralized treatment of Kingston's sewage, and transport of the treated effluent to agricultural areas west of the city for irrigation and aquifer recharge, is the only remedy to this problem, but the plan remains to be implemented.

### **Deforestation**

Jamaica's natural forests, which account for 24.3% of the total land area, are being diminished for subsistence crop cultivation and pasture, for charcoal production, and for the establishment of timber plantations of exotic pine and coffee. Soil erosion is one of the many consequences of deforestation, and Jamaica loses approximately 80 million tons of soil per annum. Deforestation also contributes to the loss of valuable nutrients from the remaining soil, and to the reduced moisture retention properties of the land. As a result, dry season surface flow in streams is reduced or eliminated, flash flood hazards are increased, river channels are blocked by debris, and nearshore marine life is smothered by higher stream sediment loads.

### **Beach Erosion**

The illegal removal of beach sand, particularly along the north central and northwest coasts, has resulted in the erosion of the remaining sandy shoreline, impacting recreational

opportunities and contributing to the vulnerability of inland areas to coastal flooding.

### **Solid Waste Disposal**

Solid waste is a pervasive problem in and around major settlements. At present, its impacts are mainly aesthetic although leachate is probably contaminating ground and surface water sources. There has been an unfortunate tendency, especially around urban areas such as Kingston, to use wetlands as repositories for large-scale dumping. Such sites become harbouring grounds for mosquitoes, creating potential health hazards.

### **Destruction of Wildlife and Wildlife Habitat**

Habitat destruction is the single biggest contributor to the continuing decline of Jamaica's unique plant and animal communities. Hunting has also had a major impact, resulting in the extinction of the Caribbean Monk Seal (Manachus tropicalis) and the reduction in numbers of the West Indian Manatee (Trichechus manatus). Among the most endangered species in the island today are the American Crocodile (Crocodylus acutus), snakes, marine turtles, and several species of birds.

### **Urban Over-crowding**

The drift from rural to urban settlement over the past two decades has led to over-crowded urban areas, resulting in high demand-supply ratios for basic amenities. Frequently, urban development has occurred on potentially productive agricultural lands or wetland areas. This is particularly true of urban growth that has taken place in the general area of Kingston Harbour. The disruption in the Harbour's aquatic food chain as a result of wetlands filling has resulted in sharp declines in this formerly prolific fishing area.

## **KEY ISSUES AND CONSTRAINTS TO ENVIRONMENTAL MANAGEMENT**

Jamaica is an island ecosystem. Activities in any one sector often have far-reaching consequences on other sectors. In attempting to minimize adverse impacts, there will inevitably be conflicts between development and conservation. Jamaica's need for economic development is overwhelming, and the resource base on which



this development depends is limited. If Jamaica's economic development is to be sustained, it is essential to devise strategies that will promote the type of growth that incorporates long-term conservation objectives and promotes the wise use of natural resources.

If environmental management is to be effective, four essential elements are needed:

- o A firm and unambiguous commitment by Government to pursue environmental goals which, in turn, should be reflected in formal national policy and priorities;
- o An institutional structure designed to implement environmental programs, and which clearly assigns responsibility to specific governmental agencies.
- o Sufficient monetary and technical resources to carry out the activities mandated by legislation and formulated by the agencies; and
- o An informed and aware constituency to provide input and political support to implement governmental policy and action programs.

Despite the plethora of environmental legislation and the institutional arrangements for environmental management in Jamaica, there is continued abuse and misuse of the environment and of Jamaica's resource base. The major factors contributing to this situation are: an apparent lack of government commitment to, and the relatively low priority accorded environmental programs; serious weaknesses in the present operating capabilities of environmental agencies; shortage of financial resources; and the low level of public awareness and support for resolving environmental issues.

#### **Lack of Clear National Policy on the Environment**

In contrast to the absence of national environmental policy, Government is clearly committed to a policy of national economic development. This is apparent from both clearly stated and publicized goals and objectives, and the infusion of financial resources to attain these goals. Current governmental priorities are clearly focused on promoting those sectors and sub-sectors which will earn foreign exchange in order to repay national debt. Accordingly, governmental priorities have focused on the following:

- Transformation of agriculture, including crop

substitution to emphasize the production of export crops;

- Promotion of tourism as a major earner of foreign exchange;
- Support of industrial development, particularly labor-intensive manufacturing;
- Reducing dependence of the economy on bauxite mining.

These are commendable objectives, deserving of support. However, by comparison, there is no clear governmental policy commitment to environmental protection, and sound resource management. In addition, not even an enunciation of national policy exists in some key sectors. For example, there is no islandwide coastal management policy to guide shorefront development, nor is there a national policy for designating protected areas and national parks. National policy on environmental education is also lacking, although the development of a policy on science and technology is in the process of formulation. Lack of government commitment is also reflected in the relatively low status afforded the agencies responsible for environmental management, and the very small percentage of the national budget that is allocated to these agencies to carry out their programs.

The commitment to environmental protection should be as great as the commitment to economic development. Without adequate attention to safeguarding Jamaica's environment, the cumulative impacts (e.g., extensive soil erosion, ground water contamination, etc.) will damage or destroy the resource base on which sustained, long-term development depends. Adoption by Government of a National Policy on the Environment would signal a meaningful commitment to addressing the need for more effective environmental management.

#### **Deficiencies in the Institutional Structure for Environmental Management**

As a result of the research conducted during the course of the sector studies, it has become clear that the institutional structure for effective environmental management is deficient in terms of both the legislative mandate and the organization of environmental agencies.

Absence of a Ministry of the Environment. As noted previously, environmental management is afforded a low priority by Government. Although NRCDC has principal responsibility for many aspects of environmental management, it has little influence on the actions of other agencies whose activities have major environ-

mental impacts. Furthermore, NRC D's position within Government has been downgraded from a department to a division, and it has been shifted between ministries several times in recent years, hindering its ability to establish a firm leadership role in resource management.

The NRC D and ECD, the principal environmental management agencies, have been given divisional status within the organizational structures of their respective ministries, thus reducing their ability to control both financial and human resources from the agency level. Additionally, not all ministries and agencies fall within the regulatory control of the environmental management machinery. Some significant development plans (e.g., those of the Urban Development Corporation and the Ministry of Agriculture) are approved by Ministerial Order.

In reviewing the legislative and administrative basis for environmental management, jurisdictional overlaps, duplication of effort, and lack of coordination between the various agencies responsible for resource management is prevalent and widespread. For example, four agencies have responsibility for some aspect of water exploitation or conservation, yet there is little or no coordination at the planning level for this resource.

Establishment of a Ministry of the Environment, operating within the guidelines of a National Environmental Policy, would go far toward successfully addressing these weaknesses.

Legislative Problems. Despite numerous laws, there is no comprehensive environmental legislation in Jamaica. While many statutes contain environmentally-related provisions (e.g., protection of wildlife species, pollution of harbours, etc.), specific guidelines are often lacking or there are major gaps in coverage.

Ineffective and fragmented environmental legislation, coupled with the absence of regulations or with regulations that are simply not enforced, has reduced the effectiveness of environmental management in Jamaica. Fines for breaches of the various conservation laws represent little deterrent to continued environmental abuse. Breaches of the Wildlife Protection Act, for example, are subject to fines of J\$100.00. In terms of fragmentation of managerial authority, several pieces of legislation often relate to the same resource. For example, the Underground Water Control Act and the Water Act address aspects of water resource management, but there is no comprehensive National Water Act.

Enforcement Problems. The inability to enforce existing legislation results, in part, from an acute staff shortage at the agency level. At the NRC D, for example, there are only two persons with part-time responsibility for enforcement of the Wildlife Protection Act, Beach Control Act and the Watershed Protection Act. The environmental personnel employed at the Petroleum Corporation of Jamaica, a statutory organization within the Ministry of Mining, Energy and Tourism, is now larger than the combined technical staffs of both the NRC D and the ECD.

### **Shortage of Financial and Technical Resources**

Economic stagnation or recession internationally has had a significant impact on developing countries such as Jamaica. Budgetary shortfalls have severely constrained the ability of Government to effectively manage the country's natural resources. The resource management agencies are plagued by lack of adequate finances and difficulties in recruiting and retaining trained personnel. While the basic institutional framework needed for environmental management has been in place for some time, the funds to adequately staff and administer the relevant agencies, and enforce the existing environmental legislation are lacking. An examination of the Estimates of Expenditure show that the combined budget allocated to the two major environmental agencies (NRC D and ECD) for the financial year 1986/87 was \$5.7 million — approximately one-tenth of one percent (0.1%) of the total budget for the Government of Jamaica.

### **Low Level of Public Awareness**

Finally and ironically, perhaps the most important of all the impediments to effective environmental actions is the low level of public awareness. Until a greater proportion of the population is aware of the benefits to be gained from environmental management, action by Government will be slow in coming. An environmentally aware constituency is needed to provide the impetus to governmental commitment and to support the activities of responsible agencies, and is thus an essential element in ensuring a better quality of life for all Jamaicans.

## FRAMEWORK FOR ENVIRONMENTAL MANAGEMENT

---

### INSTITUTIONAL FRAMEWORK

In the pursuit of national economic development, alteration of the natural environment is inevitable if the needs of a growing urban industrial population are to be satisfied. Prior to the 1970's, development was often pursued without any consciousness of the adverse impact it might have on the natural environment. Some of the resulting problems have been summarized in the preceding section. The groundswell of international concern with the environment heralded by the 1972 Stockholm Conference, has influenced events in Jamaica, as it has in many other countries. New legislation was adopted, new agencies created, and a growing consciousness was generated regarding the need to directly confront the negative aspects of urban, industrial and agricultural development. The Institutional Overview in Part I describes the history of Jamaica's legislative and organizational efforts to deal with specific environmental issues.

One major initiative which could be taken to achieve integration in environment matters, would be to establish a Ministry responsible for environmental matters, aided by a National Advisory Council on the Environment. The constitution of the Council should reflect the range of environmental interests affecting national development activities. The Council could advise the "Minister" on priority areas and policies, and on environmental programmes

to be pursued to achieve national objectives. The Council could also monitor ongoing environmental programmes and offer guidance for future activities and projects. The composition of the Advisory Council should be multidisciplinary in character, with at least seven but not more than eleven members with expertise in various areas. The Council could create subcommittees to examine particular problems being considered.

### GOALS AND STRATEGIES

#### Goals

The general goal of environmental policy is to preserve the quality of life while achieving sustained socio-economic progress. The environmental objectives of a newly-established Ministry might be as follows:

- o Promote and ensure the wise use of the nation's natural resources in the interests of present and future generations. Minimize any adverse impacts that development may have by establishing an environmental review process for major development proposals.
- o Establish, make operational, and periodically update standards and guidelines for managing the nation's land, water, air, and flora and fauna.

## DEFINITIONS

**Environment** means the physical factors of the surroundings of the human beings including land, water, [atmosphere, climate, sound, odour, taste], the biological factors of animals and plants and the social factor of aesthetics.

**Pollution** means any direct or indirect alteration of the physical, thermal, chemical, or biological properties of any part of the environment by discharging, emitting, or depositing wastes so as to affect any beneficial use adversely, to cause a condition which is hazardous or potentially hazardous to public health, safety or welfare, or to animals, birds, wildlife, fish or aquatic life or to plants.

**Environmental pollution** refers to any situation of air pollution, water pollution, soil pollution, noise pollution, and offensive odours, arising from industrial or human activities in which human health and the living environment are adversely affected.

**Pollutant** means any substance whether liquid, solid, or gaseous which directly or indirectly (a) alters the quality of any segment or element of the receiving environment so as to affect any beneficial use adversely, or (b) is hazardous or potentially hazardous to health.

**Element in relation to environment** means any of the principal constituent parts of the environment including water, atmosphere, soil, vegetation, climate, sound, odour, aesthetics, fish and wildlife.

**Noise pollution** is a form of sensory pollution related to sound volumes being beyond acceptable levels so as to cause harm or be harmful to the living environment.

**Air pollution** is a condition in which undesirable effects on human health and the living environment are likely to be brought about by the various pollutants existing in the atmosphere. These pollutants include, among others, sulphur oxides, nitrogen oxides, carbon oxides, particulate matter, photochemical oxidants.

**Water pollution** refers to the condition in which the quality of water in a lake, river, stream, sea, or underground aquifer has deteriorated, or in which pollutants are found in such amounts that would have undesirable effects on human health and the living environment.

**Wastes** includes any matter, whether liquid, solid or gaseous, which is discharged, emitted, or deposited in the environment in such volume, composition or manner as to cause an alteration of the environment.

**Offensive odour** is a form of sensory pollution caused by pollutants which impact on the olfactory organ. (Examples are ammonia, hydrogen sulphide.)

**Soil pollution** is the condition in which cadmium, copper, arsenic, and other metals are accumulated in farmlands through air or water pollution, thereby resulting in agricultural crops and products being contaminated with pollutants or being prevented from growing.

- o Increase public understanding of the island's ecology, promote methods for the conservation and development of its natural resources, and instill environmental consciousness among all sectors of the population.
- o Establish risk criteria and undertake risk assessments of various man-made or natural activities which could affect public safety.

## Strategies

To achieve these goals the "Ministry" could pursue a multi-faceted approach involving institutional collaboration, promulgation of legislation, and information dissemination.

Inter-Governmental Collaboration. Environmental protection touches upon many fields of

governmental activity. Thus cooperation and collaboration between and among various agencies of government is needed and, in certain cases, should be institutionalized. In particular, collaboration with those agencies whose activities most directly impinge on the environment should be obtained with respect to the following:

- Establishing ambient environmental quality guidelines, criteria and standards for the control of all forms of pollution and establishing the appropriate mechanisms to ensure their compliance.
- Investigating problems of pollution and waste management as well as occurrences of unusual natural or man-made phenomena which may pose risks to the public health and safety.
- Conducting research related to pollutants and wastes.
- Conducting studies on environmental planning and design related to the wise use of resources.
- Investigating the quality of the natural environment and reviewing environmental monitoring programmes.
- Gathering, publishing and disseminating information relating to pollutants and wastes and the available technological options for effectively dealing with them.
- Reviewing and continually updating disaster preparedness and contingency plans and appropriately communicating these to the concerned public.

Regional Cooperation. Regional cooperation and collaboration should be pursued, either directly with counterpart organizations and government entities in other countries of the region or indirectly through international or regional organizations in order to:

- Undertake projects of common concern to participating countries in the region.
- Review existing plans, relative to environmental aspects having regional implications.
- Plan for contingencies with respect to natural or man-made occurrences which have regional impacts, such as major oil spills, sea mining operations, etc.

- Exchange of information, experts, equipment or other resources to assist or facilitate the solution of environmental problems in specific countries.

Legislation. Comprehensive national legislation needs to be established which will:

- Rationalize the body of environmental legislation, to make the existing laws more effective and enforceable.
- Institute a process which will include environmental reviews/assessments of major developmental projects.

Public Information. To promote environmental consciousness among various industrial and business groups, and the general public, the appropriate Ministry should seek to:

- Provide the general public with information regarding environmental protection and conservation of natural resources.
- Apprise business and industry of the latest technological developments in pollution abatement and control.
- Continue to link with regional and international agencies regarding information transfer and exchange.
- Establish an environmental information system which will include information on relevant legislation, projects/programmes, and institutions doing work on the environment, both in the public and private sector, including educational institutions, as well as providing information on the availability of environmental services.
- Generate, assess and disseminate data concerning the country's environmental resources and/or the results of various environmental investigations.

Policy and Program Oversight. Provision must be made within the overall institutional framework for continuous review and modification of policy as development proceeds. The inputs of affected government entities and various public and private organizations, must be solicited in the review process.



Plate 10 - Meeting in Mandeville.

## POLICY AND PROJECT RECOMMENDATIONS

---

### RECOMMENDED GUIDELINES FOR THE DEVELOPMENT OF A NATIONAL ENVIRONMENTAL POLICY

With more than two million people dependent on the limited resource base of an island environment, the Government of Jamaica must accept the challenge of planning for long-term, sustainable development. Major components of Jamaica's economy (such as mining, tourism, and agriculture) are directly linked to that resource base. If quality of life is to be enhanced over the long-term, it is essential that Jamaica's limited resource base be managed by policies that are environmentally sound. If such policies are to be more than pious, but ineffectual expressions of faith, certain concrete actions need to be taken. These include establishing an effective institutional structure for environmental protection, promoting public information and encouraging public debate on environmental issues and, above all, promulgating a clear mandate from the highest level of government to incorporate environmental objectives into the development planning process.

Environmental programs and standards for Jamaica cannot simply be adapted from overseas examples. They must be devised within the context of the socio-economic realities of the society. A large segment of Jamaica's population is poor, and poverty is both a cause and an effect of environmental degradation. Policies, programmes and standards, as well as

enforcement practices, must be realistic, practical, and supported by an informed public.

The objectives of environmental policy are to enhance the well-being of Jamaicans and to preserve the quality of life for present and future generations. The development and implementation of national policy guidelines on the environment is a complex, and controversial exercise. If pursued diligently, it is likely to result in some disruption to existing social, economic, cultural and political relationships. For that reason, the issues to be addressed call for considerable debate and discussion by a wide cross section of interests. Once adopted, every agency, ministry, statutory body and private interest group should be bound by the terms and conditions of pertinent environmental guidelines and standards.

In an attempt to initiate the process of policy formulation, some precepts to be kept in mind in devising environmental policies are enunciated below.

- o respect for the intrinsic value of all forms of life
- o vigilance in protecting the integrity of the ecosystem
- o recognition of the importance of preservation of species diversity and continuity

- o appreciation of socio-cultural factors in developing governmental policies and programmes
- o support for measures resulting in an environmentally aware public
- o forging a partnership between the public and private sectors in support of long-term resource management goals.

The material presented in this section, derived from careful analyses of the sector profiles, as well as from previous efforts at developing environmental policy guidelines in Jamaica, is intended to carry the debate forward by providing a framework for the formulation of a national policy on the environment. Where appropriate, sectoral projects conducive to immediate implementation are also identified.

## **SECTOR GUIDELINES**

Environmental policies, objectives, and projects are suggested for each of the following sectors.

### **Fisheries Resources**

#### Policy

It shall be the policy to ensure the conservation and enhancement of fisheries resources such that the continued existence and viability of all species are guaranteed.

#### Objectives

- o To conserve known fishery habitats so that there is no net loss of habitats, nursery areas or feeding grounds.
- o To ensure population enhancement, particularly in overfished nearshore locations.
- o To develop and implement catch methods which preclude the taking of juveniles.

#### Projects

- o The development of enhancement programmes for various economically important fisheries species.
- o The development of a comparative fishery resources conservation programme including habitat management.
- o Initiation of a project to establish optimum net sizes to protect the resource and benefit the fisherman.

- o Strengthening the institutional base required to conserve fishery resources, including the development of fisheries stock assessment capacity.

### **Energy Resources**

#### Policy

It shall be the policy to develop, as far as possible, indigenous energy resources while maintaining good environmental quality.

#### Objectives

- o To develop a co-ordinated approach toward the sustainable exploitation of indigenous energy resources.
- o To ensure that the siting and operation of power/energy generating facilities is carried out such that acceptable environmental criteria are met.
- o To evaluate the use of non-indigenous energy resources, bearing in mind the multi-use potential of these resources.

#### Projects

- o The development of effluent guidelines and provision of the necessary legal and institutional arrangements to ensure their enforcement.
- o Research and development of fast-growing trees and grasses with a high biomass content that can be used for fuel.
- o Development of public education programmes aimed at increasing the understanding of the relationship between energy, natural resources and the ecosystem.

### **Human Resources and Culture**

#### Policy

It shall be the policy to ensure the development of the human resources of the country to such a level so as to allow for the participation of the wider public in the environmental management process. An essential element of environmental policy should be the training, development and effective utilization of all technical personnel involved in environmentally related programs.

#### Objectives

- o To safeguard the quality of all human environments with particular reference to environmental health and aesthetic values.



- o To develop public awareness of environmental issues so that the population can participate in the decision making processes which will ultimately affect their quality of life.

#### Projects

- o The establishment of public educational programmes aimed specifically at promoting the understanding of interactions between economic development, the natural environment and national well-being.
- o The development of an effective legal and institutional framework which will safeguard the quality of the human environment.
- o Promotion of environmental activities within the educational system, including extra-curricular activities.

### **Tourism and Recreation**

#### Policy

It shall be the policy to preserve and enhance Jamaica's aesthetic and environmental attributes, and to broaden the range of recreational opportunities available to local and overseas tourists.

#### Objectives

- o To identify the recreational potential of particular features of the natural resource base.
- o To ensure the effective management of recreational facilities so as to maintain acceptable levels of environmental and aesthetic quality.
- o To encourage and develop public awareness of the reciprocal relationships between good environmental quality and sustainable tourism development.

#### Projects

- o The identification and evaluation of alternative features of the resource base which have recreational potential, with a view to relieving pressure on existing over-used areas (e.g., beaches).
- o The development of a legal and institutional framework which will ensure effective management of recreational resources and facilities.
- o The monitoring and assessment of impacts of the tourist industry on the island's natural

resources; i.e. beaches, water quality, wild-life and culture.

- o Enforcement of the Beach Control Act with particular reference to the protection of reefs, seagrasses, and beach sand.

### **Mining and Minerals**

#### Policy

It shall be the policy to ensure that mining proceeds in an environmentally sound manner and that the activities involved do not permanently foreclose other development options.

#### Objectives

- o To ensure continued productivity of mined-out areas by means of effective rehabilitation programmes.
- o To ensure the conservation of socio-cultural values where relocation of individuals is inevitable.
- o To increase the understanding and appreciation of mineable resources and the social, economic and environmental impacts of mining.

#### Projects

- o The comprehensive and quantitative evaluation of minerals especially the base metals.
- o The development of other mineral commodities particularly limestone and silica sand.
- o The development of land use policy which will seek to protect economically significant mining areas, thus arresting the loss of potentially important mining areas to urban sprawl and agriculture.

### **Environmental Education**

#### Policy

It shall be the policy to provide environmental education both at the formal and informal levels to the population at large.

#### Objectives

- o To incorporate socio-cultural approaches and the reciprocal exchange method in the environmental education process.
- o To ensure functional co-ordination between the various components of the environmental education system.

- o To develop comprehensive programmes for the acquisition, storage and dissemination of environmental information.
- o To establish an effective institutional and legal framework for environmental information and education.

#### Projects

- o The establishment of effective legal and institutional frameworks to facilitate the promotion of environmental information and education.
- o The production of environmental education tools for use at both the informal and formal levels.

### **Forestry Resources**

#### Policy

It shall be the policy to ensure the integrity of forest resources with respect to the benefits that such resources confer in soil and water conservation, in economic development, as wild-life habitats, and in the aesthetic and recreational values which they provide.

#### Objectives

- o To continue the evaluation of forest resources bearing in mind their importance in conservation and economic development.
- o To maintain the existence of indigenous stands on steep slopes vulnerable to erosion.
- o To develop and encourage the understanding of the role of our forests, particularly with regard to soil and water conservation.

#### Projects

- o The development of both effective legal and institutional frameworks designed to oversee a comprehensive Forest Management Plan which, in the short-term, will address immediate issues of rehabilitation, replanting denuded slopes and, in the long-term, provide forest resource enhancement through the establishment of economically beneficial stands.
- o Research and development of uses of local forest by-products (pharmaceuticals, veneering products for furniture, etc.).
- o The development of schemes involving the planting of fast growing trees specifically for use as fuel.

- o Provision of incentive schemes to encourage timber farming by private farmers.

- o The development of special techniques to reduce soil erosion in timber harvesting and road construction, particularly in areas of steep slopes.

### **Water Resources**

#### Policy

It shall be the policy to ensure adequate quantity and acceptable water quality to meet the needs of industry, agriculture and the general population who rely on water not only for domestic use, but also for recreational and industrial purposes.

#### Objectives

- o To conserve water resources bearing in mind the intrinsic environmental value of this resource, its role as a habitat, and the importance of maintaining a viable hydrological regime.
- o To ensure adequate supply and an acceptable level of water quality for all sectors throughout the island.

#### Projects

- o The improvement of inter-connections between sources of water supply to reduce waste and to ensure efficient distribution.
- o The upgrading and construction of water treatment facilities.
- o The expansion of monitoring and assessment programmes for both marine and fresh water resources.
- o The rehabilitation of catchment areas to reduce the rate of surface run-off, thus contributing to the supply of ground water.
- o The rehabilitation of the irrigation infrastructure.

### **Agriculture**

#### Policy

It shall be the policy to ensure that agriculture development is based on sound principles of resource management. Agricultural practices should enhance soil fertility, prevent soil erosion and maintain the productive capacity of the resource base.

### Objectives

- o To develop and implement conservation oriented farming technologies specifically adapted to local conditions.
- o To promote the use of more productive agricultural systems that assure the use of all resources on a sustained basis.
- o To ensure economic use of irrigation water so as to maintain acceptable groundwater conditions.
- o To ensure that the utilization of agro-chemicals does not impair environmental quality.
- o To arrest the loss of productive agricultural lands to other development options.
- o To ensure that the introduction of new crop species be carefully evaluated so as to protect the ecological integrity of the environment.
- o To promote the use of land-use and land capability data to assist in decision-making with respect to the implementation of agricultural development projects.
- o To develop public education programmes geared towards improving the appreciation of the need for sound environmental management principles as a means of ensuring sustainable and productive agricultural development.
- o To develop effective legal and institutional frameworks so that the objectives outlined above may be realized.

### Projects

- o Integrated planning of watershed management in the badly eroded watersheds, especially for the Kingston Metropolitan Region.
- o Monitoring the impact of agri-chemicals on soils, and surface and ground water resources.
- o Monitoring and assessment of the environmental and social impacts of all agricultural developments (e.g., AGRO 21, CIDCO, and FIDCO).
- o Development of a national land use policy which provides guidelines for the most efficient use of land.

## **National Parks and Protected Areas**

### Policy

It shall be the policy to identify and designate areas of aesthetic, recreational, scientific or education value and to provide for the protection and management of such areas.

### Objectives

- o To provide the legal and institutional mechanisms necessary to establish and conserve national parks and protected areas.
- o To promote an understanding of the need to conserve national parks and protected areas for their aesthetic, recreational, educational and scientific value.
- o To allow for the existence of economic activities within national parks and protected areas while maintaining their uniqueness and ecological diversity.

### Projects

- o The drafting of legislation aimed at providing the legal framework for the establishment and conservation of national parks and protected areas.
- o The development of the Blue Mountain National Park with special emphasis on the identification of unique features and ecological diversity.
- o The development of the Canoe Valley National Park while taking into account the need to develop the economically viable opportunities of the park.

## **Industry and Industrial Pollution**

### Policy

It shall be the policy to ensure that industrial activity proceeds in an ecologically sound manner; that it does not impair environmental quality or exert any adverse effects upon the human resource.

### Objectives

- o To ensure that the siting of industry is carried out so as to reduce adverse local impacts.
- o To ensure effective disposal of industrial effluents bearing in mind the need to maintain an acceptable environmental quality.

- o To foster a reciprocal relationship between government and industry in an effort to achieve effective environmental management.
- o To develop public educational programmes geared toward increasing the understanding of the relationship between industry and the environment.

#### Projects

- o Establishment of guidelines and effluent discharge standards for the various categories of industrial waste.
- o Tax incentives to encourage waste recycling and reuse.
- o The development of legal and institutional mechanisms for effective environmental management in the industrial sector.

#### **Coastal Resources**

##### Policy

It shall be the policy to ensure the maintenance of coastal integrity and the pursuit of non-conflicting and sustainable development options such that the environmental quality of coastal eco-systems is improved and maintained.

##### Objectives

- o To ensure sustainable development of the coastal zone of the island.
- o To maintain and enhance ecological diversity and productivity in the coastal zone.
- o To encourage public awareness of the importance of coastal resources in enhancing both economic well-being and the quality of life.

##### Projects

- o Preparation of an island-wide coastal zone management plan.
- o Design of a comprehensive programme for the rehabilitation of badly impacted coastal resources such as seagrasses, mangroves and beaches.
- o Preparation of effluent discharge guidelines for coastal water.
- o Development of the legal, institutional and administrative measures necessary for the enforcement of the Beach Control Act.
- o Design of incentive schemes that encourage mariculture and aquaculture in the near-shore environment.

- o Public education programmes geared toward demonstrating the relationship between the conservation of coastal resources and the integrity and productivity of the coastal zone.

#### **Wildlife Resources**

##### Policy

It shall be the policy to conserve indigenous wildlife species as part of the natural heritage as well as for their scientific and educational importance.

##### Objectives

- o To ensure the protection of wildlife habitats.
- o To ensure the preservation of all wildlife species.

##### Projects

- o Evaluation of wildlife resources and their habitats.
- o Development of conservation programmes for wildlife species and their habitats.
- o Development of programmes aimed at strengthening institutional capabilities to effectively enforce the Wildlife Protection Act.
- o Initiation of public awareness programmes geared toward increasing the appreciation of the island's wildlife resources.

## PART III: SECTOR ANALYSES



Plate 11 - Boy with reaped yams; Hillside farming in Trelawny.



Plate 12 - Peace and quiet reflection in the St. Andrew Hills.



Plate 13 - Blue Mountains coffee picker with laden basket.

## HUMAN RESOURCES AND CULTURE

---

### OVERVIEW OF HUMAN RESOURCES AND CULTURE

Jamaica's population, slightly more than 2 million at the 1982 census, is characterized by great diversity in ethnic, cultural, and socio-economic backgrounds. Alternative periods of conflict and accommodation between divergent groups has shaped the country's economic and cultural history, and has had a profound impact on population growth, characteristics and distribution.

#### Historic Population Growth

When Jamaica was discovered by Columbus on his second voyage in 1494, it was inhabited by an estimated 60,000 Arawak Indians who lived near the coast. The Arawak's fell victim to European diseases and harsh treatment, and died out by the mid-seventeenth century. The Spanish first settled in 1510, but did little to develop or populate the island in the nearly 150 years before the British arrived in 1655. The British developed plantation agriculture based on the increasing demand for sugar in Europe and the availability of slaves from Africa. Jamaica became one of England's most valuable agricultural colonies, as well as a major port in the Caribbean.

In the first 150 years of British rule, the population of the island grew largely as a result

of slave imports and white immigration. The growth of the black population was almost entirely a consequence of the slave trade. Blacks and whites contributed to the formation of a third group - commonly referred to as the coloured. By 1785, the population included an estimated 30,000 whites, 10,000 free coloured, and about 250,000 slaves living on the plantations.

Since the days of slavery the population has risen steadily, and in recent years has grown rapidly, despite considerable emigration. The first census of Jamaica, taken in 1844, put the population of the island at 377,000. From 1844 to 1881, it increased to 581,000, spurred, in part, by the opening of Jamaica to indentured immigration of East Indians and Africans. During this period, it is almost certain that the death rate declined from the high levels which prevailed during slavery. This growth occurred despite the cholera epidemics of the 1850's.

From 1881 to 1921, population increased to 858,000. At the same time, there was considerable external migration, resulting mainly from the opening up of new development prospects abroad. The commencement of work on the Panama Canal and the development of the banana industry in Central America proved great attractions to Jamaican workers. The expansion of the Cuban sugar industry in the opening years of the 20th century created a

demand for Jamaican workers on sugar plantations. The forging of an important link between Jamaica and the U.S. resulting from the development of the banana trade, coupled with the latter's open door immigration policy, offered yet another attraction for emigration. Adverse conditions in Jamaica, resulting from a succession of disastrous hurricanes and stress in agriculture also played an important part in stimulating migration.

Between 1921 and 1947, a combination of factors resulted in an entirely new pattern of population growth. U.S. quota laws, first passed in 1921, effectively curbed emigration from Jamaica, as did restrictions on entry to Latin American countries. The absence of large-scale, labour-intensive development projects within the region slowed emigration. The immigration of indentured labourers came to an end in 1914; and external migration no longer provided an escape hatch for population growth. With improvements in public health, mortality rates fell substantially. By 1943, the population of the island reached 1.237 million.

A resurgence of external migration dominated the post-World War II years. Movements to the United Kingdom reached a peak in the years 1959-1961, and came to an end with the passing of the Commonwealth Immigration Act of 1962. Mortality rates continued to decline. The 1960 census reported a population of 1.6 million. Although the rate of natural increase in the post-war years was higher than in any other period (23.4 per 1,000), because of high emigration rates, the annual rate of population growth averaged 1.6% for the period 1921-1943.

From 1960 through the early 1970's, a new type of emigration appeared. This involved professional and semi-professional personnel migrating to the U.S. and Canada. The annual average outflow of 28,000 in the decade 1960-70 was by far the largest such movement ever experienced in the island, equivalent to 53% of the natural increase for that decade.

### **Cultural Background**

The population of Jamaica is almost entirely derived from immigrant streams entering the island since its capture by the British in 1655. By far the largest number came from West Africa during the slave period. At the time of emancipation, blacks outnumbered the white settlers by about ten to one; today about 96% of the population is coloured or black. A small number of indentured Indian labourers were

settled in Jamaica in the last half of the nineteenth century, and now comprise about 2% of the total population. All other groups, including Europeans and Chinese, make up less than 2% of the total.

Each of the ethnic groups that arrived in Jamaica brought with them their own unique cultural characteristics. From these various population strains is emerging a cultural identity unique to Jamaica. The quest for a cultural identity has been accelerated since the attainment of nationhood 23 years ago. Although some cultural exclusiveness has persisted, the movement towards a national cultural identity continues, characterized by the national motto "Out Of Many One People".

## **POPULATION TRENDS**

### **Population Size and Composition**

Jamaica's population at the 1982 census was 2,190,357. Urban dwellers accounted for 47.8% of the population, while 52.2% were classified as rural. (The percentage of urban to rural population increased by 6.6% between 1970 and 1982.) Geographical features significantly affect settlement patterns: settlement is considerably restricted in those areas of steep and rugged terrain in the centre of the island, as well as in regions of swamp along certain sections of the coast. Figure 10 shows the general density distribution of the population by Parish.

The Caribbean, as a whole, has a far higher ratio of people to land area than any other sub-region of the Americas (130 per sq. km. as compared to 40 per sq. km. in Central America and 12 per sq. km. in North America. Based on the provisional count of the 1982 census, Jamaica's population density was 205 persons per sq. km. (See Table 4.)

Jamaica's average annual rate of population increase is 1.4%, placing it among that group of countries which has reduced their rate of population growth to a fairly moderate level. This recent rate is the same as that which prevailed during the decade 1960-1970, largely because the level of migration was lower in the 1970-80 period than it was during the 1960-70 decade.

Although Jamaica is a multi-ethnic society, ethnic groups other than those of African origin comprise a very small minority of the popula-



**Table 4:**  
**Population Density in Selected Countries**  
**of the Circum-Caribbean**

<u>Country</u>	<u>Density per sq. km.</u>
Barbados	584 (1980)
Dominican Republic	122 (1981)
Guadeloupe	179 (1982)
Trinidad and Tobago	224 (1980)
Jamaica	205 (1982)
Source: United Nations Demographic Yearbook, 1983	

tion. Based on the 1970 census, the combined total of those classified as East Indian, White, and Chinese made up 3.1% of the total Jamaican population; blacks accounted for 90.9%; 5.9% were listed as of "other races"; and for 0.1%, no race was stated (Statistical Yearbook of Jamaica, 1980). However, the impact of these minority groups cannot be gauged solely by their numbers. Jamaica was a slave society for over 150 years and a colony for over 300. During this lengthy period of its modern history, the society was controlled by a small minority of European origin. The powerful position of this minority has exerted considerable influence on the culture, values and local evaluation of phenotypic features. Many of these groups — Jews, Lebanese, Chinese — with traditions of activity in commerce and trade have carved out viable niches for themselves in these fields in the Jamaican society to which they came as immigrants. Hence, they are minority groups of considerable influence extending well beyond their numerical strength.

### Migration

Estimates of migration from Jamaica over the period 1960-1984 show fluctuations which are in some cases, quite striking and, in part, reflect changes in immigration policy in the countries to which Jamaicans have traditionally migrated. (See Table 5.) These data, while generally considered to underestimate the actual level of emigration, nevertheless do give some idea of the extent of movement, and of the fluctuations that occurred from year to year. For example, the large number of migrants recorded between 1960 and 1962, followed by a sharp fall-off in 1963, indicate

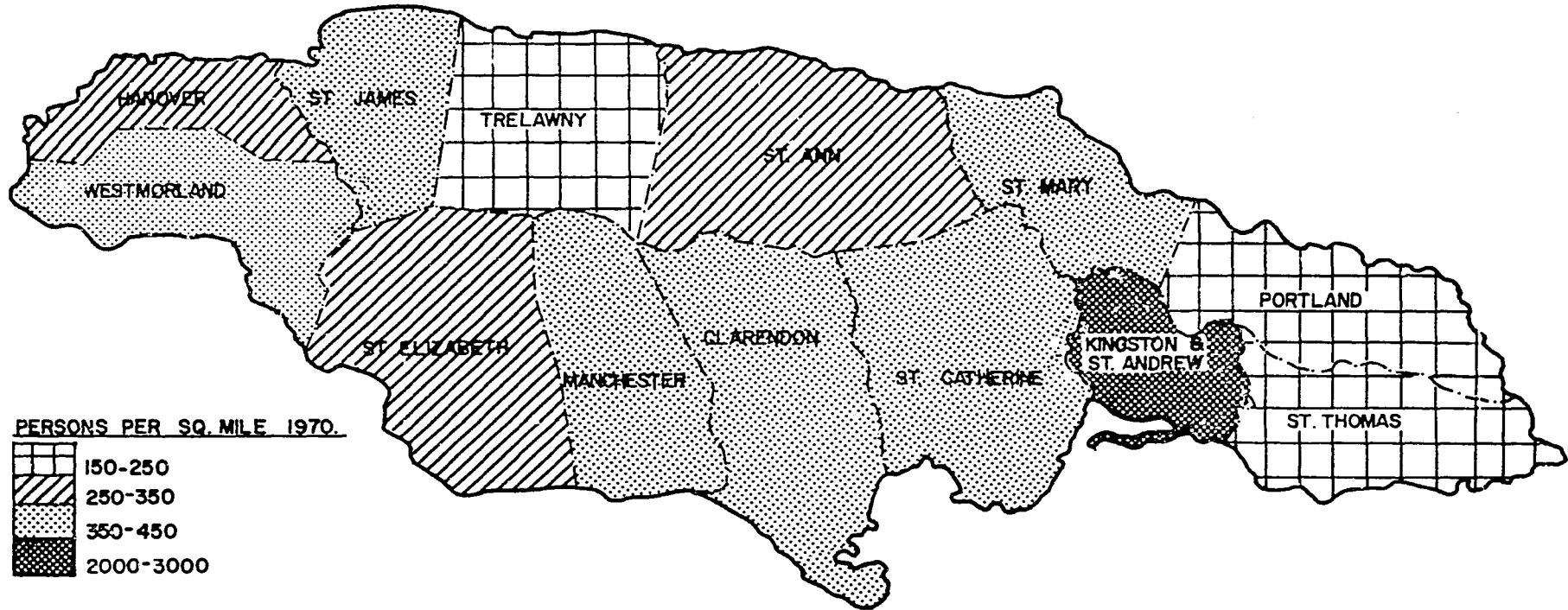
the frantic efforts to enter the United Kingdom before the Commonwealth Immigration Act became effective in 1962. North America — both the U.S.A. and Canada — has become the primary destination of Jamaican migrants since the mid-1960's.

A study of the migration flow to the U.S.A. and Canada, conducted by the National Planning Agency (now the Planning Institute of Jamaica), attempted to characterize the composition of the migrating population and to estimate its social cost to Jamaica. (See Table 6). (One advantage of the study is that it substantiates the alleged undercounting noted above in the estimates prepared by the Immigration Department). This study revealed that 46.2% of the 214,298 emigrants destined for the U.S.A. and Canada between 1970 and 1980 were members of the labour force. The majority, 53.8% of the migrants, were housewives, children or others with no occupation. Of the workers who migrated, just under 19% were in the categories of professional, technical, administrative and managerial personnel. For the period 1977-1980 the percentage in this highly skilled category was even higher, 26.6%. Considering that professional, administrative and related workers comprise consistently less than 10% of Jamaica's labour force, the extent of the loss of skilled manpower becomes more apparent.

The highly mobile character of Jamaica's population is further apparent in the level of internal migration. (See Table 7.) Between 1969 and 1974, 28.4% of the population changed their parish of residence. In the most mobile age group (25-34), 45.9% changed parishes at least once during the five year period.

FIGURE: 10

# POPULATION DENSITIES AND DISTRIBUTION BY PARISH



SOURCE: Statistical Yearbook of Jamaica 1980.

**Table 5:**  
**Estimates of Net Migration 1960-1984**

<u>Year</u>	<u>Net Migration</u>	<u>Year</u>	<u>Net Migration</u>
1960	-30,300	1973	-10,200
1961	-38,500	1974	-12,900
1962	-28,700	1975	-12,100
1963	- 7,300	1976	-22,200
1964	-13,500	1977**	-21,100
1965	- 6,500	1978***	-17,800
1966	- 8,900	1979	-21,400
1967	-20,000	1980	-24,300
1968*	-20,000	1981	- 5,900
1969	-29,000	1982	- 9,800
1970	-23,000	1983	- 4,300
1971	-31,500	1984	-10,500
1972	-11,200		

- \* Central Planning Unit Estimate
- \*\* Provisional Estimate from the Registrar General's Office
- \*\*\* Department of Statistics Estimate

Source: Statistical Institute of Jamaica, Demographic Statistics, 1984.  
Compiled from data collected by the Immigration Department.

**Table 6:**  
**Distribution of Emigrants to North America: 1970-80**

<u>Occupational Group</u>	<u>1970-80</u>	<u>%</u>	<u>1977-80</u>	<u>%</u>
Professional and Technical	11,978	5.6	5,362	6.6
Administrative and Managerial	6,643	3.1	4,124	5.1
Farmers and Farm Managers	638	0.3	212	0.3
Clerical and Kindred	15,619	7.3	6,729	8.3
Sales Workers	2,774	1.3	1,195	1.5
Craftsmen, Foremen, Kindred	13,990	6.5	4,636	5.7
Operators and Kindred	18,001	8.4	4,466	5.5
Private Household Workers	14,764	6.9	2,896	3.6
Service Workers except Private	8,879	4.1	3,627	4.5
Labourers including Farm Labourers	3,881	1.8	1,589	2.0
Occupations not Stated	1,860	0.9	792	1.0
<b>TOTAL WORKERS</b>	<b>99,027</b>	<b>46.2</b>	<b>35,628</b>	<b>44.0</b>
Housewives, Children, Others with No Occupation	115,271	53.3	45,372	56.0
<b>TOTAL EMIGRATION</b>	<b>214,298</b>	<b>100%</b>	<b>81,000</b>	<b>100%</b>

Source: National Planning Agency: Emigration to North America from Jamaica 1970-80, A Special Report (1982).

**Table 7:**  
**Population by Age Group and Number of Parishes Lived in**  
**Between June 1969 and June 1974**

Age Group	Total Population	Never Moved	Number of other Parishes lived in							Not Reported	
			1	2	3	4	5	6	7		
Both Sexes											
Under 5	268,885	248,388	15,884	908	5						3,700
5 - 4	617,896	534,306	66,651	5,584	79	22	-				11,254
15 - 24	304,500	236,649	81,613	14,246	1,202	404	42	-	52		6,292
25 - 34	195,153	79,572	69,032	17,678	2,189	489	67	76	94		7,956
35 - 44	168,449	86,896	55,813	16,241	1,564	386	95	90	67		7,297
45 - 54	154,141	81,266	48,135	12,999	599	261	261	133	234		8,216
55 - 64	131,436	74,060	38,460	10,623	1,098	148	425	22	211		6,389
65 and over	128,848	76,303	35,506	8,748	1,729	634	157	204	46		5,521
Total	2,005,308	1,435,440	411,094	87,027	10,164	2,682	1,047	525	704		56,625
Source: Statistical Institute of Jamaica - Demographic Statistics, 1984											

### Population Projections and Some of Their Implications

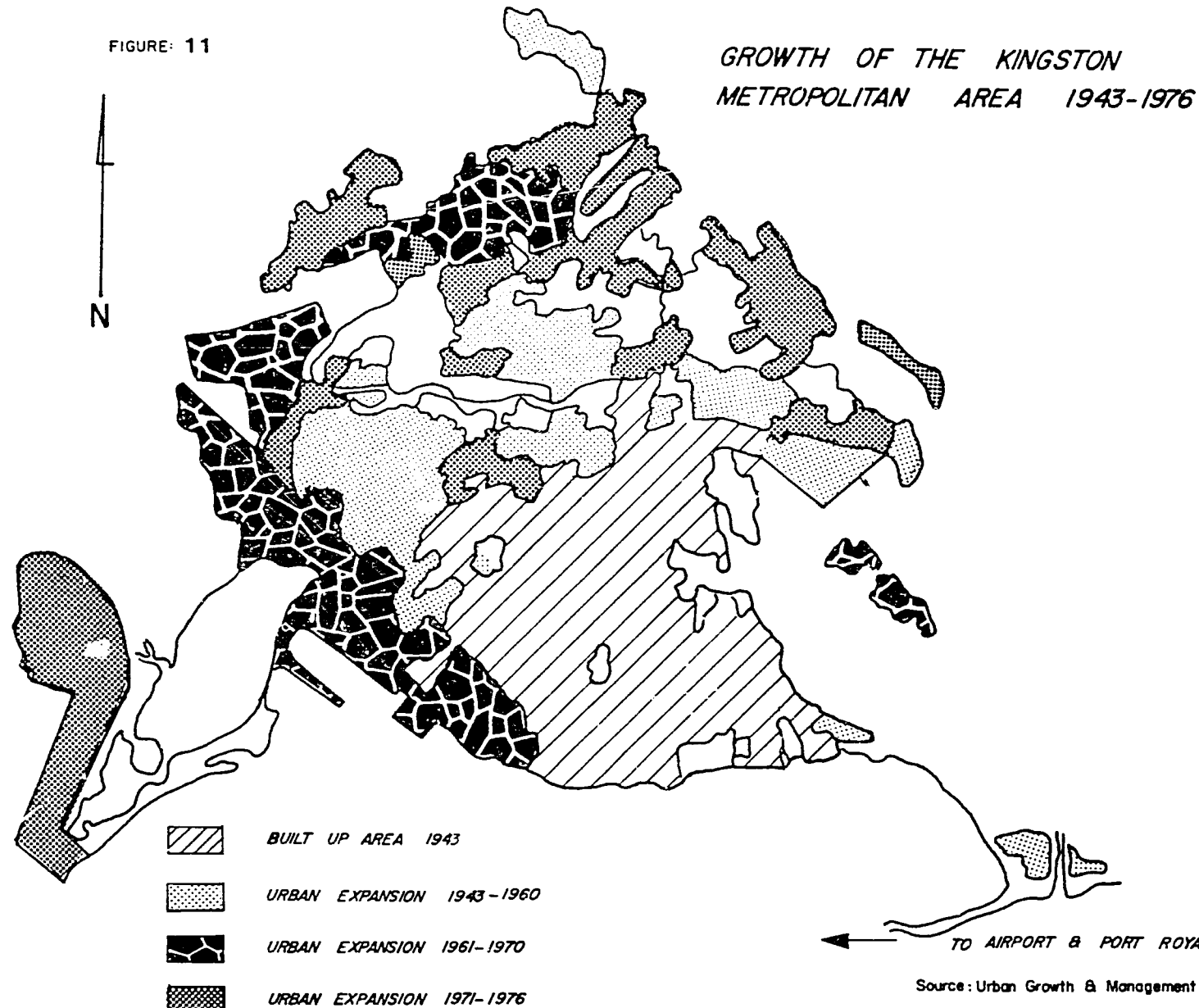
Between the 1920's and the 1960's, the Kingston Metropolitan Area (KMA) experienced a very high rate of population growth, both through natural increase and by net migration from rural areas. The population in the metropolitan area almost doubled between 1943 and 1960, growing from 238,300 to 419,400. Between 1960 and 1980, this growth in population led to the development of large settlements around the perimeter of the old metropolitan area. (See Figure 11.) The population of the Portmore area, for example, grew from just over 2,000 in 1970 to over 66,000 in 1982. However, with the limited exception of the Central Village/Spanish Town area, the construction of new housing adjacent to the old Kingston Metropolitan Area has not been accompanied by the growth of satellite industrial and commercial zones to support the new population distribution. For example, the Urban Growth and Management Study, conducted in the mid 1970's found that residents in outlying 'suburbs' were dependent to a very high degree for jobs and services located within the KMA. (See Table 8.)

Population trends for the island as a whole have looked promising since the decline in the fertility rate and the rate of population increase which started in the early 1970's.\*

\* It should be noted that the alleged decline in the fertility rate has not been definitively established. Some experts — notably Professor G.W. Roberts, the foremost authority on Jamaican and Caribbean demographic patterns — question the reliability of the data on which the decline is supposedly based. Professor Roberts points to the deterioration of the system for collecting vital statistics at the local community level (the fee paid to register births has remained the same for 60 years) and the demoralizing working conditions at the Registrar General's Department to support his skepticism. If the fertility rate has indeed fallen it might be attributed to a combination of factors: the effect of the family planning programme, as well as the increasing opportunity for schooling to the secondary level and beyond that have opened up for working class girls and boys in the past two decades.

FIGURE: 11

GROWTH OF THE KINGSTON  
METROPOLITAN AREA 1943-1976



Source: Urban Growth & Management Study. Nov. 1978.

Projections made in the early 1980's suggest that the fertility rate will continue to decline to replacement level by 1995-2000 under the moderate projection. As of 1984, the number of children per woman had fallen to 3.3. (See Population and Jamaica's Future: A Statement of National Population Policy, 1982, and Economic and Social Survey, 1984.) It is anticipated that the island's population will be around or slightly under 3 million in the year 2000. (See figure 12.)

While this may be a welcome trend to those responsible for providing education, housing, jobs and other services, the overall decline does mask certain problem areas which can already be detected and require urgent attention. The legacy of high rates of population growth in the 1950's and 1960's is the unusually large number of persons reaching their 20's in the 1980's. While in 1980, there were approximate-

ly 350,000 persons in the 20-29 age group, by 1990 there could be 550,000 persons in this age group.

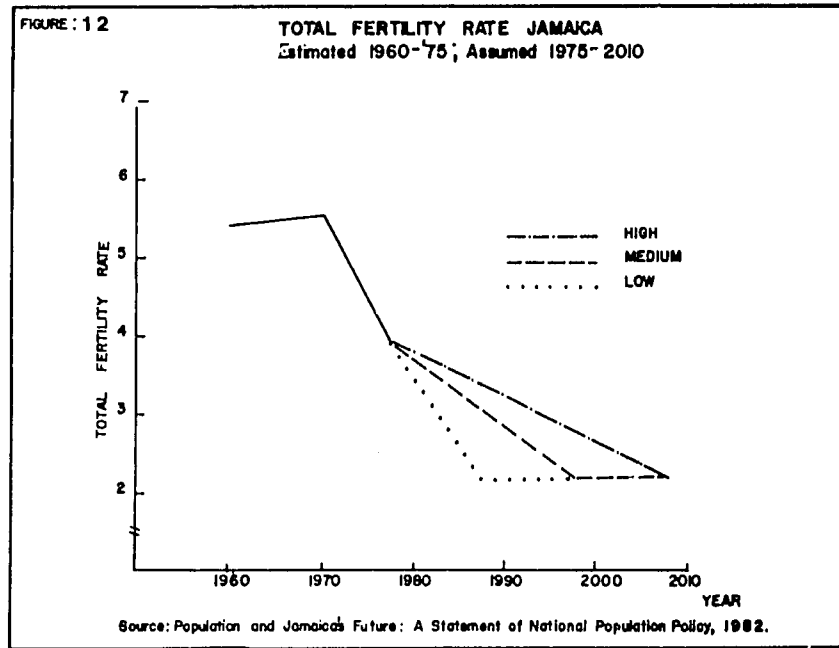
The large increase in the number of people in their 20's comes at a time of dramatic decline in housing construction. (See Table 9.) From 1983 to 1984, for example, there was a decline of almost 52% in government-sponsored housing starts and a 33.6% decline overall, when construction activity in both the public and private sectors is taken into account (See Economic and Social Survey, 1984). Even without the recent downturn, the rate of new housing construction has consistently been well below the estimated need, now said to be 12,500 units per year (see Davies, 1984). Moreover, the high rates of inflation and high interest rates make the possibility of home ownership even more remote, precisely at a time when the number of young people starting new families is at a peak.

**Table 8:**  
**Degree of Dependency of Communities in the K.M.R. on the K.M.A.\***

<u>Communities in the K.M.R.</u>	<u>Work Place in K.M.A.</u>	<u>Recreation in K.M.A.</u>	<u>Out of Area Doctor</u>	<u>Out of Area Shopping</u>	<u>Schools in K.M.A.</u>
Gordon Town	74%	40%	37%	50%	74%
Golden Spring	60%	26%	100%	82%	62%
Swain Spring	66%	66%	100%	67%	100%
Spanish Town	14%	4%	4%	4%	12%
Ensom City	64%	35%	99%	100%	36%
Willowdene	42%	12%	97%	97%	18%
St. Thomas Coast	28%	2%	99%	89%	5%

\*KMR: Kingston Metropolitan Region; KMA: Kingston Metropolitan Area

Source: Urban Growth Management Study, 1978



**Table 9:**

**Level of Housing Construction 1974-1984**

<u>Year</u>	<u>Public Sector Agencies</u>	<u>Private Sector</u>	<u>Total</u>
1974	1621	64	1685
1975	3598	614	4212
1976	4638	3214	7852
1977	4384	2453	6837
1978	4601	275	4876
1979	3653	1116	4769
1980	1959	1284	3143
1981	1838	466	2304
1982	5019*	1210	6229
1983	1560	1872	3432
1984	1173	1867	3040

\*A large percentage of these were converted from previously constructed Sites and Services Units.

Source: Davies, 1984 and Economic and Social Survey 1984.

The coincidence of these various trends suggests that in the next decade or so, further strain will continue to be placed on the existing housing stock and infrastructure, particularly in the KMA. There is likely to be an increasing tendency for families to double-up, and for the pressure of population on housing and public services to increase. Thus, a municipal system which had never really caught up with the accelerating demand for services engendered by the high rates of population growth in earlier decades, will be taxed still further, especially in view of the contraction of government spending in the 1980's.

### The Labour Force and Education

A quantitative profile of the labour force over the period 1968-1984 indicates both a consistency of certain patterns, as well as incremental shifts caused by changes in the political economy. The percentage of workers in the

agricultural sector has fallen slightly since the mid-and-late-1970's, reflecting the thrust toward more capital-intensive farming under the current administration. Similarly, the expansion that occurred in the public sector in the mid-to-late-1970's has been followed by more recent cut-backs in this sector, also a reflection of shifting governmental policy.

However, the distribution of occupations by sectors, notwithstanding changes in policy and in the level of economic activity, has shown remarkable consistency. (See Table 10.) For example, the percentage of the population involved in agriculture has remained fairly consistent over the period and seems to underscore the apparent resilience of the island's small farming peasantry. The high percentage of self-employed workers as compared to other occupations appears to indicate the vitality of the "informal" sector in the Jamaican economy and its tendency to grow precisely when the formal economy is in decline. (See Table 11.)

Table 10:

Percentage Employed Labour Force by Industry Group

Industry Group	1968	1972	1976	1980	1984
Agriculture,* Forestry and Fishing	38.0	33.6	35.3	36.8	32.7
Mining and Quarrying	-	-	1.2	1.2	0.9
Manufacturing	10.7	12.7	11.0	10.9	12.8
Construction and Installation	7.0	6.6	5.4	3.6	4.4
Transport Communication and Public Utilities	4.2	4.1	4.8	4.7	4.6
Commerce	11.9	13.2	12.5	12.6	14.2
Public Administration	9.6	10.8	15.7	15.0	12.8
Other Services	18.6	19.0	13.8	14.9	17.6
Industry not specified	-	-	0.6	0.3	-

\*For the years 1966 and 1972, Agriculture includes Mining.

Source: Statistical Institute of Jamaica: The Labour Force (calculated from various issues).



**Table 11:**  
**Percentage Employed Labour Force by Occupation**

<u>Occupation</u>	<u>1968</u>	<u>1972</u>	<u>1976</u>	<u>1980</u>	<u>1984</u>
Professional, Technical Administrative, Executive Managerial, and Related Occupations	5.5	7.0	9.5	8.6	8.8
Clerical and Sales	9.5	12.3	11.7	12.1	11.3
Self-Employed and Independent	37.3	34.8	37.1	41.0	40.2
Services	12.8	13.6	11.3	11.8	14.0
Craftsmen, Production Process and Operating Occupations	14.9	17.0	13.9	11.7	13.7
Unskilled Manual	20.0	15.3	16.2	14.6	12.0
Occupation not specified	-	-	0.4	0.2	-

Source: Statistical Institute of Jamaica: The Labour Force (calculated from various issues).

The unemployment rate for women has been consistently more than twice that for men. (See Table 12.) Moreover, young women have been disproportionately affected. Even though major increases in government spending are unlikely, given present economic constraints, the employment of women and young people in conservation programmes would be appropriate if spending levels increase.

A general indication of the educational status of the Jamaican population may be gleaned from Table 13, which shows the ratio of population enrolled in primary and secondary schools to total population for those age groups. The ratios should have increased significantly by 1980.

**Table 12:**  
**Unemployment Rate Jamaica\***

	<u>1968</u>	<u>1972</u>	<u>1976</u>	<u>1980</u>	<u>1984</u>
Total	18.5	22.5	24.2	26.8	25.4
Male	12.0	13.6	14.7	16.0	15.7
Female	27.3	34.1	35.6	38.4	36.5

\*With the exception of 1980, when the survey was conducted in November, all rates are for the survey month of October.

Source: Statistical Institute of Jamaica: The Labour Force (various issues).

**Table 13:**  
**Adjusted School Enrollment Ratio**

<u>Primary School</u>		<u>Secondary School</u>	
<u>1960</u>	<u>1970</u>	<u>1960</u>	<u>1970</u>
82.0	85.0	43.0	59.0

Source: World Bank World Tables, 1980.

## CULTURE

### Lines of Differentiation\*

While cultural ideas that cut across the entire society can readily be identified, it is also necessary to take note of significant variations resulting from historical patterns in the development of the society. Topography and the requirements of the production regime have been central factors in the internal differentiation of the Jamaican population. Large sugar estates occupied the most fertile plains and alluvial valleys of the island since the early eighteenth century, while much of the remaining area of low slope with more shallow soils or inadequate rainfall for sugar cane cultivation, were taken up by cattle and pimento estates. As a means of feeding the slave labour force, plantations traditionally allocated the more mountainous sections of their holdings, in plots of an acre or so in size, to slaves for cultivating food staples for home consumption and for sale at the regular Sunday market.

It was from this well-practiced pattern of cultivation and marketing that the Jamaican peasantry emerged after Emancipation, gradually buying small plots of land (usually the hillside land of ruined estates) with their accumulated savings. Inequality of holdings, both as to quality and relative size, has always characterized the rural population. This pattern has never been significantly modified by government-sponsored schemes of land settlement which began in the 1890's.

The first general line of differentiation, then, is between plantation and peasantry, plantation worker and peasant farmer — although even here the situation is complicated by the frequency with which one finds workers who divide their time between own-account cultivation and hired labour. Within the broad peasantry category, one might find significant differences, for example: between communities of fishermen and communities of small farmers; between church-settled and non-church-settled free villages; between areas where a profitable cash crop grown for export has come to dominate, such as bananas or coffee versus areas that grow food crops for home use and local sale; between land settlement (or more recently land-lease) areas and their counterparts settled without government assistance; or between areas

where the bauxite/alumina industries have been established, versus those areas more remote from these operations.

Similarly, the profile of the traditional sugar plantation areas and its neighbouring villages must embrace considerable variations having to do, for example, with whether the estate is owned by a family or local interests, or by a foreign controlled multi-national corporation. Again, the pattern of abandonment, or conversion to other crops, of large holdings previously in sugar cane, which has been occurring in spurts since the mid-nineteenth century, is a constant source of change making for differentiation in the rural population. Large areas of St. James and St. Ann parishes, for example, have been taken out of sugar cane, while, most recently, large holdings in Clarendon have been put into high-technology winter vegetable farming.

In addition, there are other variations which characterize the Jamaican population and settlement patterns, including the traditional rural/urban difference and the presence of small urban settlements around the coastline which previously served as export and service-centres for the plantations; the growth of centres specializing in tourism such as Ocho Rios, Negril, Runaway Bay, and the larger Montego Bay; and the persisting uniqueness of the island's Maroon communities, settled by runaway slaves whose autonomous existence was recognized by treaty from the late eighteenth century. Thus, within a national environmental programme, there is need for small-scale projects which not only address the objectives of environmental management, but seek to accommodate the distinctive social characteristics of the sub-region within which they are to be implemented.

Most of the interior towns and villages developed after the end of slavery in 1838, in response to the growth of the small settler population. Figure 13 illustrates the hierarchy of present and projected central places around the island. Several of today's important interior towns (such as Browns Town, Linstead, Chapelton, Christiana and Highgate) developed as market centres, whose growth was stimulated and manned largely by enterprising ex-slaves. With their development, the island's network of internal communication became more reticulated, shifting from coastal boat traffic and a few primary interior routes which predominated before the nineteenth century, to a dense system of interior roadways linking the new settlements.

\* As background to the discussion of this section see: Higman, 1976; Mintz, 1974; Price, 1966; and Frucht, Comitas, 1973.

FIGURE: 13

# SETTLEMENT STRATEGY



- REGIONAL CENTRES
- SUB-REGIONAL CENTRES
- DISTRICT CENTRES

Source: Document Prepared for Eighth Session, U.N. Commission on Human Settlements (1965)

## Cultural Symbols and Environmental Policy

There are two main schools of thought regarding the interpretation of Jamaican (and Caribbean) culture. The two differ in their view of how the society is constituted, how it holds together, and consequently would suggest somewhat different paths of action in an attempt to chart an environmental policy direction consistent with socio-cultural reality.

The first school of thought, known as the plural society model, holds that the various ethnic strands that make up Jamaican society have persisted in their distinctiveness into the present. The racially mixed intermediate group, which came into being under slavery, is regarded as a distinctive group under this model. In this view, the various strands which make up the rope of the society are in constant danger of coming unstrung: conflict, based on ethnic and cultural differences, is an ever-present possibility. Political force holds the various strands together: colonial domination in the first instance, and political parties run by the intermediate ethnic group, but incorporating other elements to mask their domination, in the post-colonial setting (see M.G. Smith 1965, 1974).

The second mode of interpretation, which might be described as the creole society view, emphasizes the integrative development of a cultural system: interaction of the various ethnic strains, under a common regime of production, to form a creole language, world view, and system of ideas that are distinctively Caribbean. (This view is represented in such studies as Brathwaite, 1971 and Mintz, 1974.)

It is important to recognize that the socio-cultural system is a dynamic one, in process of formation, and subject to forces of change from various directions.\* However, there have been few attempts to bridge the gap between scholarly studies of society and culture in the Caribbean, and the design of policies and programmes; in most instances the two activities are carried out in isolation. Yet, the creole society model suggests that there are shared cultural ideas that can be built on to help assure the success of policies and projects. One such set of ideas that is relevant for present purposes revolves around the conception of the "yard" — that portion of living space which surrounds the house which Jamaicans, urban and rural dwellers alike, from all classes, recognize and treat as socially significant.

The "Yard" as Cultural Symbol. The yard is an extension of the living space of the household, where certain domestic activities, such as laundering, might be carried out; where children play games; and where men and women carry on social activities with their peers. The yard is usually circumscribed by a vegetative or man-made fence. Within its boundaries, a distinctive range of items is likely to be found growing. Permanent fruit trees such as citrus, mango, ackee, avocado, and breadfruit provide snacks for the children and portions of the family meal when in season, as well as readily available items to be presented as gifts to visitors. Vegetables and seasonings such as tomatoes, thyme, escallion and peppers are also grown there to furnish flavouring ingredients for the family pot, while flowering plants and ornamentals are carefully tended for their decorative value. In times of surplus, the products from the yard's kitchen garden may be sold to higglers in the internal market system.

The close association of the yard with the domestic grouping — its meals, the recreational activities of its members and the like — points to the social significance or meaning of this circumscribed space for Jamaicans. Its symbolic significance is further underscored by the circumspection with which it is approached by non-household members who call from its perimeter to announce their presence; by its use in many rural communities as the burial ground for deceased family members and site for

---

\* Many, who accept the creole society model, for instance, also argue that many aspects of African culture were forced "underground", and that part of the dynamic of cultural process in present day Caribbean society involves the coming to terms with these undervalued aspects of the cultural system (see, for example, the introductory essay in Nettleford, 1978). Movements such as that of Garvey or the rise of Rastafari do not, in this view, represent forces that seek to pull the society apart at its ethnic seams, but rather forces that seek to enrich it by having cultural elements which have hitherto been suppressed, recognized. The influence of the North American cultural system through the constant circulation of people, and that of the mass media, is yet another force that impinges on the socio-cultural system and makes for change.

burying the placenta of the newborn; and by the ritualistic regularity with which it is swept at early morning in town and country. The physical care given to the communal yard in the cities may be lacking by comparison with the situation in village communities or middle class and owner-occupied yards in the urban area itself. Nevertheless, working class urban dwellers still recognize the yard's significance as a social community, even though they may be one of several tenants, and only there as transients hoping to move on to better surroundings when they become more established in the city (see Mintz, 1974, Ch.9 and Brodber, 1975).

The "yard" is, for the Jamaican peasantry, traditionally set apart from the "ground": the small plot or plots of land which the man of the household (and sometimes the woman) farms. As on the slave plantation, so too in the post-Emancipation settlements, the ground was often located some distance away from its proprietor's home. Still today, small farmers often have to walk several miles to reach their farms at early morning. There may be some social activity at a man's ground as he stops at midday to cook a pot of food to share with his co-workers who are members of his reciprocal day-labour group, but this has neither the scale, grace, nor consistency of social activity in the yard. The "ground" has rather the quality of a man's makeshift encampment where he can cook, rest, store his tools, or take shelter from the rain, but from which he goes home to the "yard" after working. The cropping pattern of the ground is characterized by a mix of items which bear at different times, grow at different heights (permanent fruit trees give foliage cover to crops planted beneath them which are rotated from season to season) and so help to give a range of options, and distribute the risk of the enterprise.

Set apart from both "yard" and "ground" is the "bush", that untamed uncultivated wilderness, to which one holds no special attachments. This is the province of non-domestic animals and the refuge of fugitives. One may fell trees

in the bush for building purposes or hunt birds there but, in general, people's relationship to it is predatory and non-permanent.

The foregoing set of contrasts, though not etched in the cultural consciousness with quite the rigidity that this schematic presentation might suggest, does point to a certain difference of attitudes and perceptions as one moves from the near environment to the more distant one.

This is a preliminary and incomplete formulation that could possibly lead to identifying significant culturally formed perceptions of the environment held by Jamaicans. It suggests many possibilities. One of these is the potential for the core symbol, "yard", to be employed in creating a positive perception and reflexive relationship between people and their surroundings, at least some of which may be regarded as place-distant, and with indifference, at present. The idea would be to draw on the positive associations of "yard" to increase the level of commitment to more distant spheres.

The Theme of "Naturalness". Another underlying cultural theme endowed with its own symbols which might be drawn upon in an environmental consciousness-raising programme, is the theme of "naturalness". The theme is explicitly stated in Rastafari ideas, which categorize items as more or less wholesome according to their relative degree of perceived "natural" content. Items of food or clothing, as well as modes of expression and occupations and much else are ranked, so to speak, using this criterion. The tendency may be part of a larger cultural concern with the land and people's connection with it. Thus, one often observes animated and eager discussions, among persons who might be meeting each other for the first time, about this or that plant or tree in the garden. Closer acquaintances readily share remedies from the vast folk pharmacopia or pass on slips of plants to be rooted in some

<u>"Yard"</u>	<u>"Ground"</u>	<u>"Bush"</u>
Women	Men	Fugitives and non-domesticated animals
Meticulously arranged and cared for	Cultivated, but not neatly ordered	Disordered, "wild"
Near	Intermediate	Distant

distant garden. Plants are often used matter-of-factly to lubricate social relationships. Or, to cite another very African example, libations will be poured on the ground as offering to the spiritual forces connecting man with nature on any number of ceremonial social occasions.

It is evident that a consciousness about the natural environment and man's relationship to it is deeply embedded in the Jamaican cultural system. But in practice this consciousness will manifest itself in very different ways in response to local and individual circumstances, economic constraints and the like. Thus, the most useful socio-cultural analyses (more useful because more pointed) will emerge from the consideration of particular environmental problem areas in relation to particular projects.

Still, it is possible to suggest one culturally-induced response to worsening economic conditions which are being experienced at present. With respect to economic pursuits, Jamaicans tend to engage in a number of actual or potential income earning activities at any one time, even those people who are employed in a steady job. This tendency both to think and act in terms of multiple options is equally evident in social relations as it is in employment. In response to the loss of a job or the contraction of a sector of the economy that affects household income from a particular source, individuals respond by emphasizing other already existing options to a greater degree or by developing new ones. The yard itself, for instance, (as living space rather than as abstract construct) may be converted into a multi-family dwelling unit as a means of earning extra income for the owner or supporting additional family members, or it may be used as a base for producing items for sale. Option-building suggests the first line of response to growing economic constraints. As conditions deteriorate further, however, it becomes a less adequate means of defence.

Jamaica's cultural tradition, therefore, often regarded as diffuse and incoherent, does yield to careful analysis and should be a primary consideration in the processes of environmental policy formulation and project implementation.

#### **KEY ISSUES AND PROBLEMS**

A number of important issues and problems related to population trends and cultural characteristics have been discussed in the previous sections. These are summarized as follows:

1. Jamaica is among the most densely populated countries in the Americas. Very little of its usable land area is uninhabited, although the agricultural system is less intensive than it is in other high density regions such as South Asia.
2. Even though the percentage of people involved in agriculture has remained relatively constant over the past 15 years or so, the ratio of urban to rural population has been increasing.
3. Self-employed persons and small business enterprises make up a large percentage of the employed work force. The implications of this for environmental planning need to be carefully considered.
4. Persistently high rates of unemployment affect women and the young to a much greater extent than other segments of the population.
5. Jamaica has a highly mobile population.
6. The provision of urban jobs and services has not matched the growth of the urban population over the past several decades. In addition, an increasingly large cohort of 20 year olds comes of age in the 1980's, precisely at a time when housing construction has declined and interest rates increased, making the shortage of housing and services, particularly in urban areas, an increasingly acute problem.
7. The differentiation of the Jamaican population makes it important to consider the unique conditions of those areas where environmental management projects are to be sited.
8. A cultural analysis can provide insights as to the environmental consciousness of the Jamaican population as well as suggest ways of approaching issues such as environmental education and project planning.

#### **DIRECTIONS FOR THE FUTURE**

1. The importance of the informal sector and small business enterprises must be taken into account in any programme of environmental management. Small enterprises are perhaps more difficult to monitor and have more limited resources for pollution control and waste treatment than is the case with larger firms. On the other hand, there is great

potential for implementing low-budget environmental management within specialized sections of the informal sector. In the case of sidewalk vendors, for example, designing a low-cost, portable display stand which could be built or purchased by vendors, or organizing systems of waste disposal which vendors could carry out and monitor by themselves, could make a significant difference aesthetically, as well as in the cost of waste removal services. Similar proposals could be made for other segments in the informal sector to meet environmental problems that are unique to them.

2. Even though large amounts of government spending are unlikely given present economic constraints, the employment of women and young people in conservation programmes would be appropriate if spending were to increase. It would seem prudent for the mix of projects to be proposed under the national environmental policy to include a few which would be highly labour intensive and targeted to train and employ persons in the groups which experience highest unemployment. If the projects are conceived and planned in advance, they could more readily be implemented, if government spending were to increase.
3. Careful study of the socio-cultural background of the particular area where environmental management projects are to be implemented should be an integral part of project planning, and communities should be involved in implementation. Much of the study and monitoring function might well be undertaken at minimal cost through secondary schools in or near the project site. With suitable guidance from NRCD staff, the teachers of history, social studies and the biological sciences could construct research tasks for students in the higher grades (fifth and sixth forms), which might provide most of the background material needed for the projects.

A case study from St. Lucia — An Experiment in Participatory Resource Management — might serve as a model for this approach. The report describes the work which the Eastern Caribbean Natural Area Management Program has been carrying out in one section of the east coast of St. Lucia. To cite one feature of the project, high school students did an investigation of the social history of the area, tracing its transition through sugar cane cultivation, its use as a U.S. base during World War II, and as an industrial zone in

more recent times. The students also observed and interviewed traditional charcoal burners who make their living, in part, by collecting and burning wood from an area of mangrove within the project site. Based on the ethnographic research, the environmentalists on the project were able to assess the level of collection that was taking place; gain insight into the pattern of environmental control which the charcoal burners themselves had initiated; and could better continue dialogue with residents (including charcoal burners) to coordinate further plans for sound environmental management in the area. The students themselves prepared a separate report on their research. This approach might readily be adopted in Jamaica.

## Annex 1: Community Organizations and Private Voluntary Organizations

Table 14 provides a preliminary overview of organizations that exist at the local community level, outlines some of their characteristics relevant to environmental planning, and rates their potential for providing local-level leader-

ship and institutional support for environmental projects. A summary profile of private voluntary organizations already involved with environmental issues is provided in Table 15.

**Table 14:**  
**A Profile of Community Based Organizations and Institutions in Jamaica**

Organization	Membership Base	Salient Features	Rating*
Trade Union	Centered in the workplace with national central structure	Do not often take up matters other than relate to working conditions In many rural areas membership low	Poor
Churches	Local community and linked with national parent body	Many denominations involved in education historically Small land base, no tradition of involvement in agriculture Undercurrent of competition between the various churches in a community but co-operation takes place on projects from time to time. Tradition of providing leadership especially in rural areas Reach large numbers of people.	Fair/Good
Political Parties	Local groups and national organization	Groups often not active between elections Potentially divisive Base of active Members not large	Poor
Service Clubs	Urban and larger rural communities and national networks	Membership tends to be middle and upper middle class Project oriented focus	Fair/Good (depending on the area where project to be located)
Schools	Local communities integrated with national educational structure	Reach large numbers Educational system does not encourage student-initiated extra-curricular activity apart from sports, dependency on teacher leadership Environmental projects can be integrated with existing curriculum goals (see below) Often have school garden projects Teachers are often local community leaders.	Good/Very Good
Farmer's Organizations	Local communities and national parent bodies	Crop-based except for JAS Often weak or inactive Tendency for larger farmers to dominate	Poor/Fair
Youth Clubs	Local communities	Organization's life-span may be limited to a few years as founding cohort matures May welcome projects as a focus for their activities	Fair/Good

\*This is a subjective rating of the organization's potential for providing institutional support and leadership for environmental projects based on the salient features identified.



**Table 15:  
Private Voluntary Organizations Concerned  
with Environmental Conservation**

<u>Organization and contact person</u>	<u>Membership</u>	<u>Activities</u>
Jamaica Geographical Society Dr. Alan Eyre University of the West Indies Mona Kingston 7	200	Sponsors conferences, lectures and seminars Publish newsletter three times per year Published edited volume of articles <u>Conservation in Jamaica</u> , Brian Hudson, ed., based on papers presented at meetings sponsored by the society in 1970-1971.
Natural History Society of Jamaica Miss Rena Boothe Zoology Department University of the West Indies Mona Kingston 7	150 (app. 50 active)	Sponsors lectures, slide and film presentations. Conducts field trips Makes representations to government authorities on conservation matters Collaborates with other organizations for study and preservation of the island's environment  Publishes <u>Nature News</u> , one or two issues per year
Jamaica Junior Naturalists Mr. Gerald Lemonious Crocodile News P.O. Box 156 Mandeville MANCHESTER		Publishes news letter, <u>Crocodile News</u> , quarterly Organizes JJN clubs in schools Conducts field trips
Jamaica Society of Scientists and Technologists Mrs. Marcia Creary Petroleum Corporation of P.O. Box 579 KINGSTON 10	200 app.	Promotes annual "Science Week" Makes representations to and collaborates with governmental and statutory bodies Organized 1984 seminar "The Forests of Jamaica" the proceedings of which are to be published as a book.
Jamaica Agromedical Association Mrs. Janice Reid CARDI University of the West Indies Mona KINGSTON 7	47	Publishes occasional newsletters Sponsors lectures and seminars and disseminates audio-visual materials on pesticide safety  Advise on pesticide management and reinforcement of pesticide control legislation Assist with pesticide related accidents Publishes newsletter, about three issues per year
Geological Society of Jamaica Mrs. Elsie Arons P.O. Box 579 KINGSTON 10	75	Organizes professional lectures and sponsors and annual student essay competition  Awards an annual scholarship to study Geology at UWI  Publishes the <u>Journal of the Geological Society of Jamaica</u> , a newsletter, and scholarly monographs
Jamaica Camping and Hiking Association Mr. Peter Bentley P.O. Box 216 KINGSTON 10	21 (limited liability Co)	Members run recreational camp sites and help maintain hiking trails Alerts relevant authorities to environmentally harmful practices in forest reserve areas Assists with reforestation projects Assisted with preparation of <u>The Special Interest and Naturalist Guide to Jamaica</u> Linkages with private firms that promote alternative tourism
Negril Association for the Conservation of Nature Mrs. S. A. Grizzle P.O. Box 33 Negril WESTMORELAND	35	Initiated preparation of an evaluation report on the proposed peat mining project in Negril Aims at developing a national membership of persons concerned with protection of the natural environment from the hazards of overdevelopment
Association of Science Teachers of Jamaica Mrs F. Cummissiong School of Education University of the West Indies Mona KINGSTON 7	200	Sponsors an annual conference on science education which has a topical focus that changes each year Organizes an annual science exhibition for schools Offers an ecology course for 6th forms with the assistance of NRCD
Gosse Bird Club Mrs. Audrey Downer Point View Oakridge KINGSTON 8	100 (app. much fewer numbers active)	Publishes Broadsheet newsletter twice per year Conducts Bird-banding field trips Occasional film shows for schools and organizations



Plate 14 - Cast students: Work-study group.

# ENVIRONMENTAL EDUCATION

---

## OVERVIEW OF ENVIRONMENTAL EDUCATION

### Historical Perspective

The major impetus for the development of environmental education in Jamaica has come from a national commitment to environmental management influenced largely by the international community. At the 1972 Stockholm Conference on the Environment, Jamaica's representative was Rapporteur General. The conference placed great emphasis on the role of environmental education in improving the quality of life. Following this conference, the major international environmental agencies were established and public environmental education was included in their mandate.

The Intergovernmental Conference on Environmental Education (October 14-26, 1977, Tbilisi, USSR), organized by United Nations Educational Social and Cultural Organization (UNESCO) in cooperation with United Nations Environmental Programme (UNEP), reinforced the initiatives that had been adopted by governments following the Stockholm Conference. The Tbilisi conference made recommendations for action by member states and international organizations to promote and develop environmental education. Out of this grew a number of Caribbean regional training activities under the auspices of the UNESCO-UNEP International Environmental Educational Programme. These activities emphasized curriculum development and teacher

training in environmental education. Workshops organized under this programme received support from educators in Jamaica. It is a result of these international initiatives that the formal environmental education programme existing in Jamaica today has evolved.

### Functions of Environmental Education

Environmental education promotes an awareness and understanding of ecological principles and their relationship to human activities. The majority of Jamaicans have a "natural environmental consciousness". This stems from an awareness of the role that resource exploitation plays in the economic development of the country (e.g., agriculture, industry - bauxite/alumina, and tourism - beaches, forests, wildlife). Environmental education in Jamaica grew out of the need to protect a resource base that was rapidly deteriorating largely as a result of uninformed development decisions.

### Components of Environmental Education

Environmental education consists of both a formal and an informal system. The formal system is comprised of a network that includes the school system at the primary and secondary levels, and the tertiary institutions of higher education. Education within this system begins with the development of a general awareness of the physical world, followed by the introduc-

tion of environmental principles and their relationship to man. It culminates at the tertiary level with the acquisition of professional qualifications in various environmentally-related disciplines.

The informal component of environmental education consists of a network that spans both the private and public sectors, and includes environmentally-oriented interest groups, elements of the institutionalized education system, service clubs, government agencies, some industries and the church. These varied groups have used such instruments as exhibitions, workshops, posters, pamphlets, talk shows, articles and television programmes to promote environmental themes.

Unfortunately, the mass media (newspaper, radio and television) has been less concerned with promoting environmental awareness. Environmental education is not included as part of the programming policy of the media houses. Where presentation of environmental issues has occurred, it has been as a result of the personal interest of reporters and journalists rather than from a commitment to the environment emanating from the media houses.

The impediments to environmental education are mainly financial. Funding is urgently needed to finance the tools for the educational process, compensate the resource personnel required, and provide for the dissemination of information. Additionally, coordination is needed between government, industry, and non-governmental organizations if the sector is to be effective in contributing to sustained economic development in Jamaica.

### **Coordination and Programmes for Environmental Education in Jamaica**

At the national level, attempts have been made to coordinate environmental education following the challenge by the governments of Latin America and the Caribbean at the Regional Intergovernmental Meeting held in Mexico in March 1982. This challenge called for the establishment of a national environmental training network with linkages to a regional network.

Jamaica took the first step required for the establishment of such a network in 1983, when a brief meeting was convened by the Natural Resources Conservation Division (NRCDD) with representatives from the Office of Disaster Preparedness (ODP), the Forestry Department,

the Ministry of Education, and the University of the West Indies (UWI). The group met to exchange ideas on environmental education and to hold preliminary discussions for the development of a network. It was agreed to prepare a list of all organizations and individuals relevant to environmental education, and to invite them to describe their aims, achievements and resources for furthering environmental education in the country. This exercise would result in:

- o mutually reinforcing and enriching the individual educational efforts of all participants;
- o defining national priorities for environmental education; and
- o obtaining full participation of Jamaica at the international level in regional cooperative programmes in environmental education.

In May 1984, a meeting convened by the U.W.I. School of Education produced the following recommendations:

- o that an educational institution should be involved in coordinating environmental education activities;
- o that steps should be taken to gather pertinent information in a single location;
- o that the School of Education at the University of the West Indies be the clearing house for information on local environmental education activities;
- o that a directory of resource persons, papers, reports, and on-going activities in environmental education should be prepared and circulated.

Subsequent to this meeting in June 1985, the Faculty of Education coordinated the development of a "Preliminary Directory of Some Environmental Education Activities in Jamaica". The Directory is still incomplete as the information presented represents the synthesis of eleven replies to a request to 47 individuals and agencies. The Faculty of Education (UWI) has made the following statement with regard to the Directory: "From such a small pool, the information must be totally unrepresentative of the true situation with regards to such activities". Nevertheless, the information contained in the Directory is useful and represents the most comprehensive source of information presently existing on environmental education activ-

ities in Jamaica. The Directory is divided as follows:

- Coastline Studies and Marine Ecology
- Environmental Chemistry
- Freshwater Ecology
- Mining and Industry
- Natural Disasters
- Plant Ecology/Vegetation Surveys
- Papers/Publications.

The UNESCO/UNEP International Environment Education Programme is the regional programme mainly responsible for the development of environmental education in Jamaica. The main thrust of this programme has been the training of qualified personnel including teachers, organizers of informal activities for young people and adults, administrative personnel, educational planners and researchers of environmentally relevant subject matter, and the development of educational and methodological guidelines.

In this context, the following national and regional activities have been organized:

- o Subregional Training Workshop on Environmental Education for the Caribbean, Antigua, June 9-20, 1980.
- o National Training Workshop on Environmental Education, Kingston, Jamaica, March 3-5, 1981.
- o Subregional Workshop on Teacher Training in Environmental Education for the Caribbean, Mona, Jamaica, July 18-29, 1983.

Table 16 summarizes the major events in the development of environmental education in Jamaica.

YEAR	EVENTS
1975	Launching of the International Environmental Education Programme, UNESCO in cooperation with UNEP.
1977	First Intergovernmental Conference on Environmental Education, UNESCO-UNEP, October 14-16, Tbilisi.
1980	Subregional Training Workshop on Environmental Education for the Caribbean, Antigua, June 7-20, UNESCO.
1981	National Training Workshop on Environmental Education, Ministry of Education (Government of Jamaica and UNESCO, March 3-5.
1983	Subregional Workshop on Teacher Training in Environmental Education for the Caribbean, School of Education, UWI, in cooperation with UNESCO-UNEP IEEP, July 18-29.
1983	Introductory Meeting Toward the Development of an Environmental Education Network for Jamaica, convened by Natural Resources Conservation Department, Ministry of Mining and Natural Resources, Government of Jamaica, October 19.
1984	Meeting to develop an Environmental Education Network in Jamaica, May 18.
1985	Preparation of Preliminary Directory of Some Environmental Education Activities in Jamaica, Faculty of Education, UWI, Mona.

## **STATUS OF ENVIRONMENTAL EDUCATION IN JAMAICA**

Environmental education is presently being carried out in Jamaica at both the formal and informal levels. Initially, there was a heavy emphasis on the informal system operated mainly by government resource management agencies. This approach was in keeping with the need to reach the wider public within a very short time period, as it was recognized that without an informed public, the efforts of environmental management would be fruitless. However, financial constraints have restricted the Government's initiative in recent years.

The influence of both the formal and informal components have been of great value in influencing development decisions related to resource exploitation and conservation. As a result, a growing segment of the society is being prepared to play an active role in the decision-making process. The evolution of this movement is outlined in the following discussion of the formal and informal environmental education system in Jamaica.

### **Formal Environmental Education**

Formal environmental education is seen here as the promotion of an awareness and understanding of ecological principles and their relationship to human activities within the institutionalized education system. This system is comprised of learning institutions at the primary, secondary, and tertiary levels.

Primary Level. At this level, students are exposed to a general awareness of the environment, the relationships between living and non-living components, and the development of desirable attitudes towards their surroundings. The approach generally employed is the "infusion" method whereby environmentally relevant content is "infused" within subjects already being taught as part of the general curriculum. This approach is quite effective since it relates concepts to standard educational topics. It involves minimal additional work by the teacher and requires no extra financing. The principles learned at this level form the basis upon which the more specific aspects of ecology will be superimposed at the secondary level.

Secondary Level. In recent years, curriculum development at the secondary level has reflected the significant influence of environmental issues affecting the society. The syllabuses for Grades 7-9 include general science, agricul-

tural science, and social studies all of which introduce a variety of environmental principles into the curriculum. In addition, the release in 1983 of the Caribbean Examination Council (CXC) (Grade 11) science syllabus for general use has had tremendous impact at the secondary level, and has positively influenced syllabus development at both the lower and higher levels of the educational system.

In the development of the CXC syllabuses, a stance was taken on the integration of environmental information into the school curriculum. This concern is expressed in the development of the syllabuses for biology, chemistry, physics and integrated science. An examination of the biology syllabus revealed a commitment to imparting environmental information as evidenced in the following statement:

"Biology, by its very nature is of immediate relevance to every individual since it deals with life processes, the knowledge and understanding of which can serve to improve at a very personal level the quality of man's life. This understanding should generate a concern for the care of the total environment which supports life."\*

The biology syllabus suggests to teachers that "every opportunity be taken to relate biological studies to the environment and to use an ecological approach wherever pertinent." The teachers are encouraged to use local and regional examples to illustrate biological principles and to make the course as relevant as possible in order to heighten the student's awareness of the effect of science on society.

The aim of the CXC is to expose each student to the environmental experiences suggested within the varying syllabuses if the student is to perform creditably in the examinations. The CXC with its emphasis on subjects of regional (Caribbean) relevance, is an excellent vehicle to educate and, therefore, heighten the environmental awareness of the upcoming generation.

Tertiary Level. At the tertiary level, there are five major institutions which presently carry out aspects of environmental education. The University of the West Indies (UWI), the West Indies School of Public Health (WISPH), the College of Arts, Science and Technology

---

\* Correspondence Re: Environmental Education in Jamaica, Joyce Glasgow, School of Education, UWI, July 1984.

(CAST), Teachers' Colleges, and the College of Agriculture. (See Table 18.) The students of Teachers Colleges are exposed to environmental themes through informal talks and seminars organized by the Association of Science Teachers of Jamaica (ASTJ) in conjunction with resource agencies such as the Natural Resources Conservation Division (NRC D).

o University of the West Indies (UWI): At the University, the Faculties of Natural Sciences, Social Sciences, Medicine, and Arts and General Studies all offer courses which include environmental concepts and themes. Within the Faculty of Natural Sciences, the Departments of Geography, Zoology, Chemistry, Botany and Physics, offer aspects of environmental science including environmental chemistry and pollution control, resource management; i.e., of terrestrial, aquatic, plant and animal resources, waste management and recycling. In total, an estimated 600 lecture hours per academic year are devoted to environmentally related topics.

The applied courses offered by the Departments of Chemistry, Zoology and Botany in particular cover a significant range of environmentally related topics. However, students can graduate from the Faculty without being exposed to any of these applied courses. These graduates will form part of the pool of "pure scientists" (geologists, chemists, taxonomists, etc.), whose skills are vital to the problem-solving aspects of environmental management.

Thus, the teaching of the pure sciences plays an essential part in the education of the country's environmental management personnel and as such constitutes a vital but not immediately visible component of environmental education.

A significant amount of environmental research is presently being carried out at the UWI, notably in the Departments of Chemistry, Zoology, Botany, Physics and Geology. This reflects the high priority the subject is being allotted in the formal education system. Here, the groundwork necessary for the solution of some of the island's major environmental problems is being laid.

The Faculty of Social Sciences offers courses in agricultural development, economics, rural sociology, urban studies, and health and social organization as part of their degree programs. These courses cover environmentally relevant

topics. In addition, the Faculty also offers a one-year diploma course in Health Management to B.Sc. graduates or candidates with other technical/professional qualifications or experience.

The Department of Social and Preventative Medicine within the Faculty of Medicine addresses environmental health issues through its 13-week Certificate in Community Health, and its 12-month diploma in Public Health. The Certificate Course is offered to holders of a Bachelors Degree or other relevant professional qualification with practical experience, while the Diploma Course is specifically for qualified medical practitioners with at least two years of practical experience.

The Department of Mass Communications within the Faculty of Arts and General Sciences offers a core course entitled "Mass Communication and Society". This course is offered during the first year of the Mass Communication Degree Programme. Its objectives include the analysis of the role and function of the mass media in their socializing, conservation and national transformation process. Because of the particular interest in environmental matters of the director/lecturer of this course, a strong environmental bias runs throughout the course as "society" in this context is taken to mean the total environment.

In addition to the structured courses offered at the UWI, there is the recent formation of the Environmental Studies Group, an inter-faculty group with the intention to:

- promote inter-faculty studies in environmental studies;
- assist Faculty ESGs in their activities;
- publish an annual bulletin of UWI environmental related activities through an editorial committee;
- organize seminars to promote public awareness; and
- identify funding sources for environmental research and education at UWI.

The goal of the group is to introduce environmental content in the inter-disciplinary and multi-disciplinary teaching and research programmes at the UWI. The group has suggested that environmental principles

be taught to the wider university community through a compulsory university core course as, for example the History of the Caribbean, which is one of three university courses presently offered.

- o West Indies School of Public Health (WISPH). This institution falls under the administration of the Ministry of Health and trains public health nurses and inspectors (Environmental Health Officers) who monitor the community's environment for the detection and abatement of nuisances associated with disease.

The syllabus used during the three-year diploma course includes principles of epidemiology, waste management, pollution control, occupational health, recreational sanitation, and vector control, among others. The course work covers a two year period while the third year is a period of internship under the guidance of supervisors selected from the host community and trained by the WISPH. The students are expected to function as Public Health Inspectors during this period.

- o College of Arts, Science and Technology (CAST). At present, CAST offers a six-week summer course entitled "Water Works and Sewage Plant Operations". This course includes such topics as water chemistry, water and sewage treatment and bacteriology and is specially geared toward the needs of the National Water Commission and other similar private and public sector agencies throughout the region.

At the end of the six weeks there is an examination and the successful candidates are awarded a Certificate of Successful Completion. Those candidates with an average of more than sixty percent are invited back the following year for a one week period of further study, and upon successful completion of this segment, candidates are awarded a "Water Works and Sewage Operators Certificate" (equivalent to a Grade "D" Operator within the United States Sanitation Works System).

In addition, CAST offers a course in Environmental Chemistry, which introduces students to the causes and effects of and the solutions to the different types of pollution. The course involves thirty lecture hours per academic year and requires the completion of a research paper.

At CAST, the three year Diploma in Physical Planning Technology produced its first gradu-

ates in 1981. In this course, the students are exposed to subjects such as ecological principles in planning, resource management, environmental pollution, waste management and environmental impact assessment. As such, they are given a sound understanding of Jamaica's biophysical environment and taught the skills necessary to help plan and oversee the sustainable development of the island.

At the present time, CAST is moving towards the introduction of a diploma programme in Environmental Technology which would retain certain basic features of the current two year Certificate in Chemical Technology course, while introducing additional environmentally relevant subject matter. The course was to be introduced in phases, commencing September 1985, beginning with the chemical technology core course and a few elective courses. The themes will become more specialized in the third year (September 1987-88). The graduates from this course would be expected to function at the technologist level, having a grasp of fundamental principles of environmental science and technology, sanitary science and engineering as they relate to the improvement of the biological, chemical and physical environment. The full implementation of this diploma course, however, depends on the potential for job placement of graduates.

A summary of CAST's extra curricula involvement in Environmental Education is presented in Table 17.

- o Teachers Colleges. With the introduction in 1981 of the new Diploma Programme for students of teachers' colleges, the opportunity was taken to emphasize environmental themes, enabling the students to introduce the relevant components in primary and secondary school curricula. Topics such as the use and development of resources, disaster preparedness, industrialization and urbanization are included in some units of the social studies syllabus. In addition, the student teachers are exposed to the more practical aspects of ecology through informal talks and seminars organized by the Association of Science Teachers of Jamaica (ASTJ), in conjunction with resource management agencies such as the Natural Resources Conservation Division (NRC D).
- o College of Agriculture. During their course of study culminating in the award of the Associate Degree in Agriculture, students are



**Table 17:**

**CAST's Extra Curricula Involvement in Environmental Education**

- CAST organised a one-day seminar on June 5, 1984 "Man versus the Environment" to discuss the status of environmental pollution, total pollution load, mode of disposal, role of environmental regulatory agencies in Jamaica and views of industries about legislative requirements for the disposal of industrial waste. This was sponsored by the Ministry of Science, Technology & Environment, the Natural Resources Conservation Division and the Pan American Health Organization.

- Organised a 5-day certificate course on "Jamaica and its Environment" during March 11-15, 1985, in association with UNESCO to mark the National Science Week organised by Jamaica Society for Scientists and Technologists (JSST). The following topics were discussed:

- Jamaica's Environment
- Marshland Utilization
- Marine Environment
- Hellshire Development
- Health and Environment
- Water Pollution
- Air Pollution
- Tourism and Environment
- Agriculture and Environment

The theme of this course was public awareness. Ninety-nine participants from schools/colleges, the ministry, and senior citizen groups attended.

- Organised a panel discussion on "Needs of Environmental Technology Education in Jamaica" on June 5, 1985. This activity was in keeping with plans by the institution for the introduction of a three year diploma programme in Environmental Technology.

The agencies that participated were:

- National Water Commission
- Environmental Control Division, Ministry of Health
- Natural Resources Conservation Division, Ministry of Agriculture
- Urban Development Corporation
- Petroleum Corporation of Jamaica
- Hellshire Bay Development Company
- Pan American Health Organization
- United Nations Educational, Scientific and Cultural Organization
- United Nations Industrial Development Organization
- Jamaica Bauxite Institute
- Jamaica Tourist Board
- University of the West Indies
- College of Arts, Science and Technology
- Many environmentally conscious people of Jamaica
- NGC representatives

- Organised a Project Work Competition on "Jamaica's Environment and Pollution" to mark World Environment Day, June 5, 1986. The deadline for submission was November 30, 1986. Prizes were awarded to successful candidates. This project stressed the need to prevent pollution, role of students/ and the role of individuals in environmental pollution control.

- CAST recently completed a survey to find out the status of Technology in Jamaica; mainly the needs in the fields of chemical technology and environmental technology graduates in terms of jobs, to arrive at a conclusion before finalization of the curriculum.

introduced to environmentally relevant topics such as soil conservation techniques, and fertilizer and pesticide application.

### **Informal Environmental Education**

Informal environmental education in Jamaica is defined as the promotion of an awareness and understanding of ecological principles and their

relevance to human activities outside of the institutionalized education system. Informal environmental education in Jamaica consists of two major components: the public education activities carried out by the public sector resource management agencies; and the efforts of the non-governmental organizations (NGOs), including the business community and service clubs. (See Table 17.)

Public environmental education had its beginnings in the educated and professional circles of Jamaica. However, as the negative consequences of ill-advised decision-making resulted in the deterioration in the quality of life, the general public was forced to become involved with environmental issues. Although the majority of the population is not well enough informed or organized to influence development decisions, the voice of small sectors of the population is being heard, in respect to resource exploitation and conservation.

The major thrust of the informal environmental education system in Jamaica is to foster the appropriate attitudes which are vital to sustainable development. The economic realities in Jamaica are such that continued exploitation of the resource base is necessary for national development. Educational efforts have therefore been geared towards informing society of the resource limitations, and the development options available within our fragile island ecosystem. The method employed in this public awareness effort is the presentation of complex environmental principles in simple terms easily assimilated by the wider public. The major vehicles for the dissemination of this information has been through the mass media, public exhibitions, posters and informal lectures and seminars.

To date, public education efforts have resulted in only marginal attitudinal changes. Inappropriate watershed management practices continue to result in soil erosion, diminished aquifer recharge, reduced surface flow and heavy siltation downstream; beach sand continues to be illegally mined with increasing incidences of coastal erosion; endangered wildlife species continue to be exploited; and the daily degradation of air, land and water resources by industrial waste continues. The attitudinal changes required to reverse this trend must come from a concerted effort by both the public and private sectors to inform and educate the public.

At the present stage in Jamaica's development, a change in national attitude that endorses the conservation and wise use of the resource base is urgently needed. The achievement of this goal will require a well coordinated public environmental education programme, as Jamaica cannot afford to repeat the development mistakes of its northern neighbours.

The following is a description of the major elements involved in the informal environmental education system in Jamaica.

Public Sector Agencies. These agencies include the Natural Resources Conservation Division (NRCD), the Fisheries Division, the Office of Disaster Preparedness (ODP), the Forestry Department, the Environmental Control Division (ECD), the Energy Division, and the Town Planning Department. The majority of these agencies have some public education programmes. In addition, these agencies carry out extensive on-the-job training, bolstering the capability of their technical staffs which form the core of the country's environmental resource personnel.

The major components of the public education programme of these agencies are:

- o Publications. Pamphlets, posters and leaflets are produced on a regular basis. Additionally, technical staff members contribute articles for publication in journals and magazines outside of the agencies.
- o Media. From time to time, the agencies prepare programmes on the environment and specific conservation issues in collaboration with Jamaica Broadcasting Corporation (JBC), Radio Jamaica Ltd. (RJR) and Jamaica Information Service (JIS). Articles are also periodically developed for publication in the "Daily Gleaner".
- o Exhibitions. The agencies take advantage of the Annual Denbigh Agricultural Show to mount extensive exhibits depicting various aspects of resource management and conservation including disaster management. In recent years, on World Environment Day, several of the agencies, in particular those with direct involvement with environmental management, have mounted exhibitions depicting various aspects of Jamaican ecology. Exhibitions are also mounted for schools and other institutions during the year.
- o Lectures, Seminars, Workshops. Occasional seminars and workshops are organized by the resource management agencies. In addition, members of the technical staff are used as resource personnel by outside organizations and institutions.
- o Community Outreach. The most effective informal environmental educational strategy is organized along the lines of the traditional extension services. Several of the resource management agencies have educational programmes at the community level. The Ministry of Agriculture has a well-developed Agricultural Extension Programme, aspects of

which are geared towards soil conservation and pesticide application and control. There are four regional offices, 13 executive offices (one for each parish), 65 parish divisions (4-6 per parish) and 401 extension areas distributed around the island. Communication, and therefore education is done almost exclusively by personal contact using demonstration plots. This on-the-spot approach has been very successful in demonstrating soil conservation techniques around the island.

Of the recent informal or public environmental education efforts by Government agencies, probably the most successful has been that of the ODP, which was established in 1980. At the ODP, physical planning with particular reference to natural (earthquakes, hurricanes, etc.) and man-made catastrophes (oil spills, hazardous substances, etc.) are the agency's major concern. Discussing the virtues of preparedness, the ODP conducts its public educational campaign on a broad front. The success of these efforts can be attributed to the heavy economic implications of most natural disasters. As a result of this, it was not difficult to encourage the assistance of the private sector in public education programmes on disaster management.

Despite some notable accomplishments, the efforts of Government with regard to environmental education are indeed inadequate. This is due mainly to the fact that the public environmental education programmes of these agencies are not institutionalized or structured. Additionally, the economic constraints affecting the country have caused agencies to reduce their involvement in this activity.

### **Non-Governmental Organizations (NGOs)**

The participation of non-governmental interest groups concerned with environmental management has been a part of national life for a number of years. The original focus of these organizations was directed towards resource conservation (emphasis on wildlife) and outdoor recreation. Presently, a wider cross-section of the general population have begun taking an active interest in issues associated with resource exploitation. In response to the escalation of environmental problems, the scope of the NGOs has expanded considerably to include all aspects of environmental management. The role of NGOs, therefore, continues to be vital to the education of the public at large. The major non-governmental organizations presently carrying out environmental education are:

- The Natural History Society of Jamaica;
- The Jamaica Society of Scientists and Technologists;
- The Jamaica Geographical Society;
- The Jamaica Geological Society; and
- Association of Science Teachers of Jamaica.

(See Tables 18 and 19.)

Some recent activities in public environmental education carried out by NGOs include:

- o Seminars on natural resources, such as the one on water organized by the Jamaica Society of Scientists and Technologists in 1983;
- o Annual observance of National Wood and Water Day, jointly organized by the Jamaica Geographical Society and the Natural History Society;
- o Public discussions such as the one on peat mining organized by the Negril Chamber of Commerce in 1984; and,
- o Annual Bauxite Symposium organized by the Jamaica Geological Society.

In addition, exhibitions such as the Annual Schools Science Exhibition promoted by the ASTJ has been instrumental in exposing the public to a variety of environmental themes.

Significant work in environmental education is being done by the Natural History Society of Jamaica, a non-profit organization whose original purpose was to provide a source of indigenous information to teachers and others by publishing its Natural History Notes and organizing lectures and field trips. The present objectives of this organization now include the study and conservation of the Jamaican environment, as well as the promotion of public environmental education.

Other environmentally oriented NGOs include the Jamaica Camping and Hiking Association which promotes the publication of information on outdoor recreation, and has compiled a booklet for those who wish to explore the island's natural attractions other than the beaches. Additionally, the Jamaica Junior Naturalists is a non-profit conservation-oriented organization for young people between the ages of six and eighteen years. This group provides opportunity for study of the flora, fauna and other natural resources of the island, and encourages an appreciation of the need for conservation of the Jamaican environment.

**Table 18:  
Tertiary Institutions Offering Environmentally Related Course and Programmes**

<u>Institution</u>	<u>Course</u>	<u>Programme</u>	<u>Certification</u>
<u>University of the West Indies</u>			
Faculty of Natural Sciences	Animal Ecology Plant Ecology Applied Chemistry Applied Zoology Applied Ecology Physical Planning Agricultural Geography General Geography Advanced Urban Geography Geography of Developing and Developed Areas	Part of the requirements for B.Sc. General	B.Sc.
Faculty of Social Sciences	Agricultural Development and Policy Agricultural Economics Rural Sociology and Urban Studies Health and Social Organization	Part of the requirements for B.Sc. Social Sciences  Health Management	B.Sc.  Diploma
Faculty of Medicine		Community Health Public Health	Certificate Diploma
<u>College of Arts Science and Technology</u>	Water Works and Sewage Treatment Plant Operators Course Environmental Chemistry	Planning Technology On-the-Job Training Certificate in Chemistry Technology	Diploma Certificate Certificate
<u>West Indies School of Public Health</u>	Environmental Hygiene, Ecology, Water & Waste Water Management, Food Hygiene	Public Health Inspection Basic	Diploma
<u>College of Agriculture</u>	Agricultural Engineering, Soil & Water Conservation, Soil Fertility Management	Part requirement for Associate Degree in Agriculture	ASc. Agriculture

**Table 19: Major Public Sector and Non-Governmental Organizations in Jamaica which Provide Aspects of Environmental Education**

AGENCIES	ACTIVITIES								
	Courses	Seminars	Informal Lectures and Talks	Articles	Pamphlets, Posters, Leaflets, etc.	Provision of Resource Personnel/Information of Environmental Issues	On-the-Job Training	T.V./Radio Talk Shows & Features	Exhibitions
Natural Resources Conservation Division		0	0	0	0	0	0	0	0
Office of Disaster Preparedness		0	0	0	0	0	0	0	0
Forest Department		0	0	0	0	0	0	0	0
Environmental Control Division		0	0	0	0	0	0	0	0
Bureau of Health Education		0	0		0	0	0	0	
Fisheries Division		0		0	0	0	0	0	
Inland Fisheries Unit						0	0	0	0
Town Planning Department		0			0	0	0		
Institute of Jamaica		0		0	0	0	0	0	0
Water Resources Division			0	0		0	0	0	

AGENCIES	ACTIVITIES								
	Courses	Seminars	Informal Lectures and Talks	Articles	Pamphlets, Posters, Leaflets, etc.	Provision of Resource Personnel/Information of Environmental Issues	On-the-Job Training	T.V./Radio Talk Shows & Features	Exhibitions
Agro-21					0	0			0
Forest Industries Development Co.						0	0	0	
Jamaica Industrial Development Corporation							0		
Association of Science Teachers of Jamaica		0	0						0
Natural History Society of Jamaica		0	0	0	0	0		0	
Geological Society		0	0	0		0		0	
Geographical Society			0	0		0			
Jamaica Junior Naturalists				0		0		0	
Jamaica Society of Scientists and Technologists						0			
School of Education, UWI		0				0			
Jamaica Agricultural Society				0	0	0	0	0	
Negril Association for the Conservation of Nature			0			0			
Hope Zoo Trust						0			
Media Houses (Gleaner, RJR, JBC)				0				0	
Entity			0			0			

**KEY:** ● Major activity  
○ Moderate activity

To date, the contribution of the business community to environmental education efforts has been minimal. The contributions made by Shell, sponsors of the Jamaica Junior Naturalists, are commendable. Bata Company has financed the printing of environmental teaching materials and sponsored a national essay competition on trees.

The service clubs, whose membership is largely from the business community, have also made modest contributions to the informal environmental process by sponsoring talks and seminars on the environment. The shooting and fishing clubs have shown little interest in protecting the habitat (forest, wetland and reef) upon which their sport depends.

Although small in scale, the efforts of the NGOs have been noteworthy. The membership of these groups usually includes professionals, students, teachers, and middle-management civil servants. The total number of persons who actively participate is estimated to be less than two thousand persons.

## **KEY ISSUES AND PROBLEMS**

### **Lack of Financial Resources**

Government's public environmental education efforts have been scaled down in recent years due to financial constraints. An examination of the "Estimates of Expenditure for 1984-85" for the resource management agencies revealed that very little has been allocated to environmental education.

In the absence of an institutionalized public environmental education programme, the strategy adopted by the NRC in recent years has been to include public education as part of the Capital Development Budget for conservation. In the Capital Development Budget for the financial year 1983/84, \$50,000 was earmarked for public education. This budget and programme was managed by an Information Officer under the direct supervision of the Principal Director.

Inadequate remuneration to teaching staff has resulted in high staff turnovers. This trend has affected the pace at which environmental education advances in the formal education system, as some of the teachers that are lost have had environmental training. The teachers

that remain in the system are overworked and demoralized by the poor working conditions. This is particularly true at the primary level where there is currently a one-to-forty teacher/pupil ratio.

The lack of funding also reduces the ability of the teaching institutions to purchase equipment and teaching aids necessary for practical demonstrations of environmentally related scientific principles at all levels of the system. Additionally, there is little, if any, funding for transportation to facilitate field study. Where funding is provided, the level is often inadequate.

### **Shortage of Environmental Educators/Resource Personnel**

The training of teachers in various aspects of environmental management requires resource personnel. Within the Jamaican context, these personnel would largely be drawn from two sources: the resource management agencies of government, and the university community. Presently, both groups are shrinking due to lack of institutional support.

### **Lack of Adequate Media Involvement**

Presently the media houses do not include environmental issues as part of their regular programming policy. This results from the exclusion of environmental issues from national media coverage.

### **Absence of an Environmental Education Policy**

The individual efforts of a few professionals within the resource management agencies, non-governmental agencies, and the formal education system are limited as they are operating in the absence of a national environmental education policy. Such a policy would both strengthen and put into perspective the various activities and programmes related to environmental education. The policy would also provide added justification for funding from the private sector as well as from the international community.

### **Lack of Coordinated Arrangements for Environmental Education**

In 1983, the resource management agencies, along with representatives of the formal educa-

tion system, initiated discussions aimed at developing a coordinated approach to environmental education. The organizer of the meeting, the NRC D, was already serving as the national focal point for the referral of environmental information. The NRC D was therefore urged by UNEP to establish a national network for environmental education as part of the project objectives of the Regional Environmental Programme for Latin America and the Caribbean. These efforts were strengthened during a follow-up meeting held in 1984, at which UNESCO was represented. This meeting has led to the preparation of a "Preliminary Directory of some Environmental Education Activities in Jamaica". Efforts at national coordination need to be reinforced and carried forward until there is a National Environmental Education Network.

### **Lack of Socio-Cultural Approaches in Environmental Education**

The environmental education strategy has not adequately considered the social and cultural factors operating within the Jamaican society. For example, the planting of the navel string (umbilical cord) of infants with a tree is a cultural practice that is responsible for some amount of afforestation, albeit minimal. To date, such a tradition has been largely overlooked as a means by which to involve a large segment of the population in everyday environmental management. As part of this approach, the society could be encouraged to plant trees for any number of significant occasions, e.g., birthdays.

### **Lack of Reciprocal Approach to Environmental Education**

The solution to environmental problems frequently requires historical data. Examination of the Jamaican environment has clearly revealed that the public at large (the peasant, the fisherman, wayside vendor) has a vital part to play in providing information not recorded elsewhere. The importance of informal information sources needs to be recognized, particularly if we wish to ensure the involvement of the community in environmental education. In addition, mechanisms need to be established to pass on information gained at the community level. Just as the community needs to understand the role of government in providing some of the solutions to local environmental problems, so does government need to be made aware of the role of the community in making a contribution to environmental management.

### **Inadequate Involvement of Private Sector in Public Environmental Education**

Only a relatively small number of NGOs are actively involved in public environmental education. Recognition must be given to these organizations. There should be public recognition and appreciation extended to those citizens, whether they are industrialists, trade unionists, developers, professionals, or simply interested citizens, who participate in efforts to improve Jamaica's environment.

Community groups and service clubs, such as the Boy Scouts, 4-H Clubs, Lions Club, Jaycees, etc., have a potentially significant role to play in the dissemination of environmental information due to the nature of their far-reaching community efforts.

### **DIRECTIONS FOR THE FUTURE**

1. The development and implementation of a National Policy on Environmental Education is urgently needed.
2. The development and funding of Public Environmental Education Programmes within Government's resource management agencies is needed.
3. Incentive schemes within the Public Sector should be provided to attract and retain staff needed for environmental education.
4. The level of private sector involvement in and funding for environmental education should be increased.
5. Socio-cultural approaches to environmental education should be utilized.
6. The fostering of a reciprocal approach to environmental education between the community and researchers is needed.
7. Means should be devised for increasing mass media involvement in environmental education as part of National Media Policy.
8. Provision should be made for fellowship/scholarships to facilitate specialized training in various aspects of environmental education.

9. The development of a generalized environmental studies core course is needed as part of the requirements for certification from all tertiary institutions.
10. Institutionalized environmental education programmes are needed at the principal government agencies dealing with environmental management.
11. Development of a National Environmental Education Network should be pursued.



Plate 15 - Section of Coastline - Negril Beach (1967).



Plate 16 - Section of Coastline - Kingston (1975).



## COASTAL RESOURCES

---

### OVERVIEW OF COASTAL RESOURCES

Jamaica's coast is between 495-550 miles in length, punctuated by numerous inlets and bays. Its varied and irregular coastline gives rise to a unique ecosystem formed by the integration of coastal features that include harbours, bays, beaches, rocky shores, estuaries, mangrove swamps, cays and coral reefs. These natural features provide a coastal resource base that contributes significantly to the economic well-being of the country. Relative to tourism, the worldwide image of Jamaica is based largely on the beauty of the island's beaches, coastal waters, and shoreline environment. These coastal resources, however, are especially sensitive to the effects of over-use and mismanagement, and many areas exhibit some degree of degradation. The island's principal commercial and population centres are also located on the coast, and urban development pressures on coastal resources are intense and persistent.

### Delineation of Coastal Area

For purposes of describing and analyzing Jamaica's coastal resources, as well as for discussing resource management issues, inland and seaward coastal area boundaries have been established, and coastal management units have been delineated. (See Figure 14.)

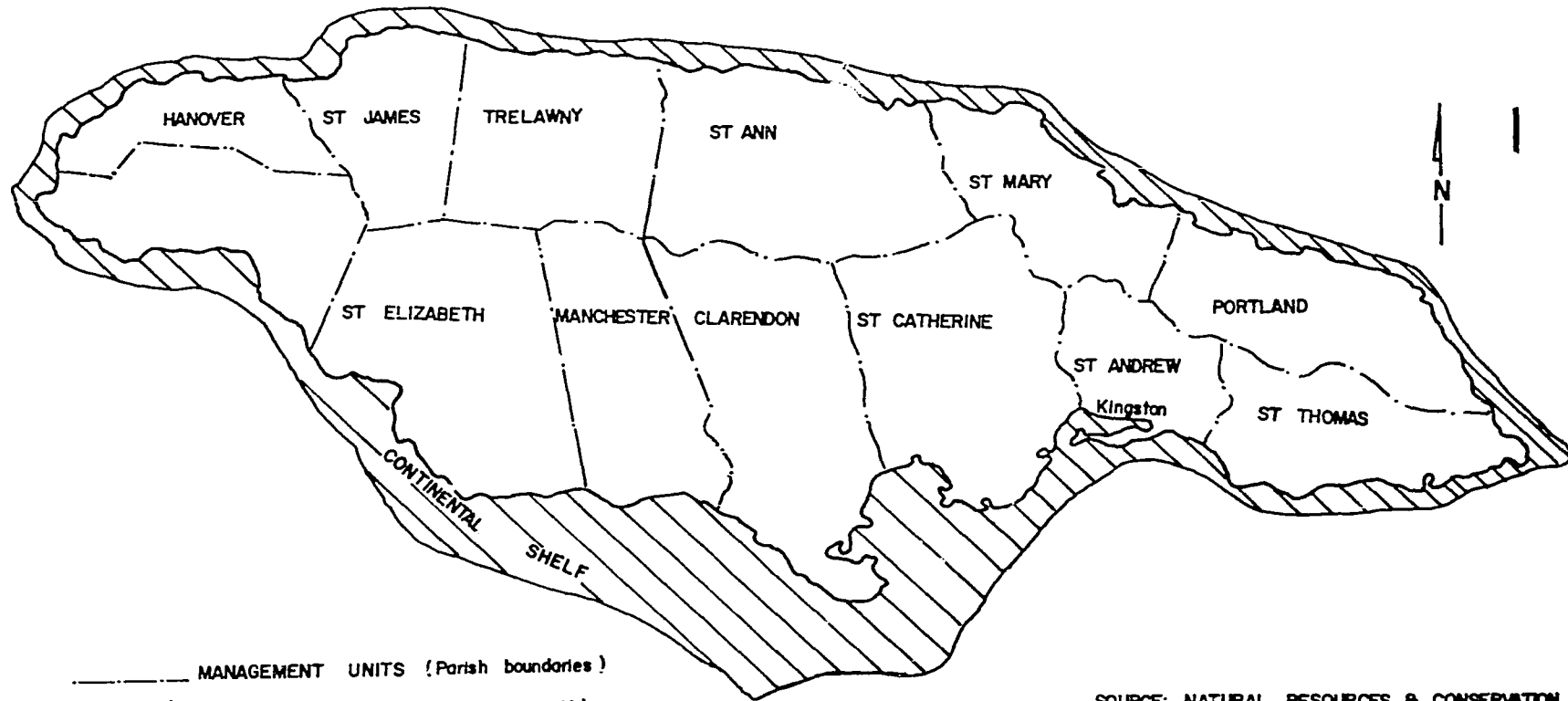
Inland Boundary. The inland boundary is the 100-ft contour, chosen in order to encompass all nearshore lands with the potential to significantly impact coastal waters. Included within the 100-foot contour are the major wetlands of Jamaica, rocky shore areas with sharp increases in land elevation, and coastal plains. The coastal plain is less than two miles wide along most of the north coast and areas of the south coast. In other locations, the plain widens, notably in the eastern and western ends of the island, and in the Clarendon and the St. Catherine plains on the south coast.

Seaward Boundary. The seaward boundary is marked by the furthest extension of the island's shelf. The edge of the shelf delineates the extent of the neretic zone. On the north coast, this shelf is relatively narrow, and the sea floor drops quickly to depths ranging from 5,000 to 30,000 feet. On the south coast, however, between Kingston and Black River, the shelf extends offshore for a distance of approximately 20 miles and is 80 miles long. This neretic zone supports the major portion of the island's fishery and is a major recreational area, particularly on the north coast.

The outer limit of Jamaica's territorial waters is 12 miles from the island. Pursuant to the International Convention on Law of the Sea, Jamaica is presently drafting a bill for the

FIGURE: 14

COASTAL AREA BOUNDARIES AND MANAGEMENT UNITS



----- MANAGEMENT UNITS (Parish boundaries)  
- - - - - OUTER BOUNDARY (Continental shelf)

SOURCE: NATURAL RESOURCES & CONSERVATION DEPT.

establishment of a 200-mile Exclusive Economic Zone (EEZ), which would include the existing 12-mile territorial sea plus an additional economic zone of 188 nautical miles. Work on this bill is being done through an inter-agency drafting committee within the Ministry of Foreign Affairs. The establishment of such a zone would allow Jamaica to secure all cays, shoals, and banks of long usage that are presently beyond the territorial sea. This would enable Jamaica to enforce its fishing laws and regulations within a larger area, thus restricting foreign fishing to the surplus of Jamaica's allowable catch.

Although considerably off-shore, the Morant and Pedro Cays are also included in the description of coastal area resources. The Morant Cays are located 33 miles SE of Morant Point and the Pedro Cays are on the Pedro Bank about 40 miles S-SW of Portland Point. Although there are other banks within the territorial waters, these are the only offshore cays big enough to act as a semipermanent or permanent base for offshore fishermen.

Coastal Management Units. Within the coastal region, 13 smaller geographical areas, or coastal management units have been delineated according to parish boundaries. (An overview of land and water uses in each coastal management unit is included in Annex 1.)

### **Coastal Area Resources**

The coastline of Jamaica has been classified according to four shoreline types: sandy or gravely beach; rocky shore, cliff or elevated reef; mangrove forest or swamp; and coral reef. (See Figure 15.) In general, the south shoreline is edged by long, straight cliffs, mangrove swamps, herbaceous wetlands and black sand beaches. White sand beaches are found on the north coast; the northeast coast is very rugged. Fringing reefs have developed in places along the north and northeast coasts. Around the entire island, the coastline is very irregular, indented with bays and extended by sand spits and bars.

The coastline is also characterized by a number of salt water lagoons, such as the Yallahs Ponds in St. Thomas and the Great Salt Pond in St. Catherine. Other major enclosed water bodies that occur in coastal areas are largely freshwater, and include such sites as Mystery Lake and Green Grotto in St. Ann, and the Wallywash Pond in St. Elizabeth.

Offshore Islands, Cays, and Reefs. Jamaica's nearshore cays are found mainly off the south coast with the exception of Booby Cay, which is off the west coast near Negril. The majority of these cays are small (less than 2 acres), accessible only by private boat and lack suitable infrastructure for their development as recreational centres. Two of the larger cays, however, Lime Cay, south of Kingston, and Booby Cay, west of Negril, have been developed into significant recreational sites.

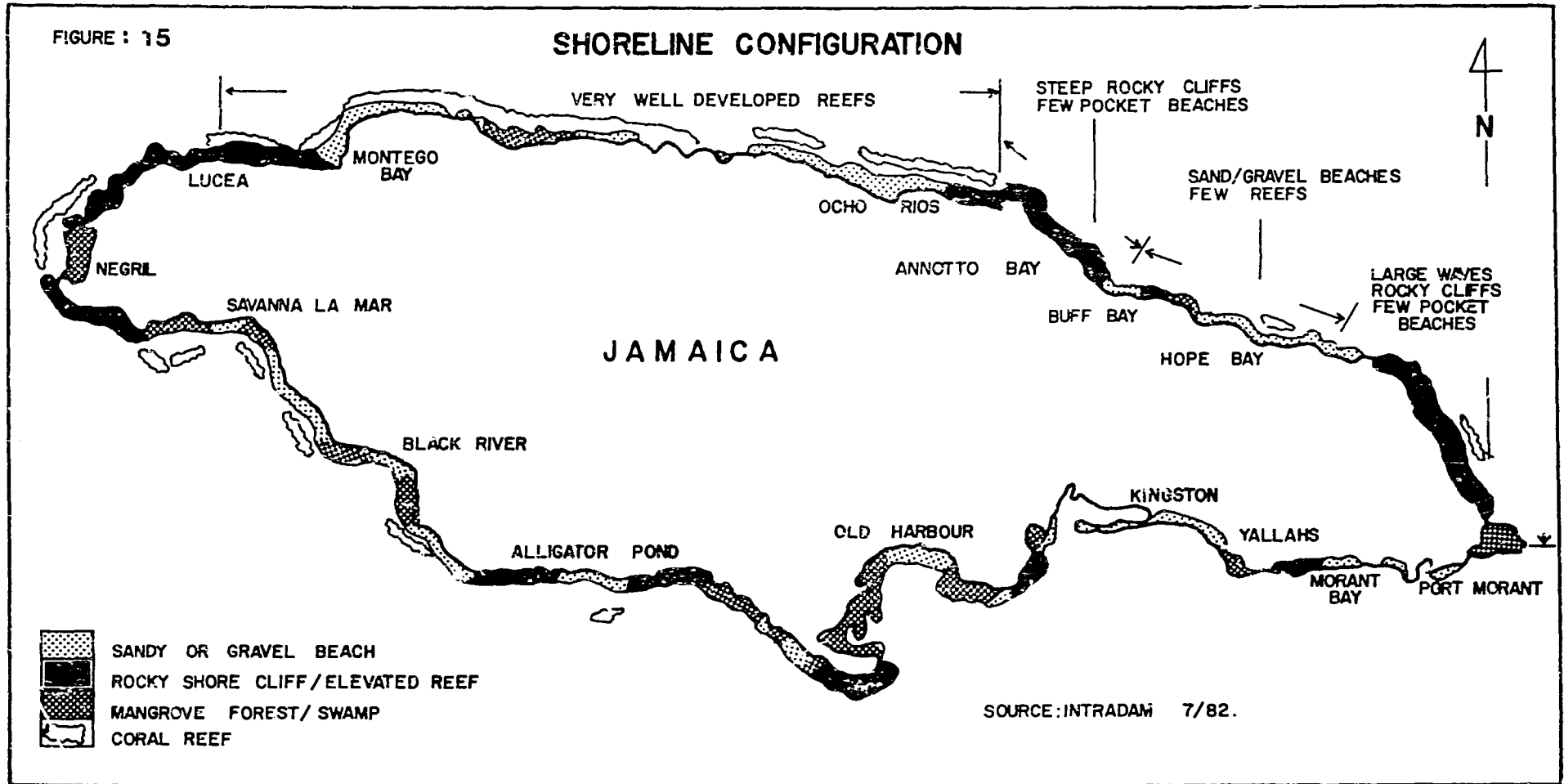
Lime Cay is approximately two acres in size and is the largest of many cays scattered a few miles south and east of the entrance to Kingston Harbour. It is mainly used by private boat owners from Kingston as a picnic and swimming/snorkeling area. Day trips to the area are also organized periodically from some of the Kingston hotels.

Booby Cay is approximately 1,000 feet from the promontories of Rutland Point on the west coast of the island, and has been developed by Hedonism II, one of the hotels in the Negril area, as a picnic and snorkeling area.

The offshore cays are the Morant and Pedro Cays situated off the south coast of Jamaica. The Morant Cays consist of four small limestone cays located about 40 miles southeast of Morant Point. They are separated from the mainland by deep water and not continuous with the rest of the continental shelf surrounding Jamaica. The cays are surrounded by the shallow water of the Morant Bank, which is a productive fishing area.

The Pedro Cays are a group of four coralline islands situated on the southeastern edge of the Pedro Bank, about 58 miles south of Great Pedro Bluff and about 100 miles from Kingston. Like the Morant Cays, they are the base for fishing on the surrounding bank.

On the north coast, fringing coral reefs extend almost continuously along the edge of the shelf from Negril to Morant Point. On the south coast, the greater part of the shelf is devoid of coral reefs, except on the eastern portion between Kingston and Portland Bight, where larger reefs and numerous coral cays exist. On the western section of this coast, the reefs tend to be small, patchy and not as well developed (Goreau, 1958). These reefs provide habitat for numerous species of flora and fauna and are important for both fishing and recreational use.



Beaches. The beaches of Jamaica are of international renown, and are perhaps the greatest factor contributing to the growth and success of the island's tourist industry. Vast stretches of white sand beaches are found along the north coast and provide the location for the principal resort areas, including Negril, Montego Bay, and Ocho Rios. These white sand beaches originate from the offshore coral reefs as a result of erosion of the offshore corals and calcareous algae. The eroded material is deposited in the lagoon area behind the reefs as white sand. Many of the south coast beaches are nourished by river sediments (as the offshore coral reefs are not as extensive), and are typically of black sand.

Vegetation. The coastline of Jamaica consists, for the most part, of limestone rock or low fringing coral shelves. High sea cliffs and headlands are infrequent. Variation is provided by the occurrence of bays with sandy spits, beaches (including cays and banks), and by alluvial or peat deposits at river estuaries. The larger bays and sheltered estuaries are mainly on the south coast. Consequently, coastal plant communities are characteristic of three types of substratum. (Detailed descriptions of the plant communities associated with the three types of substratum are given in Asprey and Robbins, 1953. However, these descriptions need to be revised and updated to accurately reflect current conditions of coastal vegetation.)

Mangrove and herbaceous swamps, characteristic of peat or alluvial deposits, have been extensively studied by the NRC D and the PCJ. These areas cover over 30% of the coastline of Jamaica and are mainly found on the south coast. They are characterized by salt tolerant mangrove species, such as Rhizophora mangle (red mangrove), Laguncularia racemosa (white mangrove), Avicennia germinans (black mangrove) and Conocarpus erectus, and the swamp fern (Acrostichum aureum). At the upper reaches of some of these wetlands, where there is a greater influx of freshwater, the vegetation is dominated by freshwater macrophytes such as Cladium sp., Typha domingensis (Bullrush). (See Table 20.)

The two largest wetlands in Jamaica are the Negril Morass (5,657 acres) and the Black River Lower Morass (15,000 acres). The vegetation in these wetlands is well documented. (See NRC D/TGI, 1982; Coke, 1983; see also Tables 21 and 22; Proctor-Grondmij Report, 1964.) Three species of seagrasses occur in the shallow and sheltered bays of the nearshore marine

habitat: turtle grass (Thalassia testudinum); manatee grass (Syringodium filiforme); and shoal grass (Halodule Wrightii). A rare species is Halophila decipens.

Fish and Wildlife. Marine wildlife consists of marine mammals, including manatees (Trichechus manatus) and bottlenose porpoises (Tusiops trunestus), and several transient species of whales. There is also a great variety of corals and reefs associated with fish and invertebrates. These have been adversely affected by overfishing and marine pollution. Turtle populations have significantly declined in recent years, but since 1982 have been protected under the Wildlife Protection Act. Marine birds breed mainly on the cays. The species which are exploited include Sterna fuscata and Anous stolidus, whose eggs are collected commercially. Coastal marine areas also support numerous species of fish, which are categorized as bottom-dwelling (demersal) or swimming (pelagic).

Generally, the shallow coastal areas on the south coast are the most productive areas, and aquatic wildlife (except for coral reefs) tends to be concentrated on the south coast. Mangroves and coastal lagoons are of particular importance as breeding and feeding areas for many species of wildlife including crocodiles and birds.

Water Quality. Most rivers are pollution free at their sources, but a significant number of these, especially the major waterways, receive polluting materials, such as industrial wastes, garbage and agricultural chemicals. These pollutants reduce stream oxygen values and increase nutrient levels, conditions which have led to a reduction in fish and shrimp life and the proliferation of aquatic vegetation.

Although there is no comprehensive compilation of water quality data for the coastal waters of Jamaica, NRC D has conducted water quality monitoring in the following areas known to be affected by pollution: Alligator Pond/Port Kaiser; Black River Lower Morass; Bull Bay; Swamp Safari in Trelawny; Gunboat and Buccaneer Beaches; Ocho Rios Bay; and other major public recreational beach sites along the north coast as far west as Negril. NRC D has also continued work initially undertaken by the Kingston Harbour Quality Monitoring Committee, mainly through the Division's Ecological Conservation Project. Through this project, the major pollution sources in Kingston Harbour have been identified and characterized (NRC D, Kingston Harbour Pollution Monitoring, File No. 2/4/16; Wade, 1976).

**Table 20:**  
**Dominant Plant Species in Jamaican Wetlands**  
 (\*Most Common)

Management Unit	Wetland	Dominant Plant Species
Saint Ann	Pear Tree Bottom	<u>Typha domingensis*</u> , <u>Conocarpus erectus</u> , <u>Acrostichum aureum</u> , <u>Phragmites sp.</u>
Portland	Turtle Crawle Swamp	<u>Avicennia germinas</u> , <u>Rhizophora mangle</u> (Dog zone, grasses, sedges, herbs).
	Saint Margaret's Bay	<u>Alpinia allughas</u> , <u>Typha domingensis</u> (Fully covered by freshwater vegetation).
	Orange Bay	<u>A. allughas</u> .
	Windsor Castle Swamp	<u>T. domingensis</u> , <u>A. aureum</u> .
Saint Thomas	Cow Bay Swamp Albion Swamp	<u>R. mangle</u> , <u>T. domingensis</u> , <u>Cladium jamaicense</u> .
	Great Morass	<u>R. mangle</u> , <u>C. erectus</u> , <u>A. germinas</u> .
Kingston	Palisadoes and Port	<u>R. mangle</u> , <u>C. erectus</u> , <u>Languncularia racemosa</u> , <u>A. germinas</u> (Mangrove dominated).
Kingston/Saint Catherine	Hunt's Bay - Dawkins Pond	Same as above.
Saint Catherine	Hellshire, Cabarita Swamp	Same as above - Mangrove forest.
	Amity Hall Swamp	<u>R. mangle</u> , <u>C. erectus</u> , <u>L. racemosa</u> , <u>A. germinas</u> (Mangroves)
	Great Salt Pond	<u>R. mangle</u> , <u>T. domingensis</u> .
Clarendon	Cockpit - Salt River Swamp	Mangroves, <u>T. domingensis</u> , <u>Nasturtium officinale</u>

Table 20: continued

Management Unit	Wetland	Dominant Plant Species
	Macarry Bay Swamp	Mangroves, <u>T. domingensis</u> , <u>A. aureum</u> , <u>Acacia tortuosa</u> .
	West Harbour Swamp	Mangroves, <u>Batis maritima</u> .
	Jackson Bay Swamp	<u>L. racemosa</u> , <u>A. nitida</u> , <u>B. maritima</u> .
Manchester	Canoe Valley	<u>C. erectus</u> , <u>R. mangle</u> , <u>L. racemosa</u> , <u>A. aureum</u> , <u>Sabal jamaicensis</u> , paragrass, crab thatch. Sawgrass, typha, phragmites
Saint Elizabeth	Luana Point Swamp	Mangroves, <u>S. jamaicensis</u> , <u>Dalbergia sp.</u> , <u>A. tortosa</u> .
	Lower Black River Morass	<u>C. jamaicense</u> , <u>T. domingensis</u> , <u>S. jamaicensis</u> , <u>Roystonea princeps</u> , <u>R. mangle</u> .
Westmoreland	Cabarita Swamp	Mangroves
Westmoreland/Hanover	Negril Swamp	<u>C. jamaicense</u> , <u>C. erectus</u> , <u>Acrostichum, sp.</u> , <u>R. princeps</u> , <u>S. jamaicensis</u> .
Trelawny	Bush Cay/Florida Lands	Mangroves
	Hague Swamps	<u>R. mangle</u> , <u>A. germinas</u> , <u>L. racemosa</u> , <u>Acrostichum sp.</u> , <u>Phragmites sp.</u> , <u>Arundo sp.</u> , <u>T. domingensis</u> .

Source: Natural Resources Conservation Division, 1982.

**Table 21:**  
**Number of Species in Plant Communities, Negril Morass**

<u>Plant Community</u>	<u>No. of Species</u>	<u>Dominant Species</u>
<u>Cladium - Sagittaria</u> Association	12	<u>Cladium jamaicense</u> <u>Sagittaria langeifolia</u> <u>Ipomea sagitata</u>
Hummocky Swamp	22	<u>C. jamaicense</u>
<u>Roystonea</u> Forest	14	<u>Roystonea sp.</u>
Conocarpus Forest	23	<u>Conocarpus erectus</u> <u>C. jamaicense</u>
<u>Sabal</u> Forest		<u>Sabal jamaicensis</u>
Mixed Swamp-Margin Forest	5	<u>C. erectus</u> <u>Rhizophora mangle</u> <u>Avicennia nitida</u> <u>Languncularia racemosa</u>
<u>Scleria</u> Association	8	<u>Scleria eggersiana</u>
<u>Cyperus giganteus</u> Association	6	<u>Cyperus giganteus</u>
Conocarpus shrub/ <u>Acrostichum</u> Association	11	<u>Dalbergia ecastaphyllum</u> <u>Acrostichum aureum</u>

Source: Compiled from Coke, et al., 1982.

In addition, there has been some limited mapping and analysis of water circulation patterns at selected coastal sites, for example, Ocho Rios Bay, Montego Bay, Johnson Town, Negril, Black River, and Alligator Pond (NRCD Files, NRCD/TGI, 1982; JAVEMEX unpublished data).

Harbours. There are 15 active ports along the Jamaican coast. Kingston Harbour, one of the

finest harbours in the world, is protected from the open sea by the Palisadoes Peninsula. (See Figure 16.) Other active ports and harbours are Port Morant, Port Esquivel, Salt River, Rocky Point, Port Kaiser, Black River, Savanna-la-mar, Lucea, Montego Bay, Falmouth, Port Rhodes, Ocho Rios, Oracabessa, and Port Antonio. These harbour areas represent the major coastal economic centres of Jamaica.



**Table 22:**  
**Number of Species in Each Plant Community,**  
**Black River Lower Morass**

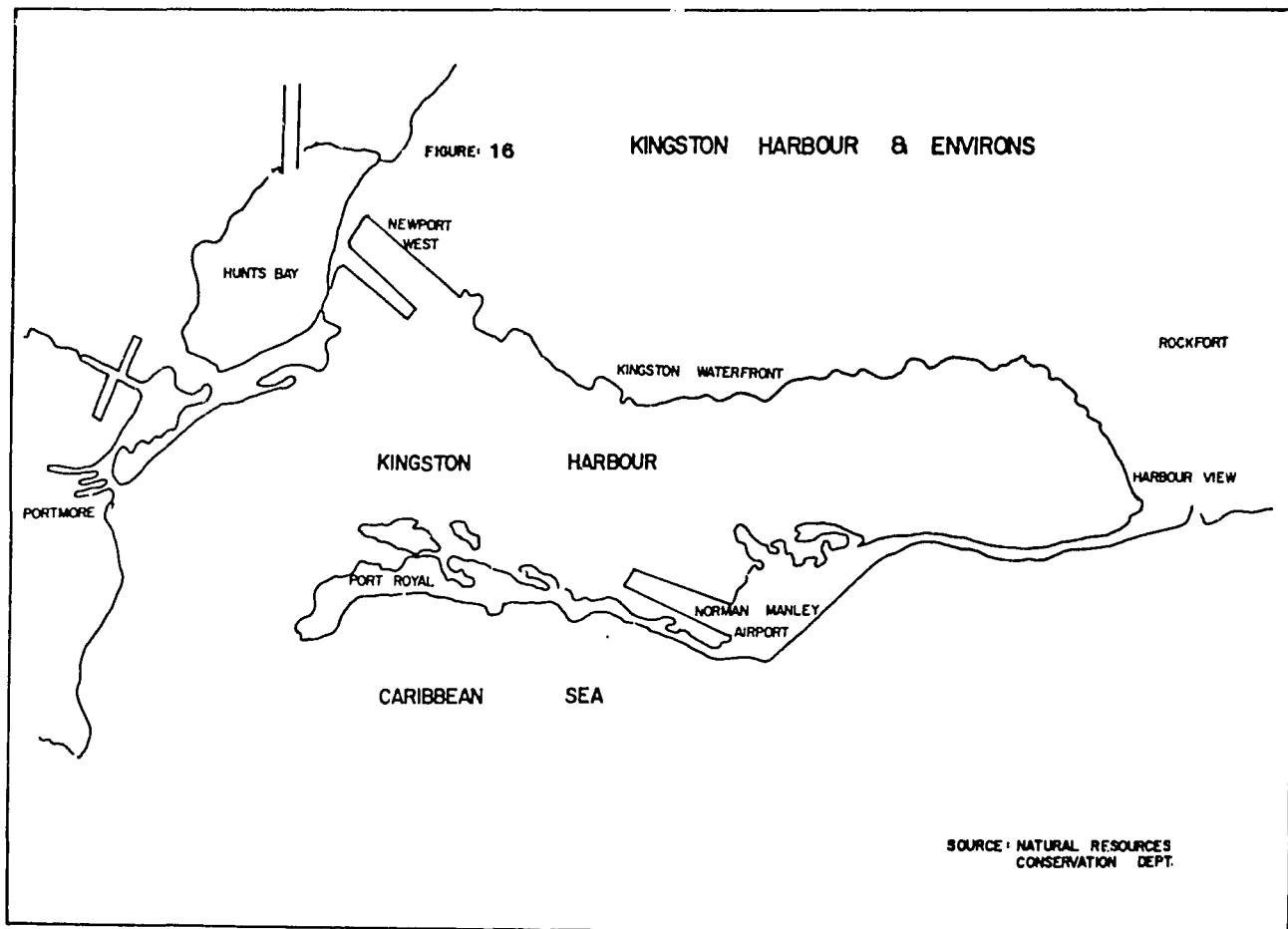
<u>Plant Community</u>	<u>No. of Species</u>	<u>Dominant Species</u>
Mangrove Forest	10	<u>Rhizophora mangle</u> <u>Conocarpus erectus</u>
Swamp Forest	47	<u>Rostonea princeps</u> <u>Grias cauliflora</u>
<u>Crinum/Sagittaria</u> Zone	20	<u>Crinum americanum</u> <u>Sagittaria lancifolia</u>
<u>Scirpus Olneyi</u> Zone	8	<u>Scirpus olneyi</u>
Hummocky Swamp	24	<u>Cladium jamaicense</u> <u>Lippia nodiflora</u>
Thick <u>Cladium</u> Zone	19	<u>Cladium jamaicense</u>
<u>Typha</u> Zone	33	<u>Typha domingensis</u> <u>Cyperus giganteus</u>
<u>Typha</u> Hummocky Swamp	16	<u>Cladium jamaicense</u> <u>Eleocharis cellulosa</u>
<u>Cladium/Sagittaria</u> Association	41	<u>Cladium jamaicense</u> <u>Sagittaria lancifolia</u>
<u>Typha/Thalia</u> Zone	17	<u>Typha domingensis</u> <u>Thalia geniculata</u>
<u>Cladium/Conocarpus</u> Zone	14	<u>Conocarpus erectus</u>

Source: JICA (1983); After Coke et. al. (1982) and NRCD & TGI (1981).

o Kingston Harbour, situated on the south coast, is a semi-enclosed body of water which has a narrow channel (approx. 800 ft.) connecting it with the open sea. Three main regions are the Inner Harbour, the Outer Harbour and Hunts Bay. Nearly all imports to Jamaica are channeled through Kingston. The commercial section of Kingston Harbour is provided with the following facilities: rail-mounted container gantry cranes; transported cranes; two cruise-ship piers; wharf facilities for lumber and corn; jetties at Petrojam; bunkering facilities at Esso; a dry cargo dock; two pleasure boat marinas; and terminal facilities for gypsum.

o The Montego Bay Freeport is situated on the north coast of Jamaica and is provided with the following: a tanker berth (600'); two other berths (588', 387'), which are also used for cruise ships; and a marina for small craft.

o Port Antonio Harbour is also situated on the north coast. It has a horseshoe shape and is used mainly for the export of bananas and some sugar. This harbour is provided with a deepwater wharf owned by the United Fruit Jamaica Company. Sugar is also shipped over the same wharf. It also has a cruise ship pier and two pleasure boat marinas.



## **AGENCIES AND INSTITUTIONS**

There are several agencies in Jamaica with roles and responsibilities affecting the use and protection of Jamaica's coastal resources. The lead agency is the Natural Resources Conservation Division (NRCD), which is specifically charged with the responsibility for coastal resources management. Other agencies are concerned with coastal resources in the course of carrying out their primary functions which may not be specifically tied to coastal resources management. These agencies include the Petroleum Corporation of Jamaica, the Urban Development Corporation, the Fisheries Division of the Ministry of Agriculture, the Town Planning Department, Ministry of Local Government, the Institute of Jamaica, the Port Authority of Jamaica, the Jamaica Industrial Development Corporation, the Jamaica National Investment Promotions Ltd., and the Mines and Geology Division of the Ministry of Mining, Energy, and Tourism.

### **The Natural Resources Conservation Division (NRCD)**

The Natural Resources Conservation Division is the primary government agency responsible for conservation and management of the island's natural resources. Of NRCD's five divisions, the Recreation and Conservation Division and the Aquatic Resources Division are especially concerned with coastal resources management. The other three divisions - Resource Management Division, Technical Information Service, and Watershed Engineering Division - are also involved with coastal management efforts, although to a lesser degree.

Recreation and Conservation Division (RCD). The RCD is responsible for developing and managing national parks, beaches and unique areas; preserving lands with ecologically important functions; and establishing wildlife conservation areas. The RCD is currently involved in developing and managing marine as well as land-based parks for recreational and educational purposes. Coastal areas which have been recommended for park designation and development include the Hellshire Hills, a portion of the Palisadoes, Alligator Pond, Portland Bight and the Ocho Rios and Montego Bay Marine Parks.

The RCD also carries out the provisions of the Beach Control Act, 1956, which established the Beach Control Authority (BCA). The BCA is empowered to declare public recreational

beaches, rescind public beach orders (i.e., revoke or cancel licenses for the use of the beach) in the interest of better development, and acquire beachlands in the public interest. (The RCD now carries out the responsibilities of the Beach Control Authority.)

The RCD also implements the Wildlife Protection Act (WLPA) and is given the authority to establish game sanctuaries under this Act. Game sanctuaries established under this Act and located in coastal areas include a forest reserve near the Gut River (Manchester coast) and a fish sanctuary at Montego Bay.

Aquatic Resources Division (ARD). The ARD has no direct supportive legislation and functions as a technical assessment and advisory unit to the Beach Control Authority as established by the Beach Control Act (1956). The Division carries out water quality monitoring of coastal and inland waters to detect the presence of pollutants with deleterious effects on aquatic life. The ARD Wetlands Branch carries out surveys of wetlands pertaining to the conservation and development of these areas. The Oceanography Branch investigates and provides information on the dynamic processes occurring in coastal areas (e.g., currents, littoral drift) relative to erosion control, and provides advice on the construction of coastal structures such as groynes, seawalls and jetties.

### **The Petroleum Corporation of Jamaica (PCJ)**

Although not specifically charged with coastal resources management, the PCJ conducts several activities with significant actual or potential effects on coastal resources. These activities include offshore and onshore oil exploration; peat energy research and wetlands management (specifically in the Negril and Black River Morasses); OTEC research; and management of the Petrojam Refinery.

### **The Urban Development Corporation (UDC)**

Most of the designated areas within which the UDC has sole authority for planning and implementation of various development projects are located on or in close proximity to the coast. UDC projects in Montego Bay, Ocho Rios, Hellshire, Oracabessa and on the Kingston Waterfront are especially significant in terms of their relationship to the coastal environment and their actual and potential impacts on coastal resources.

## **The Fisheries Division**

The Fisheries Division of the Ministry of Agriculture has not been actively involved in coastal resources management for several years, focusing instead on the issuing of fishing licenses, registering of boats, and selling of gas, boats and fishing equipment to fishermen at subsidized prices. The Division, however, is now in the process of divesting its gas and fishery equipment distribution operations and will become a more research-oriented agency, with emphasis on resource management.

## **Town Planning Department (TPD)**

The TPD, through its various land use planning and development review functions, can guide coastal area development and address the potential negative impacts of proposed development on coastal resources. The TPD operates under the Town and Country Planning Act of 1958 and the Local Improvements Act of 1914. Coastal areas have been the subject of special attention under these Acts, since most of Jamaica's population and urban development is located along the coast.

The TPD is the functional arm which carries out policies established by the TCPA. The policies and the regulations under which the TPD operates are set out in the Manual for Development prepared by the TPD. The Manual provides guidelines to all those in the government and private sectors involved in planning, development and project design.

The Manual outlines beach and coastline preservation policies, including:

- a. Where areas of unique terrain, flora or fauna exist, such areas can be declared National Parks, and large-scale development or urbanization prohibited.
- b. A developer may be required to preserve, within a subdivision development, natural features such as large trees and groves, water courses, waterfalls and protected watersheds. The inclusion of seaside parks in coastal developments may also be deemed necessary where there are areas of scenic beauty, recreational or ecological value deserving of conservation.
- c. The plan for any coastal development should ensure that special areas are left for fishing beaches and for good bathing beaches with access from the public thoroughfare.

- d. Advertisements should be avoided in conservation areas, and no building, structure, wall or fence approved which obscures the view of any area of scenic beauty. No continuous wall or building should be allowed which blocks views of the sea. Hotels should also blend in with surroundings, and have the minimum effect on the environment.

- e. Alteration of wetland areas for development purposes should not be undertaken as such changes destroy or significantly impair basic wetlands functions. If such development is allowed, however, a thorough ecological study is required prior to any development.

- f. Development not specifically designated as a harbour or industrial site is to be set back from the high water mark. The amount of setback required will be dependent on physiographic conditions and on any existing seaside parks. There are certain requirements for industries with potential for air, noise and surface water pollution. Developers should not discharge toxic waste in the water arbitrarily and should not violate the Wildlife Protection Act.

Certain agencies are consulted by the TPD in the review of particular development plans. The NRCDC is usually asked to approve all developments impacting coastal areas (such as wetlands and beaches) and, along with the Ministry of Health, to approve of waste and sewage disposal facilities accompanying such development.

## **Ministry of Local Government**

The Parish Council in each parish examines all development plans in its respective parish, including those in the coastal areas, and works in conjunction with the Town Planning Department in reviewing these plans.

## **The Institute of Jamaica**

Two divisions in the Institute of Jamaica are involved in aspects of coastal resources use and conservation. The Natural History Division's (NHD) major role in coastal resource management is in public education. For example, it displays collections of flora and fauna occurring in coastal areas, including coral, fish, manatees, turtles, etc., and displays and distributes posters prepared by the NRCDC on endangered coastal area species.

The Jamaica National Heritage Trust (JNHT) is concerned with the conservation and preservation of several monuments — historical buildings, forts, naval and military monuments and areas of unique natural beauty — including those in coastal areas. The posting of preservation notices in the listed areas precludes any development which may have adverse ecological effects on designated natural resources. Coastal areas of natural beauty designated by the JNHT and protected under the Natural Heritage Act include the Dunn's River Falls, the Blue Hole\*, Glistening Waters (Oyster Bay) and Godswell. Three coastal areas with protected buildings are Port Royal, Fort Clarence and Seville Park.

### **Port Authority of Jamaica**

The Port Authority of Jamaica has authority over the construction of piers, jetties, warehouses and wharves. In addition, the Port Authority has several other functions related to coastal resource management, including: regulation of coastal structures on or over water (Marine Division and Engineering Division); prevention of harbour pollution by boats; provision of aids to navigation within the ports of Jamaica and the Pedro and Morant Cays (Marine Division); monitoring and control of oil spills (in cooperation with the Coast Guard); review, approval, construction, and leasing of buildings on the foreshore in areas under the Port Authority's jurisdiction; and provision of information on ship traffic (Statistics Dept.).

The Harbours Department's role in resource management is to prevent pollution of the harbour by vessels which dispose of bilge or wastes of any form into harbour waters. The marine police aid the Harbours Department in enforcing regulations.

### **Other Agencies**

The Jamaica Industrial Development Corporation (JIDC) is not directly involved in coastal resource use or management, but several of the JIDC's factories are located along the coast: in Montego Freeport, Annotto Bay, Lucea, Morant Bay, Seafort, Falmouth, Port Antonio, Seville and several sites in Kingston and Saint Catherine.

The Jamaica National Investment Promotions Limited (JNIP) may act as intermediary for the implementation of development projects involving the use of coastal resources. The JNIP

promotes manufacturing, tourism (development of spas and other attractions, watersports and marinas), and agricultural development (including fish and prawn farming). Investment proposals which may impact the coastal environment are referred to the NRCDC for comments on potential environmental effects.

The Mines and Geology Division of the Ministry of Mining, Energy and Tourism administers the Quarries Control Act of 1983, which provides for the licensing of extraction of quarry materials, including rock, gravel, and sand found on the seabed, shoreline, or foreshore.

## **LEGISLATION AND REGULATIONS**

The legislative basis for coastal area management is provided, both directly and indirectly, by several laws, including: the Beach Control Act; the Wildlife Protection Act; the Petroleum Act; the Town and Country Planning Act; the Local Improvements Act; the Urban Development Act; the Fisheries Industry Act; the Morant and Pedro Cays Act; the Natural Heritage Act; the Harbours Act; the Port Authority Act; and the Quarries Control Act.

### **Beach Control Act**

The Beach Control Act established the Beach Control Authority (BCA) and vested in the Crown the foreshore, the floor of the sea and the overlying water, and prohibits the use of both in connection with any commercial enterprise without a license obtained from the RCD. The RCD is also empowered to declare protected areas and prohibit activities such as fishing, waste disposal, dredging and coral removal in such areas. Under the authority of the Beach

---

\* The Blue Hole in Portland provides a good example of the implementation of JNHT conservation policies in the coastal area. The site was designated as an area of natural beauty by the Portland Coastal Development Order of 1963, but has also attracted development proposals for resort and private use. In conjunction with the Beach Control Authority, the Portland Parish Council and Town Planning Department, the JNHT worked to protect and conserve the fragile ecosystem. Interim preservation notices were prepared for the area to ensure that its scenic beauty and the integrity of the lagoon remained unspoiled.

Control Act, the RCD approves all plans for the development of beaches, inspects beaches to ensure adherence to BCA prescribed safety and cleanliness standards, and enforces regulations pertaining to declared protected areas.

Several regulations and orders have been gazetted under the Beach Control Act. These include: the Beach Control Act Regulations of 1978, which address hotels, commercial and public recreational beaches, regulate beach activities and the care of beaches, and outline the rights of license; and the Beach Control (Protected Area, Montego Bay) Order, and the Beach Control (Protected Area, Ocho Rios) Order, which declare the Montego Bay and Ocho Rios Marine Parks as protected areas.

### **Wildlife Protection Act**

The Wildlife Protection Act (WLPA) prohibits the removal, sale or possession of turtle eggs and immature or juvenile fish, and the use of dynamite or any other explosive, poison or noxious material to kill or injure fish. The Act also prohibits the discharge of trade effluent or industrial waste from any factory into harbours, lagoons, estuaries, and streams.

### **Petroleum Act**

The Petroleum Act, 1979, gives the PCJ exclusive right to explore and develop petroleum resources in an orderly and rational manner while ensuring that the exploration and development process minimizes adverse effects on the environment. The Minister of Mining, Energy, and Tourism may make regulations for the prevention of pollution and the undertaking of remedial action in respect to any pollution which occurs, as well as the protection of fishing, navigation and other activities in the area in which petroleum operations occur. In accordance with the Act, the Minister may extend the functions of the PCJ to include development of other energy sources in Jamaica, including coastal peat resources.

### **Town and Country Planning Act and Local Improvements Act**

The Town and Country Planning Act established the Town and Country Planning Authority (TCPA), which has responsibility for ratifying Development Orders containing broad-based land use plans and regulations. These Development Orders are prepared by the TPD to control

the development of land in both rural and urban areas, secure proper sanitary conditions and conveniences, co-ordinate building of roads and public services, protect and extend amenities and conserve and develop resources. Development Orders have been prepared for the following coastal areas: St. Elizabeth, Montego Bay, St. James, Hanover, Negril-Green Island, Trelawney, Westmoreland, St. Ann, Ocho Rios, St. Mary, St. Thomas, Portland and Kingston.

The Local Improvements Act requires that anyone wishing to subdivide land for building, lease, sale, or other purposes must provide the local planning authority with a plan for approval. The Subdivision Section of the TPD coordinates interagency review of subdivision applications and forwards recommendations (approval, denial, approval with conditions) to local planning authorities.

### **Urban Development Act**

The Urban Development Act, March 1968, provides the UDC with the authority to acquire, manage and dispose of land within or outside of designated UDC areas, and to act as the sole planning authority within the designated areas.

### **Other Legislation and Regulations**

The Fisheries Division operates under the Fisheries Industry Act of 1976 and the Morant and Pedro Cays Act of 1907. Under the Fisheries Industry Act, the Fisheries Division is responsible for issuing fishing licenses and licensing and registering fishing boats. The Morant and Pedro Cays Act of 1907 prohibits fishing, slaying or capture of birds, capture of turtles, removal of eggs or the frightening of birds using firearms and noise-making devices, without a license.

The Port Authority operates under the Harbours Act of 1874 and the Port Authority Act of 1972. The Harbours Act authorizes the Port Authority to declare harbours and establish or alter the boundaries of harbours. The Marine Board, which is comprised mainly of Port Authority employees, is empowered to make rules for the regulation and control of any of the island's harbours and the ship channels entering into them. The Act prohibits the discharge of rubbish, earth, stone, ballast, mud, oil, mixtures with oil or its residues, in any harbour or in ship channels. Removal of stones and gravel from reefs, shoals or cays of Port

Royal, and from other cays is also prohibited.

Under the Port Authority Act, the Marine Division of the Port Authority regulates the construction of structures on or over water. Such structures must be approved by the Marine Division, subsequent to structural approval (i.e., of detailed drawings of the proposed structure) by the Engineering Department.

## **PLANS AND PROGRAMMES**

Several plans and programmes currently proposed by government agencies and private developers will affect coastal areas. These proposals involve both development and conservation-oriented projects, and include the Kingston Region Coastal Management Study, the National Parks Programme, the Negril Morass Recreational Park, restoration of Half Moon Bay, development of tourist resorts, peat mining for energy production, Agro 21 shrimp farming, and a factory building programme. These proposed programmes are briefly described in the following sections; some are described in more detail under other sector headings.

### **Kingston Region Coastal Management Study**

A report on coastal zone management needs in the Kingston Region has recently been prepared by the U.N. Centre for Human Settlements, in cooperation with the Town Planning Department and the UN Development Programme\*. The report includes a number of recommendations for legislation, research, education, and development projects. (See Table 23.)

### **National Parks Programme**

Recommended policies for the establishment of National Parks are being prepared by the NRC D for submission to the Ministry of Agriculture. These recommendations address a draft National Parks Act, priority park development areas, economic and other benefits to be gained from park establishment, and operational requirements. The priority park development areas located in, or including, coastal areas are Canoe Valley, Negril Swamp, Portland Bight and Ridge, Port Royal and Palisades, Black River Lower Morass, and Hellshire Hills. Marine parks are proposed for Ocho Rios, Montego Bay, and Discovery Bay.

### **Negril Royal Palm Reserve**

As part of PCJ's Negril wetlands management and development programme, the PCJ Operations Division is planning a recreational park project to protect a threatened stand of Royal Palm in the southern portion of the Negril Morass. (PCJ is also planning to establish a crocodile reserve at Fort Hill Property, in St. Elizabeth.)

### **Restoration of Half Moon Bay**

The UDC is investigating the feasibility of restoring the severely eroded Half Moon Bay Beach at Hellshire, and developing the beach into a recreational area.

### **Development of Tourist Resorts**

Among the tourist-related development projects currently being planned throughout the island are UDC-planned projects in Negril and Hellshire. Within the next five years, the UDC plans to develop the Rutland Point area of Negril as a major resort centre. Several hotels will be built and public beach facilities provided, along with camping grounds. Subsequently, other hotels will be added along the Negril coast, accompanied by a residential development at Orange Bay. The UDC's plans to develop the Hellshire area include construction of a shopping mall, expansion of residential areas, and construction of tourist accommodations.

### **Peat Mining**

Large peat deposits in the Negril Morass and the Black River Lower Morass have the potential to be utilized for electricity generation. After several years of research, the PCJ has determined that peat mining could be undertaken in these areas in an environmentally acceptable manner. The studies carried out also indicated that the project would be economically feasible at the oil prices that prevailed in 1984. While the PCJ has projected

---

\* E. Bruce Johnson. "Coastal Zone Management: Kingston Region; From the Mouth of the Milk River, Clarendon Parish to the Yallahs Salt Ponds, St. Thomas Parish." January 18, 1985.

**Table 23:**  
**Summary of Coastal Zone Management**  
**Recommendations for the Kingston Region**

Legislation

1. To create a Jamaican Coastal Zone Management Authority, under the chairmanship of the Deputy Prime Minister.
2. To make mandatory an Environmental Impact Statement for all major coastal developments (public or private).
3. To merge the TPD, NRCD, ODP and Rural Physical Planning Division into a new Ministry of Planning and the Environment.
4. To formally establish Marine National Parks.
5. To formally establish the territorial sea boundaries of Jamaica.
6. To establish a deadline for water quality standards and use criteria for different classifications of marine waters and to fund additional staff for monitoring.
7. To create a coastal zone management planning program for all of Jamaica.

Research and Education

1. Review of all environmental protection legislation to remove confusion and overlap and to strengthen penalties for violators.
2. Development of a broad-based CZM curriculum at UWI.
3. Research study of the flushing characteristics of Kingston Harbour.
4. Study of marine ecology and physical and chemical characteristics of Great Salt Pond to determine the effect of opening the pond to the sea.

Development

1. Construction of a marina along the waterfront of Kingston's new city centre to focus on marine recreation and tourist potential.
2. Give consideration to promoting the Green Bay area of Port Henderson Hill and/or parts of the Hellshire Development as sites for high rise offices for International companies.
3. Utilization of westward (landward) slope of Port Henderson Hill for middle and upper income residential development.
4. Conduct light tackle sport fishing surveys for the creation of a new tourist and sportsman-oriented industry at Milk River, Mahoe Gardens, and Port Royal Cays.
5. Investigate the Tarentum plain as a dollar-earning millionaire's retreat or as the site for an industrial estate for hazardous materials.
6. Investigate the development potential of the Yallahs delta and the upland behind Yallahs Salt Pond for a new town, new industrial estates, and possible resort development and investigate the Salt Ponds as sites for brine shrimp aquaculture.

Source: Coastal Zone Management: Kingston Region. W. Bruce Johnson. Jan. 18, 1985 (U.N. Project: Integrated Development Plans (Jam/82/010) Technical Report No. 9)



various environmental as well as socio-economic benefits stemming from peat-to-energy development, others foresee adverse impacts on wetlands ecology and fisheries habitats.

### **Shrimp Farming-AGRO 21**

AGRO 21 has completed a feasibility analysis on the use of coastal lands for aquaculture, with emphasis on marine and freshwater shrimp cultivation, primarily for export. Areas which have been studied include Duckenfield, Amity Hall, Rio Minho, West Harbour, Milk River, the fringes of Mitchell Town and the Upper and Lower Black River Morasses. Once these areas have been studied in more detail, specific sites will be selected and developed.

### **JIDC Factory Building Programme**

The JIDC's National Factory Building Programme for 1985/86 includes several garment factories scheduled to be located in coastal areas, including Hague, Montego Bay, Kingston and Sandy Bay.

## **PROBLEMS AND ISSUES**

Jamaica's coastal resources are utilized for many purposes. Although some uses have little significant environmental impact, others cause significant adverse effects on the coastal environment. The major portion of Jamaica's development has occurred in coastal areas; most of its urban centres, industries, tourist resorts and population are located in the coastal region. Coastal resources are also utilized as a source of building materials, for agriculture, recreation and waste dilution. The following sections highlight the various development pressures and associated problems affecting the island's coastal resources.

### **Urban Impacts**

The majority of Jamaica's urban centres are on the coast, and development has tended to sprawl outward from these centres. Urban expansion, while providing needed employment opportunities and contributing to improvements in living standards can, and has, resulted in the degradation of coastal area resources. As urban expansion progresses, for example, housing schemes have been improperly sited, wastes and effluents discharged into the sea, and

sensitive environmental areas destroyed or degraded. Numerous other environmental impacts have also arisen.

The expansion of some urban centres has resulted in adverse effects on, and, in some cases, the destruction of ecologically sensitive areas, such as mangrove swamps. The filling of mangrove swamps to create new land for urban development has resulted in numerous environmental problems, including the loss of nursery areas for fish and shrimp species and increased vulnerability to coastal flooding.

- o A prominent example is the filling of mangrove swamps adjacent to Hunt's Bay and of Dawkins Pond, Saint Catherine, to establish the Portmore residential area. The removal of the Hunt's Bay and Dawkin's Pond mangroves resulted in the destruction of the habitat of the mangrove oyster which was the basis of a moderate-scale oyster fishery.

- o Areas of the shore adjacent to Kingston Harbour have also been reclaimed in order to provide waterfront land for the construction of shipping facilities, offices and commercial enterprises, and several industries. Portmore is now considered to be especially vulnerable to flooding from the sea as a result of the removal of mangroves, which also provide an important source of detritus for reef fish and act as protective buffers against coastal flooding.

- o In Montego Bay, UDC housing and recreational development at Catherine Hall affects about 40 acres of mangrove swamps at the mouth of the Pye River. The UDC's 345-acre Montego Bay Freeport area was created by dredge and fill operations which destroyed much of the mangrove and associated fishery habitat of the Bogue Island area. Dredge and fill operations at the Montego Freeport area have also resulted in the destruction of the reef and beaches near the Seawind Hotel, and in coastal erosion problems.

- o At Hellshire, approximately 27,000 acres are currently slated for development to accommodate the growing population of the Kingston Metropolitan Area. The Hellshire Hills area contains a unique arid limestone forest, and several endemic species of plants and animals, some endangered.

Expansion of the island's urban centres has also resulted in increased waste generation with the potential for polluting coastal waters. Sewage disposal and storm run-off into Kingston Har-

hour has resulted in eutrophication, high bacterial levels and elimination of benthic life. Discharge of sewage from the New Braeton housing scheme sewage plant has polluted the Great Salt Pond, which has also been proposed for saltwater shrimp farming and recreational development.

### **Agricultural Impacts**

Agricultural development in Jamaica has resulted in adverse impacts on coastal wetlands resources. Some prominent examples are:

- o Hague Swamps: During agricultural reclamation of the Hague Swamps in Trelawny in 1977 by the Agricultural Development Corporation, all of the mangroves adjacent to and south of the main road between Duncans and Falmouth were cut down, and 600 acres drained and put into rice production. The project was later abandoned after 250 acres of the reclaimed land became too saline for rice cultivation. The project also resulted in the destruction of phosphorescence in Oyster Bay.

- o Black River Morass: The Black River Morass has been under agricultural development pressure from as early as 1941, when the Black River (Upper Morass) Reclamation Act was enacted. In 1955, 500 acres of rice were planted. Increased outflow rates from drainage of portions of the Upper Morass has resulted in increased siltation in the Lower Morass. In 1964, a comprehensive agricultural study on reclamation of the Black River Morass for agricultural use concluded that the drained morass, with proper management, would become a viable farming enterprise although initial large investments would be needed.

Currently, the Upper Morass of the Black River is being utilized for rice production by BRUMDEC. To date, 1,000 acres have been planted, and a further 2,000 acres are scheduled for cultivation. Through the BRUMDEC project, a joint venture between the Jamaican Government and the Inter-American Development Bank, a total of almost 3,600 hectares are ultimately scheduled for agricultural development. Other uses of the Upper Morass include cultivation of sugar cane and food crops and cattle rearing.

- o Negril Morass: The Negril Morass has also been affected by drainage for agricultural use, with 500 acres reclaimed in an effort

to investigate agricultural potential; 250 of these acres are used for food crop production. Drainage canals have been constructed, and partial drainage of this morass has resulted in the outflow of discolored and turbid water into the sea, and silt deposition on reefs and sea grass.

- o Meylersfield: Much of the land in Meylersfield, Westmoreland, has been drained and reclaimed to plant rice and vegetable crops. Approximately 1,750 acres will be put into production on completion of this project, which is being carried out with the assistance of the Netherlands Government.

- o Other areas: In the Great Morass of Saint Thomas, 50 acres is used for cultivation of rice, plantain, yams, and other crops, and a similar acreage is used for rice and sugar cane in Hart Hill and Windsor Castle swamps. Orange Bay Swamp, Portland, is utilized for planting rice, while 100 acres in the Amity Hall swamp is being used for both rice cultivation and fish farming.

### **Tourism Impacts**

The tourism industry, Jamaica's second largest source of foreign exchange, has directly and indirectly impacted Jamaica's coastal areas. Much emphasis has been placed by the government on the continued development of tourism, which is based in large part on the quality of the island's coastal resources. There are roughly 115 hotels and guest houses in Jamaica, the majority of which are located in the coastal area.

Pollution, boat traffic and increased water use associated with tourism activities have adversely affected fragile coastal ecosystems. Many hotels have individual sewage treatment plants which discharge effluent into coastal waters. Coral reefs in close proximity to sewage outfalls have been stressed by the detergents, suspended organic matter and degreasing agents in the effluent. Some of the treatment plants do not operate efficiently because of improper operations and load variations. Tourist centres have also experienced pollution problems caused by population growth and increased waste generation. For example, in Ocho Rios, the Turtle River, a sewage plant and a drainage canal have all contributed to pollution of Ocho Rios Harbour. Watersports and boat traffic create potential oil and noise pollution effects, and sometimes result in anchor damage to reefs. The aesthetic value of the famous Blue Hole

in Portland, for example, has been affected by oil pollution from watersports in the adjacent lagoon.

Use of coastal organisms as souvenirs to supply the tourist industry has contributed to degradation of coastal resources. Although black coral is protected by the Beach Control (Protected Area, Black Coral) Order of 1976, it is still illegally extracted and used to make jewelry. Conch, starfish and other reef organisms are also reaped for souvenirs. Crocodiles have been hunted for sport and for skins since the early 1960's.

Land reclamation and beach construction activities associated with the development of the Seawind Beach Hotel in Montego Bay resulted in the death of the adjacent reef. The man-made beach is currently plagued with erosion problems, and sand bags are used as remedial measures. Land reclamation has also been carried out in other areas, including Ocho Rios, Kingston and Montego Bay, to create beaches, resort areas and cruise ship piers. The attempts of the New Falmouth Resorts, Ltd. to reclaim and develop mangrove lands adjacent to Oyster Bay in 1968, resulted in changes in the ecology of the Bay and a drastic decline in the bioluminescence.

### **Industrial Impacts**

As industrialization has progressed in Jamaica, improper planning and waste disposal, increased demand for developable land, increased shipping traffic, population growth around industrialized centres, and various other factors have resulted in adverse effects on coastal resources.

Water Pollution. Water pollution has resulted from several kinds of industrial activity:

- o Industries located on the coast have historically used coastal waters for waste dilution. Industries on the Kingston Waterfront, for example, such as the oil refinery, fish processing plant, detergent manufacturers, and canning and bottling establishments, discharge wastes into the Harbour. Slaughterhouse waste water is also an important contributor to coastal water pollution in some areas. In addition, the solid and liquid wastes dumped by some industries into nearby gullies may also find its way to harbour waters.
- o Industries located on inland sites can also contribute to the pollution of coastal waters by discharging wastes into rivers which flow

to bays, ponds or estuaries. Sugar industry wastes, for example, have polluted the Black and Cabarrita Rivers, and drainage of waste from the Bernard Lodge sugar factory into the Great Salt Pond has resulted in fish kills. The death of shrimp, immature reef and estuary fish at Rocky Point, Clarendon has been attributed to the discharge of dunder from the New Yarmouth and Monymusk sugar factories. Hunt's Bay receives wastes from a condensory and a citrus processing factory in Bog Walk.

- o Bauxite industry activities have also polluted coastal environments, especially at Port Kaiser, Port Esquivel, Port Rhodes, Rocky Point, and Reynolds Pier. At Reynold's Pier in Ocho Rios, bauxite ore spilled into the water during loading operations has drifted over reefs and smothered corals, and the death of the affected reef has been predicted. A large amount of dust is sometimes generated during loading operations, and suspended sediment has also led to a reduction of light and poor visibility in the water. At Port Esquivel and Port Kaiser, alumina spilled in the water has impacted seagrass beds.

Due to increased shipping, refining, and the development of oil-using industries along Jamaica's coast, the occurrence of oil pollution in the coastal waters has increased significantly in the last thirty years. All of the ports in Jamaica with significant ship traffic have been affected by oil pollution. Oil pollution has resulted in the degradation of recreational resources, and the loss of fauna and flora in valuable and productive ecosystems, and a major oil spill could have a serious impact on the tourist industry. The NRC D has recently completed an islandwide oil pollution monitoring programme.

- o The Esso Oil refinery (now Petrojam), was built on reclaimed land bordering Kingston Harbour in 1963. Since that time, the refinery has been a source of pollution to Kingston Harbour due to inadequate treatment and pipeline leakages. Ships discharging oil into the island's harbours have also been found to be major sources of pollution in the water column and on the water surface.
- o Portland Bight, on the south coast, has two ports — Port Esquivel and Rocky Point, both of which handle bauxite, petroleum products and domestic cargo. Texaco has an oil storage facility at Port Esquivel which supplies the Jamaica Public Service (JPS) plant at Old Harbour. In 1974, significant oil

pollution in the Bight was attributed to oil tankers cleaning out their tanks a short distance outside of the ship channel. The windward sides of the cays south and east of the Harbour entrance were heavily contaminated and mangroves severely damaged. A similar incident was reported near Port Esquivel where nearby cays and five acres of seagrass beds were damaged in 1984. The impacted cays continue to be susceptible to pollution from oil tanker bilge. Also in January, 1984, leaks in the Texaco oil storage pipeline discharged around 500 barrels of oil into the sea affecting shallow bays, beaches, cays, seagrass, mangrove and the resident fauna. Tar balls were found on the cays, where recreational users frequently complain of the level of oil in the sand.

o Port Rhodes has also been the site of oil spills caused by the discharge of bilge from tankers. Port Kaiser at Alligator Pond was the site of a major oil spill in 1981 when the grounded tanker ERODONAS spilled some 600 tons of fuel oil. Several miles of the coastline were impacted and fishermen suffered economic losses both from damage to fishing gear and loss of fishing time. At Reynolds Pier in Ocho Rios, leakage in the oil pipeline in 1981 resulted in contamination of ground water supplies. Fire at an inadequately protected ESSO storage tank in Montego Bay resulted in oil entering the marine environment in 1981.

The potential for a major oil spill is ever-present in Kingston Harbour due to the heavy ship traffic and the discharge of oil-contaminated ballast. The offshore discharge of ballast near the harbour has affected the Port Royal mangroves and sessile organisms such as oysters which are especially sensitive to oil. Pelagic tar is higher in the outer harbour than in the inner harbour. On the cays south of the Harbour, tar balls with a maximum diameter of 6-feet have been recorded, and block tar up to one yard long and one foot thick has been observed.

Due to increased ship traffic, both rocky and sandy shores around the island are being affected by oil which has been spilled or discharged offshore. Fresh tar balls have been collected from Hellshire and Portland beaches, and north coast beaches are frequently raked to remove tar, a process which induces beach instability. (The distribution of stranded tar on the southern coast of Jamaica is shown in Figure 17.)

Shipping accidents also have the potential to

pollute coastal environments. In 1974, for example, the MVC SANKATY, with 1,500 tons of sulphur aboard, ran aground at Bare Bush Cay, Portland Bight, and 170 tons of sulphur were dumped overboard in order to float the ship. The surplus deposit was spread over an area of approximately 6,000 square feet, and had filled the holes and crevices between the underlying coral. More recently, in May 1985, 1,200 tons of ferrosilicone ore were dumped onto the sea floor from a ship which ran aground in the Pedro Banks area.

Solid Waste Pollution. Solid waste pollution in the coastal area also results from improper disposal of industrial wastes. In Yallahs, Saint Thomas, for example, a canning factory uses the nearby beach for dumping waste products, and the existing berm does not afford adequate protection from high seas. This dump was implicated in the poisoning of marine organisms in March, 1985.

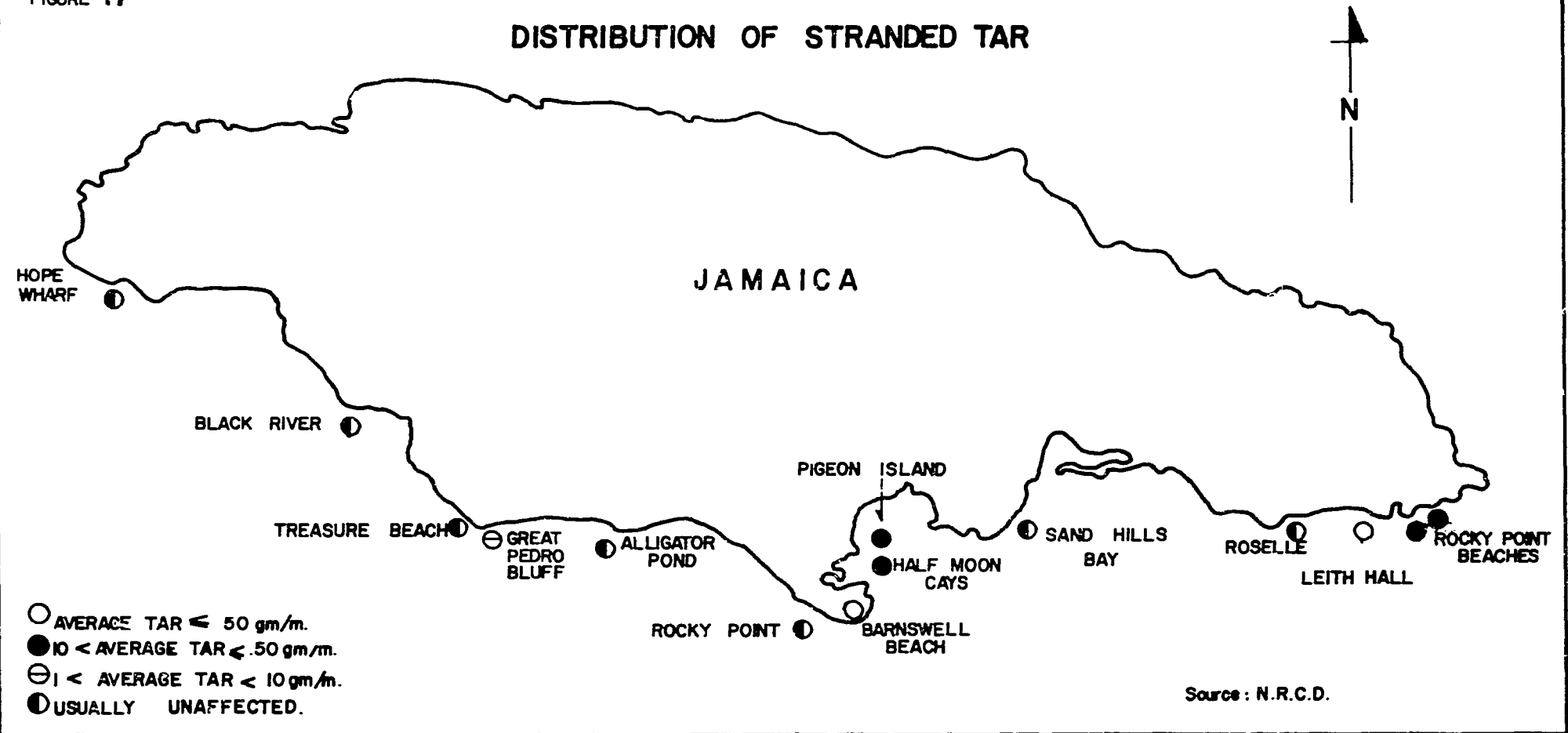
Failure to properly enforce strict dumping regulations is the main factor leading to contamination of the marine environment by solid and liquid waste. Because inshore coastal waters are by far the most productive and because they move predominantly along the coast, pollution of these waters leads to the rapid depletion of natural resources and the quick transmission of diseases associated with the pollutants. The almost fully-enclosed Hunts Bay is a prime example of an area affected by waste run-off from the city, compounded by artificial structures (i.e., the causeway), which impede proper marine circulation. This region, once the filtering area for Kingston Harbour, is now virtually stagnant and foul.

Air Pollution. There is no available, documented data on air pollution in coastal areas of Jamaica. Factories in industrial areas do, however, produce a variety of gaseous emissions. In addition, the cement factory at Rockfort has infilled the adjacent land with its waste products, and the finer particles are blown by wind over considerable distances. In 1979, corn dust from milling operations in the Rio Bueno area was linked to the respiratory stress of nearby residents.

Air pollution has now reached a critical level in the Kingston metropolitan area and associated coastal regions. Although automobile emissions are among the chief causes, other sources (e.g., the new J.P.S. Power Barge) emit highly toxic gases constantly. Like other point sources, there is no control over stack emissions from the J.P.S. installations. However, NRC D

FIGURE 17

### DISTRIBUTION OF STRANDED TAR



has attempted to provide some guidelines on this stack emission based on U.S. EPA standards. (NRCD File, J.P.S. Power Barge).

### Coastal Erosion

Coastal erosion has resulted from normal processes involving wind currents, and waves and has also been accelerated by man-induced activities such as sand removal from beaches. (Areas of critical beach erosion are shown in Figure 18.)

The removal of sand from beaches around Jamaica for use as building material has caused several problems, most notably beach erosion affecting both bathing and fishing beaches. In western Jamaica, where river sand is scarce, it is prohibitively expensive to truck sand from other areas, and the Mines and Quarry Division is unable to recommend a suitable substitute (e.g., crushed limestone). Although the mining of beach sand also provides needed employment in several areas, the removal of sand from beaches for sale to the construction industry has affected coastal dynamics in several areas with potentially significant economic effects. The tourist industry has expressed concern over the removal of beach sand in several areas, including Florida Beach, Trelawny, where the removal of large quantities of sand by bulldozers has threatened the stability of the adjacent Trelawny Beach Hotel. In Saint Thomas, concern has been expressed over the impact of continued sand removal (and sale of this sand to government agencies) from beaches valuable for tourism purposes.

Illegal removal of sand and resulting beach erosion have caused particularly serious problems in the following areas:

- o Johnson Town, Hanover. Sand removal in this area has occurred both along and below the high water mark. Sand is sold to both private contractors and government agencies, including the Hanover Parish Council and the Public Works Department. The removal of sand has resulted in the inland movement of the sea, with resulting loss of land, crops and houses. In 1980 damages caused by Hurricane Allen were aggravated by unstable shore conditions and the decreased beach area available for the dissipation of wave energy. By 1982, the coastline had receded to the road linking Lucea and Montego Bay. Through 1983, the situation worsened and by January 1984, land was being reclaimed by the sea and residents were being evacuated.

- o Hope Wharf, Westmoreland. Removal of large quantities of sand from this area has contributed directly to coastal erosion along approximately 3,000 feet of coastline.

Continued removal has also resulted in the formation of beach pools which provide breeding areas for mosquitoes. The erosion problem also affects a fishing beach and the property of an adjacent coconut plantation, and poses a flooding threat to nearby residents. The village, once 200 feet from the shore, is now less than 50 feet away.

- o Crane River, St. Elizabeth. Over a period of 14 years, sand removal from the Crane River Bathing beach has caused extensive erosion; 25 feet of the former beach area has been eroded.

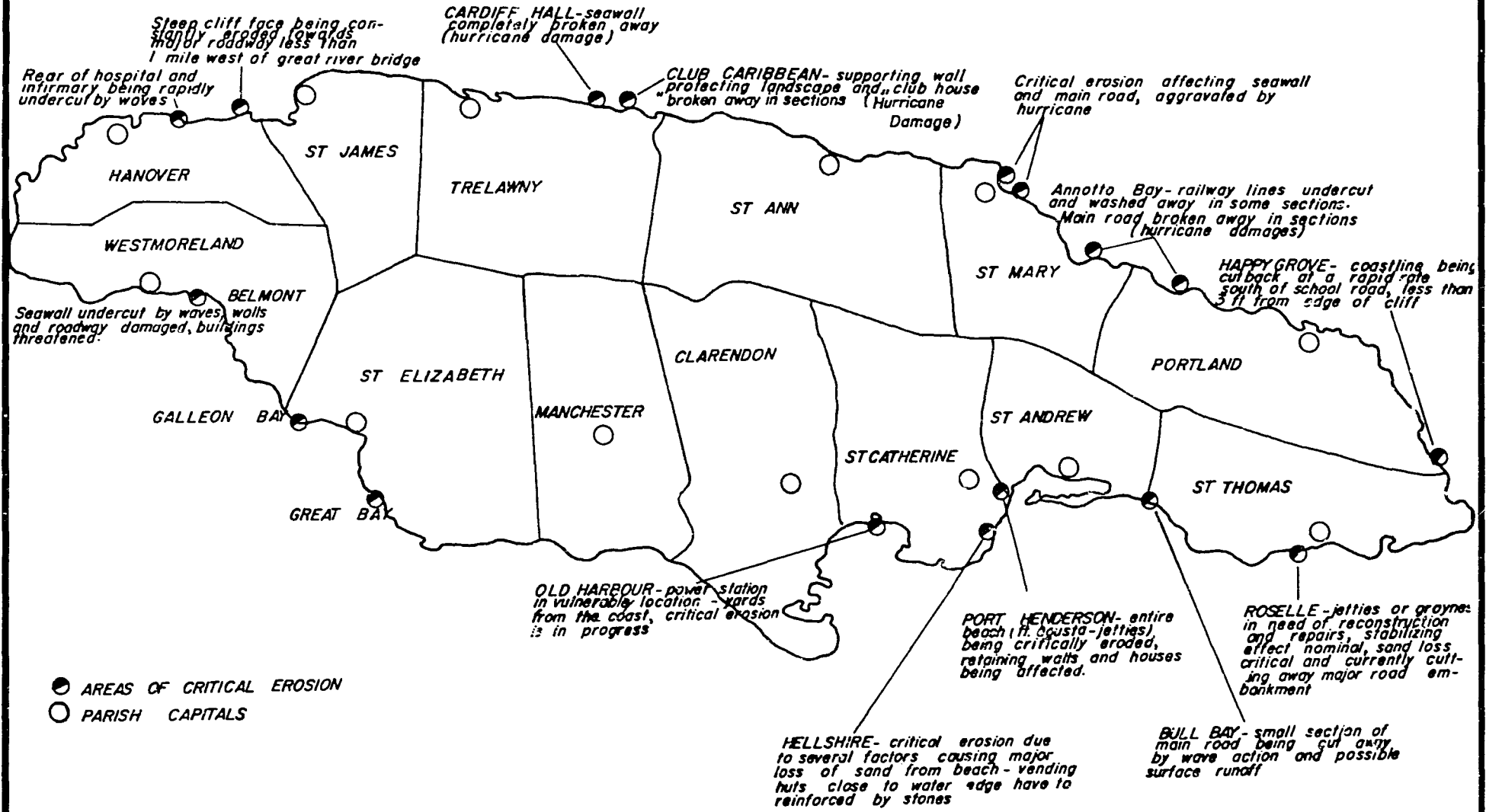
- o Mahoe Bay/Rose Hall, St. James. Sand was being removed from these beaches as early as 1976 and the continued removal has caused severe damage to the Saint James coastline. Sand has been removed by contractors attached to the Donald Sangster International Airport drainage project, and has also been used in land reclamation projects. At Mahoe Bay, several acres of coastal land have been transformed into ponds.

- o Portland Coast. Removal of sand from the seashore between Saint Margaret's Bay and the Ken Jones airstrip in Portland has led to reduction of the shoreline by 20 feet over a 15 year period; the sea now reaches the road. The sand is used for local construction and by the Portland Parish Council.

Beach erosion is also caused by factors other than sand removal. The use of coastal areas for housing and tourism development and the erection of protective structures such as seawalls and groynes also contribute to coastal erosion and the narrowing of beaches. At Kent Avenue in Montego Bay, for example, a seawall was constructed to protect several hotels including the Sunset Beach, Lodge, and Chatham Hotels. High wave energy conditions, however, eroded the wall 30 yards landward where it collapsed along with the road. A groyne constructed at the Rose Hall Intercontinental Hotel caused beach erosion by obstructing the natural movement of sand, and groyne construction has been implicated in the loss of 90% of Sunset Beach in Montego Bay.

FIGURE: 18

# AREAS OF CRITICAL BEACH EROSION



- AREAS OF CRITICAL EROSION
- PARISH CAPITALS

Source: Natural Resources Conservation Division.

## **Other Pressures on Coastal Resources**

Along with the above-noted development pressures, other activities have contributed to degradation of coastal resources, including mangrove destruction for charcoal and bark, use of explosives, removal of beach vegetation, and overfishing of reef fisheries.

Destruction of Mangroves. In some areas mangroves are cut and used for charcoal production. In the Negril area, for example, around 15 to 20 trees per month are confiscated from persons illegally removing mangrove trees from UDC land. At Seaview Gardens west of Kingston, the mangrove fringe separating the housing development from Hunt's Bay is being removed and used to make charcoal. The bark of the red mangrove can be used to manufacture dye, and this practice has also resulted in some mangrove destruction.

Use of Explosives. Where dynamiting has been employed as a means of capturing fish (its use has been reported in Rockfort and other areas), habitats have been destroyed. Dynamiting has also been used by illegal explorers searching shipwrecks off the Morant Cays, and the coral reef communities nearby have been damaged.

Removal of Beach Vegetation. Beach erosion presently occurring at Half Moon Bay in Hellshire has been attributed in part to the removal of dune vegetation, which has destabilized the sand and exposed the beach sand to direct wave action and inland migration. Fishermen's shacks once on land are now in the sea; stones have been placed in some areas to slow the rate of erosion. The removal of large trees from the Cove and Bruce Hill properties in Westmoreland has resulted in erosion of the beach west of this property.

Overfishing of Reef Fisheries. Overfishing has resulted in significant depletion of fish stocks and adverse socioeconomic impacts to fishermen. As catches decline, some fishermen are using smaller mesh sizes in their nets and smaller trap coverings, leading to further depletion of the fishery stocks. Foreign boats are also contributing to overfishing on the cays. Adding to the problem is the lack of restriction on the number of fishing licenses issued. Recently, as employment in other industries has declined sharply, many unemployed persons have turned to fishing.

## **Absence of Policy for Coastal Resource Management**

Although various types of development in coastal areas have had, and continue to have, adverse effects on coastal resources, there is no overall coastal area management plan to guide development in coastal areas. Neither is there any legislation specifically directed toward the management of wetlands in Jamaica. There is no specific legislation supporting NRC D's ad hoc involvement in the Town Planning Department's existing development planning and review processes. Also, the conditional guidelines attached by NRC D to development proposals are not effectively monitored due to lack of staff and funding.

## **Lack of Specific Legislation on Oil Spills**

Several drafts of a Clean Sea Act have been prepared, but there is still no indication as to when this legislation will be approved by Parliament. It has not yet been determined which agency will implement the Act, but the initial recommendation is that it should be attached to the Ministry of Public Utilities.

Pending adoption of this legislation, an oil spill contingency plan prepared by ODP is in force. In 1982, the GOJ received assistance from the Government of Norway for the development of an oil spill contingency plan. In 1985, this plan was superseded by a new contingency plan developed by ODP, with assistance from the U.S. AID.

## **DIRECTIONS FOR FUTURE WORK**

1. In recognition of the importance of the coastal zone for the Jamaican people, attempts have been made over the years to develop legislation for the control of coastal resources. The formation of NRC D in 1975 has assisted in bringing coastal zone management to the forefront, and future plans call for the implementation of a Coastal Zone Management Project. Major issues relating to the utilization of coastal zone areas could be addressed through such a project. Moreover, such a project must be seen as a medium for the development of a needed Coastal Zone Management Plan. It is recommended



that implementation of this project be undertaken with urgency.

2. The role of the Beach Control Authority in processing applications for development of beach areas needs to be elaborated, particularly with a view to ensuring that environmental impact assessment accompanies certain applications.
3. To improve the effectiveness of existing legislation, the definition of "development" in the Town Planning Act needs to be revised, for example to apply to agricultural development.
4. Enforcement of the Beach Control Act is almost nonexistent. Addition of more enforcement officers is urgently needed, as is a well-developed public education program.
5. In order to conserve beach sand and, at the same time, improve the level of sand resources available to the construction industry, it is recommended that a comprehensive inventory of these sources be made with a view to identifying exploitable deposits.
6. To ensure the improved economic viability of fisheries in Jamaica, the areas vital to the propagation of this resource (i.e., seagrass beds, coastal mangrove swamps and coral reefs) should be identified for designation as protected areas.
7. To enhance the awareness of the wider public with respect to marine life forms, it is recommended that significant results could be achieved through the establishment of a permanent attraction in the form of a sea aquarium. Given that Jamaica has been selected as the headquarters of the Law of the Sea, an aquarium broadly represented by the marine resources of the Caribbean would be an appropriate symbol of Jamaica's leadership role in preserving and enhancing the marine environment of the Caribbean.



Plate 17 - Peat Mining in Negril Morass.

## **Annex 1: Coastal Management Units**

The major land and water uses in each of the 13 coastal management units are described below\*. These management units are described in counter-clockwise order, beginning with the Kingston and St. Andrew Unit.

### **Kingston and Saint Andrew**

The coastal area of the Kingston/St. Andrew unit stretches from the Fresh River on the west to the Yallahs River on the east, and includes the Kingston Waterfront and the Palisadoes peninsula on which the Norman Manley International Airport and Port Royal are found. Existing development in the area includes a variety of commercial and industrial uses. Many of these uses, including the JPS main power plant, the Petrojam Refinery, the container port, the airport, government offices and the Bank of Jamaica must be labelled critical facilities vital to the nation's well-being. In addition, development alongside or close to the waters edge includes a variety of housing schemes with high concentrations of residential units.

Kingston is the major metropolitan area of Jamaica and the nation's centre of industry and commerce. Kingston Harbour is the most heavily-used port, offering several facilities for docking and berthing in addition to the container terminal for trans-shipment operations.

Coastal industries include food processing, cement and flour production, oil refining and garment manufacturing, among others. The JIDC has built 16 factories and 4 small industrial complexes in the coastal area, and the Port Authority has provided factory space in

the Kingston free-trade zone for manufacturers. Kingston Harbour and Hunt's Bay to the west are used for dilution of both industrial and domestic wastes.

There are several fishing beaches in this unit and two public bathing beaches, one on the Palisadoes spit and the other near the border with Saint Thomas. Due to pollution effects from industry and sewage, however, there is very little recreational use.

### **Saint Thomas Parish**

The coastal area of Saint Thomas is located between the Yallah's River and Hector's River. Large wetland areas, including the Cow Bay swamps and Great Morass, along with significant areas of deciduous forest are found along the coast. Agriculture is the principal land use, and the crops cultivated are coconuts, sugar cane and bananas. Smaller areas are used for intensive mixed farming and cattle grazing. At Bowden, oysters are grown by both private farmers and the Ministry of Agriculture. Rural housing is found in several areas. The JIDC has built three factories in the coastal area: at Morant Bay, Seaforth and Yallahs. The industries here are involved in manufacturing and food processing.

### **Portland Parish**

The coastal area of Portland extends from Hector's River to Palmetto Point. Two prominent wetland areas are the Turtle Crawl and Windsor Castle swamps. Coastal vegetation also includes deciduous forest and shrub species. Agriculture is a major land use; the main crops are bananas and coconuts, with smaller areas cultivated with sugar cane or used for intensive mixed farming. Cattle grazing also takes place.

Residential development covers significant tracts of land, with urban residential development found in the capital town of Port Antonio. There are six hotels/guest houses located in the Port Antonio-Dragon's Bay area. Port Antonio is expected to grow as a tourist center in the future. Six public bathing beaches and ten fishing beaches are in use.

Surface mining takes place between West Harbour and Saint Margaret's Bay, and sand is extracted from beaches at Saint Margaret's Bay to supply the construction industry. The Port of Port Antonio actively serves cruise ships and banana exporting vessels, and the eastern

---

\* All land use information, unless otherwise stated, was obtained from the Jamaica Resource Assessment Project of the Jamaican Ministry of Agriculture, Rural Physical Planning Unit, in cooperation with the CRIES Project (Michigan State University and the US Department of Agriculture Soil Conservation Service). Port statistics were provided by the Port Authority of Jamaica. Information on tourism and fishing beaches was derived from the Jamaica Tourist Board Information Service (JTB, 1985) and the National Physical Plan (TPD, 1978), respectively.

section of the East Harbour, Port Antonio, is used for the cultivation of oysters by the Ministry of Agriculture.

The JIDC has leased factory space to short term users, but there are no other significant industrial uses.

### **Saint Mary Parish**

The coastal area of Saint Mary is located between Palmetto Bay and the White River. Coastal vegetation is primarily deciduous forest. Land-use is dominated by agriculture, with sugar cane the major crop, followed by bananas and coconuts. Smaller areas are utilized for orchards and intensive mixed crops. Cattle is raised on both improved and unimproved pasture land. Urban and rural residential development is also found along the coast. Tourism activities are relatively few, with only five hotels along the coast. There are four public bathing beaches and nine fishing beaches. Industrial use is limited, although the JIDC is developing a small industrial complex at Annotto Bay. A former centre of industry — Gray's Inn Sugar Factory — has been shut down.

### **Saint Ann Parish**

The coastal region of Saint Ann is bordered by the White and Rio Bueno Rivers. The Pear Tree River Swamp is a prominent wetland area, and the coastal vegetation also includes large deciduous forest stands and some shrub-covered areas. Land along the coast is used mainly for agriculture, tourism, and rural and urban housing. Cultivated crops are sugar cane, bananas and coconuts. Cattle rearing is conducted on both improved and unimproved pasture. There are approximately 23 hotels and guest houses along the coast of Saint Ann, and Ocho Rios is one of the island's major resort centres. Residential areas occupy a significant portion of the coast, especially in the towns of Runaway Bay, Discovery Bay, Ocho Rios and Saint Ann's Bay, the capital. Saint Ann has nine fishing beaches and six public bathing beaches. There is a small industrial complex at Seville (JIDC).

There are two ports in St. Ann: Port Rhodes at Discovery Bay and Reynold's Pier in Ocho Rios. The former is operated by Kaiser Bauxite Company for shipping of bauxite. Most of the vessels visiting Ocho Rios during the past year were cruise ships. A few cargo ships loaded

sugar for export, but since Reynolds has ceased operations in Jamaica, no bauxite was shipped during the first quarter of 1985.

### **Trelawny Parish**

The coastal area of Trelawny stretches from the Rio Bueno River to the end of Long Bay. Along the shoreline, the Hague Swamps provide habitat for a diverse bird population. In addition to wetland species, the coastal vegetation includes deciduous forest species. Urban and residential housing is an important land use, especially in areas such as Falmouth, the capital, and the town of Duncans. There is some tourism, cattle ranching and agricultural use, the latter being confined to relatively small areas of sugar cane.

The Port of Rio Bueno was used by only three cargo ships between January and March 1985. The only coastal area factory is located in Falmouth, and is used for garment manufacturing. Another factory is currently being built by the JIDC for a similar purpose.

### **Saint James Parish**

The coastal area of Saint James is located between Long Bay and the Great River. The shoreline is vegetated with deciduous forest and also includes smaller brush-covered areas. Montego Bay, the capital, is a major tourism and recreational centre. There are 39 hotels/guest houses in and around Montego Bay and several natural and man-made beaches.

The population of Montego Bay exceeds 25,000, and another major contributor to land-use is urban and rural housing. Housing developed by the UDC includes the approximately 5,000 unit Catherine Hall Estate developed in the 1970's. Sugar cane is the main crop planted, although bananas (mixed with forest) are also grown. Cattle rearing takes place on a relatively large scale. Wetlands reclamation has occurred in several areas to provide new land for tourism, housing and industrial development. There are seven public bathing beaches in Saint James.

Significant commercial and industrial activity occurs in Montego Bay, which is the second largest city of Jamaica. The Montego Bay Freeport has five factories and one small industrial complex for garment manufacturing, woodwork and food processing. The Port of Montego Bay is very active, receiving both

cargo and cruise ship business. A total of 59 ships used the port during the first quarter of 1985, 50 of which were cruise ships carrying 48,681 passengers. The Sangster International Airport is located on the coastline.

### **Hanover Parish**

The coastal area of Hanover extends from the Great River to Long Bay and includes a large portion of the Negril Morass. Deciduous forest vegetation is also found along the coast. Land use includes housing, agriculture, cattle rearing and tourism. Urban and rural residential use is significant, especially in the towns of Lucea Harbour, Hopewell and Green Island Harbour. The main crop cultivated is sugar cane, with a relatively small amount of coconut planted near Great River Bay. There are four hotels along the Hanover coast. Although there are only two public beaches, the entire portion of the Negril beach can be used for recreation.

In Lucea, there are only two factories, built by the JIDC and rented out to manufacturers of garments and baseballs, plus a meat processing plant. The Port of Lucea is no longer in active use. The Ministry of Agriculture uses the Green Island Harbour as an oyster culture station. There are 14 fishing beaches in Hanover, and the fishing industry is quite active.

### **Westmoreland Parish**

The Westmoreland unit extends from the midpoint of the Negril Great Morass to Scott's Cove. Deciduous forest vegetation is also found in the coastal area along with agricultural activities and housing. The main crop is sugar cane, but a small amount of extensive and intensive farming as well as cattle rearing takes place. Urban housing is concentrated around the capital, Savannah-la-mar.

Around half of Negril's seven miles of white sand beach is within Westmoreland's coastal area and is used for local recreational as well as tourism purposes. Between South Negril Point and the border, there are six hotels/guest houses, and expansion of tourism facilities is planned for the Negril area.

The fishing industry is very active with 14 fishing beaches in use. Other industrial use is limited. The JIDC has built one factory in Paradise Cove. The Port of Savannah-la-mar handled no cargo between January and March

1985, but during the similar period in 1984, sugar was shipped from this port.

### **Saint Elizabeth Parish**

The coastal area of St. Elizabeth extends from Scott's Cove to Alligator Pond Bay. The largest portion of this region is covered by the Black River Morass, a combination of coastal and non-coastal wetlands. Large portions of the coastal area are also covered by deciduous forest and brush. The Black River, which drains the Morass and is the largest river in Jamaica, is used for waste dilution, (especially from sugar factories), and supports an important artisanal fishery, which produces an estimated J\$3 million per year. Large land areas are utilized for rice cultivation and sugar cultivation, and other tracts of land are covered with coconuts, extensive and intensive mixed farming. Smaller areas are utilized for rural housing and there is some tourism activity around Black River Bay. There are several recreational beaches, including Treasure Beach.

Port Kaiser, near the border with Manchester, is an industrial area. Between January and March, 1985, 10 ships called at the port, discharging general cargo and loading alumina.

### **Manchester Parish**

The coastal area of Manchester is located between Alligator Pond Bay and the Milk River. There is little development along the Manchester coast, and the area is covered with deciduous forest stands, brush and wetlands. Near the border with Saint Elizabeth, there is some extensive mixed farming. Alligator Pond is a local fishing and recreational centre.

### **Clarendon Parish**

The boundaries of the Clarendon coastal area are the Milk River on the west and Bower's River on the east. The area between Carlisle Bay and Milk River Bay is heavily used for growing sugar cane. Smaller areas are used for cultivating tobacco and intensive mixed farming. The Amity Hall swamp is used for rice cultivation, and at Mitchell Town there is a station for the culture of freshwater fish. Recreational and tourism activities are limited. Public beach facilities are provided only at Carlisle Bay, but other beach areas are also used. The Milk River Spa is located near the border with Mandeville. There are small

pockets of rural residential use. Two ports on the Clarendon coast are Salt River and Rocky Point. The former is not in active use. Rocky Point, however, is used for exporting bauxite and discharging general cargo.

### **Saint Catherine Parish**

This management unit is bounded by Bower's River and the Fresh River. Deciduous and wetland vegetation predominate, and the principal land uses are agricultural and residential. The major crop is sugar cane, but some intensive mixed farming occurs in the more inland areas. The major residential area (with a population over 70,000) is Portmore, which is built largely on reclaimed wetlands, and is now the second largest urban centre on the island. Hellshire Hills to the west of Portmore is gradually being developed by the UDC, and both the Portmore and Hellshire developments are intended to accommodate the growing housing needs of the Kingston Metropolitan Area.

This coastal area contains the largest fishing beach in Jamaica, Old Harbour Bay, which handles around 8% of annual inshore landings. There are six other fishing beaches, and Hunt's Bay is used for shrimp fishing.

The Hellshire beaches have evolved as major recreational areas for the residents of Kingston and Saint Catherine, especially with the development of Fort Clarence and access to Half Moon Bay and Engine Head. Port Esquivel, near the border with Clarendon, is a busy port handling the export of bauxite and the discharge of general cargo and fuel oil. Texaco operates an oil storage facility near the port.



Plate 18 - Part of Rio Cobre showing Groynes to prevent soil erosion.



Plate 19 - Erection of Groynes along river.

## WATER RESOURCES

---

### OVERVIEW OF WATER RESOURCES

Jamaica's water resources, inclusive of rainfall, are unevenly distributed throughout the island. However, on a national level, it is estimated that there is sufficient water to meet the foreseeable demand, based on the following:

- o Reliable ground and surface water yield is about 4,260 Mm<sup>3</sup>/year (20% of the mean annual rainfall of 21,100 Mm<sup>3</sup>/year); and
- o Projected year 2015 national demand is about 1,570 Mm<sup>3</sup>/year (including 80% for agriculture, 15% for domestic use and 5% for industry).

However, for 1985, there was a developmental shortfall as indicated by the following:

- o 1985 total supply capacity is about 875 Mm<sup>3</sup>/year (including 65% for agriculture, 27% for domestic use and 8% for industry); and
- o Estimated 1985 national water demand is about 1,030 Mm<sup>3</sup>/year (including 77% for agriculture, 16% for domestic use and 7% for industry).

### Rainfall

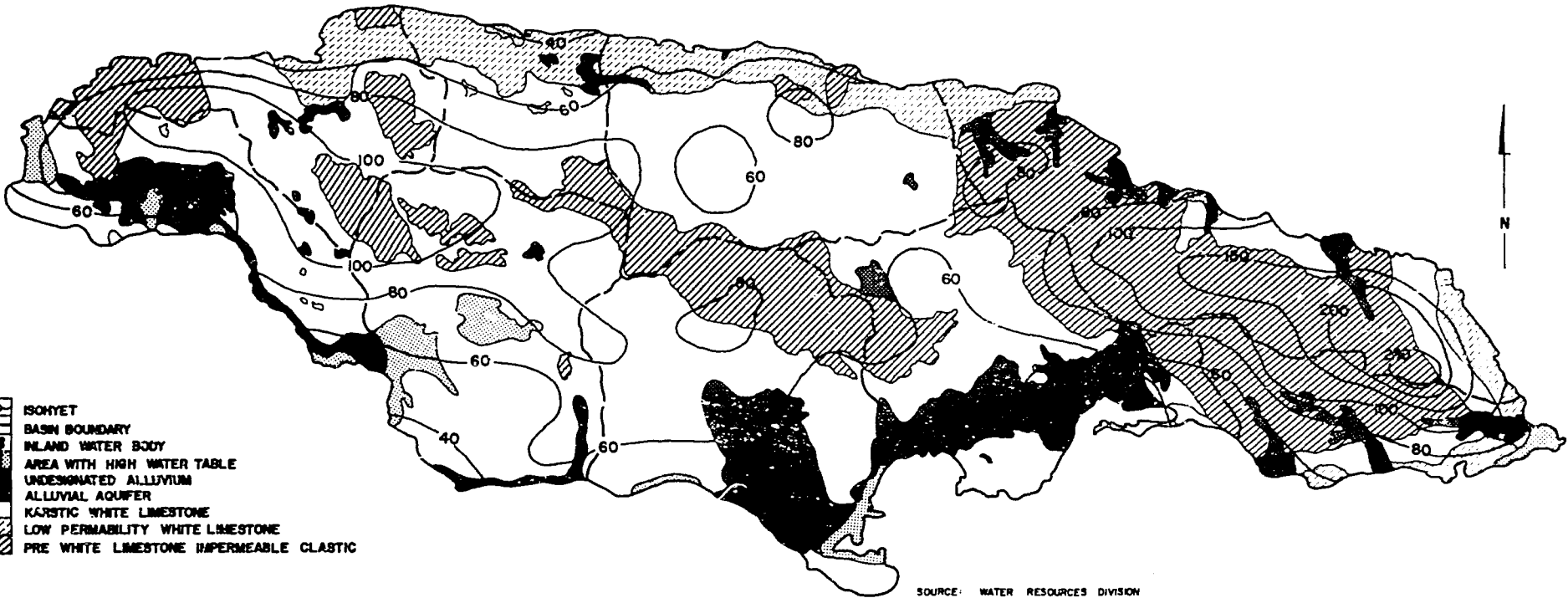
The spatial distribution of rainfall varies from over 3,000 mm. in the northeast to less than 1,500 mm. in the south central coastal plains (see Figure 19). Seasonal variability is also high, with 35% of the rainfall occurring from September to November, 21% from May to June, and 56% in the remaining seven months.

Rainfall is an inadequate source of domestic water, unless rainwater storage facilities are provided. As a source for rainfed agricultural production, rainfall in the south and north central coastal plains is insufficient and too variable to satisfy the moisture requirements of most crops. However, for most of the rest of the island, rainfall is sufficient to sustain production of such crops as pasture and coconuts and, in the west and northeast, banana and sugar cane.

### Surface and Ground Waters

The island has been divided into ten basins, based on hydrologic criteria, for which water resources assessments have been completed at

FIGURE: 19 JAMAICA - MEAN THIRTY YEAR RAINFALL (1931 - 1960)





varying stages of accuracy (mainly at the desk study level). The dominant surface and groundwater features are shown on Figures 20 and 21.

There is a high stream density on the impermeable pre-white limestone rocks, and surface water dominates these areas. On the white limestone outcrops, drainage systems are ill-defined and groundwater dominates in these areas. Variations between these two predominant patterns occur, for example in the Great River and Blue Mountain (South) Basins, as a result of differences in the transmissive characteristics of the white limestone.

**Quantity.** The annual mean and reliable ground and surface water potentials of the ten basins were assessed by the Underground Water Authority (UWA) in 1985. (See Table 24.) The data indicate that 56% of the total mean annual rainfall is lost to evapotranspiration, while 44% contributes to ground and surface waters (i.e., the average annual yield). Approximately 45% of this average annual yield to surface and ground waters (or 20% of annual rainfall) is considered reliable, and can, therefore, be used as the basis for designing water development projects.

The north-draining basins contribute 56% and 48%, respectively, of the national annual average and reliable yields, with the Blue Mountain (north) Basin alone contributing 29% of the total annual average yield and 14% of the annual reliable yield. Of the total reliable yield of 4260 Mm<sup>3</sup>/year, 79% is contributed from the limestone aquifer, and 18% and 3% respectively from surface water runoff and the alluvial aquifer. About 15% of the reliable yield of 3345 Mm<sup>3</sup>/year from the limestone aquifer is developed through wells—mainly in the Rio Cobre and Rio Minho Basins. However, in the other basins, the water is generally available as baseflow and is exploitable through run-of-river developments.

**Quality.** The quality of ground and surface waters throughout the island is normally suitable for agricultural purposes. With treatment like softening, sedimentation, and disinfection, water quality is generally suitable for industrial and domestic purposes (UWA, 1985). There are, however, exceptions which may be caused by natural or man-made activity.

Groundwater originating from the White Limestone aquifer frequently shows high turbidity

**Table 24:**  
**Average Annual Distribution of Water Types**

BASINS	Rainfall		Evapotranspiration	Avg. yield	Reliable Yield						
	Depth	Volume			S.W Run Off	G.W.		Total			
						mm	(2)	Ls.	Al.	Amt.	% of
			(3)				(2)	(3)			
Blue Mtn. (S)	(4)	2.5	1690	907	783	96	36	17	149	9	19
Kingston	(4)	1.4	310	179	131	10	15	21	46	15	35
Rio Cobre	(4)	1.6	2010	1369	641	15	378	25	418	20	65
Rio Minho	(4)	1.4	2420	1602	818	31	361	78	471	19	58
Black River	(4)	1.7	2530	1559	971	49	625	-	674	27	69
Cabaritta River	(4)	2.2	1890	1073	817	-	451	-	451	24	55
Great River		2.1	1680	858	822	65	316	-	381	23	46
Martha Brae River		1.7	1150	668	482	20	202	-	221	19	46
Dry Harbour Mtn.		1.8	2450	1302	1148	154	691	-	845	34	74
Blue Mtn. (N)		3.2	5070	2348	2722	334	270	-	604	12	22
Total Amount		19.6	21203	11868	9335	774	3345	141	4260		
%		100		56	44					20	46
% of Av. Yield					100	18	79	3			

- (1) Units except for Rainfall Depth, in Mm<sup>3</sup>/year.
- (2) Product of Depth (mm) x Area (km<sup>2</sup>).
- (3) Ground plus surface waters.
- (4) South Draining Basins. Others north draining.

FIGURE 20 JAMAICA- LOCATION OF MAIN SURFACE WATER FEATURES

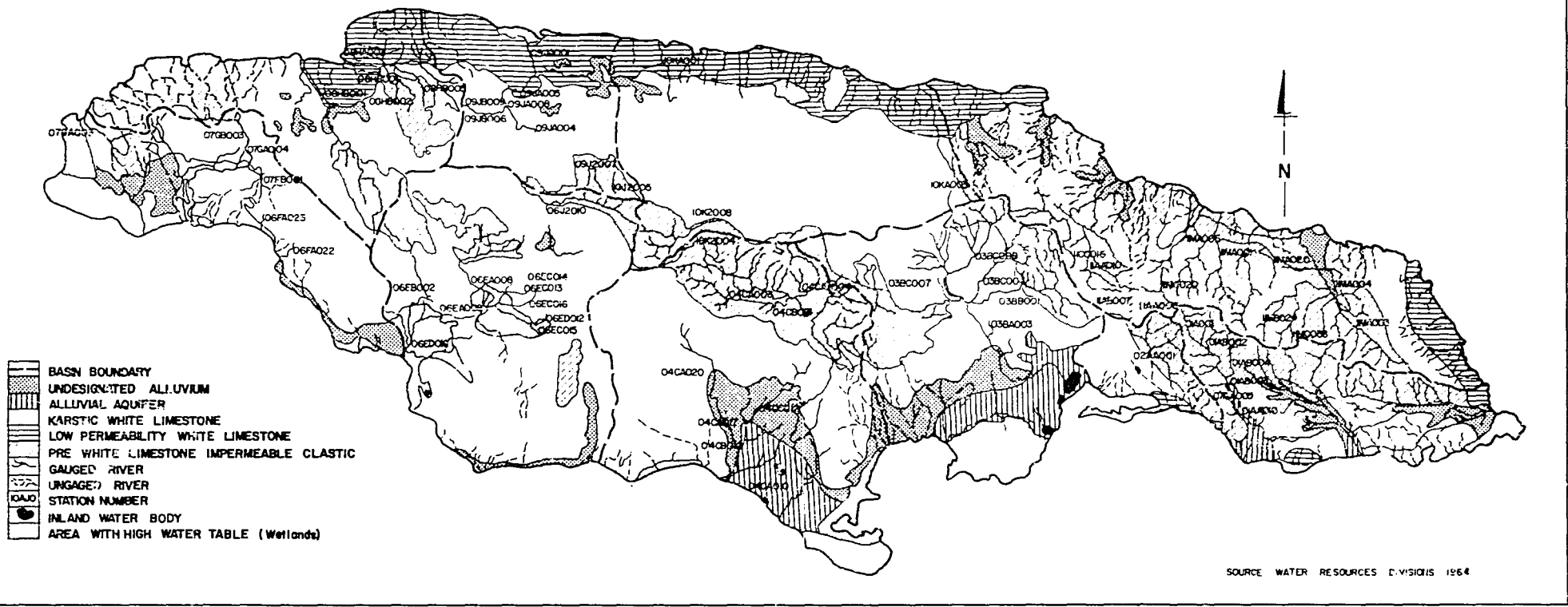
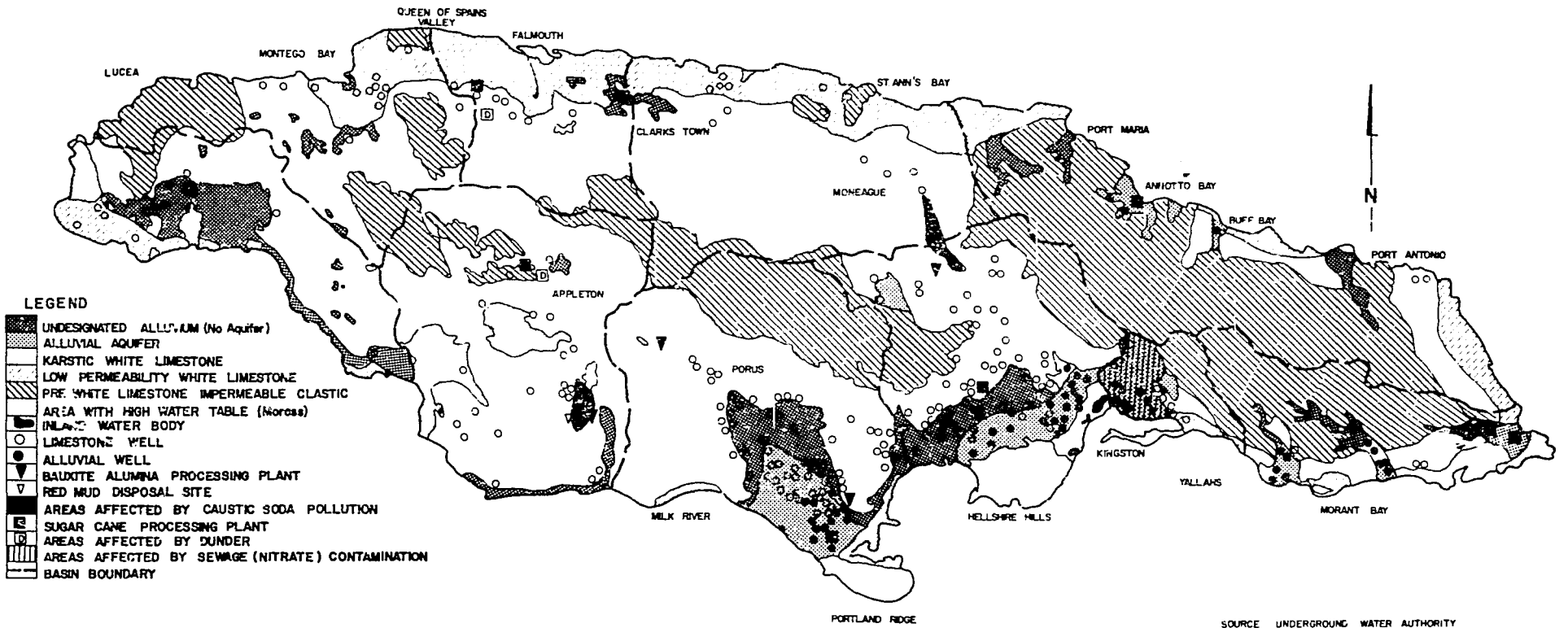


FIGURE 21 JAMAICA - LOCATION OF SIGNIFICANT GROUNDWATER FEATURES



due to the natural, highly transmissive characteristic of the karstic limestone, which enhances rapid movement of surface water to the groundwater environment. This characteristic creates the potential for several types of man-made contamination by:

- Channelling of effluent from surface disposal sites to groundwater, for example, in the Queen of Spain Valley (Martha Brae River Basin) by a sugar cane processing plant; and in the Linstead Ewarton area (Upper Rio Cobre Sub-Basin) and Essex Valley (Black River Basin) by bauxite-alumina processing plants.
- Salinisation of coastal aquifers resulting from localised over-pumping of water from these aquifers (as in the case of the Rio Cobre and Rio Cobre Basins).

There are also anomalous cases of impaired groundwater quality, for example, as reflected in higher than expected chlorinity levels in the springs forming the Cockpit and Gut Rivers (Rio Minho Basin) and the Ferry River (Rio Cobre Basin).

Surface waters — especially those in rivers originating from the pre-white limestone outcrops — generally exhibit high sediment load after rainfalls, due to the need for improved watershed management in the upland catchment areas. In addition, pollution by industrial effluents has impaired surface water quality, for example in Rio Cobre, the Black River (Elm River tributary) and the Cabarita River.

**Watersheds.** There are 33 declared watersheds. The boundaries for these are defined under the Watershed Protection Act of 1963. (See Figure 22 and Annex 1). The watersheds may be divided into two groups:

- Those draining the white limestone areas, with rivers showing relatively small flow fluctuations. In interior valleys, these rivers are prone to flooding.
- Those draining the impermeable, pre-white limestone outcrops, with rivers showing high flow fluctuations. These rivers are prone to washouts following high intensity rainfall events.

### **Existing Water Supply Systems**

The locations of the major water supply systems for the urban domestic, agricultural and indus-

trial use sectors are shown in Figure 23. In addition to these major systems, there are many smaller systems, as well as over 500 rural systems supplied from spring or river sources. Many rural communities, mainly in upland karstic areas, are served by household or community rainwater collection systems, because there are no nearby surface sources or, if present, groundwater is not easily accessible.

### **Sectoral Water Supply and Demand**

The UWA has evaluated the existing supply capacity, current demand, and projected year 2015 demand for the agricultural, domestic - urban, tourism and rural, and industrial use sectors. Other sectors, such as hydropower and recreation are not easily quantified since the potential for multi-purpose utilization exists. (Data on water requirements to support faunal and floral habitats, although quantifiable, are not available.)

The estimated 1985 supply capacity and the estimated 2015 demands for the respective sectors are shown in Table 25 (after UWA 1985) and summarized below:

- The south-draining basins use about 89% of the present supply (775 Mm<sup>3</sup>/year, comprising 747 Mm<sup>3</sup> from local sources and 28 Mm<sup>3</sup> imported from the Blue Mountain North Basin); and account for 93% (959 Mm<sup>3</sup>/year) of the 1985 demand and 91% (1434 Mm<sup>3</sup>/year) of the year 2015 demand. Against these, the south contributes 52% (2209 Mm<sup>3</sup>/year) of the total national reliable yield.
- The Kingston, Rio Cobre and Rio Minho-Manchester Highland Basins use 76% (590 Mm<sup>3</sup>/year) of the supply to the south, with the corresponding demand figures being 79% for 1985 and 60% for year 2015. However, included in the supply is 40 Mm<sup>3</sup> from Cockpit Springs in Rio Minho and potentially 60 from Ferry Springs in Rio Cobre, both of which have water usage limitations because of unsatisfactory quality. As a result, the resource availability-demand relationship is unfavourable.
- Of the total supply capacity of 532 Mm<sup>3</sup>/year to the Kingston, Rio Cobre and Rio Minho Basins, agriculture uses 70%; the Kingston Metropolitan Area uses 23%; urban centres in the Rio Cobre Basin use 5%; and urban centres in the Rio Minho Basin use 2.6%.

FIGURE 22

# JAMAICA - HYDROLOGIC BASINS AND WATERSHEDS

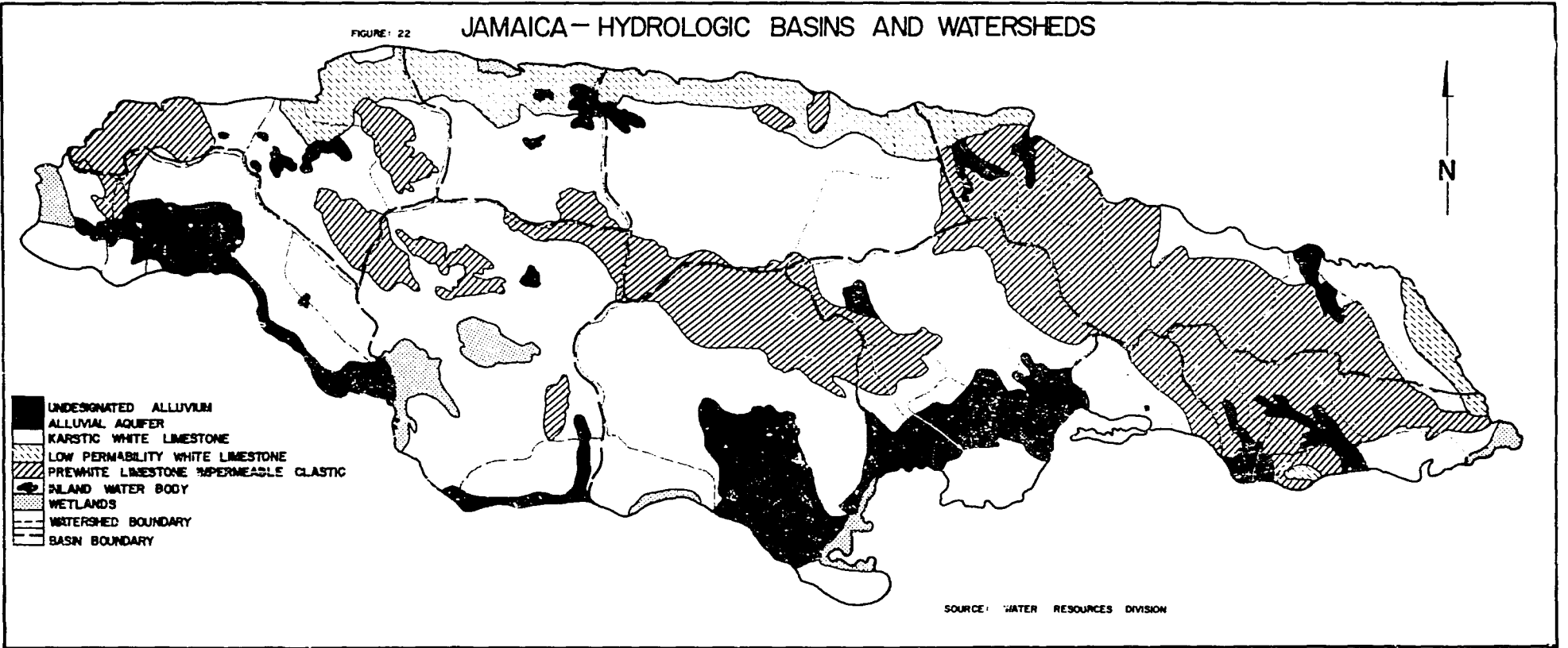
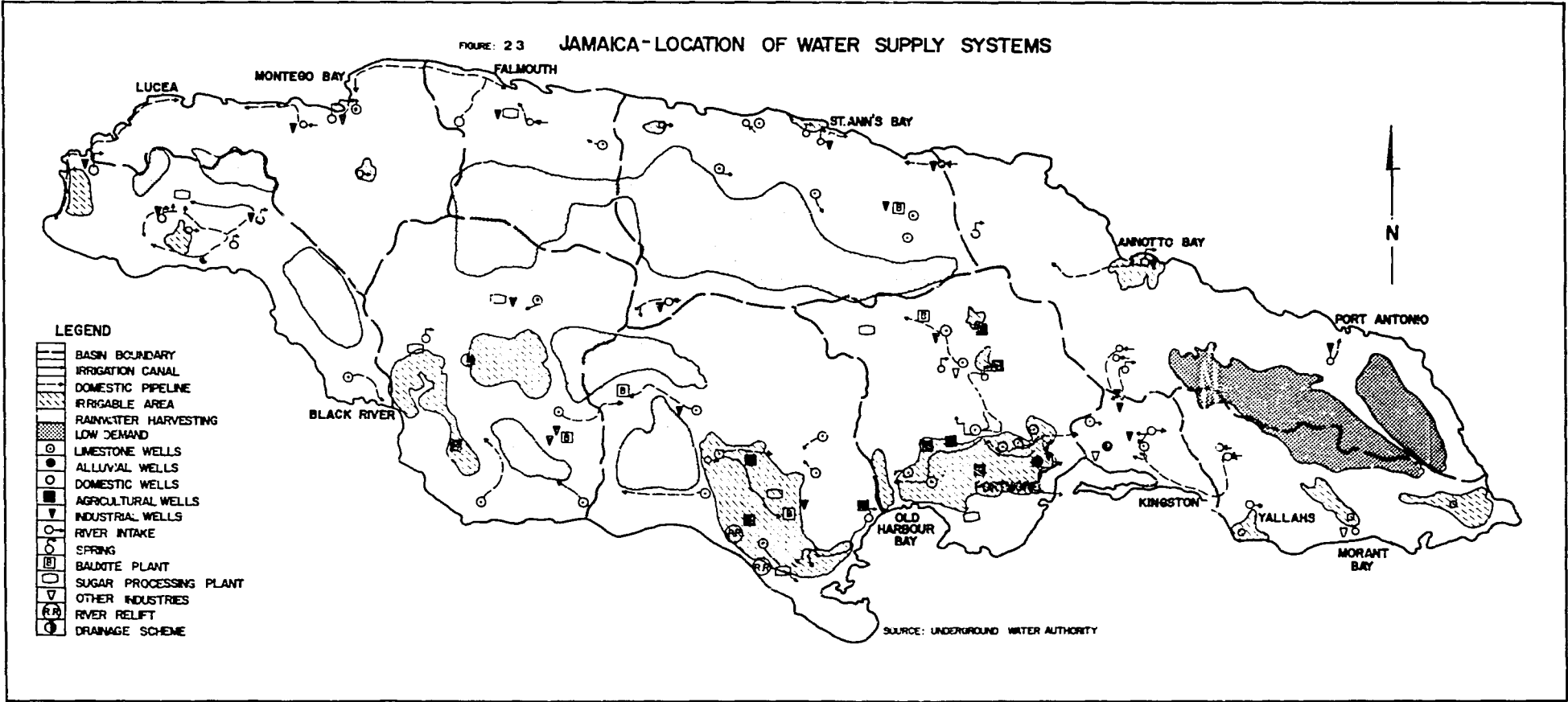


FIGURE 2.3 JAMAICA-LOCATION OF WATER SUPPLY SYSTEMS



**Table 25:**  
**Distribution of Demand and Supply**

USE SECTORS	BASINS	Blue Mtn. (S)	Kingston	Rio Cobre	Rio Minho etc.	Black River	Cabaritta River	Great River	Martha Brae River	Dry Harbour Mtn.	Blue Mtn. (N)	TOTAL	
		(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	Amt.	%
<b>1985 DEMAND</b>													
Rural (2)		1.7	0.9	3.3	5.7	3.1	2.3	2.5	1.2	3.1	3.2	27	3
Urban (3)		2.0	72.7	25.4	9.2	2.5	3.7	10.0	1.2	5.7	5.6	139	13
Industry		1.0	5.8	14.0	19.0	18.5	6.0	2.0	2.4	2.4	-	73	7
Agriculture		11.2	2.0	197.3	400.3	134.9	16.5	2.2	5.0	9.3	12.0	790	77
TOTAL	Amt.	15.9	81.4	240.0	434.2	159.0	28.5	16.7	11.6	20.5	20.8	1029	100
	%	1.5	8.0	23.5	42.0	15.5	3.0	1.5	1.0	2.0	2.0	100	
<b>2015 DEMAND</b>													
Rural (2)		4.3	2.4	8.6	13.0	6.5	4.9	6.0	3.1	6.9	6.7	62	4
Urban (3)		2.6	89.3	36.0	10.6	2.7	4.5	13.7	2.6	7.2	6.1	175	11
Industry		1.0	13.5	14.0	19.0	18.5	6.0	4.6	4.2	2.4	-	83	5
Agriculture (4)		60.5	2.0	280.5	372.5	355.6	107.5	2.2	26.0	12.2	30.7	1250	80
TOTAL	Amt.	68.4	107.2	339.1	415.1	383.3	122.9	26.5	35.9	28.7	43.5	1570	100
	%	4.5	7.0	21.5	26.0	24.0	8.0	2.0	2.0	2.0	3.0	100	
<b>1985 SUPPLY</b>													
Rural		1.1	1.0	1.9	5.8	4.8	1.3	1.9	1.3	0.9	2.7	23	3
Urban		2.7	23.2	29.0	9.3	3.5	4.7	10.5	1.7	6.1	8.9	100	11
Industry		1.0	5.8	14.0	19.0	18.5	6.0	2.0	4.2	2.4	-	73	8
Agriculture		11.2	2.0	174.3	201.0	126.5	16.5	2.2	5.0	9.3	12.0	560	64
SUB-TOTAL		16.0	32.0	219.2	235.1	153.3	28.5	16.6	12.3	18.7	23.6	756	
EXPORT		26.5	< 0.1	32.5	8.3	8.3	3.9	0.2	10.3	1.8	28.1	120	14
TOTAL		42.5	32.0	251.7	243.4	161.6	32.4	16.8	22.5	20.5	51.7	875	100
Local Capacity	Amt.	16.0	119.0	227.6	235.8	154.5	29.5	29.2	12.5	19.1	24.7	875	100
	%	2.0	13.5	26.0	28.0	18.0	3.0	3.0	1.5	2.0	3.0	100	

1. South Draining Basins. Others north draining.
2. Per Capita of 25 m<sup>3</sup>/year (1985) and 50 Mm<sup>3</sup>/year (2015)
3. Per capita of 100 m<sup>3</sup>/year except Kingston and Rio Cobre - 120 Mm<sup>3</sup>/year
4. Product of Unit Demand (m<sup>3</sup>/ha/yr. x 10<sup>3</sup>) x Area (ha.)

**Agriculture.** The agricultural sector utilizes about 64% of the present supply capacity of 875 Mm<sup>3</sup>/year. Irrigation water supplied from publicly developed resources falls under the auspices of the Ministry of Agriculture, and is controlled through local Irrigation Authorities under the Irrigation Act of 1956. The Authorities presently in place are: Houndslow (Black River Basin); Mid-Clarendon (Rio Minho Basin); St. Dorothy and Charlemont (Rio Cobre Basin); and Braco (Dry Harbour Mountain Basin). An Authority has not been established for the Rio Cobre Irrigation Works.

The amount of irrigable and irrigated lands, as well as unit water demands, in each basin were estimated by the UWA (1985) using data from the Comprehensive Resource Inventory and Evaluation System (CRIES, 1983 and Hall, et. al., 1984). (See Table 26.)

Water demand in each basin was also estimated by UWA, which assumes the gross cropping pattern indicated in Table 26. (The category classified as "varied" includes sugar cane, for which water requirements it was assumed would suffice for most crops excluding those in the

rice and fish farming categories.) The data indicate that the Rio Cobre and Rio Minho Basins together account for 80% of the irrigated area of 41,940 hectares and 64% of the estimated total irrigable area of 76,010 hectares.

However, inefficient use of irrigation water now occurs in the Rio Cobre and Rio Minho Basins, as indicated by the current high unit demand. With the potential for increase in irrigable area, priority should be given to improving the management of irrigation water.

Domestic. Domestic water distribution is the responsibility of the National Water Commission (NWC) of the Ministry of Public Utilities. The domestic sector uses about 27% of the present supply capacity of 875 Mm<sup>3</sup>/year. The per capita consumption rate currently used for design purposes is about 100 m<sup>3</sup>/year in urban areas outside of Kingston and Montego Bay. Although the criterion for rural designs is not known, Stanley, et. al. (1980) indicated about

15 m<sup>3</sup>/year, and the value for tourism is about 400 m<sup>3</sup>/year. UWA estimated present demand using these design values. For the year 2015 projection, UWA assumed the same values for urban areas and tourism, and an increase to 50 m<sup>3</sup>/year/person for the rural areas.

Industrial. The industrial sector, including industries with privately developed water systems, uses about 8% of the present capacity of 875 Mm<sup>3</sup>/year. Small industries with low water requirements are supplied from the domestic water supply systems. The bulk of the industrial water is used by the bauxite mining and processing and sugar processing companies.

#### Unquantified Water Demands

Water is also used to generate hydropower and for recreation. (Water is also required for environmental reasons, e.g., to maintain wildlife habitats, but, as noted above, this demand requirement has not been quantified.)

**Table 26:**  
**Distribution of Irrigated and Irrigable Land and Unit Demands**

BASINS	A R E A (1)						Unit Demand (Varied Crops) (2)	
	Irrigated			Irrigable			1985	2015
	Varied Crops	Rice (4)	Fish (3)	Varied Crops	Rice (4)	Fish (3)		
Blue Mtn. (S)	810			5600			13.75	10.80
Kingston	160			160			12.35	12.35
Rio Cobre	11600	(5)	400	20200		800	15.80	12.50
Rio Minho etc.	21160		100	27000		1000	18.75	12.50
Black River	1810	2470	30	4550	6500	400	12.50	10.80
Cabaritta River	1200			1200	2100		13.75	13.75
Great River	200			200			10.80	10.80
Martha Brae River	400			2400			12.50	12.50
Dry Harbour Mtn.	600			1000			15.40	12.50
Blue Mountain (N)	1000			2900			12.35	10.80
<b>TOTAL</b>	<b>Crops</b>	<b>38940</b>	<b>2470</b>	<b>530</b>	<b>65210</b>	<b>8600</b>	<b>2200</b>	
	<b>Grand</b>	<b>41940</b>			<b>76010</b>			

1. Units for Area = hectares<sub>3</sub>(ha).
2. Units for Unit Demand = m<sup>3</sup>/ha/year x 10<sup>3</sup>
3. Unit demand taken as 45 x 10<sup>3</sup> m<sup>3</sup>/ha/year
4. Unit demand taken as 35 x 10<sup>3</sup> m<sup>3</sup>/ha/year
5. About 400 hectares are being put into rice. Not accounted for in water demand.



**Table 27:  
Hydropower Facilities**

River	Design Discharge (CFS)	Design Head (Ft.)	Capacity Power (MW)	Basin
Roaring River	100	500	4	Dry
Upper White River	225	230	3.2	Harbour
Lower White River	180	378	4.5	Mountains
Rio Bueno	170	295	2.4	
Black River	300	290	6.0	Black River

Hydropower Facilities. There are currently five hydropower facilities, the largest being located in the upper reaches of the Black River. Table 27 lists these facilities and the design discharge committed to power generation.

Feasibility studies have been completed on the hydropower generation capabilities of several other rivers: Great River (Great River Basin); Laughlands Great River (Dry Harbour Mountain Basin); Buff Bay, Swift and Spanish Rivers and Rio Grande (Blue Mountain-North Basin); Yallahs and Morant Rivers (Blue Mountain-South Basin); and Rio Cobre (Rio Cobre Basin).

Recreation. Several waterfalls have been developed as inland tourist attractions. Among these are: Dunns River Falls (Ocho Rios area of Dry Harbour Mountains Basin); Somerset and Reach Falls (both in the Blue Mountain-North Basin); and Y.S. River Falls (Black River Basin). Rafting is practised on the lower reaches of the Rio Grande (Blue Mountain-North Basin), Martha Brae River (Martha Brae River Basin) and the Great River (Great River Basin). The Black River is used for recreational purposes and has potential for sport fishing.

There are also about 35 thermal and non-thermal mineral springs utilized for recreational, and reportedly therapeutic, purposes. Among these are Bath (Blue Mountain-South Basin); San Souci and Windsor (Dry Harbour Mountain Basin); Burton and Spring Garden (Great River Basin); Black River Spa (Black River Basin); Milk River (Rio Minho - Manchester Highland Basin); and Rockfort (Kingston Basin).

## **INSTITUTIONS AND LEGISLATION**

### **Government Agencies**

Numerous government agencies are involved in the management and regulation of Jamaica's water resources, under the authority of several water-related laws dating back to 1922. The major agencies, and their authorizing legislation, are listed in Table 28, categorized as regulatory, resource management or developmental.

### **Private Sector**

Private involvement in the water resources sector is mainly concerned with design and construction of water supply and other water works. Industrial and agricultural enterprises develop and operate water supplies.\* Consulting and contracting engineering services evaluate supply sources and design and construct water works under contract with the Government or private sector organizations.

### **Non-Government Organizations**

Various non-governmental organizations provide assistance to the sector through funding and provision of equipment and personnel. Among

---

\* Licences for the use of groundwater are obtained from the Underground Water Authority.

Table 28:

## Government Institutions and Agencies Involved in the Water Resources Sector

AGENCY	FUNCTION
<b>Regulatory</b>	
Underground Water Authority	Administers Underground Water Control Act of 1959, including licensing of well abstraction.
Natural Resources Conservation Division	Administers Watershed Protection Act of 1963 and Beach Protection Act. Controls developments in watersheds.
Environmental Control Division	Administers Public Health Act of 1974 (Revised). Provides standards for domestic water consumption and waste disposal.
Ministry of Agriculture	Administers Irrigation Act of 1956 through local Irrigation Authorities.
National Water Commission	Administers Act of 1980. Includes resource regulation.
(No agency assigned)	Water Act of 1922. Purpose is to control development and use of surface water resources. Scheduled for amalgamation with UWA.
Mines and Quarries Division	Administers Mining Act of 1947. Also controls water developments in areas under mining lease.
<b>Resource Management</b>	
Underground Water Authority <sup>1</sup>	Evaluates and manages water resources availability.
Natural Resources Conservation Division	General environmental management.
Meteorological Division	Investigates climatic factors, including rainfall.
<b>Developmental</b>	
National Water Commission <sup>2</sup>	Develops and operates domestic water supply systems.
Irrigation Authorities	Manage and operate local irrigation water supply systems.
Petroleum Corporation of Jamaica	Develops water resources as required for its operations.
Natural Resources Conservation Division	Develops watersheds, beaches and National Parks.
Various Government Agencies	Develop and manage irrigation systems in areas where they are located (e.g. sugar and banana cultivations).
Caribbean Engineering Company	Constructs water supply systems for Government agencies (e.g., National Water Commission).
Urban Development Corporation	Develops, manages and markets domestic water supplies (e.g., Runaway Bay Water Company).

<sup>1</sup>Formerly Water Resources Division; amalgamated in April, 1985.

<sup>2</sup>Parish Councils formerly responsible for rural supplies; amalgamated in late 1985.

these are: United Nations Development Program (UNDP); Food and Agricultural Organization (of United Nations) (FAO); United Nations Children Fund (UNICEF); Inter-American Development Bank (IADB); World Bank (WB); United States Agency for International Development (USAID); Canadian International Development Agency (CIDA); Overseas Development Agency (England) (ODA); Japan International Development Agency (JIDA); and Division for International Cooperation, Israel (DIC).

## PLANS AND PROGRAMS

### Ongoing and Proposed Projects

Data on some of the major water supply systems for the urban domestic, agricultural and industrial sectors are shown in Table 29, with some indication of their capability to meet the present and year 2015 demand. Major ongoing and proposed projects are described briefly below.

Blue Mountain Multi-Purpose Project. Completed by SWEEO for the National Water Commission in 1980, this project would involve diversion, storage and transmission of water from the Blue Mountain (North) Basin to the Kingston Metropolitan Area. Hydropower and domestic water are potential products of the Project.

Small Scale Hydro-Power Study. Under this study, which is being done for the Petroleum Corporation of Jamaica (PCJ) with support funding from CIDA, ten projects have been identified as feasible and are under consideration for construction.

Clarendon Plains Irrigation Developmental Programme. The purpose of this UWA project is to improve irrigation and water management in the Clarendon Plains on the south coast.

Flow West Project. This was done for the National Water Commission by Reid Crowther and Partners Limited and Joint Consultants in 1983. The objective is to collect and treat sewage from the Kingston Metropolitan Area and use the treated effluent for irrigation in the St. Catherine Plain (Rio Cobre Basin).

National Water Resources Development Master Plan Project. Being undertaken by the Underground Water Authority, the Government of Israel and the United Nations Development

Programme, this plan should provide a dynamic framework for the optimal utilization of the islands' water resources.

## ISSUES AND PROBLEMS

Key issues and problems in the water resources sector are related to inadequate source investigation, difficulty in satisfying water demands, variation in water quality, and institutional and legislative inadequacies. These problems and issues are discussed briefly below.

### Inadequate Source Investigation

A number of existing and potential problems appear to be attributable to inadequate source evaluation prior to implementation of developmental projects. These are summarized in Table 30.

### Satisfying Water Demand

Some problems in satisfying water demand are related to natural causes — in particular, the uneven distribution of water resources caused by climatic, geological and physiographical factors. Additionally, geology, physiography and watershed condition restrict the siting of dams. Dams located in the karstic limestone areas would be subject to high leakage and consequently low storage, and unfavourable slopes and high erosion adversely limit many otherwise favourable sites in the non-limestone areas.

There are also man-made problems related to satisfying water demand:

- High distribution/transmission losses of up to 30%, especially in the urban centres like Kingston, Montego Bay and May Pen;
- Poor irrigation water management with consequent low irrigation efficiencies in the plains of Clarendon and St. Catherine; and
- Inappropriate cropping patterns; for example, the cultivation of water-consumptive crops such as rice, in water-deficient areas such as the St. Catherine Plains, rather than concentration of such enterprises in sections of St. Elizabeth and Westmoreland where surface water is plentiful.
- Improperly managed watersheds which tend to increase surface runoff and, consequently, reduces ground water recharge.

**Table 29:**  
**Data on Main Water Supply Systems**

SECTOR UNIT	Service Area and Quantity	Source		COMMENTS
		NAME	Capacity (Mm <sup>3</sup> /yr.)	
URBAN DOMESTIC (POPULATION x 10 <sup>3</sup> )	Kingston 500 (1)	Hope River (R)/Mona Limestone (LS) Wells	x 7	Capacity seem adequate for year 2015 demand of 105 Mm <sup>3</sup> /year. Problems caused by high system losses, limited capability for intra system transfers, and seasonal source fluctuations.
		Alluvial Wells	x 6	
		Yallahs R	(6) 32	
		Wag water R/Hermitage	(7) 28	
		Up. Rio Cobre Ls. Wells	(2) 12	
		Lr. " " " "	(2)	
		TOTAL	108	
URBAN DOMESTIC (POPULATION x 10 <sup>3</sup> )	Portmore 67 (2)	Up. Rio Cobre Ls. Wells	x 2	Expansion from present sources for year 2015 demand of 10Mm <sup>3</sup> /year.
		Alluvial " "	x 4	
		TOTAL	6	
URBAN DOMESTIC (POPULATION x 10 <sup>3</sup> )	Montego Bay 65 (3)	Reading Spring	x 2	Solutions, to present inconsistent quantity and quality of import, and high system losses; needed for year 2015 demand of 14 Mm <sup>3</sup> /year.
		Limestone Wells	x 7	
		Martha Brae Ls. Wells	(8) 10	
		TOTAL	19	
URBAN DOMESTIC (POPULATION x 10 <sup>3</sup> )	Mandeville 40 (4)	Porus Ls. Wells	x 3	Commissioning of import in 1986 should provide sufficiency for year 2015 demand of 6 Mm <sup>3</sup> /year.
		Pepper Ls. Wells	(5) 8	
		TOTAL	11	
AGRICULTURE (HECTARES x 10 <sup>3</sup> )	Clarendon (Clar.) Plains 21.3 (4)	Alluvial Wells	x 38	Respective potential areas of 28,000 & 21,000 hectares, requiring 370 and 280 Mm <sup>3</sup> /yr with cropping pattern as at present i.e. varied crops. Both need: - irrigation efficiency increase from about 30% to say 60%; increased conveyance facilities, and less water consumptive crops. - optimal utilization of sub-quality water from Cockpit and Gut Rivers (Clar. Plains) and Ferry River (St. Catherine Plains). - possible storage facilities on Rio Minho and Rio Cobre.
		Limestone Wells	x 105	
		Cockpit River	x 39	
		Recycling	x 20	
		TOTAL	202	
AGRICULTURE (HECTARES x 10 <sup>3</sup> )	St. Catherine Plains 11.5 (2)	Alluvial Wells	x 27	Respective potential areas of 6700 and 4750 hectares requiring 210 and 145 Mm <sup>3</sup> /year. Present, and also projected cropping pattern, estimated as 45%, 57% and 2% respectively for varied crops, rice and fish farming. Systems require improved, and expanded irrigation infrastructure.
		Limestone Wells	x 36	
		Rio Cobre Canal	x 104	
		Recycling	x 20	
		Clar. Plains Ls. Wells	(3) 8	
		TOTAL	195	
AGRICULTURE (HECTARES x 10 <sup>3</sup> )	Upper Morass 1.7 (5)	Limestone wells	x 20	Respective potential areas of 6700 and 4750 hectares requiring 210 and 145 Mm <sup>3</sup> /year. Present, and also projected cropping pattern, estimated as 45%, 57% and 2% respectively for varied crops, rice and fish farming. Systems require improved, and expanded irrigation infrastructure.
		Black River	x 112	
		TOTAL	114	
AGRICULTURE (HECTARES x 10 <sup>3</sup> )	Lower Morass 2.6 (5)	Limestone Wells	x 6	Respective potential areas of 6700 and 4750 hectares requiring 210 and 145 Mm <sup>3</sup> /year. Present, and also projected cropping pattern, estimated as 45%, 57% and 2% respectively for varied crops, rice and fish farming. Systems require improved, and expanded irrigation infrastructure.
		Y.S. River	x 6	
		TOTAL	12	

- (1) Kingston Basin  
(3) Great River Basin  
(5) Black River Basin  
(7) Blue Mountain (North) Basin

- (2) Rio Cobre Basin  
(4) Rio Minho - Manchester Highland Basin  
(6) Blue Mountain (South) Basin  
(8) Martha Brae River Basin

x = Local Sources

Blank = Imported Sources

**Table 30:**

**Problems Related to Inadequate Source Evaluation**

Name of Scheme	Existing/Potential Problems	Cause/Comments
Port Antonio Water Supply Source	Under Utilised Treatment Plant	Project was originally based on the use of surface water from Rio Grande. Subsequently groundwater utilization (induced) was decided, making the treatment plant constructed redundant.
Queen of Spain Valley Well Source (to Montego Bay)	Fluctuating turbidity and well output	No integrated investigation of area prior to construction of scheme, and thereby insufficient understanding of the turbidity problems associated with well development in karstic limestone aquifers.
Ferry Spring Water Supply (potentially to Kingston)	Increased water levels due to impoundment have caused reduced flow. Anticipated separation of brackish and fresh water has not been achieved.	No investigations of groundwater environment prior to construction.
Yallahs River Diversion to Kingston	Likely reduction in irrigated water supply in Yallahs Delta	Diversion is likely to affect low river recharge to the alluvial aquifer - the likely source for irrigation water supply.
Hog Hole diversion from Rio Cobre Irrigation Canal to Spanish Town	Reduced flow, in excess of domestic take off, for irrigation in lower St. Catherine Plains	Hydraulic characteristics of canal changed by dam - resulting in reduced capacity.
Allumina effluent (Red Mud) Disposal sites	Pollution of ground and surface sources at Ewarton and Moneague, and groundwater at Essex Valley. Potential problem in Rio Minho - Manchester Highlands Basin.	Location of sites without sufficient investigation of characteristics of flow in the karstic limestone aquifers.
Victoria Banana Farms at Paranassus in Clarendon Plains	Washouts during high rainfall as occurred in November 1985.	Inadequate investigation of surface run off characteristics of the Rio Minho.
Proposed Morass Draining Projects (Upper and Lower Morass - St. Elizabeth)	Potential damage to bio-habitats in the coastal wetland.	

## Water Quality

Natural water quality problems are reflected in:

- High turbidity in many limestone aquifers (e.g., Queen of Spain Valley), because of high conduit velocities associated with ground-water movement in karstic aquifers.
- Salinisation of coastal springs (e.g., Ferry, Gut River, and Cockpit Springs), possibly because of the high transmissivity and low storativity of the associated karstic aquifer. (An alternative hypothesis is that a low permeability barrier, formed by some coastal limestones fringing the coast, is absent in these areas.)
- High turbidity in rivers originating in non-karstic limestone areas like the Blue Mountain (North and South) Basins.

Man-made water quality problems are generally associated with changes in the environment (some with deleterious effect) as a result of development. There are many examples, including:

- Salinisation of limestone aquifers caused by localised over-development in the Clarendon and Lower St. Catherine Plains;
- Nitrate contamination of the Liguanea Plains alluvial aquifer caused by the growth and urbanization of Kingston without planned sewage systems;
- Increased erosion and resultant heavy sedimentation of rivers, caused by road construction and inappropriate agricultural practices in watersheds with a high proportion of pre-limestone karstic (e.g., Yallahs and Hope Rivers);
- Potential damage to the environment if control measures are discontinued, as is possible in the Essex Valley area of the Black River Basin, consequent on the closure of the Alpart Plant;
- Pollution of streams caused by lack of effluent disposal standards, as in the cases of Rio Cobre at Bog Walk, Cabarrita and Black River, and the potential for contamination of the Hope and Yallahs Rivers by agrochemicals; and,
- Potential nitrate contamination of the limestone aquifers of the Kingston Basin if high density urban developments of the limestone

wells is continued without appropriate waste disposal systems.

## Legislative and Institutional Problems

The main legislative problems are:

- The absence of a National Water Act incorporating the Underground Water Act and the Water Act. Because there is no comprehensive water resources legislation, it is not mandatory to conduct environmental impact assessments prior to implementation of projects. Those that are done are discretionary, for example, the feasibility studies on power generation from peat by the PCJ, or are requested by the Beach Control Authority and Town and Country Planning authority; and,
- Inclusion, within the National Water Commission Act, of provisions for resource evaluation and control which appear to be conflicting with the principal role of the NWC as a developmental agency.

The main institutional problems are:

- The non-representation of the UWA on the Town and Country Planning Authority, which requires input on water resources for its proper functioning;
- Insufficient financial and manpower resources to conduct appropriate evaluations of the ground and surface water resources;
- The lack of resources to support adequate monitoring, documentation and record keeping by the agencies responsible for resource management; and,
- The absence of a National Irrigation Commission, which would provide functions for irrigation, similar to those provided by the NWC for domestic water.

## DIRECTIONS FOR THE FUTURE

There is need for several types of improvements in the water resources sector:

1. Basin studies to accurately determine the resources available for development. This is especially required for the south-draining Basins, where the present and potential demands are concentrated.

2. Improvement of the institutional and management capabilities in achieving greater efficiencies in water use; and, protection and conservation of water quality and quantity in view of the present incidences of over-development of aquifers and contamination of ground and surface waters by industrial effluents.
3. Further rationalization of the legislation governing the water resources sector, since the present situation creates potential for conflict of interest within some agencies.
4. Provision of adequate financing.

**Programs Required to Improve Management of the Water Sector**

Table 31 lists programs that are recommended to improve the management of the water sector. Implementation should be possible by December, 1986, since work has started on most of the programs and the financial requirements are expected to be modest.

Additionally, the private sector could assist development in the sector by funding research programs at the University of the West Indies, providing scholarships for professional and technical training of personnel required in the sector, and developing public awareness of the need to protect and conserve water. The non-governmental agencies should continue their traditional support of the sector and increase their support for professional training in order to reduce the sector's dependence on expatriate personnel.

**Recommended Projects**

Table 32 lists the projects recommended for development of the water resources sector. The projects, with the exception of item 3, are recommended for implementation in the short term (1 to 3 years); project No. 10 should extend to the long term (3 to 10 years) range. Estimated total financial resources required for implementation is J\$223M, of which J\$80.0M would be required in the short term and the balance annually up to 10 years.

Project	Requirements	Benefits
<b>Regulatory Investigation</b>		
National Water Act	Completion of draft, sector review, enactment of legislation, gazetting.	Integrate fragmented water resources legislation. Provide for enforcement of updated legislation.
Amend Section 29 (1) of National Water Commission Act	Sectoral discussion on relevance of section, gazette change.	Concentration of authority for water resources management in the National Water Act. Avoid duplication of function.
<b>Development Legislation</b>		
Establish Rio Cobre Irrigation Authority	Implement provisions of the Irrigation Act.	Adequate management of the Rio Cobre irrigation system.
<b>Streamline Water Sector</b>		
National Water Plan	Project underway. Requires continued input of manpower and financial resources for continued updating.	Guidelines for administration of National Water Act.
Representation on Town and Country Planning Authority	Name Managing Director of UWA as member.	Representation by water resources agencies on organization responsible for natural planning.

**Table 32:  
Recommended Projects**

Projects	Benefits	Requirements	Duration (years)
1. Extend continuous streamflow, water level and rainfall monitoring	Improve data base for development of supplies	J\$4.5 million for exploratory Drilling (30 x 200' x 16 wells and 30 x 200' x 16 coreholes) \$2.5M, Continuous Recorders (10 x Rainfall, 10 x streamflow and 10 x water levels \$0.6M Gauging Stations (10 x Rainfall and 10 x Streamflow) \$0.8M	3
2. Basin Studies of Rio Cobre, Rio Minho, Martha Brae and Aqualta Vale area of Blue Mountain - North	Accurate basins for planned water consumptive agricultural development	J\$3.0M for drilling (J\$2.0M) and Professional and Technical support (6 months/Basin = J\$1.0M)	2
3. Other Basin Studies	Provide information for future development	J\$3.5M for drilling (J\$2.0M) and Professional and Technical support (6 months/Basin = J\$1.5M)	3
4. Waste Disposal, and Agricultural Water Source, Potential of Liguanea alluvial aquifer	Alternative to securing and provision of irrigation water	J\$2.0M for Evaluation (J\$1.0M and preliminary design [J\$1.00M])	0.5
5. Leak detection survey - Kingston, Montego Bay and May Pen	Conserve Water. Delay need for new sources	J\$2.0M for Professional and Technical Support	0.5
6. Integration of Sources Kingston	As for 5	As for 5	0.5
7. Improve Irrigation water use in Clarendon and Lower St. Catherine	As for 5	J\$2.0M for Professional and Technical support	1
8. National Cropping Program	As for 5	As for 6	0.5
9. Extend National Water Quality Monitoring	Inform on effect of industrial and agricultural development on water quality	Item (J\$2.0M)	1
10. Implement recommendations of Jamaica Rural Water Supply Study (Stanley et al - 1980)	Improve rural water	J\$200M	10



### Annex 1: Major Watersheds in Jamaica

(Source: UNDP/FAO Tech.Rep. 9;1973)

<u>Watershed</u>	<u>Approx. Acreage</u>
Northwest Coast	99,000
Great River	100,200
Reading	12,200
Montego Bay	59,000
Martha Brae	162,000
St. Ann	311,600
Moneague	98,200
Rio Neuvo	29,000
Oracabessa	36,100
Fosters Cave	6,000
Water Valley	17,000
Wag Water	62,000
Buff Bay River	112,000
Rio Grande	66,000
North East Coast	67,300
Plantain Garden	46,000
Port Morant	26,000
Morant River	47,000
White River	12,000
Yallahs Town	8,000
Yallahs Valley	44,200
Cane River	18,200
Hope River	19,000
Liguanea	29,000
Fresh River	22,300
Rio Cobre	158,000
Salt Island Creek	65,000
Coleburn Gully	44,300
Rio Minho	430,000
Bull Savannah	66,000
Black River	378,200
Cabaritta River	155,000
New Savannah River	17,400



Plate 20 - Dam on Rio Cobre above old Power Station.



Plate 21 - Crocodile at Hope Zoo.

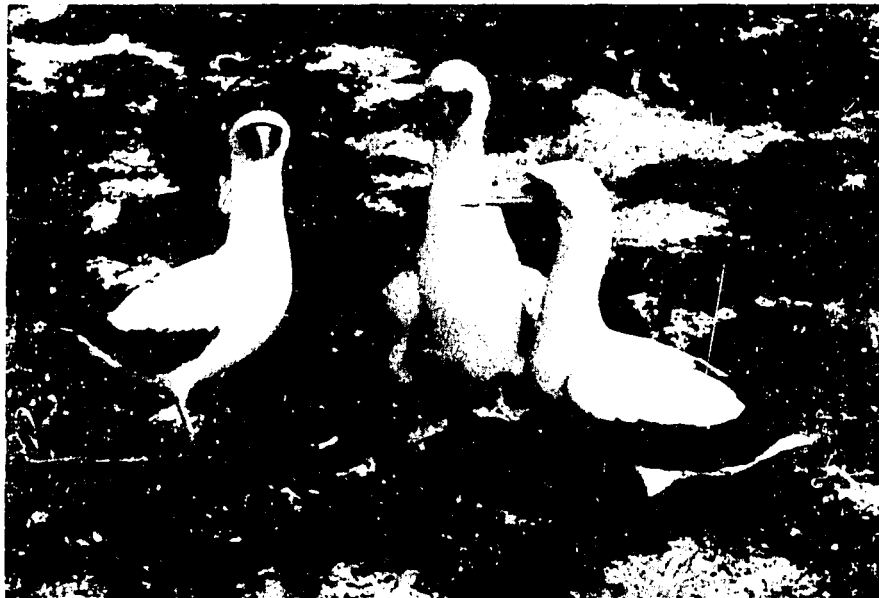


Plate 22 - Birds on Pedro Cays.

## WILDLIFE RESOURCES

---

### OVERVIEW OF WILDLIFE

A large proportion of Jamaica's wildlife (indigenous animals and plants) are found nowhere else in the world, i.e., they are endemic. Groups which have high ratios of endemic to total species include birds (27:256 breeding species); bats (4:23); lizards (20:24); frogs/toads (15:19) and orchids (46:200); ferns (82:579); flowering plants (784:3000). (See Table 33.) Jamaica's marine ecosystems are also among the most diverse in the Caribbean as are her forests, especially montane forests.

There are many species of actual or potential economic use but the potential of wildlife resources is generally underestimated. At least eight species of vertebrates have become extinct in the last 150 years and many more species of animals and plants are endangered, threatened or rare. The main threats are habitat destruction, particularly in coastal and forested areas, uncontrolled exploitation and predation by introduced species.

There is an urgent need for effective habitat protection, support for agencies working with the wildlife sector, public education, investment, research, monitoring, revision of legislation, and increased law enforcement. If these problems are not addressed in the short term, a significant proportion of Jamaica's natural heritage will be irretrievably lost.

### Major Ecosystems

It is unwise to consider animals and plants in isolation from their habitats, and therefore these are also considered briefly here. All remaining areas of natural and seminatural vegetation are under threat. The lowland forests which once dominated the coastal plains have been totally cleared. Mid and upper level forests are under unprecedented pressure and are being cleared at rates in excess of 3% per annum (Eyre, 1986). Natural ecosystems such as wetlands and coral reefs are also under pressure.

No satisfactory description and categorization of the major ecotypes of Jamaica has been written. Various systems have been designed (e.g., Lack, 1974; Asprey and Robbins, 1953; see Figure 24), but these are not adequate. They need to be revised in the light of present knowledge and recent changes in the environment. Much research is required on the ecology of terrestrial ecosystems.

All the natural ecosystems of Jamaica are currently under threat. Some, including the original lowland hardwood forests which covered the majority of the coastal plains, have been totally lost and others have been reduced to very small relict areas (e.g., riverine forest and swamp forest). There has probably been a consequent loss of endemic species.

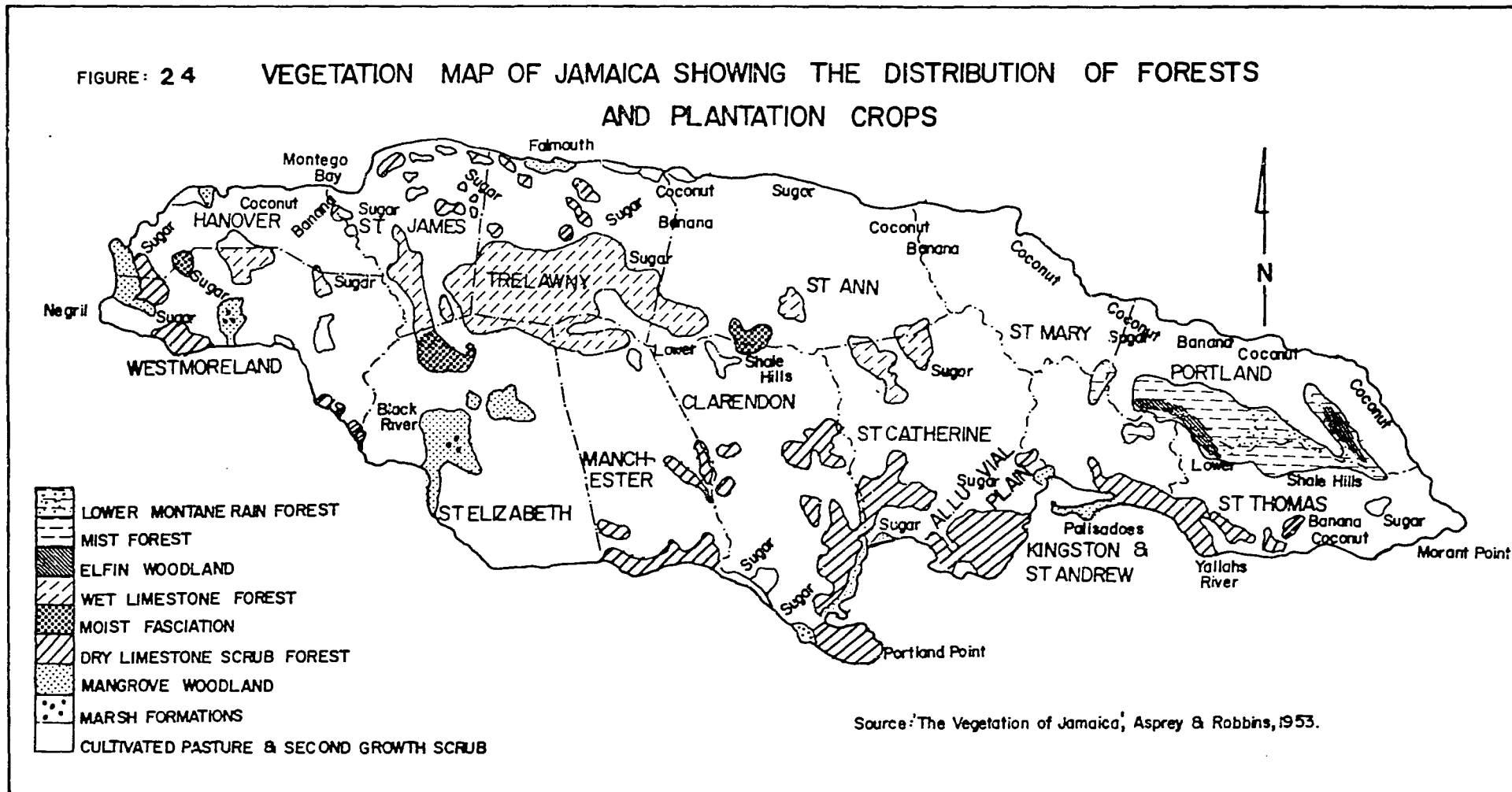
**Table 33:**  
**Some Examples of Levels of Endemism in Various Groups of Plants and Animals**

Phylum	Class	Group	Total No. of Species Present	Endemic Species		
				No.	%	
<b>Plants</b>			Total plants	c3,000	784	27
1. Angiosperms (Flowering Plants)		Orchids & Bromeliads	267	82	31	
2. Gymnosperms (Ferns)			579	82	13	
<b>Animals</b>						
<b>1. Invertebrates</b>						
a. Coelenterata		Hard Corals (Scleractinia)	64	0	0	
b. Porifera (Sponges)						
c. Onychophora			5	4	80	
d. Arthropoda	Crustacea Insecta	Total insects	c6,000	?	?	
		Mosquitoes (Culicidae)	66	20	36	
		Butterflies (Lepidoptera)	16	17	15	
		Jumping Spiders (Salticidae)	26	20	77	
		Hoverflies (Syrphidae)	56	15	27	
		Robber Flies (Asilidae)	24	14	83	
		Fireflies (Lampyridae)	48	45	94	
		Caddisflies (Trichoptera)	39	28	72	
		Dragon Flies (Odonata)				
e. Molluscs		Land Snails	c400	many	?	
		Fresh Water Snails		?	?	
		Marine Molluscs		?	?	
f. Echinoderms		Brittle Stars	22+	0	0	
		Holothurians	20+	0	0	
		Ophiurids	30+	0	0	
<b>2. Vertebrates</b>						
	Pisces (Fish)	Freshwater	25	2	8	
		Marine	c500	0	0	
	Amphibia (Amphibians)	Frogs and Toads	19	15	79	
	Reptilia (Reptiles)	Snakes	6	5	83	
		Lizards	24	20	83	
		Crocodiles	1	0	0	
		Freshwater Turtles	1	1	100	
		Marine Turtles	5	0	0	
	Aves (Birds)*	(Breeding species only)	120	27	21	
	Mammalia		36			
		Bats (Chiroptera)	23	4	17	
		Rodents	5*	2	40	
		Sirenia	1	0	0	

\*Including introduced species.

FIGURE: 2 4

VEGETATION MAP OF JAMAICA SHOWING THE DISTRIBUTION OF FORESTS AND PLANTATION CROPS



Source: 'The Vegetation of Jamaica', Asprey & Robbins, 1953.

An effective National Parks and Protected Area system is now required. In order to provide for the survival of as many endemic and indigenous species as possible, examples of all of Jamaica's natural ecosystems should be included. The following are examples of major ecotypes:

- Wetlands and mangroves
- Dry limestone forest
- Wet limestone forest
- Xeric coastal scrub
- Elfin forest
- Riverine forest
- Swamp forest
- Estuarine areas
- Montane forest
- Upper montane forest
- Coastal forest
- Offshore cays
- Inshore cays
- Thorn scrub
- Freshwater wetland
- Rivers
- Lakes
- Turtle grass beds
- Coral reefs
- Lagoons
- Salinas

The above is not intended to be an exhaustive list. Neither are the categories mutually exclusive. These categories are intended to indicate the major ecosystems whose protection must be considered in the creation of a national park and protected area system, if wildlife conservation is to be meaningfully addressed in Jamaica. Sites of scientific interest are listed in Table 34.

### **Animals and Plants**

Mammals. Terrestrial mammals are represented in Jamaica by the endemic Jamaican Hutia or Coney (Geocapromys brownii), and 23 species of bats. Hutias were once common but subsistence hunting and habitat destruction have reduced their range. Populations will continue to decline as habitat is destroyed. Bat populations may be suffering from disturbance resulting from the mining of their accumulated droppings from caves. The droppings are used as fertilizer.

The West Indian Manatee (or Sea Cow) Trichechus manatus is the most frequently encountered aquatic mammal. The population is in the order of 100 individuals. Despite protection under the Wild Life Protection Act, manatee

populations continue to decline as a result of hunting. Bottlenose Porpoises (Tursiops truncatus) are fairly abundant. Various species of whales are occasionally encountered in Jamaican waters. There have been several incidents of beaching of whales on the coast.

Introduced mammals which are pests include mongoose, rats and mice. There are also feral populations of cats, dogs, goats, and pigs.

Birds. The checklist of birds of Jamaica includes 256 species, 108 of which are known to breed in Jamaica, and 27 of which are considered endemic. Many species are threatened by habitat destruction and hunting. Almost all species are protected under the Wild Life Protection Act. Hunting seasons for doves and pigeons are sometimes declared. Some Columbids are pests of rice and sorghum.

Amphibians and Reptiles. Jamaica's amphibians and reptiles are very varied and interesting. There are high levels of endemism in all groups. Little is known of their status, ecology and distribution. There are no poisonous snakes. Marine turtle populations continue to decline despite protection. Crocodiles may be in danger in Jamaica but the status of their population requires research.

Invertebrates. Jamaica has many unique and interesting invertebrates. Particularly high levels of endemism are found amongst insects and terrestrial molluscs and much work needs to be done on terrestrial species. Jamaica's coral reefs are the best studied in the Caribbean.

Plants. The number of flowering plants in Jamaica is estimated to be about 2,800 species, this is roughly twice the number of species found in the British Isles (which is about 25 times bigger), and about the same as inhabit Sri Lanka (which is six times bigger). There are about 550 species of ferns in the island, whereas Sri Lanka and the British Isles have 250 and 66 species, respectively.



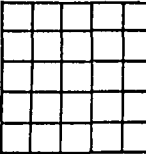

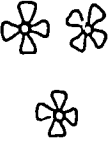
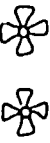
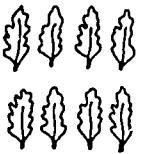


Not only is the Jamaican flora rich, but there are more than 20% endemic species, or in other words these species are restricted to this island alone (whereas in Trinidad, Lesser Antilles and Puerto Rico, the percentages of endemic species are 7%, 12%, and 13%, respectively. (See Figure 25.) It has often been stated that Jamaica represented a centre of high endemism.

Many plants may be expected to have horticultural, genetic, and pharmaceutical values which

**Table 34:  
Some Proposed Sites of Scientific Interest for Wildlife\***

<u>NAME OF AREA AND LOCATION</u>	<u>REASONS FOR PROTECTION</u>	<u>TYPE OF PROTECTION REQUIRED</u>
Mason River Field Station Kellits Clarendon	Only inland wetland in Jamaica. Presence of rare and endemic plants.	Site of special scientific interest (SSI). Ramsar site.
Middle Cay Morant Group South Cay Pedro Group	Nesting site for terns and turtles.	SSI. Fish Sanctuary Wildlife Reserve
Roselle St. Thomas	Only known breeding location for Blue Swallowtail.	SSI. Wildlife Reserve Forest Reserve
Parottee Pond St. Elizabeth	Major area for waterfowl.	SSI. Wildlife Reserve
Pedro Pond St. Elizabeth	Major area for waterfowl.	SSI
Dolphin Head Mountain	Major area for flora. Fireflies.	SSI. National Park
Fresh River St. Catherine	Remnant Riverine forest.	SSI
Styx River St. Elizabeth	Interesting swamp vegetation.	SSI
Island Viewhill Cockpit Country	Endemic species of plants.	SSI
Waterfall near Hardware Gap	Endemic species of plants.	SSI
St. Claire Cave St. Catherine	Large bat population.	SSI
White Rock Hill St. James	Endemic plant species.	SSI
Roundhill Clarendon	Endemic plant species and presence of permanent study areas.	SSI
Peckham Woods Clarendon	Endemic plant species.	SSI
Croft Mountain  Clarendon	Endemic plant species.	SSI
Windsor Estate Trelawny	Unique cave system.	SSI
West Harbour St. Catherine	Fish nursery.	Fish sanctuary (included in Portland Bight National Park)
Ecelesdown (Priestman's River) St. Elizabeth	Important area for insects.	Scientific reserve
Cornpuss Gap Millbank	Butterfly area ( <u>P. homerus</u> ).	Included in John Crow Mountain National Park
Morant Point St. Thomas	Undisturbed swamp.	National Park
Jackson Bay Coves	Large caves including endemic species.	Included in Portland Bight National Park
All remaining natural and semi- natural forests	Important for indigenous species of birds, plants, etc.	See Proposed National Park sites

Figure 25: Comparison of the Number of Species of Flowering Plants and Ferns in Jamaica, Sri Lanka and the British Isles

	JAMAICA	SRI LANKA	BRITISH ISLES
AREA	 4,411 sq. mi.	 25,332 sq. mi.	 94,214 sq. mi.
FLOWERING PLANTS	 2,800 spp	 2,600 spp	 1,500 spp
FERNS	 550 spp	 250 spp	 66 spp

are yet to be discovered. Orchids, ferns, bromeliads, gesneriads, and tree ferns are among the groups which have so far attracted attention but much work remains to be done.

**Endangered Plants and Animals**

At least eight species of animal have probably become extinct in the past 150 years. The extinctions have been attributed to the introduction of species (e.g., mongoose, cats), habitat destruction and exploitation. (Farr 1984).

About five species of animal and many species of plant are considered endangered according to international definitions although much work remains to be done on the status of most species. Many of Jamaica's endemic species are dependent on the forests and will be seriously affected if current rates of deforestation continue. (Oliver, 1986). (See Tables 35 to 39.) Continuing destruction of remaining natural coastal ecosystems is also a serious threat.

**Animals and Plants of Ecological and Economic Value**

The value of the "free services" provided by wild species has not been evaluated. For example, the role of columbids in seeding forest trees; of trees in protecting watersheds; of wild species as sources of food; bush medicines;

craft materials, etc., as part of Jamaica's heritage, have not been investigated. Genetic values have not been assessed. No estimates have been made of the percentage of species which remain to be discovered and many areas are essentially undescribed.

Jamaican wildlife has an unassessed importance to tourism, in the enhancement of the natural beauty of tourist areas. In this respect, the value of inland areas and south coast for tourism is largely untapped. The development of National Parks would undoubtedly be of immense value to the tourism sector as well as of benefit to wildlife.

There are also many species of potential for economic development. Activities in Papua, New Guinea have shown how wildlife resources may be developed in harmony with the natural environment. Crocodiles, butterflies, orchids, algae and many plants with potential horticultural value, could, with some ecological research and development, serve as adjuncts to the economy of rural areas.

This is of great importance because poverty is the single most serious threat to wildlife resources. If wildlife is to be saved, the people who are currently affecting the resources by their activities must be given more profitable and ecologically acceptable forms of employment.



Table 35:  
Critically Endangered/Extinct Species of Wildlife

COMMON NAME	SCIENTIFIC NAME	ENDEMIC	LEGAL PROTECTION (W/LPA)	STATUS	DESCRIPTION & DISTRIBUTION	THREATS & SOLUTIONS
Caribbean Monk Seal	<u>Monachus tropicalis</u>		✓	Probably extinct as a result of overhunting.	Similar to Hawaiian Monk Seal. Very abundant prior to C17 especially on off-shore cays.	
Jamaican Iguana (Guana)	<u>Cyclura collei</u>	✓	✓	Probably extinct as a result of habitat disturbance, hunting, and mongoose predation. Last specimen recorded 1969 (mumified).	Southern plains and dry limestone forests. Once common. If any individuals are left, they are in Hellshire.	Hellshire should be declared a National Park and core habitats protected and surveyed.
Giant Galliwasp	<u>Diploglossus (Celestis) occidus</u>	✓		Probably extinct for about 100 years.	Two foot long skink. Last specimen taken from Black River area, may have been swamp dwelling.	No data
Black Racer	<u>Alsophis alter</u>	✓		Probably extinct.	Black snake about 3½ feet long.	Probably destroyed by mongoose.
Jamaican Rice Rat	<u>Oryzomys antillarum</u>	✓		Extinct since 1900.	A brown and yellowish rat with whitish feet. It was probably a lowland species as it was a pest in sugar cane.	Disappearance corresponded with the introduction of the mongoose. It was particularly vulnerable because of its diurnal habits.
Jamaican Paragule	<u>Siphonorhis americanus</u>	✓	✓	Last recorded 1859.	No data	No data
Jamaican Macaw	<u>Ara gossei</u>	✓	✓	Existence not confirmed by specimens. Extinct.	No data	No data
Black-capped Petrel (Blue Mountain Duck)	<u>Pterodroma hasitata caribaea</u>			Extinct in Jamaica.	Has been rediscovered in Dominican Republic.	Mongoose, hunting, habitat destruction.

Table 36:  
Endangered Species of Wildlife

COMMON NAME	SCIENTIFIC NAME	ENDEMIC	LEGAL PROTECTION	STATUS	DESCRIPTION & DISTRIBUTION	THREATS & SOLUTIONS
Plain Pigeon (Blue Pigeon)	<u>Columba inornata exigua</u>		✓	Very rare.	Confined to forested mountainous areas.	Habitat Protection required in National Park system.
Golden Swallow	<u>Kalochelidon euchrysea</u>		✓	Very rare and local.	Found in Cockpit Country high elevations.	Reason for decline not known.
West Indian Manatee	<u>Trichechus manatus</u>		✓	Rare and declining. Population probably fewer than 100.	Large aquatic mammal valued for meat. They mainly occur on the south coastal shelf.	Subsistence hunting. Enforcement, monitoring and public education must be increased
Giant Swallowtail	<u>Papilio homerus</u>	✓	✓	Occasional in a few localities.	Largest swallowtail in western hemisphere. Found in John Crow Mountains and Cockpit Country.	Threatened by collecting and habitat destruction. Forests in major population centers threatened by plantations of coffee and pine. Habitat protection urgently required.
Black Coral	<u>Antipathes spp.</u>		partial	Rare and local.	Found below depths of 60 ft. (20m).	Threatened by collection for jewelry trade. Protected under Beach Control Act which prohibits collecting but not sale or possession. Addition W.L.P.A. proposed. Habitat protection in Marine National Parks.

Table 37:  
Some Threatened Species

COMMON NAME	SCIENTIFIC NAME	ENDEMIC	PROTECTION	STATUS	DESCRIPTION & DISTRIBUTION	THREATS & SOLUTIONS
Jamaican Hutia	<u>Geocapromys bownii</u>	✓	✓	Population still healthy but declining. (Oliver 1982, 1984)	Rodent about the size of small rabbit. Mainly nocturnal. Inhabits rock crevices and bushes in wooded hilly areas.	Rapid deforestation of habitat and increased intrusion by dogs could soon threaten this species. Increased subsistence hunting and wasteful hunting practices are also a threat. A controlled reintroduction project is being undertaken by Jersey Wildlife Preservation Trust. Habitat protection urgently required.
American Crocodile	<u>Crocodylus acutus</u>		✓	Population healthy but declining. Numbers perhaps 2-5,000.	Found in most wetlands, especially on the south coast.	Destruction of coastal wetlands for housing, industry and agriculture is the main threat. Expansion of fish farming has increased conflicts with this species. Research into control of crocodiles in fish farms, public education, and law enforcement are required. Hunting of crocodiles for sport, skin and meat must be controlled. A crocodile reserve at Luana/Font Hill, St. Elizabeth was proposed by NRCD and is to be implemented by PCJ.
Marine Turtles						
Hawksbill	<u>Eretmochelys imbricata</u>		✓	All populations declining due to hunting and habitat disturbance.	Only the Hawksbill nests frequently on Jamaican beaches.	Hunting for shells, and eggs continues at a reduced rate since 1982.
Leatherback	<u>Dermochelys coriacea</u>		✓		Jamaica may have the largest nesting population of Hawksbill in the Caribbean (Bacon, et.a. 1982)	
Green	<u>Chelonia mydas</u>		✓		Nesting takes place all round the island.	Public education, enforcement, habitat protection and research are all urgently needed.
Kemps Ridley	<u>Lepidochelys kempi</u>		✓			
Loggerhead	<u>Caretta caretta</u>		✓			
West Indian Whistling Duck	<u>Dendrocygna arborea</u>		✓	Declining.	Found in Bahamas, Cuba, Haiti, Dominican Republic and Jamaica, Cayman Island, Puerto Rico, Virgin and Leeward Islands.	Cause for decline probably habitat destruction, disturbance and hunting. Requires habitat protection.

2.

Table 37: (cont.)

COMMON NAME	SCIENTIFIC NAME	ENDEMIC	PROTECTION	STATUS	DESCRIPTION & DISTRIBUTION	THREATS & SOLUTIONS
Ring-tailed Pigeon	<u>Columba caribea</u>	✓	✓	Status not known but probably declining.	Forested hills.	Threatened by uncontrolled hunting and habitat destruction. Habitat protection required.
Jamaican Blackbird (Wild Pine Sargent)	<u>Neopar nigerimus</u>	✓	✓	Status not known but probably declining.	Forested mid-level hills.	Deforestation could be threatened by Glossy Cowbird if this invades Jamaica.
Black-billed Amazon	<u>Amazona agilis</u>	✓	✓	Declining.	Forested mid-level hills.	Deforestation, pet trade. Law enforcement and habitat protection required.
Yellow-billed Amazon	<u>Amazona collaria</u>	✓	✓	Declining.	Forested mid-level hills.	Deforestation, pet trade. Law enforcement and habitat protection required.
Jamaican Yellow Snake	<u>Epicrates subflavus</u>	✓		Declining.	Widely distributed.	May be affected by hunting and deforestation. Education and habitat protection required.
Sooty Tern	<u>Sterna fuscata</u>		✓	Declining, probably 30-40,000 breeding pairs.	Pantropical Seabird. Abundant in the Caribbean but declining throughout the region.	Decline attributed to commercial egg collection and habitat destruction.
Brown Noddy	<u>Anous stolidus</u>		✓	Declining, probably 1,000-2,000 breeding pairs.	See above.	See above.
All Wetland Species			Some	Declining.	Wetlands (form about 2% of Jamaica's land area).	Throughout the Caribbean, wetlands are being filled and used for development with serious consequences for fauna and flora.

**Table 38:  
Some Examples of Rare Species**

COMMON NAME	SCIENTIFIC NAME	ENDEMIC	LEGAL PROTECTION	STATUS	DESCRIPTION & DISTRIBUTION	THREATS & SOLUTIONS
Masked Duck	<u>Oxyura dominica</u>		✓	Rare and local throughout range.	Restricted to small inland pools, rivers, and wetlands.	Drainage of pools, hunting. Habitat protection and law enforcement needed.
Blue Swallow-tail	<u>Eurytides marcellinus</u>	✓		Locally and seasonally abundant.	Butterfly only known to breed in one area in St. Thomas.	Clearance of forest for charcoal production and agriculture. Habitat protection needed.
Pond Turtles	<u>Pseudamys jamaicensis</u>	✓		Locally common.	Small turtle found in fresh and brackish water pools and rivers.	Infilling of pools, wetlands, pollution of rivers. Habitat protection needed.
Bromeliad Crab	<u>Metapaulia depressa</u>	✓		Not known.	The only crab in the world which completes its entire life cycle bromeliads.	Clearing of forests. Habitat protection needed.
Ground Beetles	<u>Carabidae</u>	Several Species		Varies according to species.	Some species large and attractive to collectors.	Habitat destruction. Protection needed.
St. Elizabeth Minnows	<u>Cubaniethys pengellei</u>	✓		Not known.	St. Elizabeth	Changes to wells, river systems.
	<u>Cyprinodon jamaicensis</u>	✓		"	Central south coast.	Enforcement of regulations in the WLPA concerning effluents in rivers and use of traps required.
	<u>Eleotris perniger</u>			"	Large fresh water rivers only.	
	<u>E. smaragdus</u> <u>Ptereleotris</u> <u>sp. urdax</u> (undescribed)			"		
	<u>Pycnomma rosveili</u>			"		



Table 39 (cont.)

COMMON NAME	SCIENTIFIC NAME	ENDEMIC	LEGAL PROTECTION	STATUS	DISTRIBUTION	THREAT	POSSIBLE SOLUTION	COMMON NAME	SCIENTIFIC NAME	ENDEMIC	LEGAL PROTECTION	STATUS	DISTRIBUTION	THREAT	POSSIBLE SOLUTION		
Red Nickel cont'd.	<u>Rondeletia cincta</u>	✓		Endangered	Dolphin Head	-	A	Mountain Bay cont'd.	<u>Ilex puberula</u>	✓		Endangered	Waterfall near Hardware Gap	1	A		
	<u>Eupatorium dolphin</u>	✓		Endangered	Dolphin Head	-	A		<u>Eupatorium</u> sp. (new species)	✓		Endangered	Portland	1	A		
	<u>Bumelia</u> sp. (new species)	✓		Endangered	Dolphin Head	-	A		<u>Rondeletia</u> sp. (new species)	✓		Endangered	Arntully Gap, St. Thomas	1	A		
	<u>Jacquinia maerantha</u>	✓		Endangered	Peckham woods	1	A		OTHER FLOWERING PLANTS	<u>Cuervea kapplerana</u>			Endangered	-	1	A	
	<u>Ardisia byrsonimae</u>	✓		Endangered	Clarendon	1	A			<u>Anthurium venosum</u>			Endangered	Negril Hills	1	A	
	<u>Rondeletia clarendonensis</u>	✓		Endangered	Clarendon, St. Ann	1	A			<u>Coccoloba proctorii</u>	✓		Endangered	White rock hill	1	A	
	<u>Eupatorium hamatocladum</u>	✓		Endangered	-	1	A			<u>Guarea jamaicensis</u>	✓		Endangered	White rock hill	1	A	
	<u>Salvia clarendonensis</u>	✓		Endangered	Crofts Mountain	1	A			<u>Vernonia</u> sp. (new species)	✓		Endangered	White rock hill	1	A	
	<u>Lisianthus</u> sp. (new species)	✓		Endangered	-	1	A			Pancake Rose	<u>Nelumbo lutea</u>			Endangered	Pedro Ponds	1	A
	<u>Clusia</u> sp. (new species)	✓		Endangered	-	1	A				<u>Clidemia swartzii</u>	✓		Endangered	Near Ginger Hill St. Elizabeth	1	A
Mountain Bay	<u>Quina jamaicensis</u>	✓		Endangered	-	1	A	Anchovy Pear		<u>Grias cauliflora</u>	✓		Endangered	Black River Morass	1	A	
	<u>Psychotria dura</u>	✓		Endangered	-	1	A	Sapodilla		<u>Manilkara excisa</u>	✓		Endangered	Cockpit country	1	A	
	<u>Phialanthus revolutus</u>	✓		Endangered	Hellshire Hills, St. Catherine	1	A			<u>Rondeletia amplexicaulis</u>	✓		Endangered	-	1	A	
	<u>Catesbea parviflora</u>			Endangered	-	1	A		<u>Lobelia harrisii</u>	✓		Endangered	-	1	A		
	<u>Eugenia acutisepala</u>	✓		Endangered	Worthy Park Hills, St. Catherine	1	A		<u>Bernardia</u> sp. (new species)	✓		Endangered	-	1	A		
	<u>Turnera</u> sp. (new species)	✓		Endangered	Cane River Gorge St. Andrew	1	A		<u>Savia</u> sp. (new species)	✓		Endangered	-	1	A		
	<u>Lisianthus cordifolius</u>	✓		Endangered	-	1	A		<u>Buxus arborea</u>	✓		Endangered	Island View Hill	1	A		
	<u>Heppiella corymbosa</u>	✓		Endangered	-	1	A		<u>Ternstroemia calycina</u>	✓		Endangered	Trelawny	1	A		
	<u>Verbesina aspera</u>	✓		Endangered	St. Andrew, St. Thomas	1	A		<u>Schefflera troyana</u>	✓		Endangered	-	1	A		
									<u>Columnnea argentea</u>	✓		Endangered	Near Mandeville	1	A		
							<u>Mappia racemosa</u>				Endangered	Shooters Hill	1	A			

Table 39 (cont.)

COMMON NAME	SCIENTIFIC NAME	ENDEMIC	LEGAL PROTECTION	STATUS	DISTRIBUTION	THREAT	POSSIBLE SOLUTION
Sapodilla cont'd.	<u>Podocarpus</u> <u>pundicanus</u>	✓		Endangered	Mount Diablo	1	A
	<u>Myrcia skeldingii</u>	✓		Endangered	Near Mason River St. Ann	1	A
	<u>Calyptranthes</u> sp. (new species)	✓		Endangered	-	1	A
	<u>Psidium dumetorum</u>	✓		Endangered	-	1	A
	<u>Laplacea</u> sp. (new species)	✓		Endangered	-	1	A
	<u>Ocotea</u> <u>robertsoniae</u>	✓		Endangered	-	1	A
	<u>Eugenia</u> <u>lamprophylla</u>	✓		Endangered	-	1	A
	<u>Calyptranthes</u> <u>clarensensis</u>	✓		Endangered	-	1	A
	<u>Psidium</u> <u>harrisianum</u>	✓		Endangered	-	1	A
	<u>Dendropanax</u> <u>grandiflorus</u>	✓		Endangered	-	1	A

\* These are only the species which are known to be endangered.  
 Many more are undoubtedly endangered and undiscovered.

- C.D. Adams "Flowering Plants of Jamaica and G. Procter, "Ferns  
 of Jamaica provide a comprehensive list of Jamaica's flowering  
 Plants and Ferns as well as their status.

+ Threats: (1) Forest clearance + Solutions: A -National Parks and  
 (2) Collecting Protected Areas creation.  
 (3) Other 3 -Legal Protection



## AGENCIES AND INSTITUTIONS

The agencies and institutions with programs and activities affecting Jamaica's wildlife and wildlife habitat management include government and quasi-government agencies, as well as private organizations. The key agency for wildlife management is the Natural Resources Conservation Division, but several other agencies also contribute to wildlife and habitat management efforts.

### **Natural Resources Conservation Division (NRC D)**

Principal responsibility for the management of Jamaica's wildlife resources rests with the Ecology Branch of NRC D's Resource Management Division. The work of the Ecology Branch includes administration of the Wild Life Protection Act (WLPA), public education, species and ecosystems research and management, and habitat protection. One of the most important functions of the Branch is the protection of rare, endemic and endangered species and their habitats through administration of the WLPA. (See Legislation and Regulations.)

The Ecology Branch prepares a variety of public information materials, conducts educational programmes on wildlife topics, and works closely with other organizations to bring wildlife topics to the public. The Branch has also encouraged, sponsored, and carried out numerous wildlife research projects.

The Branch's development control activities include input to the conservation sections of proposed Development Orders, to the National Physical Plan, and to the Town Planning Department regarding proposed subdivision, building, and quarries developments and their potential effects on wildlife. With respect to development proposals under review, the Ecology Branch recommends environmental impact assessments (including wildlife impact assessments) when appropriate.

NRC D's National Parks Branch, Wetlands Branch and Watershed Engineering Division work with the Ecology Branch to implement programmes and activities relating to wildlife management.

### **Local Agencies and Institutions**

Several other agencies are also involved in

issues relating to wildlife management. They include:

#### Government

- NRC D (Ecology Branch, Wetlands Branch, National Parks Branch, Watersheds Engineering Division)
- Forest and Soils Conservation Department
- Fisheries Department
- Veterinary Division
- Phytosanitary Division
- Plant Protection Division
- Public Gardens Division (comprising Hope Zoo and the Royal Botanical Gardens)
- Rural Physical Planning Unit
- Natural History Division, Institute of Jamaica
- Trade Board

#### Quasi-Government

- National Heritage Trust
- Petroleum Corporation of Jamaica (PCJ)
- Jamaica Attractions Development Company (JADCO)
- Urban Development Corporation (UDC)
- Forest Industries Development Company (FIDCO)
- Coffee Industry Development Company (CIDCO)

#### Non-Government Organizations

- Natural History Society of Jamaica (NHSJ)
- Jamaica Junior Naturalists (JJN)
- Gosse Bird Club
- Jamaica Society of Scientists and Technologists
- Jamaica Geographical Society
- Jamaica Geological Society
- University of the West Indies (Zoology, Botany Geology and Geography Departments)
- Hope Zoo Trust
- Negril Society for Conservation of Nature
- Entity

Responsibilities of these agencies are summarized in Table 40.

### **International Affiliations**

Jamaica has ratified seven international agreements whose provisions have implications for wildlife. Ratifications of several more has been proposed. Jamaica is also a member of several international organizations.

**Table 40:  
Summary of Institutional Responsibilities  
for Wildlife Resources**

<u>AGENCY</u>	<u>AFFILIATION</u>	<u>RESPONSIBILITIES</u>
<b><u>Government</u></b>		
<b><u>NRCDEcology Branch (RMD)</u></b>	Department of Science & Technology, Ministry of Agriculture	Administration of Wild Life Protection Act, including conservation of birds and other rare, endemic and endangered species; control of exploitation of indigenous plants and animals; administration of hunting season; wildlife reserves and sanctuaries.  Habitat protection through liaison with National Parks Branch, other agencies and development control.  Comments on environmental impact assessments, wildlife exploitation proposals.  Design and implementation of projects for wildlife conservation and research.  Monitoring of status of wildlife populations.  Wildlife public education and materials development.  Liaison with NGO's.
<b>National Parks Branch (RCD)</b>		Proposal of National Parks areas, including critical wildlife areas.
<b>Wetlands Branch (ARD)</b>		Research and monitoring of wetland areas.
<b>Watersheds Engineering Division</b>		Protection of wildlife habitats through watershed conservation.
<b>Forest &amp; Soil Conservation Dept.</b>	Ministry of Agriculture	Development, research management and protection of forest resources.  Jurisdiction over Forest Reserves which are also Wildlife Reserves. Some Forest Reserves have been leased to FIDCO and CIDCO for pine and coffee plantations.
<b>Fisheries Division</b>	Ministry of Agriculture	Administration, research and management of fisheries resources (including some species of wildlife).
<b>Veterinary Division</b>	Ministry of Agriculture	Issuance of sanitary permits for import and export of species.
<b>Plant Protection Division</b>	Ministry of Agriculture	Issuance of phytosanitary permits for export of plants.

Table 40 (cont.)

AGENCY	AFFILIATION	RESPONSIBILITIES
Hope Zoo	Ministry of Agriculture	Maintenance of displays of selected indigenous species.  Captive breeding of indigenous and endemic species.  Public education.
Royal Botanical Gardens	Ministry of Agriculture	Maintenance of botanical gardens at Hope, Cinchona, Castleton and Bath.  Research into indigenous and introduced species.  Public education.
Rural Physical Planning Unit	Ministry of Agriculture	Production of soil capability and land use maps from remote sensing.
Natural History Division, Institute of Jamaica	Office of the Prime Minister	Maintains important reference collection of West Indian plants, animals and literature at museum.  Administers Mason River and Green Hills field stations.  Promotes conservation of flora and fauna, public education.
Trade Board		Administers trade laws with responsibility for some wildlife products.
Jamaica Defence Force	Ministry of National Security & Justice	Assists with law enforcement and specific projects.
Jamaica Constabulary Force		Assists with law enforcement.
<b><u>Quasi Government</u></b>		
National Heritage Trust	Office of the Prime Minister	Administers National Heritage Trust Law makes provision for protection of natural areas and species habitats.
Petroleum Corporation of Jamaica	Ministry of Mining and Tourism	Carries out environmental impact assessments for energy related projects.  Manages selected areas in PCJ lands including Royal Palm (Recreational) Reserve, proposed Luana Crocodile Reserve.
Jamaica Attractions Development Company	Ministry of Tourism	Administers selected wildlife projects, including Jamaica Swamp safaris.
Urban Development Corporation	Ministry of Construction	Manages and implements selected projects, including proposed Hellshire National Park and parts of Negril.
Forest Industries Development Co.	Ministry of Agriculture	Substitution of Jamaica's imported lumber with home grown pine, in some cases. Forest resources are being planted and natural forest felled and replaced by pine plantations.

Table 40 (cont.)

AGENCY	AFFILIATION	RESPONSIBILITIES
Coffee Industry Development Co.	Ministry of Agriculture	Development of coffee industry, some of which is on government owned forest lands and natural forests.
<b><u>Non-Government Organisations</u></b>		
Natural History Society of Jamaica	NGO	Promotes conservation of flora, fauna and habitats and areas of natural beauty mainly through field trips and talks.  Public education and wildlife projects.  Organises National Wood and Water Day.  Publishes "Natural History Notes".
Jamaica Junior Naturalists	NGO	Promotes conservation of flora, fauna, habitats with young people in schools and youth groups with emphasis on Mandeville area.  Publishes educational magazine for children "Crocodile News".
Gosse Bird Club	NGO	Promotes bird conservation.  Cooperates with NHSJ for national Wood and Water Day.
Jamaica Geological Society	NGO	Promotes knowledge of Jamaica's geology.
<b><u>University of the West Indies</u></b>		
Zoology Dept.	NGO	Promotes wildlife research.
Botany Dept.	NGO	Promotes botanical research.
Geography Dept.	NGO	Concern for deforestation.
Hope Zoo Trust	NGO	Upgrading and development of Hope Zoo.
Negril Society for Conservation of Nature	NGO	Promotes concern for all aspects of environment including flora, fauna, landscape.
Entity	NGO	Informal group which promotes conservation of natural and built environment.

International agencies which have assisted wild-life conservation in Jamaica include the Canadian International Development Agency (CIDA), Organization of American States (OAS), Marine Action Centre, United States Agency for International Development (USAID), and the US Peace Corps. Since its inception, the NRC D has received assistance from the United Nations Environment Programme (UNEP) and CIDA. In the case of UNEP, the emphasis has been on the creation of an effective institutional framework for resource management. Through CIDA, training programmes on resource management have been devised for NRC D staff. CIDA has also been instrumental in helping to establish guidelines for NRC D's Public Education Programme.

## LEGISLATION AND REGULATIONS

The most important law affecting the management of wildlife resources in Jamaica is the Wild Life Protection Act of 1973. In addition, all of the country's other environmental laws at least indirectly address wildlife or wildlife habitat management and protection. These other laws include the Beach Control Act, the Watershed Protection Act, the Forest Act, and the Town and Country Planning Act. The contents of some of the most important acts are summarized below.

### Wild Life Protection Act (1973)

The Wild Life Protection Act is administered by NRC D.

Protected Species. The WLPA provides for protected animals and makes it an offense to have in one's possession "the whole or any part of a protected animal living or dead". Protected animals include:

- All birds except those listed in the first part of Schedule II (birds which may be hunted in season) and those which are listed in the second part of Schedule II (pest birds which may be hunted at any time).
- Protected animals listed in Schedule III. These are:
  - Coney or Jamaican Hutia Geocapromys brownii
  - American Crocodile Crocodylus acutus
  - Jamaican Iguana Cylura collei
  - West Indian Manatee Trichechus manatus
  - Pedro Seal Monachus tropicalis

Hawksbill Turtle Eretmochelys imbricata  
 Leatherback Turtle Dermochelys coriacea  
 Loggerhead Turtle Caretta caretta  
 Green Turtle Chelonia mydas  
 Kemps Ridley Turtle Lepidochelys kempii

Protected Areas. The Act provides for Game Sanctuaries and Reserves. No hunting or egg collecting or guns or weapons capable of being used to hunt birds are allowed in Game Sanctuaries which include all areas specified in Schedule I of the Act. All Forest Reserves except the Peak Bay Reserve are Game Sanctuaries. There are no regulations governing land use under this Act.

### Other Provisions.

- Hunting. A hunting season may be declared for certain bird species under this Act.
- Fishing in Rivers. The Act specifies the types of trap which may be used to fish in rivers.
- Pollution of Rivers. It is an offense to discharge any substance into rivers which may kill fish.
- Dynamite. It is an offense to use dynamite to kill fish.

Enforcement. The Act is enforced by the NRC D. Powers under the Act are conferred on Game Wardens who nominally have extensive powers of arrest, entry to lands, search and seizure of property. In practice these powers are not exercisable. The NRC D augments its enforcement capabilities by creating Honorary Game Wardens to assist with enforcement during the Hunting Season. This system has been completely ineffective in controlling hunting.

The NRC D has attempted to create a system of paid conservation wardens who would have primary responsibility for enforcement and education of environmental laws. This system now needs financial support.

### Other Legislation

Beach Control Act. This Act, administered by NRC D, gives authority to control the exploitation of the floor of the sea and associated waters. Provisions which directly relate to wildlife are those which allow for the creation of Marine Protected Areas (these have been proposed and gazetted in Ocho Rios and Mon-

tego Bay) and for control of products from the floor of the sea. The collection of Black Coral is regulated under this act and other benthic marine organisms could be similarly protected. Developments up to 1 mile inland must also be approved by the Beach Control Authority.

Watersheds Protection Act. The Watershed Protection Commission can make regulations to NRCA to control land use in protected watersheds. The entire island has been declared a protected watershed.

Morant and Pedro Cays Act. Administered by the Fisheries Division, this controls access to, and exploitation of, the Morant and Pedro Cays and their resources, especially turtles and the eggs of the "Booby" terns.

Fishing Industry Act. Administered by the Fisheries Division, this act controls exploitation of organisms defined as "fish" for the purposes of the Act.

Forest Act. Administered by the Forestry and Soil Conservation Department, this Act provides for the creation of Forest Reserves.

Bark of Trees Act. Administered by the Forestry and Soil Conservation Department, this Act controls removal and sale of the bark of certain trees.

Town and Country Planning Act. This law administered by the Town Planning Department provides for the protection of selected trees under Tree Preservation Orders.

National Heritage Trust Act. Areas of importance, e.g., as habitat for certain species, may be protected under this Act, which is administered by the National Heritage Trust.

Trade Laws. There is a provision under Trade Law 4 which prohibits export of all raw (unprocessed) turtle shells. The NRCD advises when application for exemption are made.

Other. Other legislation which pertains to the environment includes acts relating to the Urban Development Corporation, Petroleum Corporation, CIDCO, and Harbours.

### **Control of Wildlife Exports and Imports**

Exports. There are no laws regulating quantities of exports of flora and fauna from Jamaica. Exporters generally require a phytosanitary certificate from the Plant Protection Division

(Ministry of Agriculture) or a certificate of health from the Veterinary Division of the same Ministry. Where the country to which they are going has signed CITES, export of listed species will also require a CITES certificate. NRCD is the designated authority for CITES and issues permits on a discretionary basis. CITES certificates are not issued for species collected in contravention of the WLPA and quotas may be applied (e.g., for orchids).

Imports. Imports of animals and plants are controlled under the law relating to quarantine by the Ministry of Agriculture.

### **PLANS AND PROGRAMMES**

Most of the proposed plans for research and protection of wildlife and habitats originate with NRCD. Some of these projects are funded significantly by foreign agencies, e.g., OAS or USAID.

#### **Recent and On-going Projects**

Recent and on-going projects include:

Alligator Hole River Project. A wetland wildlife management project which stresses conservation of manatees, public education, and resource development. A display centre has been constructed and will feature a display on the ecology of the area. Other features will include semi-captive manatees, nature trails and picnic sites. This project was jointly funded by OAS and NRCD.

Sea Turtle Population Assessment. The population of marine turtles in Jamaica has declined rapidly in the last 20 years due mainly to overfishing. Since 1982 all species have been protected under the ISFA. Marine turtles are also an international resource. A 1982 survey indicated that Jamaica had the highest population of Hawksbill turtles (Eretmochelys imbricata) in the Caribbean.

An intensive programme of sea turtle conservation including public education, headstarting, regulation of trade and research was abandoned in 1982 because of staff shortage at NRCD, but is still regarded as a priority.

It is hoped that a detailed evaluation of Jamaica's sea turtle stocks can be carried out in 1986-1987, if international funding is available.

Blue Swallowtail Research and Reserve Development. The Blue Swallowtail butterfly Eurytides marcellinus is endemic to Jamaica. It only breeds near Roselle in eastern Jamaica. A preliminary assessment of the ecology and distribution of this butterfly and proposals for its conservation was carried out by a Peace Corps volunteer in 1980-1982. The UWI and Natural History Society of Jamaica have cooperated in this project. Further work which is required in the future includes the development of a reserve featuring facilities for visitors and public education.

Fish Pond Predation Research. Jamaica has received assistance from USAID to develop fish farms as a protein source. Ponds in coastal areas suffer from predation by birds including brown pelicans, herons, and egrets. Crocodiles are also present in some ponds. Although all these species are protected, the main method of control is shooting. An NRC D project, carried out by a Peace Corps Volunteer and funded by USAID, has evaluated the extent of avian predation and will produce recommendations to reduce the effects in the form of a document which can be circulated to fish farmers.

"Booby" Tern Conservation and Research. "Booby" terns are exploited on the Morant and Pedro Cays for their eggs. Over-exploitation of eggs has caused the decline in the number of eggs collected from around 600,000 per annum in the 1920's to about 60,000 in the 1970's.

In 1982, the NRC D with the assistance of the JDF, the Fisheries Division and the fishermen on the Cays set up a base camp on Middle Cay of the Morant Group. The Cay was protected from eggging and research carried out. A strategy for management of the Cays has been developed, including the best way to protect the breeding population and to increase nesting habitat. It is hoped that the project will continue indefinitely.

Luana Point Wildlife Reserve. Initially proposed by NRC D, the Luana Point Crocodile Reserve is to be developed by the PCJ. The aims of the project have not been publicized, but may include displays and breeding facilities for American crocodiles, interpretive displays, nature trails, boating and camping, as well as protection of natural areas.

Manatee Population Assessment. From 1980 to 1982 NRC D carried out a series of aerial

surveys of manatees. Information was collected on dolphins and turtles. As a result the manatee population was estimated as not being more than 100. This survey needs to be repeated and updated at frequent intervals.

### **Examples of Proposed Projects**

The following serve as examples of the types of projects required. Generally what is required are active conservation projects, not research projects with no applied elements. In particular, projects which emphasize the development of wildlife as an economic resource should be stressed.

#### Species Projects

- o Captive Rearing of Giant Swallowtail Butterfly. The Giant Swallowtail (Papilio homerus) is the largest swallowtail in the western hemisphere and has considerable value for collectors. Habitat destruction is the major threat for this species as forests in its main habitat areas are being rapidly felled for plantation agriculture. NRC D has proposed, and will seek funding for, a project to investigate commercial captive rearing of this species on a village level scale. UWI is currently proposing to implement this project.
- o Jamaican Iguana Hunt. Proposed project to investigate whether any individuals of this endemic species remain in the Hellshire area.

Habitat Preservation Projects. The development of a system of National Parks and protected areas is essential for wildlife conservation. This should include large National Park sites which would be surrounded by buffer areas and zoned for various types of use. There would also be a need for other types of reserves including scientific reserves, and recreational reserves among others. A preliminary classification was included in the National Physical Plan 1974-1994.

Two Marine National Parks (at Montego Bay and Ocho Rios) have been gazetted but not enforced. The Marine Parks Action Committee has been entrusted with the task of creating a Marine Park system.

The development of comprehensive legislation, providing for establishment, management and fundraising of a system of National Parks and protected areas is urgently required (see National Parks sector report).

## PROBLEMS AND ISSUES

The main issue which affects the wildlife sector is habitat destruction caused by poorly sited development of all types. Other problems include over exploitation, for purposes of commerce, subsistence and sport. This stems from a lack of emphasis at any level on sustainable use. There is a need for a review of legislation to strengthen and update existing laws, and for the upgrading of the machinery for enforcement.

It must be emphasized that the basic causes of problems in the wildlife sector are ignorance, fear, poverty and greed. Until persons exploiting wildlife and wildlife habitats at subsistence level are provided with alternative more lucrative ways of making their living, and the country makes a commitment to sustainable use, as opposed to "mining" of resources, there can be no meaningful strategy for use of wildlife. All measures which fail to address these fundamental questions can only be regarded as stopgaps, with no real probability of success in a democratic country.

There are many ways in which natural resources can be managed sustainably. These methods usually benefit the rural communities who are the main stewards of the resources. If Jamaica is to regain, beyond the next 15 years, any meaningful portion of her rich and valuable national heritage, it is essential that priority be given to sustainable use at all stages of development. Attention must be given to implementation of the World Conservation Strategy and local environmental institutions must be rationalized, strengthened and supported.

The examples of Ethiopia, other African countries, and Haiti can be appreciated by all. Their acute political and social problems stem largely from a failure to use wisely their natural resources (especially fauna and flora). The problems listed below cannot be dealt with in isolation. A holistic approach is essential if the natural environment is to be saved.

### Habitat Destruction

Agriculture. The clearance of hillsides, primary forests, mangroves and swamp forests for a variety of agricultural purposes is the single most serious threat to the environment and wildlife. Clearance patterns are the result of distribution of land ownership and the pressures of market forces, both national and international. Among the crops which are being produced

in areas which might have been more appropriately designated for conservation are coffee, pines, ganja, vegetables, fish and shrimp. The problem is not the production of these crops but the lack of environmental impact assessment for agricultural projects, the lack of coordination between the various user groups and the apparent absence of any enforcement of regulations pertaining to land use (from the use of agricultural chemicals to the control of the use of "reserves").

Urban Development. The expansion of towns into their hinterlands in an apparently uncontrollable way, the creation of large new housing estates and even new towns in the 1970's and 1980's with very little concern for the environmental impacts as expressed by NRC D; the absence of machinery to ensure the enforcement of conditions and regulations, building and development which are drawn up by NRC D and other agencies to safeguard wildlife and other conservation interests, are serious local problems. The entire development of the Portmore area near Kingston is an environmental disaster. It is developed on an infilled mangrove swamp. The bridge installed to improve access to Kingston resulted in the destruction of one of the most productive fishing areas in the Kingston Harbour. Birds and crocodiles were also severely affected by the development. The development of neighbouring Hellshire New town has serious implications for the unique fauna and flora of the area which includes or included the Jamaican Iguana.

Road construction in remote areas which is carried out to provide work; to provide access to agricultural or industrial sites or to open areas for settlement also has serious implications when it is implemented without consideration of potential impacts on flora and fauna.

Industry. The activities of certain industries also have serious effects on wildlife. Examples are:

1. Bauxite Mining and Alumina Production. The early bauxite plants had fairly severe environmental consequences. Mining destroys the terrestrial features of the area mined which can never be replaced, even though most companies now take pains to rehabilitate the land after mining. Several areas of importance for indigenous orchids have been destroyed by mining. The Bayer process results in quantities of highly caustic red mud. The first ponds which were constructed were not properly sealed and caused pollution of



ground water. Transportation of bauxite, alumina and fumes from the processing plants are potential sources of air pollution which reduce plant production in certain areas. Loading operations at the various port and piers have resulted in aquatic pollution both from spillage of bauxite and alumina and oil.

2. Sugar Processing. The dunder which is the result of sugar processing seriously affects the rivers into which it is frequently dumped, on the south coast.
3. Coffee Processing. Coffee processing wastes are also frequently dumped into mountain streams with serious consequences for the aquatic life.
4. Solar Salt Production. Solar Salt production is resulting in the unnecessary destruction of mangroves in Portland Bight.
5. Peat Mining. Peat mining which has been proposed for the Negril Morass can perhaps be done in an environmentally acceptable way. After much study the question of whether peat mining is the best use of a significant proportion of Jamaica's dwindling wetlands has not yet been satisfactorily addressed.
6. Sand, Grave, Limestone and Mining. River sand mining as well as quarrying of limestone and related products appears to be increasing in an uncontrolled fashion. The implications for wildlife have not been assessed.
7. Infrastructure. The provision of services is sometimes considered without full evaluation of the ecological consequences. Road construction is discussed above. Recently a pipeline was put in from the Yallahs River to the Mona Reservoir to increase the water supply for Kingston. This was constructed without any input from the environmentalists and has resulted in massive landslips which may affect marine and aquatic productivity and siltation in the dam which the pipeline is supplying.

These serve to emphasize the urgent need for legislation making EIA compulsory for all projects above a certain size, and involving environmental agencies from the earliest stage in the planning process so that potential conflicts may be reduced.

## **Exploitation of Wildlife**

### Hunting

1. Sport. Columbids are hunted in season. The season is regulated by the NRCD through the WLPA. Regulations concern the species which may be hunted, bag limits, season dates, licenses and shooting days. In recent years these provisions have been ignored and this has resulted in a decline of the bird populations (Momot 1985). This type of hunting is largely an elite activity. There are several Gun Clubs which attempt to encourage their members to be more responsible in their attitude to the resources. Lack of enforcement capability and lack of support for enforcement initiatives are serious problems.
2. Subsistence. Small boys with catapults take many small birds in rural areas. The birds which are killed using catapults are usually eaten. It is not clear how far these birds are important as a dietary supplement for low protein diets. Country men also hunt wild pigs and coneys. How far this is done for sport and how important this is in diets is not known.
3. Pet Trade. Parrots are popular pets in Jamaica and abroad. Despite attempts to control this trade there is still intense hunting in some parts of the country (Cook 1984).

Egg Collection. The eggs of Sooty Sterna fuscata and Noddy Terns Anous stolidus are collected as luxury food items on the Morant and Pedro Cays. These birds have been the subject of a successful programme of research and management by NRCD in conjunction with the Fisheries Division, JDF Coastguard and UWI since 1982.

Legislation and Enforcement. The legislation controlling the exploitation of wildlife is much in need of revision and updating. There is an urgent need for legislation to provide for National Parks and Protected areas.

Other areas which need attention include:

The consolidation and rationalization of the number of laws dealing with wildlife and protected areas. This should be considered at

the same time that the role of the various agencies is evaluated. If there is to be any meaningful wildlife conservation in Jamaica, there must be a strong NRC D or an equivalent powerful central government agency. Thought must be given to the best way to achieve this. One possibility would be the creation of a Ministry of the Environment which would encompass the interests of all the environmentally oriented agencies. The Ministry of Science, Technology and Environment, which was created in 1984, was a step in the right direction but did not go far enough. Its collapse put NRC D in an unfavourable position.

In the short term the WLPA needs revision. Immediate steps which should be taken include the revision of the Schedules. In particular, the Giant Swallowtail and other invertebrates including Black Coral should be added to the list of protected species.

Thought needs to be given to which of the other species listed here should be added. The fines need to be significantly increased. Other changes have also been suggested in the text but these proposals were drawn up in 1980 and require revision and further thoughts in the light of recent developments. The proposal put forward by NRC D that Jamaica should adhere to the Convention on Trade in Endangered Species, and the Convention on Migratory Animals will necessitate some modifications to Jamaica's laws especially with respect to control of export and import of wild animals and plants.

One problem area is the current lack of legislation concerning protection of indigenous plants. In the short term this could be most simply addressed by changing the WLPA so that "protected species" is substituted for "protected animals" and "species" defined to include plants. Then selected plant species could be protected under the Act in the same way that animals are currently protected. Fines and penalties are in urgent need of revision.

Enforcement is currently handled mainly by a group of three Conservation Wardens employed by NRC D. This new group of officers was intended to be involved at community level with conservation law enforcement (mostly for wildlife), public education and data gathering. It was envisaged that there would be at least two officers per parish. The Conservation Warden system should be brought up to complement as soon as possible. Officers should be provided with transportation, radios, public education

materials and equipment and the other equipment essential for them to function.

The ongoing initiatives to increase support from the Jamaica Constabulary Force and members of NGO's and the public at large must be emphasized strongly.

### **Development Control**

As mentioned above there is an urgent need to upgrade the processes of development control. Measures required include:

- Introduction of legislation which will make EIA compulsory for certain projects including agricultural projects.
- Strengthening of NRC D, TPD and the Parish Councils or equivalent regional institutions so the regulations concerning development can be enforced and monitored. This includes building regulations and Development Orders.

### **Control of Introduction of Species**

In the past the introduction of species has apparently caused the extinction of many endemic species. Great care should be taken that new species are not accidentally introduced. Existing procedures need to be modified and NRC D included in the process of approval for importation of plants or animals.

Some species spread naturally. It is not known how the advent of the Cattle Egret affect Jamaican birds in the 1950's. The Glossy Cowbird Molothrus benairensis is spreading through the Caribbean but is not thought to have reached Jamaica yet. In other countries its parasitic habit has meant that it has severely affected endemic species.

### **Commercial Harvesting**

Corals. Several species of coral are affected by commercial harvesting. Black Coral Antipathes spp. is in great demand for the production of jewelry. Although collection is regulated under the Beach Control Act, there are no controls on sale and possession, and stocks have been severely depleted by uncontrolled harvesting. It is proposed to protect Black Coral under the WLPA. Thought must also be given to the protection of other species of coral which are currently being harvested and sold

on the north coast, often in a very wasteful fashion, with serious consequences for reef ecology. A recent request for a commercial licence to exploit corals for export was rejected by the NRCD.

Tropical Marine Fish. Some interest has been shown in the harvest of tropical marine fish for export. A license was granted for a trial period but there appear to be problems associated with this trade. Illegal operators using cyanide are potentially a serious problem and may already be damaging the reefs.

Seashells. Interest has been shown in commercial harvesting of Donax shells for jewelry. It initially appears that such harvest can be sustained in certain areas (given appropriate safeguards). Care needs to be taken to make sure that commercial collecting is adequately regulated.

Orchids. There is a small industry based on indigenous orchids. Commercial exploitation has been allowed on the basis that a certain amount of collecting would be needed to establish bench grown commercial stocks. However, there is evidence that the situation is being abused and the question of orchid policy must be reviewed as a matter of urgency.

The basic problem with permitting commercial exploitation of these and other species from the wild is that there is little knowledge about the ecology and population sizes and replacement rates of target species. Even more importantly, there is virtually no formal monitoring capacity. For these reasons many countries in the region have a complete ban on all exploitation and export (e.g., Belize).

### **Captive Breeding**

Interest has been shown in captive breeding of several species including parrots and Geotrygon versicolor. Proposals have also been received for captive breeding of alligators. The last request was discouraged because of the chance that escaped animals might become established in the wild. The Hope Zoo should be encouraged to develop its interest in captive breeding.

### **Contamination of Wildlife Habitat**

Effluent discharges are another problem. Dumping of sewage, garbage, chemicals industrial and agricultural wastes into streams, rivers, sinkholes, gullies and harbours affects the

ecology of aquatic systems. There is some patchy monitoring of water quality in certain areas by NRCD and the ECD but the lack of staff, analysis facilities and support of all kinds means that there are few prosecutions, publications or even publicity about water pollution problems as they affect wildlife. There is an urgent need for the development of standards for water bodies. There is also a need for the development of a system of biological indicators of water quality. These would greatly improve overall monitoring capabilities.

Oil pollution appears to be an increasing problem. "Tar balls" from the discharge of bilge water and tank cleaning at sea or illegally carried out in harbours are common. There are also regular problems with accidental spills resulting from damage to ships. An oil spill contingency plan has been drawn up which includes a response team from all the agencies involved. It is expected that this team will be able to deal efficiently with any major oil spills in the future. Oil spills can damage mangroves and result in the death of resident species of fish, shellfish, birds and benthic organisms especially turtle grass communities (B. Wade, 1980). The planned increase in coal burning facilities may be expected to cause the types of problems associated with acid rain.

The uncontrolled use of pesticides and fertilizers on crops may also contribute to the mortality of birds and aquatic species. No figures are available about the extent of this problem.

### **Staffing and Budgetary Constraints**

The basic problems affecting wildlife management in Jamaica are lack of staff, funds and institutional support. Proper wildlife management demands a complement of highly trained, well motivated staff. The current payment and career structure of the wildlife section means that although excellent staff may be attracted to work in the section they are unlikely to stay. Inadequate pay at the lower levels and poor job satisfaction at the upper levels, combined with impossibly frustrating working conditions, are the main problems. This applies not only in NRCD but at the other institutions with responsibility and interest in wildlife; e.g., the Institute of Jamaica Natural History Division, the Hope Zoo, and the University of the West Indies.

Consideration should be given to some amalgamation of the first three mentioned above, as

well as the National Parks Branch, possibly under the Office of the Prime Minister or the Ministry of Tourism. More integration of function would improve administration of wild-life policy and help to ensure the best use of limited resources.

The level of staffing required by the present Ecology Branch of the NRC D depends on the role which NRC D is to take in the future. However, the absolute minimum staff for this Section is One Branch Chief; one graduate to deal with general wildlife enforcement and related public education programmes; one dealing mainly with development assistance and policy; and a third dealing with specific projects. Major projects such as the Alligator Hole River Project requires additional full time graduate staff. There is also an urgent need for the provision of at least two Conservation Wardens per parish. All posts require upgrading.

It is also essential that sufficient funds be provided to ensure that commitments can be met. The implementation of all Ecology Branch projects has been drastically affected by cash flow problems.

An effort should be made to stress the crucial importance of wildlife for tourism and to make sure that funding is provided proportionally.

### **Public Awareness**

There is a general lack of public awareness of wildlife values. This is true at all levels of society, inside and outside the government. It has been shown in many other countries that the natural heritage is not valued until it is almost destroyed.

There is an urgent need for the development and promulgation of public education materials including audio visuals, displays including mobile museum and mass media events. There is also a crippling shortage of basic texts on wildlife subjects. The Institute of Jamaica, the NRC D and the various NGO's all require vastly increased levels of support to enable them to work to increase the general level of knowledge about the environment.

### **Support and Representation**

From being a self accounting Department, the NRC D has been downgraded to a Division of a Department in the large Ministry of Agriculture.

The loss of autonomy and flexibility have serious implications for environmental policy and the strength of NRC D recommendations. The role of the Division appears to be projected as primarily monitoring (largely through desk study) and research. Such a role cannot address the problems of the Wildlife Sector and appears to be short sighted and ill-conceived.

The reconstitution of the Beach Control Authority and Watersheds Protection Commission is welcomed as the absence of this Authority from 1981-1984 undermined the NRC D's powers. However, there is also a need for the reconstitution of the Wild Life Protection Committee, as well as the need for more support from the Ministry. There is also a need for improved cooperation between all agencies involved with the environment.

The PCJ has taken on the EIA for energy related projects. The situation where an agency is implementor and evaluator is most unusual and would not appear to be conducive to unbiased evaluation of projects. The PCJ has also taken over a crocodile project at Luana Font Hill initially proposed by NRC D.

The UWI Zoology, Botany and Geography Departments have an essential role to play in stimulating, directing and supporting research for wildlife. They are also essential to train staff. Any move to reduce the output of qualified graduates and postgraduates will drastically affect the scientific agencies of government. Low salaries for these jobs may mean that it is impossible for UWI graduates to work with these agencies after graduation. The change in the fee structure at UWI must be deplored from this point of view.

Ideally, these departments should be preparing to increase the contribution they make to training Ecology Branch staff and to research on Wildlife Projects.

## **DIRECTIONS FOR FUTURE WORK**

### **Terrestrial Ecology Research and Development**

Little is known about the ecology of Jamaica's wildlife species. Habitat requirements, distribution, status and potential for sustainable use, all require research and development. There is a need for long-term monitoring so that a data base may be accumulated to serve as the basis for informed decisions about the future

uses of wildlife species and their habitats. Both plants and animals need much further study. The NRCO, UWI, Institute of Jamaica, Hope Zoo, and Botanical Gardens all have important roles to play in this. Wherever possible it is important that local institutions be encouraged to carry out this work (with international funding when available) and given precedence over foreign ones. The University of West Indies Botany, Zoology and Geography Departments should be encouraged to play a more active role in terrestrial ecological research.

### **National Parks and Protected Areas**

The development and implementation of a National Park and protected area system is the single most important requirement in the wildlife sector. It is essential that wildlife interests are fully considered in the development of this system. To ensure this, ecological studies will be required of the proposed areas so that appropriate recommendations can be made.

### **Development of Wildlife Resources**

Plant and animal resources of potential economic value should be identified and work done to develop them. Plants of horticultural, agricultural, and pharmaceutical value, animals which could be captive bred for export, and development of wildlife tourism are potential areas for expansion.

### **Legislation**

The existing laws require updating and revision. There is a need for new legislation for National Parks and protected areas. There is also a need for expansion of the capability for law enforcement and public education concerning the laws.

### **Public Education**

There is a need for public education. For example, a Mobile Exhibition, featuring audiovisuals and fixed and living exhibits could take the principles of conservation to rural areas, especially schools. Upgrading of the Institute of Jamaica's Natural History museum is currently being implemented with funds from OAS, but the capability of the Natural History Division needs to be expanded.

### **Development of Zoological and Botanical Gardens**

More emphasis must be placed on all botanic gardens as centres for conservation of endogenous plants of actual and potential economic value. Such projects could ultimately be self financing and help to support other habitat protection projects such as National Parks. The Hope Zoo should also be encouraged to expand and to concentrate on Jamaican and Caribbean species.



Plate 23 - Section of river in Canoe Valley - Jamaica's first National Park.

## NATIONAL PARKS AND PROTECTED AREAS

---

### OVERVIEW OF NATIONAL PARKS AND PROTECTED AREAS

One of Jamaica's greatest assets is her outstanding scenic beauty; unique plant and animal species, and enormous variety of ecosystems (including wet and dry forests, rivers, caves, mineral springs, sandy beaches, rocky shores, mangroves, herbaceous swamps, swamp forests, salinas, mountains and plains). However, natural areas are being destroyed at an unprecedented rate. The difficulty of comparing the long-term benefits of natural area protection with short-term economic benefits has been one of the primary impediments to the development of a system of national parks and protected areas.\*

Conservation of representative areas of natural ecosystems and areas of natural beauty under a system of national parks and protected areas would have many benefits:

- o To enhance and diversify local and foreign tourism through the provision of new amenities and to stimulate interest in outdoor activities such as nature tours, hiking, camping and bird watching. The economic and social benefits for rural communities make national parks and protected areas especially important.

- o To preserve natural resources which could form the basis for new industrial and marketing ventures. These resources could provide raw materials for the production of craft items, new pharmaceuticals, and horticultural plants, and can provide new genetic materials for agricultural crop production.
- o To ensure the quantity and quality of water supplies for domestic, industrial, and agricultural use.
- o To reduce the magnitude of impacts from natural disasters such as floods, fire, drought and hurricanes.
- o To protect resources on which many people depend for their livelihood (for example, provide spring and river water for farmers and spawning grounds for commercial varieties of fish).

---

\* For the purpose of this report, only natural areas are considered. Recreational parks, metropolitan parks, botanical gardens and zoological gardens, which are intensively managed by man, are excluded.

The ecological values of conserving representative areas of natural ecosystems include:

- o Provision of refuge areas for endangered and rare wildlife;
- o Protection of critical habitat for animals and plants;
- o Provision of areas for research in undisturbed conditions; and
- o Preservation of representative areas of typical natural ecosystems.

The psychological and sociological values of national parks and protected areas cannot be quantified, but are also important. These include recognition of the international significance of Jamaica's natural landscape, flora and fauna, as well as the enjoyment of Jamaica's natural heritage.

### **History of National Parks**

Interest in national parks in Jamaica was first aroused in the 1930's when Hardware Gap and Clydesdale Forest Reserves were established. These Forest Reserves included overnight accommodations and trail systems for public use. The principle of protection of natural areas was also addressed at an early date in various acts, including the Morant and Pedro Cays Law (1904); Forest Act (1942), the Wild Life Protection Act (1945); Beach Control Act (1956); and the Watershed Protection Act (1963). Although many reserves have been designated under these acts, no comprehensive national parks legislation has been introduced.

The National Physical Plan (1970-1990) stated the need for: "An integrated regional system of a wide range of parks, recreational and conservation areas reflecting Jamaica's social needs and natural environment". The subsequent National Physical Plan (1978-1998) recommended that national parks be legally designated and priority areas selected for implementation.

A Provisional National Parks Committee was established under the Forest Department in 1970 for further identification of areas suitable for National Parks and to initiate their development. In 1972 the committee continued to operate under the then Ministry of Mining and Natural Resources and, from it, emerged the National Parks Branch of the NRC D which was established in 1975.

Since 1976, several policy documents and proposals for park development have been prepared:

the John Crow Mountains and Blue Mountains (1972); Portland Bight and Ridge (Cotterell et al. 1983); Canoe Valley (Harvey, 1986); Black River Lower Morass (NRC D, 1984); Negril (1984); Palisadoes and Port Royal Cays (Cotterell, 1980); and Cockpit Country (Cotterell, 1979). Two marine national parks were declared under the Beach Control Act — Ocho Rios (1966) and Montego Bay (1973). The National Heritage Trust Act (1985) provides for the declaration of protected national heritage sites and national monuments and many sites have been designated under this act.

Despite these initiatives, however, there are no national parks in Jamaica, nor is there effective enforcement of the provisions which pertain to the protected areas listed above. Jamaica has also lagged behind other Caribbean countries in national park development.

### **Definitions**

The National Physical Plan 1978-1998 includes the following definition of National Park:

'..... an ecosystem selected to conserve in perpetuity unique and/or representative areas of nationally and internationally significant geographic, geological and biological features or phenomena. It provides opportunities for those recreational and educational activities which enhance man's understanding and appreciation of the natural environment without impairing it.'

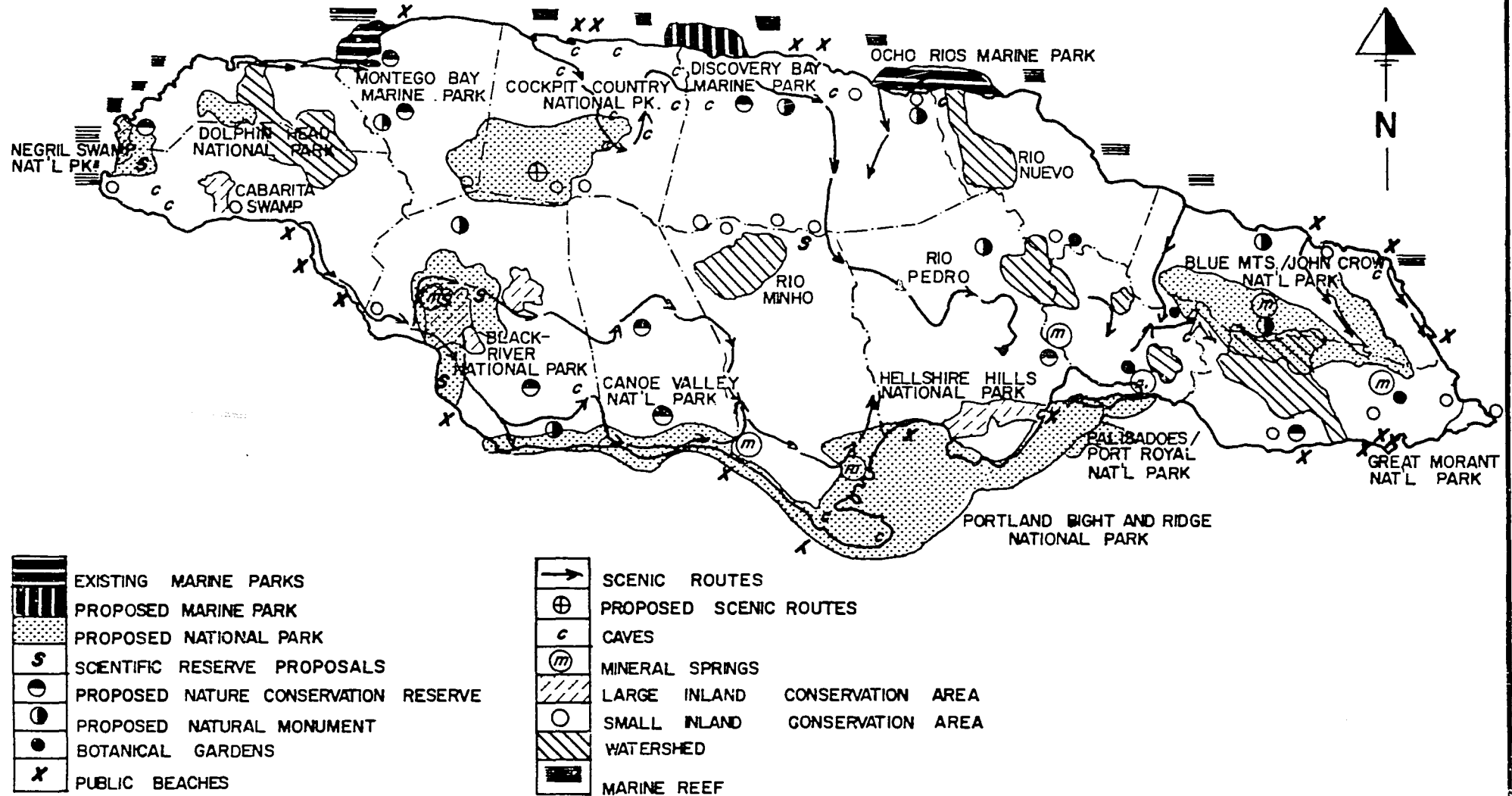
The NRC D (Harvey, 1986) has recommended that the definition of the National Park System be revised and incorporated into a new legislative framework. The criteria which were suggested for the selection of the national parks were: Jamaican significance, ecological integrity, recreational diversity, public benefits, and feasibility. (The Plan also mentioned, but did not define, two other categories — Large and Small Inland Conservation areas).

The International Union for the Conservation of Nature and Natural Resources (IUCN) has produced a classification system which is internationally recognized (CNPPA, 1984). The NRC D has suggested that Jamaica adopt these definitions. This would have many advantages, including facilitating the search for international funds for national parks projects. The proposed categories are summarized in Table 41.



FIGURE : 2 6

# EXISTING AND PROPOSED PARKS AND PROTECTED AREAS



Source : National Physical Plan, Jamaica. (1978-'98)

**Table 41:**  
**Description of Proposed Reserve Categories**  
**and Some Proposed Jamaican Areas**

<b>Definition (after CNPPA, McNeely 1984)</b>	<b>Some Proposed Areas (Harvey, 1986)</b> (List is not exhaustive)
<b>I. <u>SCIENTIFIC RESERVES/NATURE RESERVES</u></b>	
Representing natural areas containing outstanding ecosystems, geological features or species of national or international importance.	Mason River Field Station (Clarendon) Holland Swamp Forest (St. Elizabeth)
<b>II. <u>NATIONAL PARKS</u></b>	
Relatively large areas, not materially affected by human exploitation and occupation, containing special wildlife habitat and geomorphological sites of special scientific, educational and recreational interest or are landscapes of great beauty. Exploitation is limited to pre-existing uses which are not detrimental to the protection of the park. Public access for inspirational, educational, cultural or recreational purposes.	Great Morass (St. Thomas) Blue Mountains and John Crow Mountains (St. Thomas, Portland) Palisadoes, Port Royal Cay S. (Kingston) Hellshire (St. Catherine) Canoe Valley (Clarendon, Manchester) Cockpit Country (St. James, St. Elizabeth, Trelawny, Manchester) Black River Lower Morass (St. Elizabeth) Dolphin Head (Westmoreland) Negril (Hanover, Westmoreland) (Marine and Terrestrial) Ocho Rios Marine Park (St. James) Montego Bay Marine Park (St. James) Discovery Bay Marine Park (St. Ann) Marine Parks in St. Mary (Portland)
<b>III. <u>NATURAL MONUMENTS/NATIONAL LANDMARK</u></b>	
Areas containing features of outstanding natural significance such as waterfalls, caves, species or plants and animals.  Management emphasis is on the protection of the inherent features.	Fern Gully (St. Ann) Blue Mountain Peak (Portland) Rio D'Oro Natural Arch (St. Catherine) Thatchfield Cave (St. Ann) Windsor Cave (Trelawny) Lovers Leap (St. Elizabeth) Ys River Falls (St. Elizabeth)
<b>IV. <u>NATURE CONSERVATION RESERVE/WILDLIFE SANCTUARY</u></b>	
Areas managed for the stability or survival of unique or important species of animal or plant and their habitats. Habitats may be modified in the interest of target species.	Middle Cay (Morant Group) Secay (Pedro Group) Belvedere (St. Thomas) Portland Bight Fish Sanctuary Bogue Fish Sanctuary (St. James) San San Tree Preservation Area (Portland) Rocklands Bird Sanctuary (St. James) Luana/Font Hill (St. Elizabeth) * See Footnote

V. PROTECTED LANDSCAPE OR SEASCAPE

Nationally significant natural landscapes characteristic of the harmonious interaction of man and which provide opportunities for recreation and tourism within the normal life style and economic activity of these areas.

East Coast scenic route (Morant Bay to Boston Bay)  
Buff Bay scenic Route (St. Peters to Buff Bay)  
Cockpit Country scenic route (Troy to Windsor Great House)

VI. MULTIPLE USE MANAGEMENT AREAS

Large areas containing zones of biological and geological importance for education or recreation which are managed for sustained production or renewable natural resources including timber, water, pasture and outdoor recreation.

Jacks Hill (St. Andrew)  
Kingston & St. Andrew Game Reserve  
All Watershed areas  
All Forest Reserves

VII. BIOSPHERE RESERVE

Areas large enough to function as conservation units and accommodate different activities without conflict approved by Man and Biosphere International Co-ordinating Council. Four zones will be included: natural or core zone, buffer zone, restorative zone and stable cultural zone.

Specific areas to be identified later

VIII. WORLD HERITAGE SITE

Areas of "outstanding universal value" designated by the International World Heritage Committee under the International Convention concerning the protection of the World Cultural and Natural Heritage (UNESCO 1972).

Cockpit Country

\* Selection of Fish Sanctuaries (K. Aitken)

Almost every commercial fish species has well-defined nursery areas and these generally are known to have the following characteristics:

These areas are usually shallow, protected embayments which offer shelter and food for juveniles and spawning adults occasionally. It was for the preceding reasons that a number of coastal areas were chosen as fish nurseries. It is vital that some such areas be set aside and protected in the form of fish sanctuaries as without them the constant human encroachment on mangrove areas and the development of coastal areas for new housing, shipping facilities and other usage is resulting in the continuing loss of several important coastal zones known to function as nurseries. Without these areas, fish stocks, will under present conditions, steadily decline to a point beyond which they may be unable to recover.

The following areas were identified: West Harbour (West Portland Bight, Old Harbour Bay, Clarendon); Galleon Harbour (Northeastern Portland Bight, St. Catherine); Long Bay, Cuguar Bay, Manatee Bay, (St. Catherine); Falmouth Bay, Trelawny; Folly Bay in St. Thomas, Bloody Bay (including Negril Harbour), Hanover; Portions of Discovery Bay, St. Ann; Portions of Port Royal Mangrove Forest, Kingston; Portions of the Port Royal Cays (incorporate all areas within a radius of one kilometer); Middle Cay on Morant Bay and South West Cay on Pedro Bank.

## **AGENCIES AND INSTITUTIONS**

### **Government Agencies**

The agencies which have responsibilities related to national and protected areas are summarized in Table 42.

NRCD's National Parks Branch has responsibility for national park and protected area development, but has not been in a position to fulfill this role effectively because of the constraints discussed below. Until 1984, the main thrust of the work of the National Parks Branch was the formulation of proposals for national parks. Since then, more emphasis has been placed on the establishment of the Alligator Hole River Project, Clarendon/ Manchester, which is the nucleus of the proposed Canoe Valley National Park. As a result of cooperation with the Ecology Branch in this internationally funded project, significant progress has been made towards Jamaica's first national park. Facilities in the central area include an educational display, wardens quarters, a picnic area and an access point on the river. The area will be opened to the public as soon as sufficient staff have been employed to run the project.

In addition to specific national park and protected area projects, the National Parks Branch has been investigating the availability of international funds and identifying international contacts. As part of this programme, a detailed analysis of Jamaica's position on national parks was produced (Thorsell, 1981), but none of the report's recommendations have been implemented.

The lack of consensus on definitions, criteria and objectives for national parks and protected areas has contributed to problems when other quasi-government agencies have started to develop natural areas. Projects in Fern Gully and Negril Royal Palm Forest were both initially presented to the public by the Urban Development Corporation (UDC) and the Petroleum Corporation of Jamaica (PCJ), respectively, as "national parks", but failed to meet the criteria and objectives for national parks. There is an urgent need to educate agencies in the proper definition of protected areas and their management.

### **International Affiliations and Conventions**

Jamaica ratified the Convention Concerning the Protection of the World Cultural Heritage

(Paris 1972) in 1983. Jamaica has not yet proposed any sites for inclusion under this treaty, which provides for the protection of internationally important natural sites. Also in 1983, Jamaica ratified the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean (Cartagena 1983), which includes provisions for protection of fragile marine ecosystems. No other conventions relating to protected areas have been ratified.

The establishment in Jamaica in 1986 of the Regional Coordinating Unit (RCU) of the United Nations Environment Programme (UNEP) Regional Seas Programme is an encouraging step towards Jamaica's commitment to conservation at an international level. Jamaica is also a member of the Caribbean Conservation Association, but has not played an active role in the activities of this group.

## **PLANS AND PROGRAMMES**

### **Canoe Valley National Park**

In 1985, NRCD recognized that the Canoe Valley area (Clarendon/Manchester) has the greatest potential for establishment as the first national park, under existing staffing and funding constraints. Besides the outstanding ecological, geological, and historical features of the area, the considerations which supported this priority determination were:

- the economically depressed conditions of this region of Jamaica;
- the tourism appeal that already exists because of Milk River Bath;
- the proximity to Mandeville and May Pen and the reasonable accessibility from Spanish Town and Kingston; and
- the management infrastructure which already exists because of the Alligator Hole River Project.

Since the completion of visitor facilities, the National Parks Branch in cooperation with the Ecology Branch has formulated a progressive programme which includes the following goals:

- complete resource inventory;
- determine land ownership status and evaluate acquisition and easement options;
- renovate headquarters building and construct sanitary facilities;
- establish trail system and picnic areas;

**Table 42:  
Institutions Related to National Parks and Protected Areas**

<u>Institutions</u>	<u>Laws</u>	<u>Protected Areas</u>	<u>Relevant Responsibilities</u>
<u>Ministry of Agriculture</u>			
1. Natural Resources Conservation Division (Watershed Protection Commission; Beach Control Authority)	Watershed Protection Act (1963)	Protected Watershed	Control land use in protected watersheds, public education, gully and river control.
	Wild Life Protection Act (1974)	Wild Life Reserves, Sanctuaries	
	Beach Control Act (1958)	Protected marine areas (marine national parks)	Control of exploitation in designated areas, control of all development up to 1 mile in shore.
2. Forest Department	Forest Act (1937)	Forest Reserves	Controls access to and exploitation of Forest Reserves.
3. Fisheries Division	Fishing Industry Act (1975)	Fish Sanctuaries	Controls fishing in designated areas.
	Morant and Pedro Cays (1904)	Morant & Pedro Cays	Controls access to cays and exploitation of their resources.
<u>Ministry of Finance and Planning</u>			
1. Town Planning Department	Town & Country Planning Act (1957)	Conservation areas designated in development orders	Matters relating to land use planning and providing technical advice to government agencies, KSAC, the parish councils, and the Town and County Planning Authority, which administers the Town and County Planning Act.
		Tree Preservation orders	
2. Office of the Prime Minister	National Heritage Trust Act (1984)	Protected National Heritage National Monument	
3. Institute of Jamaica Natural History Division	Institute of Jamaica Act (1978) (updated)	Field Stations	Management of Mason River and Green Hills stations.
<u>Ministry of Mining, Energy &amp; Tourism</u>			
1. Marine Park Action Committee	None	None	Is to catalyse marine park development.
2. Petroleum Corporation of Jamaica	None	None	Has responsibility for management of Negril Morass.
<u>Ministry of Finance and Planning</u>			
Urban Development Corporation	Urban Development Corporation Act (1968)		Responsibility for lands designated under the Act
<u>Non-Government Organizations</u>			
1. Jamaica Orchid Society/ Alpart	None	Spur Tree Orchid Reserve	
2. Gosse Bird Club			
3. Jamaica Archaeological Society	None	River Cave	
4. Jamaica Society for Scientists and Technologists	None	None	Has advocated national park development in forest areas.
5. Natural History Society of Jamaica	None	None	Has advocated national park development in Hellshire, forested areas.

- prepare user regulations, an enforcement system, an emergency contingency plan, and plans for management, monitoring, and staff training;
- develop a public awareness and environmental education programme and a community involvement programme for local residents;
- submit funding proposals to fully implement national parks; and
- upgrade the logistical equipment and infrastructure to effectively manage the park.

### **Marine Parks Action Committee (MPAC)**

MPAC was established in 1986 by the Ministry of Tourism to act as a catalyst for marine park development. A proposal has been submitted to the Organization of American States (OAS) for funding to evaluate and determine the management and administrative needs for an operational marine national park in Jamaica. This proposal was to be funded before the end of 1986. As part of this project, a detailed funding assistance proposal will be prepared for marine parks implementation in Jamaica. The Committee has identified Montego Bay as the best location for the first marine national park. It is expected that international assistance will be found for this project.

## **PROBLEMS AND ISSUES**

### **Development Pressures**

Development pressures on sites suitable for designation as National Parks and Protected Areas stem from the lack of a formally constituted national park and protected area system; no legal requirement for environmental impact assessments; and ineffective implementation of environmental laws.

- o Urban growth and housing: The expansion of housing into the peripheral areas of towns (especially into mangroves, wetlands, foothills and gully banks) results in the loss of economic resources, natural amenities and potential park areas within easy range of urban communities. Natural resources of economic value are destroyed (e.g., fisheries, lumber and wildlife) and the population is left vulnerable to natural disasters. The Portmore and Hellshire developments are examples of this type of problem. The

expansion of housing into rural, south coastal areas, such as the verges of Pedro Pond and Porottæ Pond, also have serious implications for future reserve development and requires particularly careful control.

- o Agriculture: Many areas within potential future national parks, especially in the Blue Mountains, are being cleared of natural vegetation for coffee and Caribbean Pine (*Pinus caribbea*) plantations. FIDCO plans to convert approximately 60,000 acres to pine in the next 20 years. Extensive areas are to be cleared on the north slope of the Blue Mountain for coffee. Ganje cultivation is pushing further into the remote areas.

In addition, the exclusion of agricultural development from the planning process means that radical changes in land use may be implemented without any review of potential impacts to protected areas by concerned agencies. Access to information regarding CIDCO and Agro 21 projects and proposals is extremely difficult to obtain. "Agro 21" plans to place 200,000 acres of publicly owned land into agricultural production. Information on the behaviour of private individuals with respect to land purchases from small farmers, and its impact on unregulated expansion into forest lands and areas required for conservation, is difficult to obtain.

- o Rural poverty: Poverty contributes to cultivation of marginal lands and poor land use practices by hillside farmers. It has also contributed to the increase in charcoal burning and fuel wood collection on hillsides.
- o Harvesting of natural resources: All proposed national park and protected areas are affected by illegal harvesting which reduces their ecological value and their attractiveness to visitors. Resources currently under serious pressure from collectors and hunters include turtles, conies, birds (especially columbids and endemic species), butterflies, reef fish, black coral, hard corals, manatees, orchids, and cacti. Uncontrolled spear and pot fishing in rivers and the sea is another problem.
- o Road development: Extension of new roads into remote areas opens them to settlement and the intrusion of feral animals, with severe consequences for the natural fauna and flora. The Cockpit Country, John Crow Mountains and Hellshire Hills are proposed national parks areas which may be affected by ill-considered new road development.

- o **Pollution:** The natural environment in the proposed national parks and protected areas is being degraded by various forms of pollution. These include industrial effluents, agricultural chemicals, agricultural wastes, air pollution, and solid wastes.
- o **Quarrying:** Quarrying and mining of limestone, gypsum, bauxite and sand from beaches and rivers can be visually intrusive and cause dust, aquatic pollution and coastal erosion. Quarry development in proposed national park and protected areas should be strictly controlled.
- o **Other:** Solar salt mining (Portland Bight) and Peat Mining (proposed in Negril and possibly Black River Morasses) are two current projects which are potentially detrimental to the establishment of national parks in these areas.

### **Political and Public Awareness and Support**

The economic and social benefits to be derived from the establishment of national parks and protected areas have not been generally appreciated at higher administrative levels of government. These areas are often seen as potential obstacles to development rather than as essential components of the national development plan. This low priority given to the establishment and management of protected areas is reflected in low staffing levels, inadequate budgets and the lack of staff training opportunities for the National Parks Branch. It also results in a low level of government involvement in international initiatives, organizations and conventions pertaining to protected areas. This lack of commitment has been noted by the international funding agencies, which are consequently reluctant to allocate funds to Jamaica.

### **Policy Statement**

No further progress towards national park and protected area systems will be possible without high level government support in the form of an authoritative policy statement for the proposed system.

### **Development Control**

All remaining natural and seminatural areas in Jamaica are under intense pressures; it has been estimated that, without effective protection measures, most will be destroyed in the

next 5 to 10 years. Conflicts between development and conservation of natural areas arise where, through poor planning and control, developments are placed in inappropriate areas or without mitigation measures to minimize impacts to natural areas.

### **Legislation and Enforcement**

As shown in Table 42, there is a considerable body of legislation concerning protected areas, little of which is enforced. Any new legislation must be accompanied by effective enforcement. However, the absence of comprehensive legislation should not be an obstacle to setting up national parks and protected areas, in the short term. Existing legislation confers some of the powers needed for interim development of protected areas.

### **Institutional Capacity**

The National Parks initiative is weakened by the lack of a coordinated, multi-disciplinary approach, shortage of manpower and financial resources. There is a need for all interested parties and relevant government agencies to work much more closely, and for non-governmental agencies to become more involved, if the establishment of protected areas is to be realized in Jamaica.

## **DIRECTIONS FOR THE FUTURE**

### **Legislation**

#### Short Term Measures

- a. Revision of the Town and Country Planning Act (1957): This act is currently under review and the following provisions are recommended for inclusion in the revised law:
  - that the review process be extended to the public sector to ensure that activities such as manufacturing and agriculture are carefully assessed in terms of their effects on the environment.
  - that provisions be made for the declaration of national parks.

In the interim, it is possible to utilize the provisions of the existing Town and Country Planning Act to preserve the proposed national parks and protected areas. The NRC D

should map all areas and request that the Town Planning Department (TDP) include them in the appropriate development orders as Special Conservation Zones.

It should also be suggested to the TDP that large scale agricultural and manufacturing activities of both public and private sectors be subjected to Environmental Impact Assessment (EIA) reviews. With respect to small farmer agriculture, it is recommended that the TDP collaborate with the Ministry of Agriculture which has responsibility for the Watershed Protection Act. It is also recommended that changes in the method of processing planning applications be considered with a view to minimizing the time taken to review applications.

- b. Jamaica National Heritage Trust Act: Known Arawak, archaeological and historical sites in proposed protected areas should be gazetted as National Monuments.
- c. Beach Control Act: Revision of the Ocho Rios and Montego Bay marine parks should be gazetted and new areas in Negril and Discovery Bay added. Regulations for management of these areas could be added.
- d. Wild Life Protection Act: Gazetting of additional areas proposed under the Act. Revision of the act to include updated powers and penalties is also urgently required.
- e. Fishing Industry Act. Additional areas proposed by the NRC Fisheries Division should be gazetted.
- f. Advisory Committee. An advisory committee (like MPAC) should be established to stimulate the development of terrestrial parks.

#### Long Term Measures

- a. Development and Enactment of National Parks and Protected Area Legislation: New legislation should be developed with reference to legislation used in other Commonwealth Caribbean and other tropical countries. Given the current constraints in the Jamaican civil services, it will probably be necessary to employ a consultant to carry out this task.

The following should be included in the proposed legislation:

- A System of National Parks and Protected Areas should be established. It should

include categories based on the IUCN definitions (Table 41). Areas so declared should be permanently protected.

- Institutional Framework and Responsibilities. The responsibilities of agencies should be clearly defined and the relationship of the new act to previous acts established. Provision for inter-agency agreements should be included. The mechanism for funding, staffing and support of protected areas development should be defined and the power to collect revenues and use them in protected area development established.
- Selection of Protected Areas. Legislation should include the process of selection of protected areas.
- Public Participation in the Planning Process. Legislation should define a process which will accommodate participation of government, non-government and public groups at an early stage in the planning and development of protected areas.
- Right to Land and Associated Resources. Legislation should include authority to acquire property and rights to property. It should allow for tax incentives for land owners and various types of compensation for all those displaced by protected area development. There should also be a process to accommodate new and existing land uses where these do not conflict with the objectives of protected areas. This will involve an environmental impact assessment procedure.
- Enforcement. The act should provide for a body of enforcement agents who will be properly equipped and supported by strict penalties.
- Management. The act should include a requirement for management plans for protected areas. A provision for management zoning should also be included. Public involvement in the management of these areas is also important.

#### **Establishment of a Non-Government National Parks Trust**

An independent, non-profit National Parks and Protected Area Trust is urgently needed to implement a protected areas system in Jamaica. The National Parks Branch (NRC) would con-



tinue to be the coordinating agency, working with the Trust on policy, coordination and the legal aspects of protected area development. An arrangement of this type would free national parks and protected areas from the managerial and budgetary constraints which affect government agencies. A non-profit, non-governmental organization would be better placed to attract international funding and to coordinate local and foreign support for the program.

The functions of the Trust would include:

- Financing through fund raising and international grants and loans, park revenues and investments.
- Scientifically investigating proposed protected areas, selecting protected areas; developing management plans; proposing legislative measures; monitoring of the status of protected areas.
- On-site management of all protected areas, including enforcing of laws and native interpretation.
- Designing and implementing a public education and awareness campaign to ensure public support for the national parks and protected areas.

### **International Affiliations**

If Jamaica expects to receive international support for environmental projects, she must demonstrate her commitment by taking a more active part in the international conservation movement. This will involve adherence to treaties and active participation in organizations. The following treaties should be considered:

- Convention on Wetlands of International Importance especially as waterfowl habitat (Ramsar 1971).
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn 1979).
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington 1973).
- Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere (Washington 1940).

Organizations for which membership should be considered include: the International Union for the Conservation of Nature and Natural Resources; the International Council for Bird Preservation; and the International Waterfowl Research Bureau.

Jamaica should also play an active role in the Caribbean Conservation Association.

### **The First National Parks**

Jamaica's first national parks are expected to be Janeo Valley National Park and Montego Bay National Marine Park. In order that plans for these parks can be brought to fruition, international assistance (technical and financial) must be obtained. Temporary legal expedients must be used to create the parks and work must begin on new legislation. The question of management authority for national parks and protected areas must be addressed (for example, through the formation of a Trust). An intense campaign of public education concerning the benefits of national parks must begin as soon as possible, so that there will be grass root support for these projects.

### **Policy Document**

A policy paper should be prepared by NRCD in consultation with other relevant agencies and institutions (see Table 42) to outline the need for GOJ involvement in national parks and protected areas and to serve as a vehicle for obtaining the high level of support essential for this project. The document should address:

- the role of the Trust and of NRCD;
- management, monitoring and requirements for the establishment of the first national parks;
- the essential components of legislation, proposals for the adoption of new protected area definitions;
- economic feasibility analyses;
- staffing and training requirements;
- the essentials for an effective public education and awareness programme; and
- mechanisms for the operation and maintenance of national parks.

### **Training**

Trained, qualified staff is essential for the success of a protected areas programme.

Training of both field and professional staff should begin immediately so that personnel will be available to carry out the above recommendations. Wherever possible, training should be made relevant to Jamaican conditions and to developing country constraints. Out-of-country training opportunities should be sought in developing country settings, preferably in Caribbean countries or other countries with tropical and/or island environments. At a minimum, the immediate training emphasis for the existing Canoe Valley National Park staff should entail a four-to-six weeks, on-the-job training detail to work at the U.S. Virgin Island National Park and/or Dominica's Trois Marne Pitans National Park.

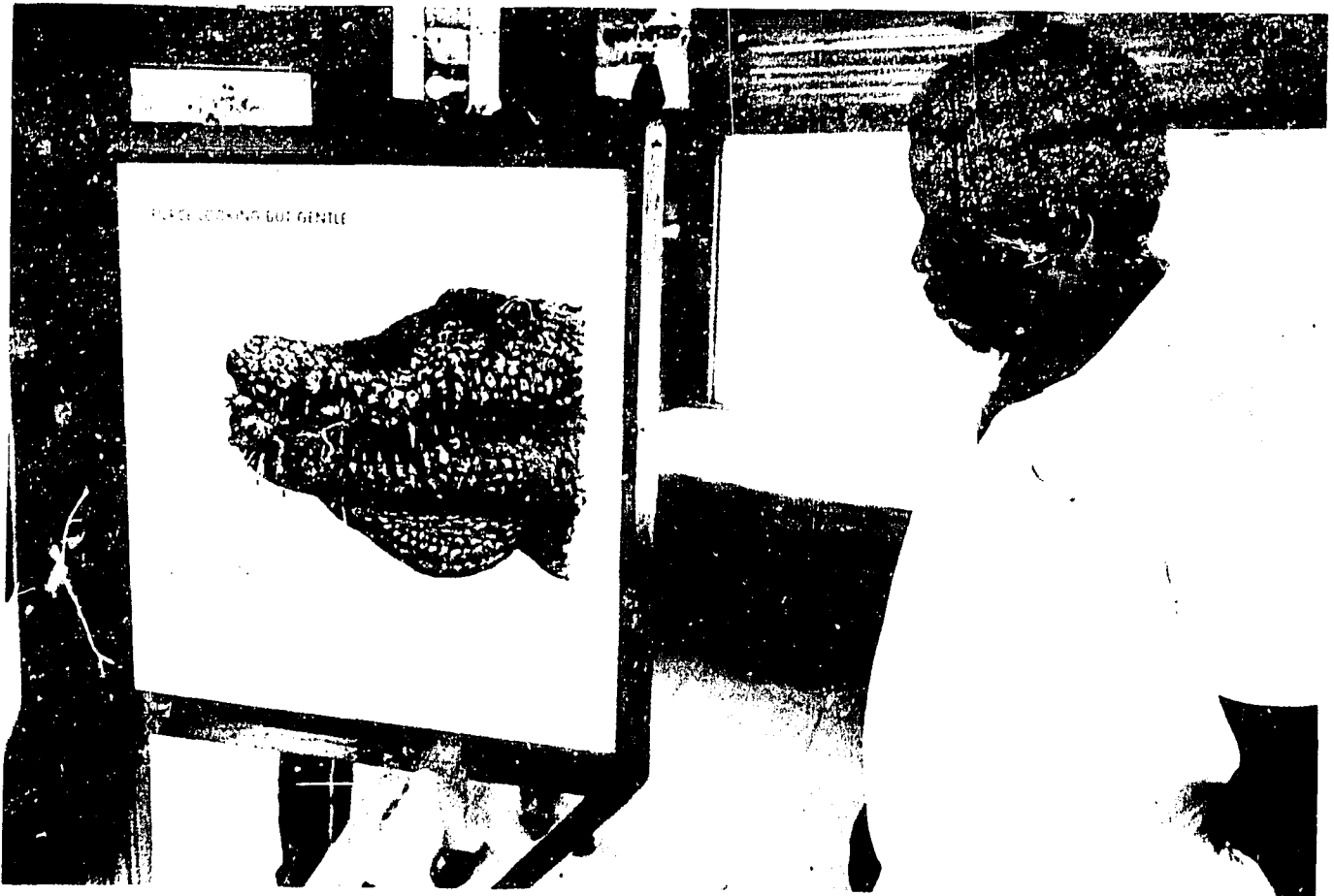


Plate 24 - Part of the exhibition room at Canoe Valley.

## FISHERIES RESOURCES

### OVERVIEW OF FISHERIES RESOURCES

The fisheries of Jamaica comprise marine and freshwater components. Within these major components, the main resources exploited are finfish and shellfish, including some molluscs. (See Figure 27.)

#### The Marine Capture Fishery

The marine capture fishery is primarily artisanal in nature; i.e., it is not highly technological and is conducted mainly by fishermen operating from canoes (Sahney, 1982). Approximately 95% of these fishermen operate on the island's coastal shelf and its associated banks. Consequently, the marine fishery is divided into two main regions: the Inshore Fishery and the Offshore Fishery (see Figure 28):

- o The Inshore Fishery includes those operations carried out on the island's shelf areas\* (the nearshore fishery) and in areas not exceeding 64 km. (40 miles) from the mainland (the near banks fishery). Historically, these regions (with a total area of 4,170 km<sup>2</sup>) have supported the bulk of fishery activity in terms of manpower and vessels.
- o The Offshore Fishery includes those operations performed outside the zone of proximal banks (i.e., in excess of 64 km. from the

mainland). Thus, it encompasses operations on Jamaica's two largest offshore fishing areas, the Morant and Pedro banks, as well as operations conducted in the territorial waters of other nations. Only fishermen operating mechanized canoes utilize the proximal banks and offshore areas.

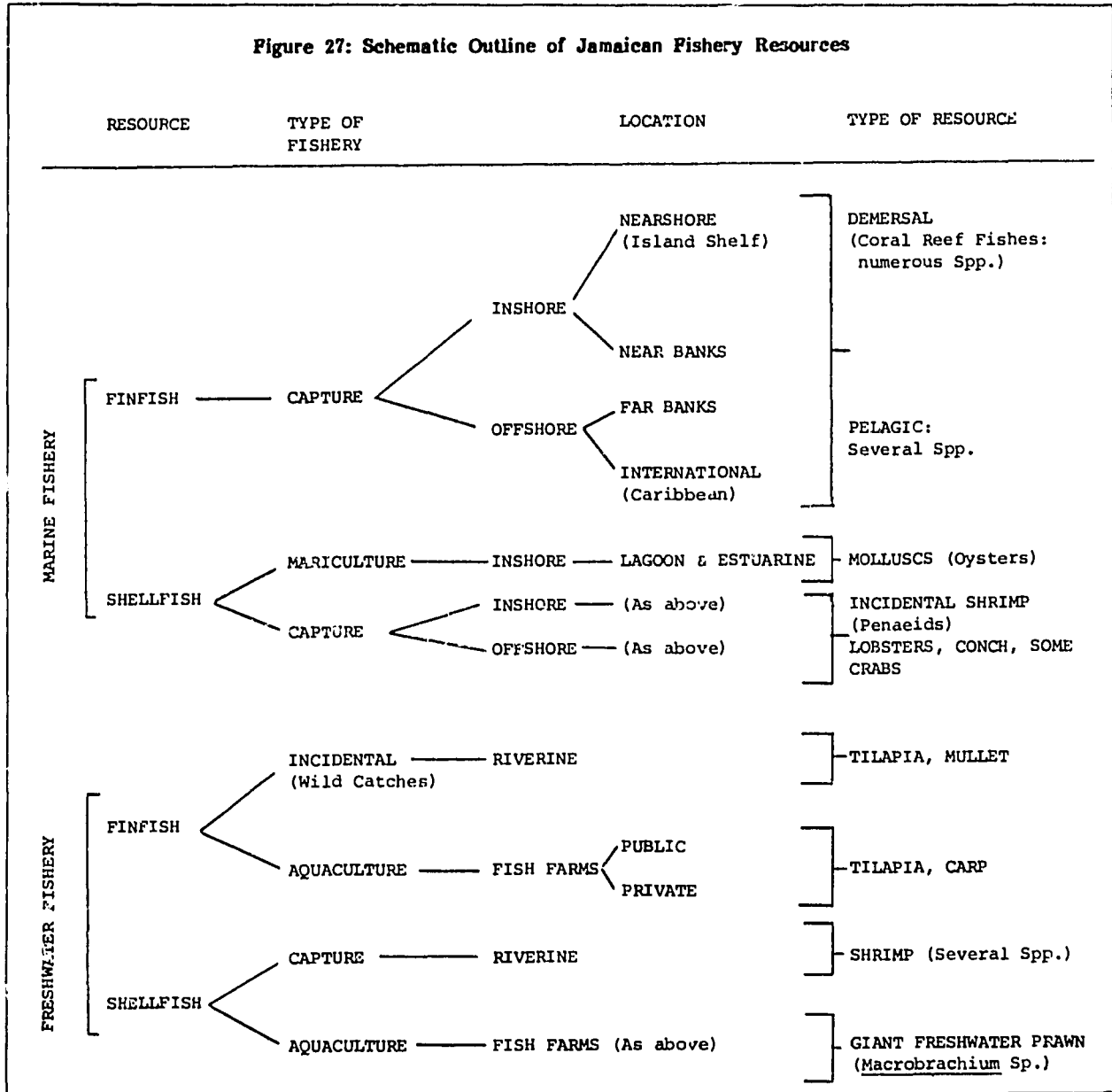
The Morant and Pedro banks are oceanic banks, rising abruptly from depths exceeding 500 m. to form submerged plateaus of average depth 30 to 40 m. The Morant Bank (259 km.<sup>2</sup> in area) contains three small cays supporting approximately 100 fishermen. The Pedro Bank (4,300 km.<sup>2</sup> in area) supports a substantial fishery carried out by at least 400 fishermen based on two of three small cays situated at the southeastern border of the bank.

Fishermen occupying the banks travel from mainland Jamaica to reside on the cays for most months of the year. In addition, the banks are fished on a daily basis by mainland-based south coast fishermen.

---

\* The Jamaican shelf is approximately 1,853 km<sup>2</sup> in area. On the northern, western, and eastern coasts, the shelf is narrow, not exceeding 1.6 km. (1 mile) in width. On the south coast, the shelf is wider, attaining a maximum width of 24 km. (15 miles) due south of the parish of St. Catherine.

Figure 27: Schematic Outline of Jamaican Fishery Resources



Fishing in extra-territorial waters previously included larger "base" vessels transporting fishermen, mainly to the southwest of Jamaica, to areas within the territorial waters of Colombia, Nicaragua and Honduras.\* Negotiations, however, are being conducted by the Ministry of Foreign Affairs and the Government of Guyana to establish treaties to allow vessels to operate to the southeast, in areas belonging to Guyana. Similar negotiations have been initiated with the Government of Belize.

Commercial Species. Commercially harvested species comprise bottom-dwelling (demersal)

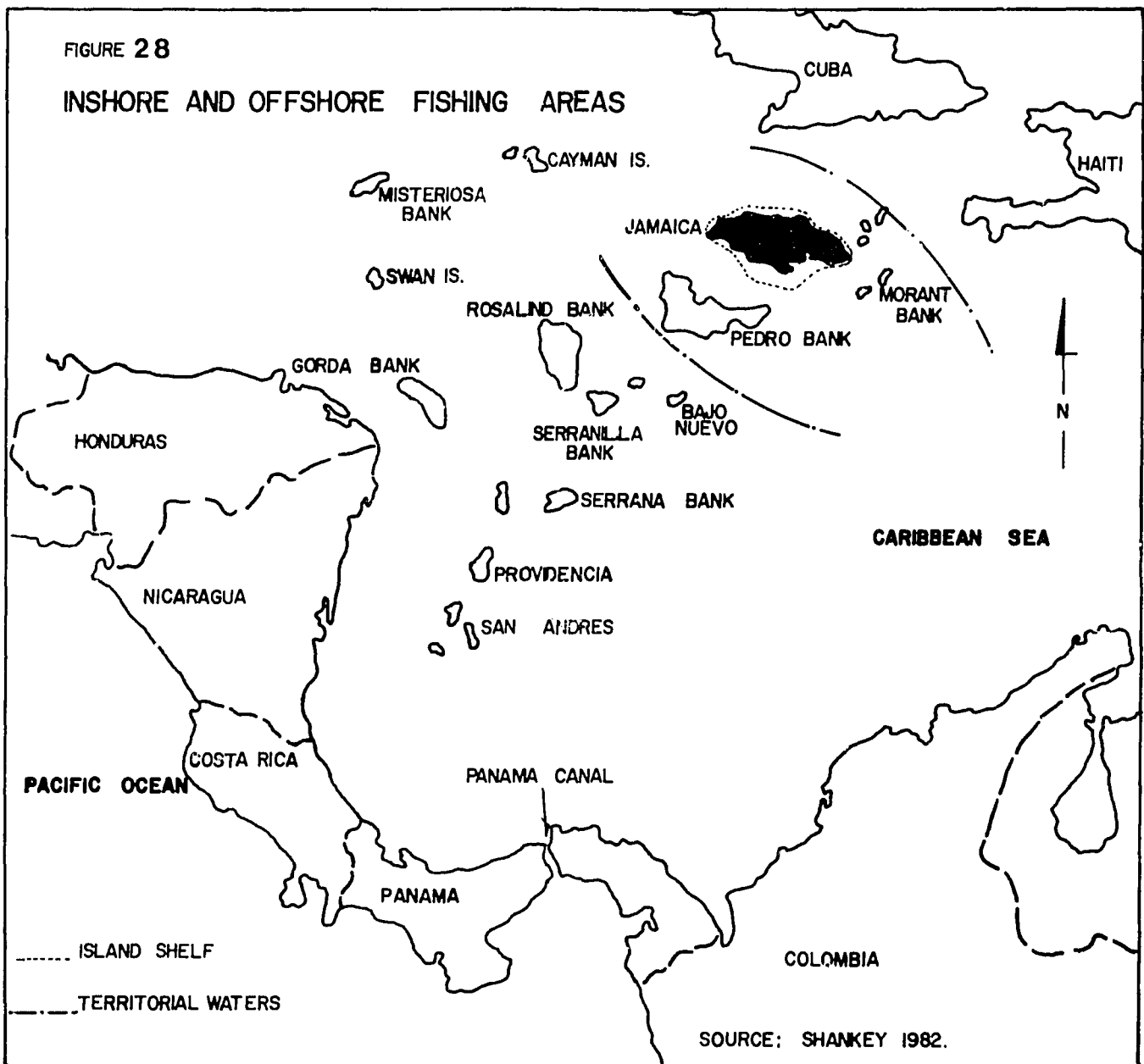
coral reef species, including finfish and shellfish, and free-swimming (pelagic) species of finfish. For marketing purposes, commercial species of finfish are classified into four grades: quality (including snappers, groupers, large jacks, kingfish, goatfish); common (including small jacks, bonito, and large parrotfish); grunts (including grunts and small parrotfish); and trash (including squirrelfish, doctorfish, triggerfish).

\* These arrangements are no longer in force.

- o The Demersal Fishery: More than 200 species of coral reef fish are landed and marketed. Of this number, 70 species constitute over 90% of all landings, while 23 species comprise more than 80% by weight of fish caught in traps (Munro, 1974). (See Table 43.) These species include fish from groups such as the groupers, snappers, grunts, goatfish and parrotfish.
- o The Pelagic Fishery: The pelagic fishery comprises far-ranging oceanic species such as the yellowfin tuna (*Thunnus albacares*), blue marlin (*Makaira nigricans*), dolphin fish (*Coryphaena hippurus*) and various sharks; and coastal-dwelling, or inshore species such as the herrings (clupeids), anchovies (engraulids), half-beaks (hemi-ramphids), mullets (mugilids),

and jacks (carangids). Oceanic species are taken by line fishing, while coastal species are taken mainly by gill and seine nets. (Lists of species taken in the oceanic and coastal pelagic fisheries are tabulated in Table 48.)

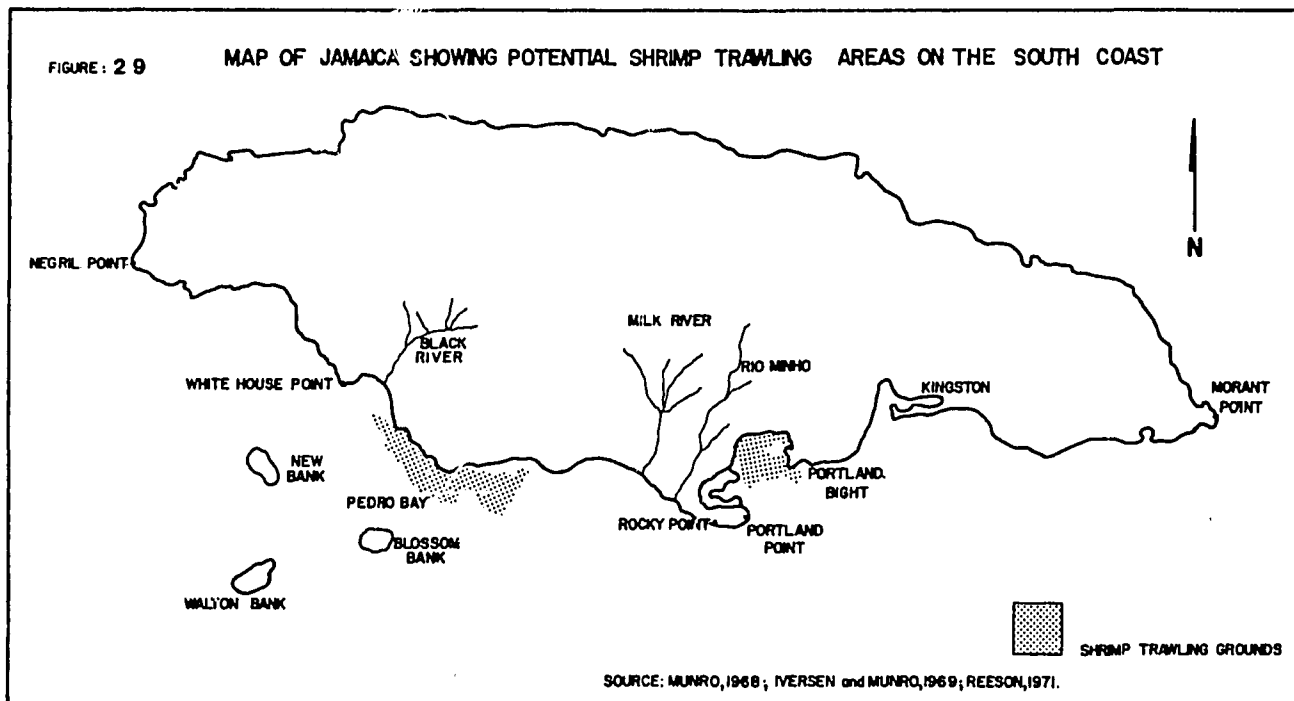
- o Other Fishery Resources: Other fishery resources of commercial value include marine shrimp, conch, and lobsters. Approximately seven species of marine shrimp of the family Penaeidae are taken on a small scale from south coast fishing areas (Munro, 1968; Iversen and Munro, 1969; Reeson, 1971). (See Figure 29). Sahney (1982) reported that, in 1981, the total landings of marine shrimp amounted to 10 tons, with a market value of J\$102,632.



**Table 43:**  
**Species of Fishes Comprising More Than 80% By Weight**  
**Of Those Caught By Traps In Demersal Fishery**

<b>ACANTHURIDAE (Surgeonfishes)</b> Acanthurus coeruleus A. chirurgus	<b>POMADASYIDAE (Grunts)</b> Haemulon flavolineatum H. melanurum H. album H. plumieri H. sciurus H. aurolineatum
<b>BALISTIDAE (Triggerfishes)</b> Balistes vetula	<b>SCARIDAE (Parrotfishes)</b> Scarus taeniopterus Sparisoma chrysopterus S. aurofrenatum S. viride
<b>CARANGIDAE (Jacks)</b> Caranx ruber C. bartholomaei	<b>SERRANIDAE (Groupers)</b> Cephalopholis fulva Epinephelus striatus E. guttatus Mycteroperca venenosa
<b>LUTJANIDAE (Snappers)</b> Lutjanus apodus Ocyurus chrysurus	
<b>MULLIDAE (Goatfishes)</b> Mulloidichthys martinicus Pseudupeneus maculatus	

Source: Munro (1974)



There is little information on conch resources. There are five species, occurring in shallow seagrass beds, and to depths of 60 m. One species, the queen conch (Strombus gigas) is large, and is fished by a loosely organised group of skin divers. Though there is no accurate documentation of this effort, estimates suggest that this is in excess of 500. The estimated annual yield for the north coast in 1979 was 250 tons total weight (Aiken, 1979).

Approximately six species of lobster are taken by hand or in traps, or with spearguns, of which the most common are the spiny lobster (Panulirus argus) and the chicken lobster (P. guttatus). Sahney (1982) reported that in 1980, approximately 251 tons were harvested. (Lists of crustacean and other fishery resources from Jamaican waters have been compiled by Aiken (1984). (See Table 48.) Since 1983 a few large-scale operations have been started on the Pedro Banks, which have significantly influenced the production of lobster.

Fishing Techniques. The most important fishing methods are: fish traps or pots (Antillean Z-trap) used to catch demersal species and accounting for 54% of all fish catches; gill and seine nets used mainly to catch oceanic and coastal pelagic species and accounting for 23% of all catches; hand lines, long lines and troll lines, used to catch both demersal and pelagic species and accounting for 17% of the total catch; and other methods including throw nets, hand-collections and spearguns used for demersal and pelagic species, accounting for 4% of the total catch. Fish traps result in the highest catch per landing (59 lbs.), and the highest value of catch per landing (\$132) of all gear used. (Sahney, 1982).

Fishery Production. Catch statistics are not available for all species. Sahney (1982) compiled information relating the annual catch by type of fish to the fishing ground for several demersal and pelagic species, revealing a production figure of 15.9 million lbs. (7,227 tons) taken by canoe fishermen in 1981. Sahney (1982) also recorded catches of 1.2 million lbs. (500 tons) taken by carrier boat operators, for a total marine fishery production of 17.2 million lbs. (7,800 tons) in 1981. Production in the canoe-based fishery has remained around the level recorded above since 1971. (See Tables 44 and 45).

Potential Yields. Various estimates of the potential yield from all Jamaican fishing areas have arrived at different estimates (Munro, 1974; USSR-Jamaica Survey, 1980; Nicholson and Hartsuijker, 1982). A combination of the most conservative estimates (Hartsuijker 1982) noted that estimates of yield made for various fishing areas by the other studies mentioned above may have been inflated.

Organization and Economics of the Fishery. The most recent survey of the industry (Fisheries Division, 1982) indicated that there were some 16,000 registered fishermen, of which 12,000 were engaged full-time in fishing as a source of livelihood. Including dependents and persons involved in vending and fisheries-related activities, the fishing industry is thought to support 150,000 persons (Aiken 1984). The incomes of fishermen are low, estimated to be an average of \$9,183 per boat per year (Sahney 1982).

**Table 44:**  
**Estimates of Fish Production From Jamaica Insular Shelf Only, From 1945 to 1981**

YEAR	ESTIMATED PRODUCTION	
	(tons)	(million lbs)
1945 - 1949	5,450	12.0
1950 - 1954	4,990	11.0
1955	6,580	14.5
1956	7,720	17.0
1958	10,260	22.6
1959	9,900	21.8
1960	10,300	22.7
1962	10,990	24.2
1968	6,630	14.6
1970	6,620	13.8
1971	7,080	15.6
1973	7,300	16.0
1975 - 1978	7,300	16.0
1981	7,220	15.9

Source: Harris (1963); Chuck (1963); Vidaeus (1970); Munro (1974); Bodurtha (1975); FAO/IDB (1979); Sahney (1982); Aiken (1984). Compiled from various sources.

**Table 45:**  
**Artisanal Fishery: Estimated Annual Catch by Type of Fish and Fishing Ground**

Type of Fish	FISHING GROUND								Total (lb) %	
	North Shelf (lb)	%	South Shelf (lb)	%	Pedro Bank (lb)	%	Other Banks (lb)	%		
Snapper (12.4)	479,145	24	1,151,951	59	197,077	10	142,414	7	1,970,587	100
Parrot (11.1)	270,771	15	954,651	54	432,779	25	108,974	6	1,767,151	100
Tuna & Bonito (2.3)	159,663	44	59,819	16	19,416	5	129,124	35	367,882	100
Goat Fish (3.8)	85,929	14	291,462	49	193,906	32	30,170	5	601,467	100
Jack Fish (8.1)	370,401	29	380,008	30	413,404	32	118,292	9	1,282,105	100
Herring & Sprat (14.7)	27,180	2	1,276,658	95	12,302	1	20,698	2	1,336,838	100
King & Wahoo (1.6)	67,192	26	129,585	51	3,052	1	56,460	22	256,289	100
Mullet (1.0)	45,353	28	93,253	58	15,973	10	6,506	4	161,085	100
Grouper & Hinds (5.7)	27,977	3	87,468	10	455,560	50	332,724	37	903,729	100
Dolphin (1.5)	34,857	15	2,578	1	602	*	203,107	84	241,144	100
Goggle Eye (0.8)	66,934	52	42,651	33	0	0	18,366	15	127,951	100
Mackerel (0.5)	3,741	5	56,367	70	17,236	21	3,235	4	80,579	100
Trigger (2.9)	37,128	8	56,375	12	250,158	53	124,137	27	467,799	100
Grunt (7.5)	60,604	5	648,224	55	455,400	38	25,652	2	1,189,880	100
Lobster (3.3)	35,411	7	310,193	60	121,723	23	51,007	10	518,334	100
Shrimp (0.1)	85	*	21,383	97	77	*	508	2	22,053	100
Turtle (0.8)	54,300	43	62,228	50	5,322	4	3,802	3	125,652	100
Other (21.9)	618,791	18	1,344,672	39	917,391	26	604,027	17	3,484,881	100
<b>TOTAL (100.0)</b>	<b>2,445,462</b>	<b>15</b>	<b>7,969,363</b>	<b>50</b>	<b>3,511,378</b>	<b>22</b>	<b>1,979,203</b>	<b>13</b>	<b>15,905,406</b>	<b>100</b>

\*Insignificant

SOURCE: Sahney (1982)



Mainland-based fishermen operate from 164 fishing beaches scattered islandwide. Approximately 55 of these beaches are large enough to accommodate 30 canoes or more. Of a total of approximately 4,500 canoes, some 54% of these canoes are mechanized, utilizing outboard motors, while the rest are powered by oars or sails. These canoes range in length from 7 to 15 m. The Offshore Fishery is serviced by approximately 12 fully-decked vessels of 15 to 30 m. length. These vessels, known as "Carrier" boats transport fish from the Morant and Pedro cays in contractual or informal arrangements with cay-based fishermen, landing these catches mainly at the Fisheries Complex in Kingston. In 1985 there were five other fully-decked vessels engaged solely in fishing (Houghton, F.O.).

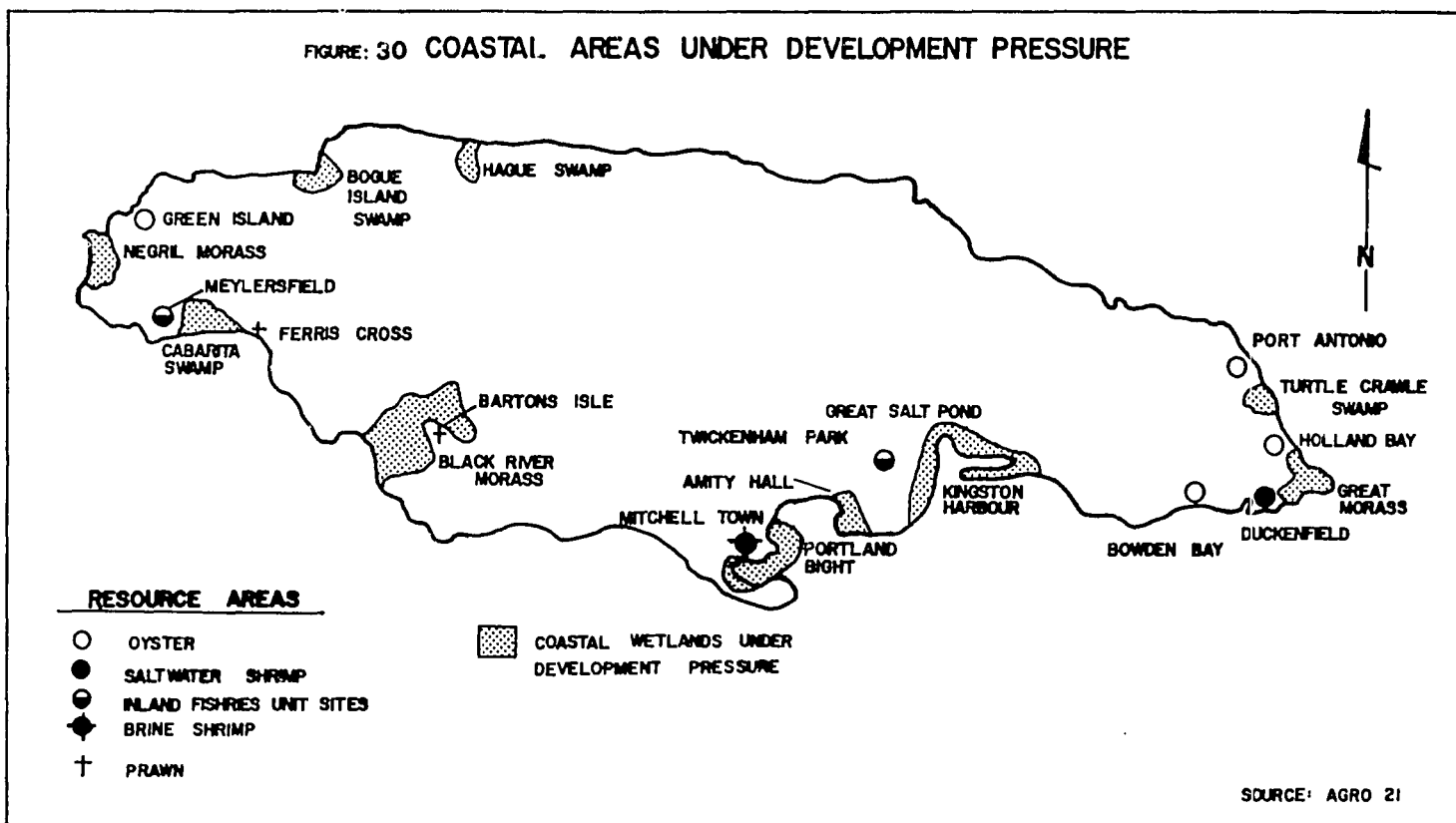
Distribution of the Catch. The bulk of the catch from mainland-based canoes is disposed of boatside at the fishing beaches, or distributed by vendors in nearby communities. Catches originating from the cays, and arriving at the Fisheries Complex, may be distributed further inland by middlemen and vendors who purchase large quantities, and who may retail to hospitals, schools and hotels.

## Mariculture

In 1977, the Oyster Culture (Jamaica) Project (OCJ) of the Ministry of Agriculture (MOA) and the Department of Zoology, University of the West Indies (UWI) was formed to study the culture of local mangrove oysters (Crassostrea rhizophorae Guilding) in Bowden Bay, St. Thomas. Since then, the Project has expanded operations from Bowden to Davis Cove in Hanover; Port Antonio in Portland; and Bogue in St. James. (See Figure 30.)

Commercial Species. Presently, the only commercial mariculture species is the mangrove oyster (C. rhizophorae), which derives its name from its habit of growing upon the stilt roots of the red mangrove (Rhizophora mangle). Another indigenous oyster, the "Flat" oyster (Isognomon alatus Gmelin) occurs naturally at several locations, including Oyster Bay near Falmouth, Trelawny, and Port Royal in Kingston. Although collected and sold fresh, it is not cultured.

Production Techniques. The culture technique comprises a suspended rack system offering an artificial substrate (cultch) consisting of bits



of used motor car tires suspended by nylon monofilament lines from bamboo or mangrove wood rafts. Naturally produced spat (young oysters) settle on the cultch during the spawning season (October–November) and are allowed to grow for 8 weeks. At the end of this period, pieces of cultch containing suitably-sized oysters (2 cm. diameter) are removed and transferred to rafts in deeper water for a grow-out period lasting 4–5 months.

Production of Oysters. Precise figures for oyster production are lacking due to a proliferation of unmonitored small farmers (1–10 rafts each), however, the project manager of the OCJ estimated that, for the period April 1984–March 1985, harvests of cultured oysters totalled 73,000 dozen. Prices for cultured oysters vary depending on location. In Kingston, they may retail for as little as J\$5/dozen, whereas on the island's north coast, they retail for J\$7–12/dozen. Oysters are distributed for sale by the farmers themselves or in small quantities by vendors to hotels, restaurants and individuals.

### **Aquaculture**

Commercial fish farming is well established in Jamaica and has been growing since 1976, when a joint USAID/GOJ Inland Fisheries Development Programme (1976–1979) was started to investigate the feasibility of the culture/farming of tilapia. This was followed by the Fish Production System Project (1979–1985).

Commercial Species. Commercial species include finfish, consisting of several tilapias (primarily the Nile tilapia or "silver perch" *Oreochromis niloticus* L. and various red-strain hybrids of this genus) and the carps (grass carp, silver carp, big-head carp and the common carp) and shellfish consisting solely of the giant freshwater prawn, *Macrobrachium rosenbergii*.

Aquaculture Production and Economics. At the end of June 1986, total land area devoted to aquaculture amounted to 1,013 acres (400 ha.), with the Government, through the Inland Fisheries Unit (IFU) of the MOA, controlling 10 acres (3.95 ha.) of this total, and the rest in private hands. The location and extent of current and proposed acreages for aquaculture projects are shown in Figure 31. All production figures given below were derived from AGRO 21 Corporation Ltd. (Agro 21).

o Tilapia: The economics of farming tilapia have been rigorously studied and data are

available for the various stages of production (Agro-21, 1985). There are currently 200 farms totalling 1,043 acres engaged in tilapia farming. During fiscal year 1985–86, 1,108 tons were harvested. The fish retail for J\$3–5/lb., depending on location and other factors (whether pondside, market, gutted, scaled, live, frozen, etc.).

o Carp: There is no acreage devoted solely to the production of carp. Rather, these fish are cultured with tilapia, mainly to "sanitize" the ponds (they consume waste materials and regulate the growth of plants in the pond). The main producer of carp is Jamaica Aquaculture Limited, Tollgate, Clarendon. The yield for 1985 is estimated to be around 22 tons. Carp seed stock are produced by the IFU, Twickenham Park, St. Catherine, and at Tollgate in Clarendon.

o Freshwater Prawn: There are presently five farms, totalling some 50 acres in area, engaged in the culture of *Macrobrachium*. One of these farms, Aquaculture Jamaica Limited, Barton's Isle, St. Elizabeth (approximately 18.6 hectares) produce seed stock. The rest are operated by small farmers. In fiscal year 1985–86, 21.5 tons were produced.

### **Fish Imports, Exports and Consumption**

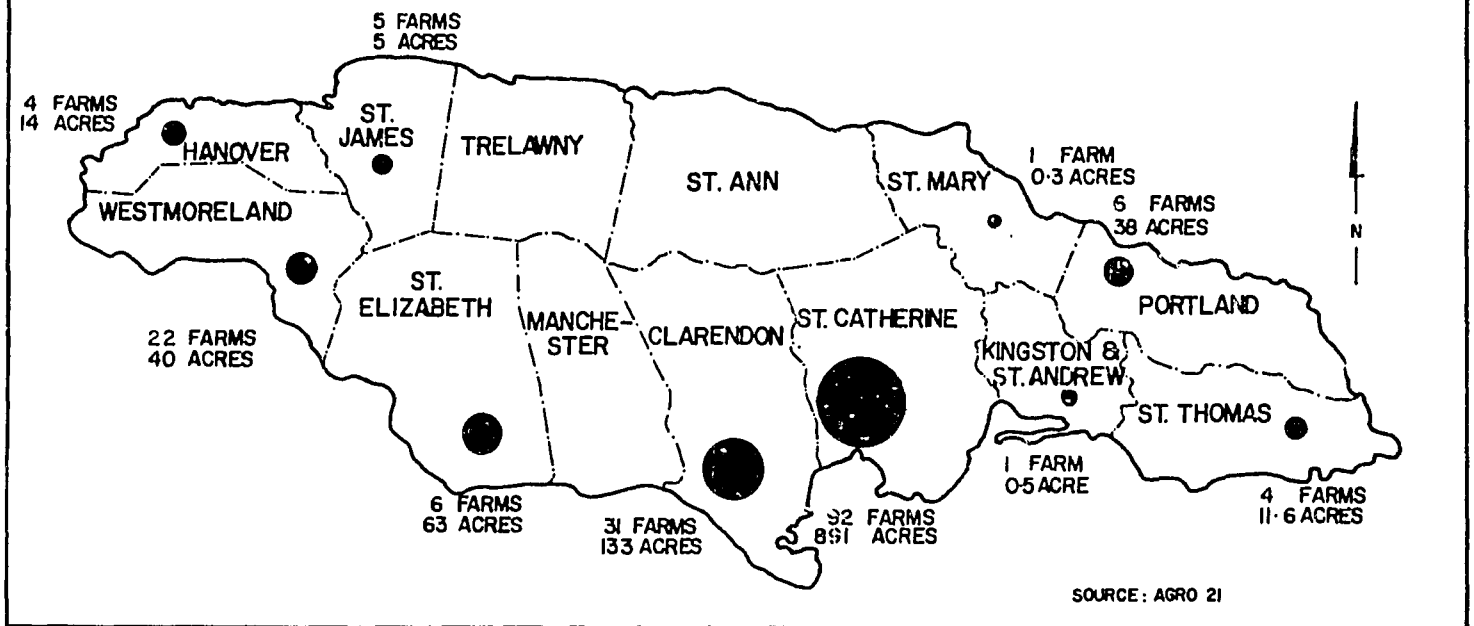
Even though finfish, shellfish and their derived products still comprise some 35% of the Jamaican diet (AGRO 21, 1985), per capita consumption of fish in Jamaica is declining. In the 1960's this was 30 kg./capita/annum, but had fallen to 10 kg./capita/annum in 1984. This decline was attributed to several factors: a stagnating marine fishery; a shortage of foreign exchange to pay for imports; increased production of substitutes (poultry, pigs); and the previous lack of development of aquaculture (AGRO 21, 1985).

In spite of decreasing per capita consumption, imports have assumed increasing importance as local marine landings of fish have declined in recent years, and the deficit between imports and exports is large. In 1984, 15,000 tons of fish and fish products (chiefly canned) valued at J\$102 million were imported (External Trade, 1984). In the same year, only 470 tons of finfish and shellfish valued at J\$1.7 million were exported.

It is likely that the growing aquaculture industry can offset some of this deficit through the export of fresh and processed finfish (smoked

FIGURE 31

**AQUACULTURE DEVELOPMENT PLAN - Location of fish farms (Mar. 1986)**



fillets) and fresh frozen shellfish. To a certain extent this is already occurring, as locally-grown freshwater prawns are replacing supplies of imported frozen marine shrimp in the local tourism sector. (In 1984 imports of shrimp totalled 17 tons at J\$574,386, while there were no exports. In 1985, an unknown quantity of prawns has been exported, mainly for market-testing surveys.) It should be possible for Jamaica to take advantage of a rising consumer demand for "luxury" seafoods now prevalent in several countries.

**Fish Processing**

A limited amount of processing is carried out on locally produced fish by three companies. These are Jamaica Aqualapia Limited (fish fillets), Aquaculture Jamaica Limited (fish fillets), and Jamaica Frozen Foods Limited (fish fillets and smoked and pickled carp). In 1985, approximately 3,000 lbs. of cleaned and frozen tilapia were exported to the Bahamas, while some 10,000 lbs. of pickled carp valued at approximately J\$16,000, were processed by Jamaica Frozen Foods Limited for local distribution by Grace Kennedy Limited.

**AGENCIES AND INSTITUTIONS**

The key management agencies and institutions focusing on Jamaica's fisheries resources include units of the Ministry of Agriculture: the Fisheries Division, the Inland Fisheries Unit, the Oyster Culture (Jamaica) Project, the Natural Resources Conservation Division; the AGRO-21 Corporation Limited, and the Zoology Department, U.W.I. (Mona).

**Fisheries Division\***

Formed in 1950, the Fisheries Division of the Ministry of Agriculture is responsible for servicing, controlling, and developing marine fisheries through the administration of laws relating to fisheries, services to the industry, monitoring of inshore and offshore fisheries, and fisheries research. The Division's spheres of activity include: training in fishing techniques; introduction of new gear technology; administration of credit facilities for the purchase of small boats and engines; upgrading the facilities of fishing beaches; and pursuance of negotiations for the expansion of Jamaica's fishing into waters outside

national boundaries. A significant function of the Division is also the sale of subsidised fuel to the fishermen.

### **Inland Fisheries Unit (IFU)\***

Formed in 1977, the IFU was set up to foster and maintain an islandwide programme of small-scale fish farming. The Unit conducts programmes in the areas of: extension services to farmers including site evaluations, survey, project design, and pond construction. The production of fish is mainly limited to carp fingerlings; training of hatchery and extension staff in fish culture techniques; research into fingerling production techniques and nutrition, polyculture systems and feed performance.

### **Oyster Culture (Jamaica) Project**

The OCJ Project was established in 1982 to develop a self-sustaining local industry of oyster culture using local materials and skills. The Projects' policies are directed towards: developing the optimum production and processing system for cultivation; developing technical support facilities for a local oyster culture industry; determining the economic viability of various scales of oyster farming; and training of local personnel for extension and farming activities. OCJ programmes include: extension services for on-site training of farmers; lectures and demonstrations in construction technology (raft), production and management; research providing biological information necessary for farming operations; and market information.

### **Natural Resources Conservation Division**

The NRCD administers the Beach Control Act (see below), which governs the use of the island's fishing beaches, conducts research and environmental impact studies relevant to the conservation of fisheries, and plays an active role in the assessment of damage to fishing gear resulting from environmental degradations such as oil spills.

### **AGRO 21 Corporation Ltd. (Agro 21)**

The AGRO 21 programme is intended to serve as a mechanism for the mobilisation of the manpower and organizational resources and activities of a wide range of public and private

institutions in the interest of national economic recovery. A Steering Committee co-ordinates the activities of the participating agencies. The functions of the AGRO 21 include: establishment of industry data banks relating to costs, transportation, marketing etc; investigation of investment opportunities for potential investors; assessment of development strategies for cultivated lands; development of strategies to improve yields, maximize agricultural returns; develop new markets for export crops; facilitate the development of secondary industries; and others.

### **University of the West Indies (U.W.I.)**

The Department of Zoology, UWI, is a major centre for training in marine sciences and aquaculture in the Caribbean region. The Department at Mona, Jamaica, provides training at undergraduate and postgraduate levels in aquaculture, and maintains the Port Royal Marine Laboratory, which carried out the first comprehensive study of the biology, ecology, exploitation and management of tropical reef fishery resources (Munro *et. al.*, 1973). The UWI also maintains one of the world's foremost tropical marine laboratories at Discovery Bay, where pioneering work in coral reef biology has been undertaken since the 1960's.

Activities of the UWA and NWC affect aquacultural development in that these agencies issue licences and permits for the construction of wells and have responsibility over the supply of water for irrigation systems.

### **Other Agencies and Institutions**

The management of Jamaica's fisheries resources is also influenced by the activities of the Underground Water Authority (UWA) and the National Water Commission (NWC).

---

\* The present fields of activity of the Fisheries Division and the IFU have been severely restricted by large decreases in their budgetary allocations, and, in fact, the Inland Fisheries Project officially ended in 1984.

## LEGISLATION AND REGULATIONS

The most important laws relevant to Jamaican fisheries are described below.

### Fishing Industry Act

The Fishing Industry Act (1975) provides for: licensing of all fishermen and vessels operating in Jamaican waters; protection of the fishery by establishment of closed seasons; creation of fish sanctuaries; and penalties for the landing and sale of illegally caught fish.

### Morant and Pedro Cays Act

The Morant and Pedro Cays Act (1907) establishes licensing conditions in the Morant and Pedro Cays, and prohibits unauthorized fishing and the removal of birds and turtles.

### Wildlife Protection Act

The Wildlife Protection Act (1964) provides powers for the conservation of wildlife, prohibits the dynamiting and poisoning of fish and the capture of immature fish and turtles (including eggs). It also provides for the establishment of Game Sanctuaries and the appointment of Game Wardens. (See Wildlife Sector.)

### Beach Control Act

The Beach Control Act (1955) provides for the regulation of activities within 25 m. of the shore line, including control over the construction of sheds and huts on beaches, and prohibits the use of public beaches for fishing activities.

### Other Legislation

Other laws of relevance to the fishing/ aquaculture industry are: the Underground Water Control Act (1954), providing control over the sinking of wells; the Town and Country Planning Act (1957), controlling the use of mangrove areas and wetlands; and the Land Development and Utilization Act, providing for the regulation of idle lands, terms of leasing, and the disposition of agricultural lands.

## PLANS AND PROGRAMMES

### Marine Fisheries

Apart from proposals by the USAID to provide funding for the purchase of outboard engines for the artisanal fishery, there appears to be no assistance forthcoming for marine fisheries. Within the limitations of its budget, the Fisheries Division will carry out the following activities:

- o In-house training at the junior technical level in the role of the division, role of division personnel, basic ecology and fisheries management principles.
- o Investigation of new resources, in particular, research into the population dynamics and ecology of the Goggeye jack (Selar crumenophthalmus).
- o Strengthening the capabilities of the division in the areas of manpower and equipment, in order to effect the division's responsibilities for training, assessment and monitoring of fish stocks and assessment of loan applications.
- o Pursuance of bi-lateral fishing treaties with other nations in order to supplement the dwindling island shelf fishery. Treaties are in effect with Columbia, and are being sought with Guyana and Belize.

### Mariculture

Expansion of Current Programmes. The OCJ plans to increase the size of its grow-out sites in Bowden and Port Morant in St. Thomas, Green Island and Davis Cove in Hanover, and Bogue Sound in St. James, in order to increase the output of cultured oysters. The cost of the expansion is projected to be J\$400,000 and is to be financed by the GOJ and the IDRC through the OCJ Project.

Supplementation of Natural Seed Stock. This programme, which commenced in May, 1985, will examine approaches to supplement natural supplies of seed, and investigate the high incidences of oyster mortality and biofouling (overgrowth of spat by marine organisms) pres-

ently being experienced. The programme is being implemented over a three-year period by the UWI, Dalhousie University (Canada), in collaboration with the OCJ. The project is being funded by the International Development Research Centre (IDRC) of Canada.

## **Aquaculture**

Expansion of Current Projects. It is proposed to expand 1984 pond acreage from approximately 162 hectares to over 1,619 hectares of food fish production by 1989, for a projected yield of 9 million kg/annum (Agro 21, 1986). Presently, 446 hectares are in construction or production, with a projected yield of 1.8 million kg. for fiscal year 1986-87. With 203 farmers in existence, precise data on projects undergoing expansion is not readily available, but some of the largest are listed in Table 46.

Development of New Projects. Projects have been proposed to increase the production of freshwater fish by the expansion of private farms in the areas of: Hill Run/Hartlands, St. Catherine (142 hectares) to yield 1.0 million kg/annum; Monymusk, Clarendon (132 hectares) to yield 600,000 kg/annum; and Amity Hall, St. Catherine (81 hectares) to yield 0.6 million kg/annum. Based on these projections, local production of freshwater fish could reach 9.0 million kg/annum by 1999. This figure represents 60% of the island's current fish imports, and could realize savings of US\$24 million/annum.

Other projects include: a proposal for the development of a saltwater shrimp farm (possibly at Monymusk, Clarendon) as a private venture; and a 1-year pilot Jamaica Broilers venture for the production of the brine shrimp (*Artemia*) in the ponds of the Portland Cottage, Clarendon Solar Salt Plant, for use as a high quality protein ingredient in fish and shrimp feeds. (See Figure 32.)

## **Affiliated Research Projects**

The Departments of Botany, Geology, Zoology, and the Discovery Bay Marine Laboratory of the UWI are engaged in research projects in the areas of: the culture of marine algae (Irish moss) for food; restoration of sea grass beds; wetland reclamation; environmental impact of the development of peat and wetlands; coral reef ecology; population dynamics of penaeid shrimps and blue crabs; aquaculture potential

of Jamaican stream fishes; aquaculture of shrimp and tilapia; and a reef-fish management programme.

## **PROBLEMS AND ISSUES**

### **General Trends Impacting Fisheries Resources**

General trends impacting Jamaica's fishery resources include: the destruction of coastal mangrove zones and wetland areas, which are important as breeding and nursery grounds; the pollution of harbours and water bodies; and the siltation of lagoon areas. (See Table 47). Development pressures impact marine fisheries primarily due to their effects on breeding areas which provide recruitment of fish stocks, but may also impact on the natural supply of spat for the mariculture industry. At present, these pressures have little impact on aquaculture activities as these operations often utilize marginal lands. The aquaculture industry itself, which utilizes swamplands or drained lands in various locations (e.g., St. Thomas, St. Elizabeth), may contribute to the destruction of breeding and nursery grounds for stocks of fish and shrimp.

### **Problems Affecting Marine Fisheries**

In general, declining catches in inshore areas are divided among too many fishermen, resulting in continuing depletion of fish stocks and very low individual (per capita) incomes. Specific issues related to marine fisheries include:

1. Rapid Growth. The artisanal fishery has grown in size from approximately 2,500 canoes and 7,500 fishermen in 1962 to approximately 4,500 canoes and 12,000 fishermen in 1983 (Aiken 1984). These increases have resulted from a natural population increase in coastal fishing villages and from the lack of economic alternatives to fishing for a livelihood.
2. Declining Catches in the Inshore Fishery. Declining catches appear to be related to increases in the number of fishermen and in the use of fine-meshed gear, which removes fish before they have attained reproductive age. Total catch per canoe declined from 4,213 kg. in 1968 to 2,484 kg. in 1981. During the same period, fishing intensity (no. canoes/ $\text{km}^2$ ) increased from 0.45 in 1968 to 0.84

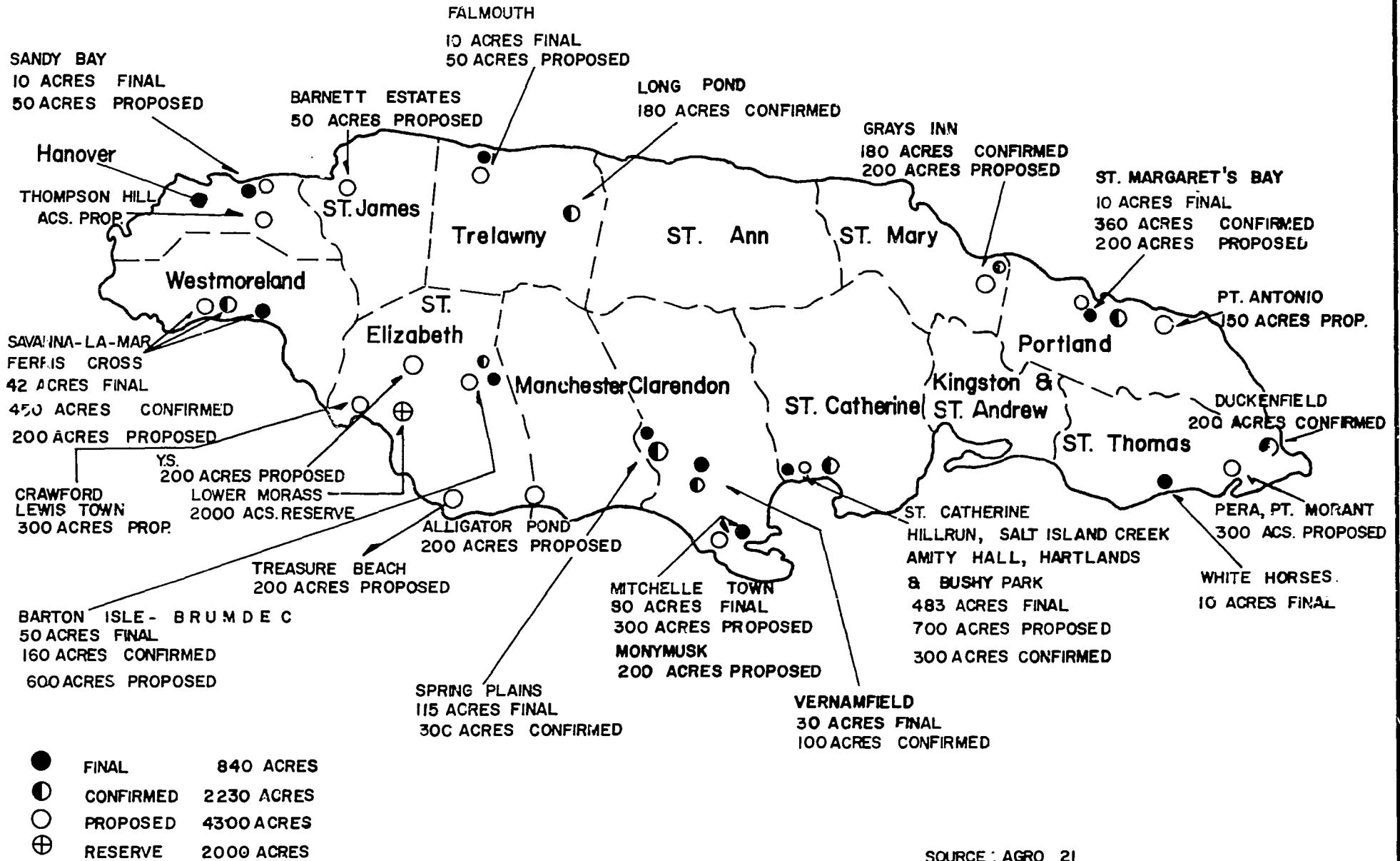
Table 46: Major Projects Undergoing Expansion in the Aquaculture Industry

PROJECT	DATE OF IMPLEMENTATION	ACREAGE		CAPITAL EXPENDITURE (J\$mill.)		SOURCE OF FUNDS
		ACTUAL	PROPOSED	1985	1987	
Aquaculture Jamaica Ltd., Brumdec, Saint Elizabeth (Freshwater prawn, tilapia)	2/83	37	200	3.7	12.0	Jamaica Broilers/Brumdec
Jamaica Aqualapia Ltd., Tollgate, Clarendon (Freshwater prawn, tilapia)	1984	110(?)	440	unknown	unknown	NIBJ/Worldwide Promoters Limited
Jamaica Aqua Farms Ltd., Westmorland (Freshwater prawn hatchery)		18	50	2.0	4.0	Local
Houghton Fisheries Jamaica Ltd., Saint Elizabeth	11/84	0-25	180	0.7(?)	9.0	Local & Foreign (Caribbean Basin Management Corp.)
Inland Fisheries/Other Private Sector Developments		117	1100			Owners' Equity/Commercial Banks
Agro Expo Farms, Portland	11/84	50	180	1.7	5.0	Foreign & Local Commercial Banks

Sources: Planning Institute of Jamaica; ACPD 21 Corporation Ltd.

FIGURE 32

NATIONAL AQUACULTURE DEVELOPMENT PLAN - JAMAICA



SOURCE : AGRO 21



**Table 47:**  
**Development Pressures Affecting Fisheries Resources**

GENERAL TREND IMPACTING FISHERIES RESOURCES	LOCATION OF IMPACT	AREA AFFECTED	AREA OF IMPACT	EFFECT/RESULT OF IMPACT	DOCUMENTATION	
1. Destruction of Coastal Ecosystems: a) Wetlands	Upper Morass, Black River, St. Elizabeth	1,760 ha	Agricultural Development (Brumdec); Sugar Factory Effluent (Appleton, Holland)	Swamp Drainage; pollution Destruction of habitat	NRCD, 1982	
	Negril Morass, Westmoreland	2,500 ha	Agricultural Development (MDA; Private)	Swamp drainage - as above	NRCD, 1982	
	Great Salt Pond, St. Catherine	180 ha	Urban & Recreational Dev. (Hellshire, Fort Clarence) Sugar Factory effluent (Bernard Lodge)	Destruction of breeding and nursery grounds for fish and shrimp; elimination of mariculture potential.	NRCD, 1982	
	Great Morass, St. Thomas	1,600 ha	Agricultural Development	Swamp drainage - as above	NRCD, 1982	
	Cabarita Swamp, Westmoreland	800 ha	Agricultural Development (MDA; IFU)	As above	NRCD, 1982	
	Hague Swamp, Trelawny	200 ha	Agricultural Development (ADC)	Destruction of breeding and nursery grounds; degradation of tourist attraction (the phosphorescent lagoon)	NRCD, 1982	
	Turtle Crawl Swamp, Portland	24 ha	Urban Dev. (not known if this was implemented)		NRCD, 1982	
	b) Mangrove Forests	Kingston Harbour	52 km <sup>2</sup>	Urban Dev. (Portmore, Edgewater Bridgeport) Industrial Dev (Newport East, Newport West, Airport)	Decimation of stocks of finfish and shrimp through removal of breeding and nursery areas.	Goodbody et al, 1969; 1970; Wade, 1976; Munro, 1971
		Oyster Bay, Falmouth, Trelawny.	N/E	Industrial Dev. (Hotel)	As above	NRCD, 1982
		Bogue Island Lagoon, St. James	N/E	Industrial Dev. (Hotel)	As above	NONE

Table 47: Continued

c) Coral Reefs	North Coast, Jamaica: Port Royal, Kingston	N/E	Dredging for harbours, Domestic sewage (hotels), Removal of corals for souvenirs, jewellery, etc. Boating damage.	Structural damage, Destruction of habitat of fish stocks; lowered species diversity.	WADE, 1981  NONE
2. Degradation of Watersheds	Yallahs Watershed Southeastern coastline. 17,800 ha.	N/E	Agricultural Dev. resulting in soil erosion.	Siltation, alteration of coastal ecosystems due to increased nutrient load and suffocation of marine sessile organisms.	NRCD (VARIOUS)
	Hope Watershed. Southeastern coastline. 8,000ha.	N/E	Agriculture; Wild fires as above	As above	As above
	Rio Cobre Watershed South Clarendon & St. Catherine shelf. 64,000 ha.	N/E	As above	As above	As above
3. Pollution of Water Bodies: a) Coastal Areas	Kingston Harbour	As above	Agricultural run-off-fertilizer pesticides; soil erosion via Rio Cobre, Duhaney River, Sandy Gully; Industrial effluents; Domestic sewage; oil pollution.	High bacterial levels, high BOD; loss of fauna and flora; health hazard.	Goodbody, 1970; Wade, 1971, 1976
	Portland Bight, Clarendon. (Not under constant pressure)	260 km <sup>2</sup>	Infrequent oil pollution from shipping (e.g. 1974)	In 1974, a significant spill destroyed fish, crustacean, bird, and mangrove life.	ECS, 1974
	Phosphorescent Lagoon, Trelawny	N/E	Sewage outfall, Falmouth Market; Agricultural & Industrial Dev.	High BOD, nutrient levels.	NRCD, 1982
	Amity Hall Swamp St. Catherine	490 ha	Sugar Factory effluent (Innswood)	High BOD, nutrient load	NRCD, 1982
	b) River Systems	Rio Cobre Basin, St. Catherine	N/E	Citrus processing waste; Milk condensing waste.	As above
Black River, St. Elizabeth; Rio Minho, Clarendon; Cabarita River, Westmoreland.		N/E	Sugar factory effluent	As above	NRCD, 1980

Table 47: Continued

4. Siltation	Kingston Harbour, Montego Bay, Ocho Rios	N/E	Natural run-off; Urban and Agricultural Dev.		WADE, 1971; 1976
5. Coastal Erosion	Johnson Town Fishing Beach, Hanover; White House Fishing Beach, St. Elizabeth; Great River Fishing Beach, St. James.	N/E	Natural processes and man-made intrusions (groyne construction, sand stealing for construction aggregate).	Destruction of beach; Storm damage potential	NRCD on-going study.
6. Population Pressure on Fishery	All Island		Increased population density in coastal communities.	Depletion of fishery resources, including non-commercial species.	

KEY TO TERMS:

- N/E = Not estimated
- ADC = Agricultural Development Corporation
- BOD = Biological Oxygen Demand
- BRUMDEC = Black River Upper Morass Development Corporation
- MDA = Ministry of Agriculture
- IFU = Inland Fisheries Unit

units in 1981. Maximum yields in the inshore fishery were probably attained around 1975-1976, but the fishery has since entered a phase of over-exploitation (Aitken/Haughton, in press). This overexploitation has resulted from a significant increase in fishing effort.

3. Lack of a Production/Catch Monitoring System. Due to the lack of a permanent system for routine collection of fisheries data, changes in fish population and production go unnoticed, making forecasting and control difficult.
4. Personnel and Financial Problems Experienced by the Fisheries Division. The lack of adequate finances results in the inability to attract suitably qualified personnel. (In the view of the Director of Fisheries, the Division needs an additional 7 professional and 24 technical staff to supplement the present complement of 29.) In 1984, the operating budget of the Division was J\$1.6 million.
5. Increases in and Equipment Fuel Prices. Despite Government subsidies, fuel and equipment prices have increased dramatically since 1974. These increases affect the cost-efficiency of long distance fishing trips, encouraging fishermen to remain inshore, thereby increasing fishing pressures in these areas.
6. Socio-Economic Problems. There are few, if any, alternatives for the employment of small fishermen. The general level of education in fishing communities is low, thus reducing the skills, mobility and employment options of fishery families.
7. Regulation. The effective enforcement of the Fisheries Act is a major problem. The difficulty of achieving effective enforcement is related to: low catch rates; insufficient enforcement personnel; and low levels of awareness among fishermen and enforcement personnel

In addition, the Jamaican Fisheries Industry is an open-access one, and there is need to limit the entry of new fishermen.

8. Praedial Larceny. Fishpot stealing is an increasingly widespread problem because of the following: increase in price of materials; inexperience of new fishermen; declining catches; inadequate enforcement; and overcrowding of fishing grounds.

9. Other Problems. Other problems may be related to: non-functioning of many fishermen's co-operatives which would share labour and reduce costs, provide credit, provide duty-free fishing equipment, fix prices, market fish etc.; deterioration of market access roads and transportation; and environmental degradation of mangrove areas. However, there is no information as to the effects of these factors on the fishery. These problems are further accentuated by the geographic (spatial) distribution of fishing beaches around the Island.

#### **Problems Affecting the Mariculture Fishery**

1. Inadequate Supplies and Protection of Seed Stock. Spat collection, although attempted in several locations, has been successful only at Bowden, St. Thomas.
2. Shortage of Manpower and Funds. Because of inadequate financial resources, the OCJ Project experiences difficulty in optimizing the efficiency of its programmes and in expanding them. There is a shortage of trained personnel for biological studies, culture operations, and extension activities.
3. Over-Harvesting. Over-harvesting occurs primarily in Old Harbour Bay, St. Catherine, where stocks are harvested before adequate natural recruitment of spat occurs, depleting stocks for the following season.
4. Praedial Larceny (poaching). The theft of cultch and indeed, whole rafts containing pre-harvest and harvest size oysters, results in production declines and loss of income to fishermen. (These losses have not been quantified.)

#### **Problems Affecting the Aquaculture Sub-Sector**

1. Costs and Prices. These problems are of several types: (a) a dependence on imported feed ingredients has driven up production costs (feed may account for 30-50% of operating expenditures); (b) increasing fuel costs have contributed to the elevation of other expenses (e.g., construction of ponds); and (c) high interest rates are forcing farmers out of business or curtailing production, while commercial bank rates applied to Agricultural Credit Bank funds and production capital borrowed by producers also stifle growth.

2. Distribution and Marketing. Lack of appropriate distributors and market outlets is restraining production. A lack of fish processing facilities also slows down or increases the difficulties of marketing fish. Inadequate cooperative efforts by small farmers to coordinate production, distribution, and quality control have reduced the sale of fish from these farms.
3. Scaling-down of IFU Operations. Budget reductions and layoffs of trained workers at the IFU have reduced the capabilities of the Unit in the areas of site survey, pond construction, project design and extension. The effects are felt most by small farmers (the majority of farms and acreages). The IFU also produced fry and fingerlings for stocking. Although larger farms produce their own fingerlings, the curtailment of IFU production has resulted in short-falls in fingerling supply.
4. Praedial Larceny. Praedial larceny is a problem to small and large farms. On large farms, security is a significant cost item. However, to small farmers who lack the resources to provide adequate security, the action can be crippling.
5. Predation. Predator removal of fish can be significant where farms are located near swamplands harbouring the crocodile (Crocodilus acutus), which removes mainly adult fish, or in coastal areas within the reach of the brown pelican and other water birds (herons, egrets), which mainly prey on juveniles. Several farms are affected, particularly those in southern Clarendon and St. Catherine, and in the Black River Morass.
6. Water Supplies. Water supplies in the parishes of Clarendon and St. Catherine are inadequate due to the deterioration of the Rio Cobre, St. Dorothy, and Mid-Clarendon irrigation systems. There is incomplete knowledge of groundwater resources for culture use, and the administration of existing water supplies is poor.

## **DIRECTIONS FOR FUTURE WORK**

### **Marine Fisheries Sub-Sector**

In order to halt, or reverse, the various negative impacts on marine fisheries, some degree of rational fisheries management is necessary.

Management schemes must consider methods to effect conservation of fish stocks and prevent overfishing, in theory, to obtain a maximum sustainable yield from the fishery. Suggested management strategies include both socio-economic management and biological management.

### Socio-Economic Management

- a. Strengthen institutions for decision-making in fisheries, and involve related sectors (including agriculture, industry, resource conservation, planning agencies, social development agencies, law enforcement agencies, educational institutions, communications media, and fishermen's representatives). Representatives of these sectors could comprise a Fisheries Management Council, as suggested by Aiken and Haughton (1985).
- b. Establishment of a fishermen's information and educational programme to enlist assistance for management measures, as such measures can only be successful if they are seen to be necessary. (Aiken and Haughton, 1985) suggest poster campaigns and informal beach talks by Fisheries Division personnel.)
- c. Effective enforcement of existing legislation. This may require the introduction of a Fisheries Warden Programme drawn from Fisheries Division personnel and from the fishermen themselves. Notably, the Offshore Fishery is poorly policed, particularly with respect to intrusions by foreign vessels which exploit stocks of the spiny lobster. This will necessitate efficient monitoring by the Coast Guard and Fisheries Division.
- d. Delineation of the Exclusive Economic Zone. There is a need for an Exclusive Economic Zone, especially with regard to the larger offshore banks. This should result in improved protection and control of the marine resources.
- e. Implementation of a programme for rural development in fishing villages. This programme might (i) encourage alternative farming activities, including small-scale agro-industry such as pig and goat farming; (ii) increase the employment of fishermen in aquaculture; (iii) set up fish processing facilities in traditional fishing areas for employment opportunities; (iv) increase fishery families education opportunities to afford them alternative skills and mobility; and (v) set up cottage industry facilities, e.g., craftwork in fishing villages.

## Biological Management

- a. Resource enhancement. The creation of artificial reefs using worn automobile tyres and hulks provides increased resource space for fish and is known to increase the biomass of fish in bays, lagoons and reefs (Smith and Tyler, 1972).
- b. Regulations. Regulations of several types (gear limitations; imposition of taxes, licenses, price controls, quotas and size limits; and establishment of protected areas or seasonal closures) produce a controlling effect on fishing effort. Regarding gear limitations, it is suggested that the size, or aperture of the wire mesh currently used in the industry (as little as 1.9 cm (3/4") aperture) is too small, trapping fish before they have attained maturity and reproductive potential. Munro (1974) recommended that no trap fishing be allowed using mesh wire of aperture less than 4.95 cm (1½ inches inter-knot aperture), predicting that this would result in increases of from 11% to 16% in the value of trap catches. The same principles apply to the use of gill and seine nets.

With regard to the imposition of size limits in the fishery, there appears to be the need to amend regulations to increase the current size limit for spiny lobsters from 76 mm carapace length. However, Aiken (1983) notes that the average length of the carapace in mature (berried) females is 84 mm. Therefore, there seems to be a case for increasing the legal size limit beyond this point, and to introduce a closed season from April 1 to July 31 annually, as is done in many countries of the Caribbean.

- c. Implementation of a Coastal Zone Management Policy. Such a policy is needed to stabilize coastal stocks of fish, shrimp and turtles by ensuring that vital breeding and nursery areas are not destroyed or degraded by development pressures. Agencies whose activities affect coastal areas should be coordinated. (See Johnson, 1985).
- d. Fishing Industry Monitoring Programme. An ongoing programme to monitor catch data, fishing effort, and biological data, is necessary to provide information for management decisions, as well as check on the efficiency of management measures. In addition this would enable a determination of the economic status of the Fishing Industry.

## **Mariculture Sub-Sector**

Improvement of Existing Programmes. Programmes requiring improvement include: the extension service and the evaluation of grow-out sites.

- a. Extension. The Project requires trained extension specialists who will transfer ideas and technology for the improvement of farming operations.
- b. Grow-out site evaluation. The Project is in the process of evaluating additional grow-out sites in order to implement production in more locations.

Research. Continuing research is required in the areas of: mortality rates at grow-out sites; investigation of alternative seed sources (i.e. hatchery systems); development of post-harvest operations (by-products and processing); and biological research geared to produce faster-growing and larger oysters.

## **Aquaculture Sub-Sector**

Issues requiring attention in the aquaculture sub-sector include: development; training; extension activities; research; and development of processing facilities and new markets for produce.

Development, Training, and Extension. These needs have become more exacerbated with the scaling down of the IFU and consequent reduction in its services.

- a. Training and extension. There is need for the IFU to continue to provide training of a practical nature in the areas of: water management in ponds; application and determination of fertilizer and fertilization rates; determination of feeding rates; stocking; harvesting; sexing; and trouble-shooting. Extension services for the provision of on-site assistance, including assistance in the development of detailed project proposals to access credit, are needed.
- b. Research. Some of the requirements of the aquaculture industry are peculiar to local conditions. Research is needed in the areas of: hatchery technology and diets; polyculture and integrated farming systems (live-stock/poultry/pig/fish/shrimp/fish); dietary and nutritional requirements including the use

of indigenous ingredients in diets; disease pathology and treatment; stock improvement through genetic manipulations (development of superior strains, e.g., "red" tilapia); and investigations of alternative culture methods (e.g., cage culture, raceway culture and brackish-water culture).

- c. Development of processing facilities and new markets. Market demand often determines the type of processing to be performed and indeed even the species to be cultured. Markets must be investigated with respect to such factors as: the structure, conduct and performance of the market; the measurement of consumer preferences and characteristics, and estimates of the demand for various products. The various processing operations (smoking, fillets) will also depend on the market demand. Markets exist in the Caribbean, North America, and in Europe.



Plate 25 - Fishermen on Pedro Cay.



Plate 26 - Fishermen using traditional type of net.

**Table 48:**  
**Fishery Resources of Jamaican Waters**

**Oceanic Pelagic Fish Resources**

**CARANGIDAE:**

*Elagatis bipinnulatus* (Rainbow runner)  
*Caranx ruber* (Bar jack)

**CARCHARHINIDAE:**

*Galeocerdo cuvieri* (Tiger shark)  
*Carcharhinus leucas* (Reef shark)  
*C. obscurus* (Dusky shark)  
*C. maou* (Oceanic whitetip shark)

**CORYPHAENIDAE:**

*Coryphaena hippurus* (Dolphin fish)

**ISTIOPHORIDAE:**

*Makaira nigricans* (Blue marlin)  
*Istiophorus albicans* (Atlantic sailfish)  
*Tetrapterus albidus* (White marlin)

**SCOMBRIDAE:**

*Thunnus atlanticus* (Blackfin tuna)  
*T. albacares* (Yellowfin tuna)  
*T. alalunga* (Albacore)  
*T. obesus* (Bigeye tuna)  
*T. thynnus* (Bluefish tuna)  
*Euthynnus alletteratus* (Little tuna)  
*Katsuwonus pelamis* (Skipjack tuna)  
*Scomberomorus regalis* (Cero mackerel)  
*S. cavalla* (Kingfish)  
*Acanthocybium solandri* (Wahoo)

**XIPHIDAE:**

*Xiphias gladius* (Swordfish)

**GINGLYMOSTOMATIDAE:**

*Ginglymostoma cirratum* (Nurse shark)

**ALEPTISAUURIDAE:**

*Alepisaurus ferox\** (Longsnout lancetfish)

**GEMPLYIDAE:**

*Gempylus serpens\** (Snake mackerel)

\* These species are rare deepwater fish of no commercial value locally.

**Coastal Pelagic Fishery Resources**

**CLUPEIDAE:**

*Opisthonema oglinum* (Atlantic thread herring)  
*Sardinella braziliensis* (Brazilian sardinella)  
*Harengula jaguana* (Scaled sardine)  
*H. homeralis* (Red-ear sardine)  
*H. clupeiola* (False pilchard)  
*Sardinella aurita* (Round sardinella)  
*Jenkinsia lamprotaenia* (Dwarf herring)  
*Chirocentron bleekermanus* (Dogtooth herring)

**ENGRAULIDAE:**

*Anchoa lyolepis* (Dusky anchovy)  
*A. hespetus* (Striped anchovy)  
*Ctenograis edulentus* (Atlantic anchoveta)

**MUGILIDAE:**

*Mugil cephalus* (Striped mullet)  
*M. curema* (White mullet)  
*M. liza* (Liza)

**CARANGIDAE:**

*Caranx ruber* (Bar jack)  
*C. caryos* (Blue runner)  
*C. latus* (Horse-eye jack)  
*Selar crumenophthalmus* (Bigeye/Goggleye scad)  
*Decapterus punctatus* (Round scad)  
*Chloroscombrus chrysurus* (Bumper)  
*Trachinotus goode* (Palometa)  
*Oligoplites saurus* (Leatherjack)  
*Selene vomer* (Atlantic lookdown)

**SCOMBRIDAE:**

*Scomberomorus cavalla* (Kingfish)  
*S. regalis* (Cero mackerel)

**HEMIRAMPHIDAE:**

*Hemiramphus brasiliensis* (Ballyhoo)  
*H. balao* (Balao)

**BELONIDAE:**

*Strongylura notata* (Redfin needlefish)  
*S. timucu* (Timucu)  
*Tylosaurus crocodilus* (Houndfish)

**SPHYRAENIDAE:**

*Sphyrna barracuda* (Great barracuda)



### Fishable Crustacean Species

#### PALINURIDAE:

- Panulirus argus (Spiny lobster)
- P. guttatus (Chicken lobster)
- Justitia longimanus (long-armed spiny lobster)

#### SCYLLARIDAE:

- Scyllarides aequinoctialis (Spanish lobster)
- Parribacus antarcticus (Sculptured slipper lobster)

#### SYNAXIDAE:

- Palinurellus gundlachi (Furry lobster)

#### CALAPPIDAE:

- Calappa flammea (Box crab)

#### CANCRIDAE:

- Carpilius corallinus (Coral crab)

#### MAJIDAE:

- Mithrax spinosissimus (Spider crab)

#### PORTUNIDAE:

- Callinectes sapidus (Blue crab)
- C. ornatus (Shellig's crab)
- C. danae (Dana swimcrab)
- C. exasperatus (Rugose swimcrab)
- C. bocourti (Blunt-tooth swimcrab)
- C. marginatus (Masked swimcrab)
- Portunus ordwayi (Red swimcrab)
- P. sebae (Redspotted swimcrab)

#### PENAEIDAE:

- Penaeus schmitti (Southern white shrimp)
- P. braziliensis (Redspotted shrimp)
- P. notialis (Southern pin shrimp)
- Trachypenaeus similis (Yellow roughneck shrimp)

#### PANDALIDAE:

- (Unidentified spp.) (Deepwater caridean prawns)

### Other Fishable Resources

#### GASTROPOD MOLLUSCS:

- Queen conch (Strombus gigas)
- Fighting conch (S. pugilis)
- Milk conch (S. costatus)
- Flame helmet (Cassis flammea)
- Emperor helmet (C. madagascariensis)
- King helmet (C. tuberosus)
- Common whelk (Cittarium pica)

#### BIVALVE MOLLUSCS:

- Mangrove oyster (Crassostrea rhizophorae)
- Flat oyster (Isognomon alatus)

#### CEPHALOPOD MOLLUSCS:

- Reef squid (Sepioteuthis sepioidea)
- Arrow squid (Loligo pealei)
- Common octopus (Octopus vulgaris)
- White-spotted octopus (O. macropus)
- Reef octopus (O. briareus)

#### MARINE ALGAE:

- "Irish moss" (seaweed) (Gracilaria sp.)

(Source: Aiken, 1984)

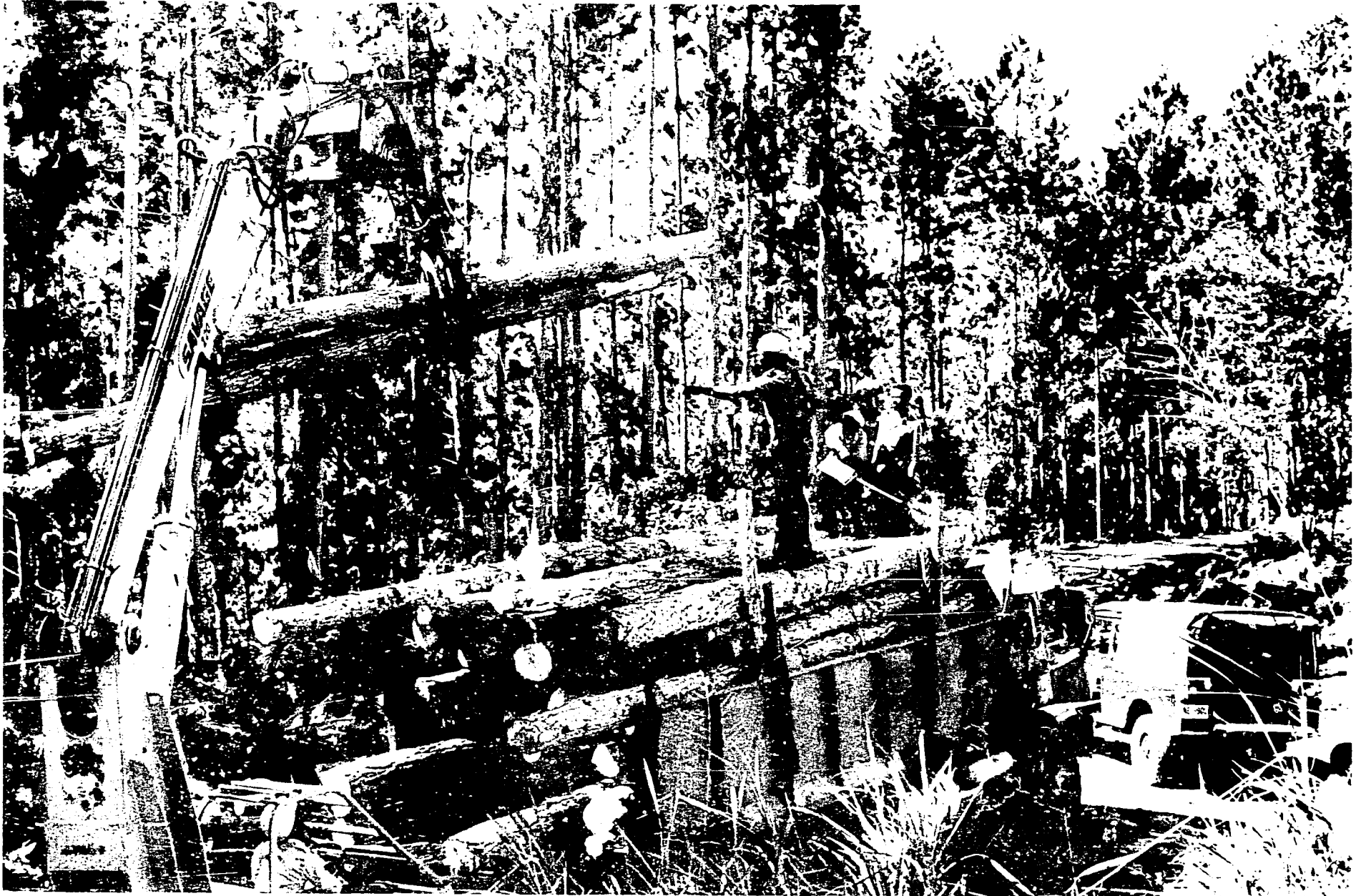


Plate 27 - Forestry Department: Crane lifting lumber.

## OVERVIEW OF FOREST RESOURCES

Forests occupy over 660,000 acres or 24.3% of Jamaica's total land mass. (See Figure 33). Most of the forested area is very mountainous, except for a narrow coastal strip, which is subject to flooding and silting from soil erosion deposits resulting from misuse of steep upland areas by many small and a few large-scale cultivations. The greater portion of the forested area is privately owned. (See Table 49.)

### Classification of Forest Resources

Jamaica's natural forest areas contain a great diversity of species — over 2,800 flowering plants, 5,500 ferns, 300 mosses and many fungi. Indigenous vegetation exists only in the Blue and John Crow mountains of the northeast, Hellshire and Portland Ridge on the south coast, and in small, scattered, uncultivable areas which are inaccessible.

Natural forests have been classified by four types, based on elevation, bio-temperature and annual rainfall (Asprey and Robbins, 1952; See Table 50):

- dry limestone forest (e.g., Hellshire, Portland Ridge);

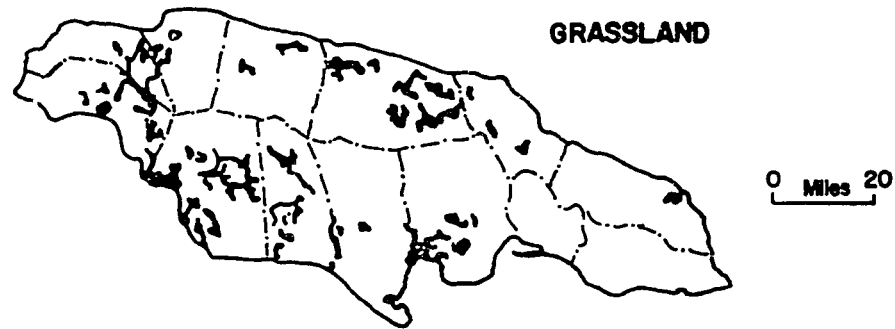
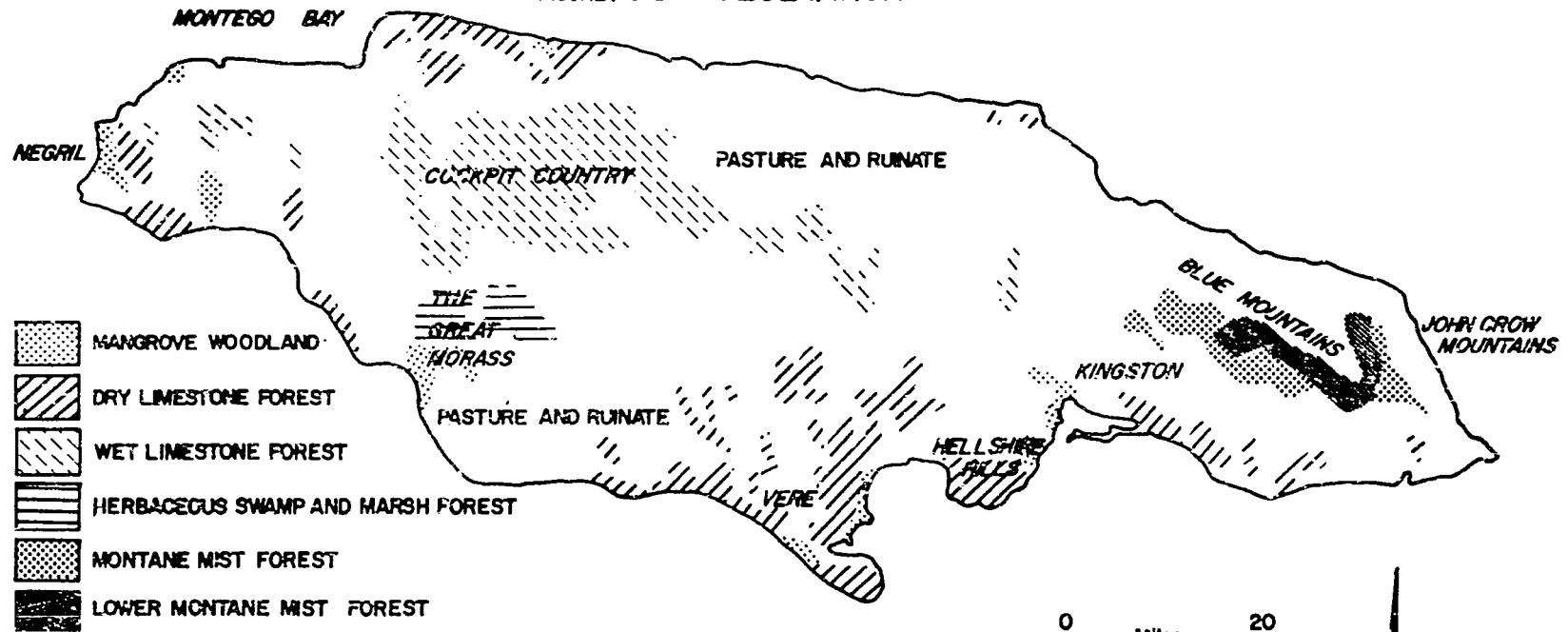
- wet limestone forest (e.g., Cockpit Country, Mount Diablo);
- lower montane mist forest (e.g., Blue Mountain Range, elevation less than 4000 ft.); and
- montane mist forest (e.g., Blue Mountain Range, elevation greater than 4000 ft.).

Marsh forests and mangrove woodlands, which occur at low lying coastal areas, and are now recognized for their important impact on the environment, have since been classified.

The predominant vegetation species and soil characteristics of each of these forest types are discussed below:

- o Mangrove Woodlands: coastal; dominated by red mangrove (Rhizophora mangle), white mangrove (Laguncularia racemosa), black mangrove (Avicennia germinans), and buttonwood (Conocarpus erectus).
- o Dry Limestone Forest (Tropical Very Dry Zone): 0-1250 ft. elevation; in southern limestone hills from Hellshire and Portland Ridge, Morant Point, Don Figuero and Santa Cruz mountain, near Negril; dry limestone of stunted diverse species, mainly birch, cedar, cotton, santa maria, breadnut with epiphytes, bromeliads and cedar at elevations above 100 feet.

FIGURE: 33 VEGETATION



 GRASSLAND AREAS

Source: Clarke, and Hodgkiss 1974. Jamaica in Maps.

**Table 49:  
Distribution of Forest Resources in Government  
and Private Lands - By Parish (Acres)**

<u>Parish</u>	<u>Government Forest Reserve</u>	<u>Private Woodlands</u>	<u>Total</u>
St. Andrew	14,722	20,825	35,547
St. Thomas	32,514	16,837	49,351
Portland	74,394	45,538	119,932
St. Mary	3,666	8,975	12,641
St. Ann	10,920	36,800	47,720
Trelawny	55,837	59,834	115,471
St. James	5,866	30,117	35,983
Hanover	1,065	12,736	13,801
Westmoreland	2,123	26,800	28,923
St. Elizabeth	18,841	43,415	62,256
Manchester	26,590	27,210	53,800
Clarendon	19,545	21,112	40,657
St. Catherine	22,367	23,072	45,439
<b>TOTAL</b>	<b>288,450</b>	<b>373,071</b>	<b>661,521</b>

Source: Jones, Roy; 1986; Workshop on Forestry and the Environment; U.W.I.)

**Table 50:  
Climatic Characteristics of Jamaica's Natural Habitat**

<u>Habitat</u>	<u>Height Above Sea Level (ft)</u>	<u>Mean Annual Bio-tempera- ture (°F)</u>	<u>Mean Annual Rainfall (inches)</u>
Dry Limestone	0 - 1250	79.5	20 - 40
Wet Limestone Forest	0 - 1250	79.5	80 - 160
Lower Mist Forest	1250	75.2	40 - 80
Montane Mist	1250	75.2	80 - 160

Source: Asprey and Robbins; 1953.

- o Wet Limestone Forest (Tropical Mist Life Zone): 0-1250 ft. elevation; tropical mist forests mainly Cockpit country, Mount Diablo and Dolphin Head Mountain; canopy dense up to 100 ft., usually of Broadleaf Terminalia latifolia, Santa Maria Calophyllum brasiliense, with many large girth trees.
- o Lower Montane Mist Forest (Premontane): over 1250 ft. elevation and up to 4000 ft. on the North Blue Mountain slopes and John Crow mountain; similar to wet limestone area; common species: stratified canopy 60'-80' Psidium montana, Symphonia globulifera and Ficus suffocans to 120' high with species of Santa Maria, slugwood, cedar and a number of very rare (mostly untouched) species on about 35,000 acres.
- o Higher Montane High Forest (Premontane Wet Forest): over 4000' evergreen zone; in the Blue Mountain area with no valuable timber due to the constant mist on the poor soils, with canopy less than 50 ft; profusely branched species, mainly Podocarpus urbanii and Cyrilla racemiflora, rare indigenous conifers, Juniperus barbadensis, little disturbed and of substantial scientific value.
- o Herbaceous swamp and marsh forests: mainly in low lying coastal areas, Negril, Black River and Trelawny; vegetation mainly sedges and rushes.

Holgate (1967) suggested another classification of forests based on the concept of Life Zones, which are influenced by both mean annual biotemperature and mean annual rainfall as well as altitude. (See Table 51.) Each zone defines the major climatic factors of the respective environment and determines the potential vegetation types likely to exist before disturbance by man. Soils, which also influence vegetation types, are classified according to the geology of the three major landforms, namely:

- Soils of Basement and Invasive Series occupying the interior mountain ranges, such as the Blue Mountain and the Bull Head regions of Clarendon, which are derived from shales, conglomerates and tuffs of variable fertility and prone to very serious erosion.
- The Upland Limestone Series in karst topography on over 60% of the island. These are of variable fertility, and include the bauxitic and shallow rendzina soils on the coast, which are usually of low fertility.
- Soil of the Alluvial Series in the coastal plains, inland basins and alluvial valleys. These are mostly fertile soils, but some can be low in nutrients and poorly drained.

Another broad classification of forest — natural, ruinate and plantation — is shown in Table 52.

**Table 51:  
Jamaica's Life Zones**

Elevation	M.A.B.	M.A.R.	Life Zones
0 - 1250 ASL	79.5°	20 - 40"	Tropical Very Dry Forest
		40 - 80"	Tropical Dry Forest
		80 - 160"	Tropical Moist Forest
		160 - 320"	Tropical Wet Forest
Over 1250 ASL	75.2°	40 - 80"	Premontane Moist Forest
		80 - 160"	Premontane Wet Forest
		160 - 320"	Premontane Rain Forest

MAB = Mean Annual Biotemperature  
MAR = Mean Annual Rainfall  
ASL = Above Sea Level

Source: Symes, Guy A. 1971 D. Jamaica Journal. Vol.15, No.4. (Based on L.R. Holgate, 1967.)

- o Natural forest of approximately 190,000 acres could be the residual 7% of the existing natural, original land zone in very inaccessible locations.
- o Ruinate is that area which has been cleared at some time and then left to regenerate. An estimated 435,300 acres exist over the island and, where practicable, offer the greatest opportunity for the establishment of new plantations in pines or hardwood for commercial exploitation at maturity in 20 to 30 years. Dominant species which still exist usually include large clumps of bamboos and climber infested ground. Left on its own, over a very long time (hundreds of years), it could develop a high forest canopy.
- o Over 47,000 acres of new forest plantations exist, mainly Caribbean pine (Pinus caribaea), in the eastern part of the island with small areas of hardwood in the central and western regions, mainly mahoe, with cedar, eucalyptus and mahogany in small quantities. There is also a small energy plantation of 45 acres of Ipil-Ipil Leucaena leucocephala and some Albizzia falcaria being observed for poles,

fuel, timber, pulp and paper purposes. Table 5 shows estimated forest plantations on forest reserves by species.

It is estimated that a total of 5,000 acres of plantations exist on private forest lands, the major acreage of which is owned by the bauxite companies. Pinus caribaea represents approximately 60 percent of the private forest plantations, with blue mahoe, West Indies cedar, and Honduras mahogany representing the major species of the remaining 40%.

Assuming that the land was totally forested prior to Spanish settlement, centuries of deforestation caused by clearing of land for farming and settlement have reduced the original forest cover by approximately 70 percent. Of the island's 33 watersheds, nineteen are very badly eroded and losing top soil at the rate of about 10-40 tons per acre per annum. Nearly one-third of the forest occurs in the east (217,471 acres) where most of the intensified forest rehabilitation programme of Caribbean pine plantation development exists (See Figure 34).

**Table 52:  
Extent and Ownership of Forest**

Type	Total Acreage	Government Owned	Privately Owned
Natural	190,000	148,000	42,000
Ruinate	435,300 <sup>1</sup>	101,300 <sup>2</sup>	334,000
Plantation (1977)	247,000	24,700	5,000 <sup>3</sup>
<b>TOTAL</b>	<b>650,000</b>	<b>274,000</b>	<b>381,000</b>

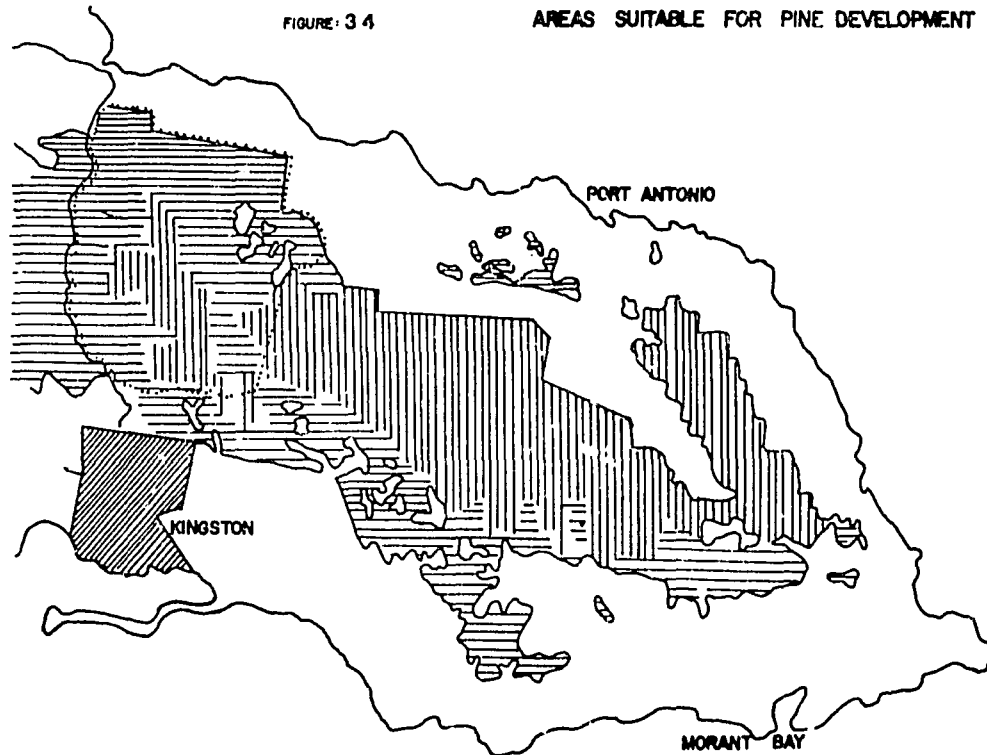
SOURCE: <sup>1</sup>USAID, 1973; <sup>2</sup>IBRD, 1979b, <sup>3</sup>FSCD 1986.

**Table 53:  
Estimated Forest Plantations on  
Forest Reserves by Species**

Species	Acres	%
Pinus caribaea	34,500	73.9
Blue Mahoe	4,593	9.8
Honduras mahogany	5,616	12.0
Jamaica mahogany	80	0.2
W.I. Cedar	142	0.3
Teak	335	0.7
Broadleaf	487	1.0
Pinus patula	50	0.1
Pinus massoniana	35	0.1
Eucalyptus saligna	315	0.7
Eucalyptus robusta	110	0.3
Other Species	437	0.9
<b>TOTAL:</b>	<b>46,700</b>	<b>100.0</b>

FIGURE 3.4

AREAS SUITABLE FOR PINE DEVELOPMENT IN EASTERN REGION



..... PROJECT AREA  
 ——— PINE SOILS  
 [Hatched] FOREST RESERVES

SOURCE: FORESTS DEPARTMENT



## AGENCIES AND INSTITUTIONS

The three principal institutions concerned with forestry in Jamaica are: the Forest and Soil Conservation Department (FSCD), Ministry of Agriculture; the Forest Industries Development Company, Ltd. (FIDCO), a wholly-owned subsidiary of the National Investment Bank of Jamaica (NIBJ); and the Natural Resources Conservation Division (NRCD), Ministry of Agriculture.

### Forest Industries Development Company, Ltd. (FIDCO)

FIDCO, established in 1978, is now managing on a leasehold basis some 23,000 acres of Government-owned pine plantation in the eastern section of the island. It is responsible for the harvesting, transporting, and sawmilling of timber from pine plantations and for increasing these plantations to 50-60,000 acres. Development loans have been granted by the World Bank and the Caribbean Development Corporation (CDC) in order to harvest and utilize 500 acres (200 ha) of native pine timber annually to 1995.

Table 54 records FIDCO's production of pine between 1981 to 1985, compared with imports through the Jamaica Commodity Trading Company (JCTC) a Government agency which has sole authority to import lumber. It is expected that FIDCO's production will continue to increase as more local timber becomes available for reaping from government and private plantations.

In the area of conservation, FIDCO has responsibility to undertake activities to arrest soil erosion on its estate, working in collaboration with other agencies.

### Forest and Soil Conservation Department (FSCD)

The FSCD was formed in 1985 by amalgamation of the former Forest Department and the Soil Conservation Units. FSCD's functions include:

- Development of plantations, especially hardwood;
- Management of forest plantations and natural forests;
- Research on fast-growing species for substitution of imported fuels and the production of fodder and nectar for honey, genetic improvement of *Pinus caribaea* and the utilization of bamboo;
- Training of professional, technical and administrative staff for the forestry sector, including FIDCO;
- Soil conservation and watershed management, in collaboration with the Land Authorities and the Natural Resources Conservation Division (NRCD);
- Forest extension and development, including private forestry, production of craft materials in collaboration with the Ministry of

**Table 54:**  
**Pine Lumber Imports and Local Production**  
**To Satisfy Local Demand**

Real Lumber Demand (in Mill. Bd. Ft.)	1981	1982	1983	1984	1985
Imports by JCTC	26.0	30.9	24.7	22.1	19.5
FIDCO's Production	2.5	1.5	2.9	4.1	6.3
<b>TOTAL</b>	<b>28.5</b>	<b>32.5</b>	<b>27.6</b>	<b>26.2</b>	<b>25.8</b>

SOURCE: Symes, Guy A. 1986. Workshop on Forestry and the Environment. U.W.I., MONA.

Youth and Community Development, Social Development Commission (SDC); and

- Forest recreation development and management, including recreational areas such as Blue Mountain Peak, Portland Gap, Hollywell, Clydesdale, Bull Head, Lovers Leap, Mon-eague, Gourie and Williamsfield, and Fellowship.

#### **Natural Resource Conservation Division (NRC D)**

The Watershed Management section of the Natural Resources and Conservation Division (NRC D) provides technical and management services to implement remedial measures for forestry operations and other activities within the watersheds. It shares responsibility with other members of the Watershed Protection Commission for the maintenance of proper land use in the watershed areas. NRC D also has responsibility for developing National Parks, monitoring forest ecology and wildlife management.

### **LEGISLATION AND REGULATIONS**

#### **Forest Act of 1937**

The Forest Act of 1937 made provision for the establishing of forest reserves and for regulating the use of and the activities of such reserves.

#### **Watershed Protection Act**

The Watershed Protection Act of 1963 provides for the designation of watersheds for conservation purposes. NRC D has primary responsibility for administering the Act, which is intended to reduce soil erosion, ensure a regular flow in rivers and streams, maintain optimum levels of ground water, and encourage proper land use. All 33 watersheds have been designated protected areas under the Act.

### **PLANS AND PROGRAMMES**

Government and private enterprise are involved in developing and utilizing Jamaica's forest resources. As noted above, the Government's role is focused on: FSCD's program of hardwood/pine establishment and research; and

FIDCO's efforts to supply industrial sawn wood and establish and develop the major pine plantations. In addition, the Government provides assistance to establish forest plantations on private lands. Also an estimated 145 sawmills throughout the country are exploiting available hardwood timber from private forests and woodlands.

#### **Watershed Management**

Two joint NRC D/FAO/GOJ projects (IFAD I and II) deal with the establishment and rationalization of the economic and environmental conditions of small hillside farmers in five specific watershed areas in the eastern region, involving 85,000 acres, and 2-3,000 farmers. A third programme for revegetation, protection and management of the Hope River Watershed is scheduled for completion in March 1989. The project is being financed by UNDP, UNEP and GOJ, and is being implemented by the NRC D and FSCD.

#### **Review of Legislation**

A review of legislation for forestry and soil and water conservation (Reid) seeks to address the need for more appropriate soil conservation directives relating to both the Watershed Protection and Land Authorities Act. With respect to forestry, the amendments seek to give the Minister of Agriculture greater control over present and future designated sites and for more direct involvement in their development, to the benefit of environmental upgrading. A draft bill (Forestry Act 1984) has been prepared and awaits ratification as soon as Government's policy has been formulated.

### **PROBLEMS AND ISSUES**

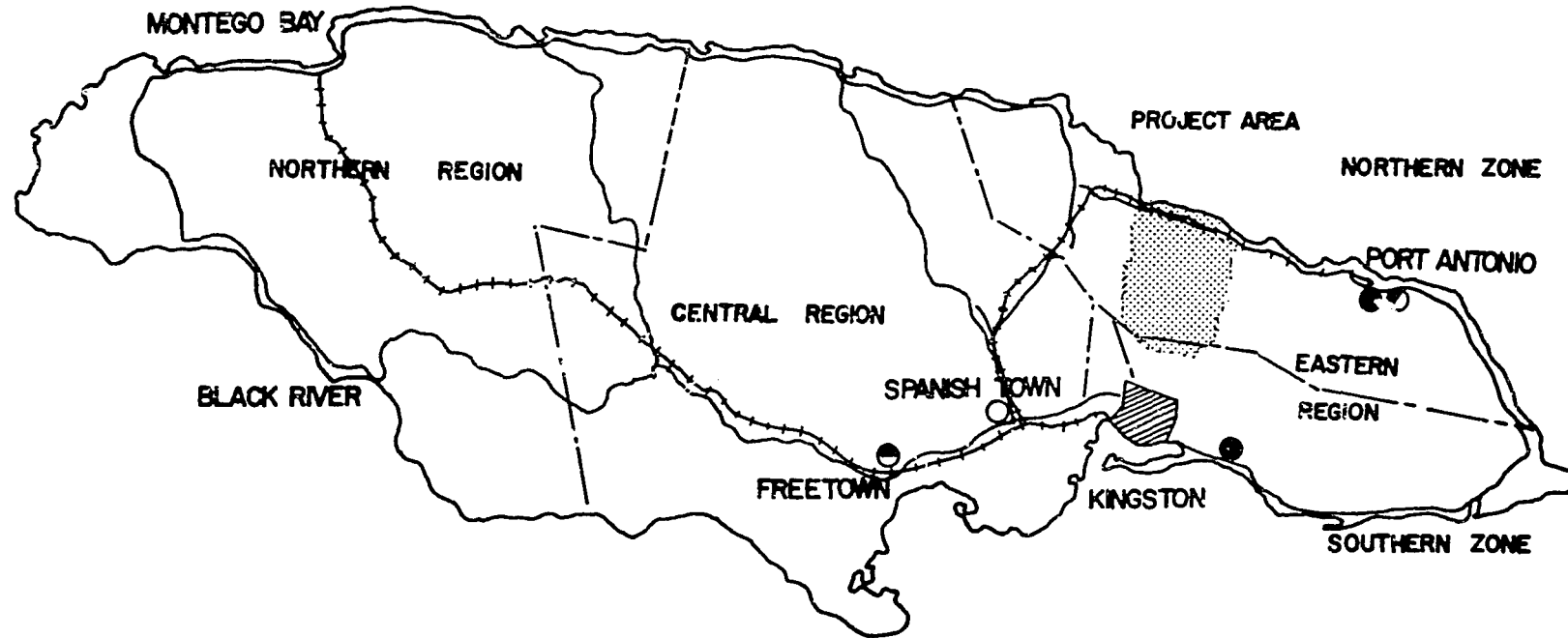
#### **Priority Problems**

The problems are:

- o Removal of the protective tree cover and lower ground vegetation from steep slopes of very erodible soil types, resulting in soil erosion ranging between 10 and 40 tons per acre per annum, with resultant low water conservation.

FIGURE: 35

### FOREST ADMINISTRATIVE UNITS & INFRASTRUCTURE



- MAIN ROADS
- RAILWAY
- - - FORESTRY REGIONS LIMIT
- ..... INDUSTRIAL PLANTATION ZONES LIMIT
- EXISTING PINE SAWMILL
- POSSIBLE FUTURE PINE SAWMILL
- EXISTING PAPERMILL
- POSSIBLE FUTURE PULP & PAPERMILL

SOURCE: FORESTS DEPARTMENT

- o Over-population of some watershed areas, resulting in misuse of forest resource for survival of families.
- o Inappropriate land use as follows:
  - cash crop farming on steep hillside erodable without soil conservation measures;
  - indiscriminate illicit burning resulting in degradation of the forest cover and environment;
  - lack of management in clear felling and extracting timber, particularly on hillsides; e.g., expansion of coffee production;
  - lack of adherence to road construction standards and specifications which increase degradation of the forest environment; and
  - continuing destruction of mangrove forest.
- o Clear cutting rather than partial removal of timber, especially from areas where a slower process would be less harmful to the environment.
- o Inadequate farmer participation in reafforestation programmes.
- o Mining of bauxite in the northern and central hardwood forest regions.
- o Destruction of rare and as yet undetermined useful species of plants.

### **Key Issues**

Prioritization of Soil and Water Conservation Programme. Soil and water conservation development programmes to arrest soil erosion and thus promote water conservation by widespread and reforestation efforts are needed. All 33 watersheds must be replanted, beginning with the nineteen most seriously eroded, to arrest erosion of farm lands. Erosion of hillsides due to poor farming practices has resulted in blockages and silting of streams and rivers, such as the Yallahs and Black rivers, as well as damage to marine fisheries on both the north and south coasts. Improvement of land use practices must be included in all watersheds in the shortest possible time and encouraging adoption of agro-forestry.

Unmanaged Exploitation of the Forest. Over-exploitation of the forest results in abuse and misuse of erodable areas when the tree cover is removed for purposes of arable cultivation. The need exists to reduce population pressure to allow larger units for economic size holdings.

Further, continued use of the forest for fuel and timber must be addressed by adequate replanting with quicker growing species. Care must be exercised to reduce the risk of losing many useful trees.

Development of a Comprehensive Land Use Policy. Presently there is no comprehensive land use policy. There is an urgent need to address the issue of the use of the hillsides in such policy.

Poor Harvesting and Road Construction Techniques. Improvement in forest harvesting and road construction techniques are needed to reduce erosion resulting from the present system of roads and verges, which are often at too steep a slope.

Cultivation of Ganja on Crown Lands. For several reasons, efforts are being made to eliminate illegal growing of ganja, among them the fact that its cultivation increases erosion. However, attempts to find a remunerative substitute crop are, to date, not very promising.

The Need for More Attractive Incentives for Private Forest Activities. Financial incentives for participation of large private farmers in forest rehabilitation programmes have not been attractive enough to date.

Rehabilitation of Mined Out Bauxite Areas. Mining operations will have to comply with requirements to restore mined out areas more quickly than is now the case.

Need for a Forest Development Committee. Institutionalizing the Forest Development Committee, approved by the Ministry of Agriculture, could give a great boost to the reforestation effort.

Need for Ongoing Research. There is need for the results of intensive research to play a more vital part in facilitating the foregoing objectives. Funding is needed to provide for a continuing development strategy that addresses these urgent problems and needs.

Need for an Ongoing Public Education Programme. Jamaican society needs to be made aware of the need to maintain the forest environment and of the consequences that occur from its destruction. Sustained educational programmes are urgently needed.

Enforcement. Provision of appropriate mechan-

isms to enforce standards, regulations and other legal provisions under laws affecting Forest Development in Jamaica.

## RECOMMENDATIONS FOR FUTURE ACTION

### Organization

A properly instituted governing body of technically competent and creative planners is needed to develop an achievable forestry programme, e.g., a 50-year programme to improve the environment with substantial intermediate benefits available from fruit tree products, from intercropping or normal thinning of the forest-tree population. This group should have executive authority, through a Chief Executive Officer, to oversee the efficient performance and coordination of the multidisciplinary team needed to operate this vast programme. A proposed structure is given in Figure 36.

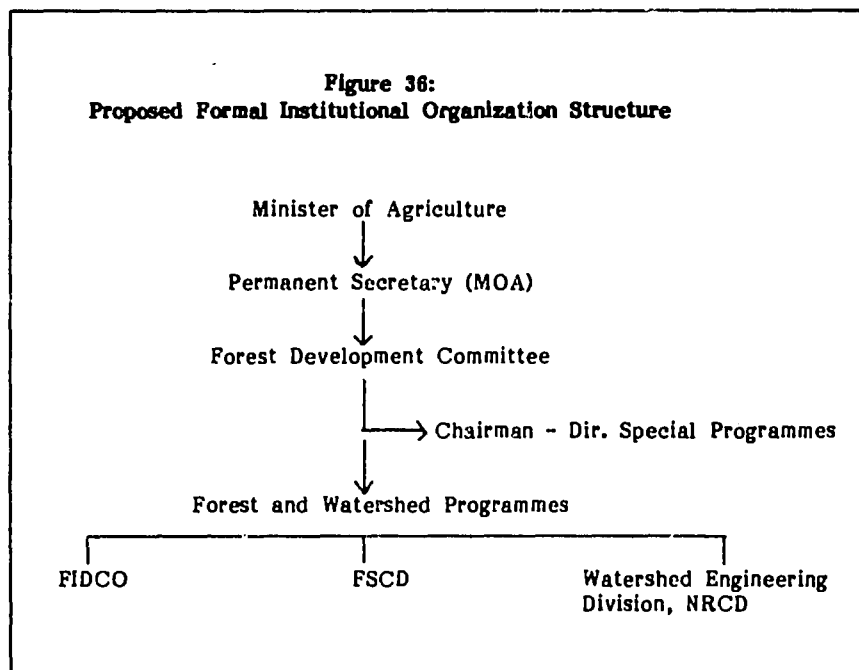
With regard to development planning, agricultural activity must come under the scrutiny of the national planning process, i.e., the Town and Country Planning Authority in order to ensure that agricultural development plans are compatible and consistent with national physical plan and overall environmental policy.

### Land Policy

There is a need to allocate land resources to satisfy national demands for forest product self-sufficiency, as well as to developing a market for locally produced by-products.

Socio-economic data and studies indicate that agriculture can not profitably be undertaken on most of the slopes now used for hillside farming. There is a need for new land use restrictions and the establishment of new codes and allocations for the short supply of arable land to sustain a rapidly increasing population.

Relocation, possibly temporarily, of some populations in hillside enterprises, may be needed to restore the forest environment to a safe condition. If the time should come when land is a constraint to population growth in Jamaica, then proper information must direct that sound actions be taken in using the available land resources. In this spirit, it is recommended that a pilot relocation project be undertaken within well defined parameters. The proposed new scheme of land classification (Table 55), which is not very different from previous ones, could form the basis for a relocation programme. Estimated cost is about J\$3,000,000 initially over a two-to-three year period.



**Table 55:**  
**New Scheme of Land Capability Classification for Jamaica**  
**(A Treatment-Oriented Scheme Especially for Hilly Watersheds)**

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.	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>	FT	F
Moderately Deep (MD) 20 - 36 in.	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub> P	FT F	F
Shallow (S) 8 - 20 in.	C <sub>1</sub>	C <sub>2</sub> P	C <sub>3</sub> P	P	F	F
Very Shallow (VS) 8 in.	C <sub>1</sub>	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, eg. contour cultivation, strip cropping, vegetative barrier, root barrier 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 eg. bench terracing, hexagon, mini-convertible terracing for the convenience of four wheel tractor framing. 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 & mini-convertible terracing on deep soil and hillside ditching, individual basin on less deep soil. Mechanization is limited to small tractor or walking tractor because of the steepness of the slope. Terracing can be done by a smaller tractor with 8 feet wide blade.
- 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°, 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 above soil conservation treatments.

2. Any land which is too wet, occasionally flooded or too stony which prevents tillage and treatment should be classified as:

- (a) Below 25° : Pasture
- (b) Above 25° : Forest

3. Gully dissected lands which prevent normal tillage activities:  
 Forest.

## **Education Programme**

Education programmes should be implemented through the media to bring about greater awareness of the need for a national forest strategy to halt the deterioration of the environment.

## **Planting Material Expansion Programme**

Suitable sources of planting material should be identified, and seeds or seedlings made ready with directives from trained personnel to facilitate a programme of tree establishment.

## **Staffing**

Suitably trained and motivated senior and junior staff, preferably residing in the areas, provided with half a million dollars over a two year period with adequate facilities to operate an appropriate research programme, will reduce the abuse of the forest. A phased development would reduce costs.

## **Forest Products Development**

Greater local use of forest products (e.g., as veneering for furniture, veneering gift items, etc.) with a good return to the forest investor, should give a greater thrust to the development and proper use of the forest. Initial export opportunities are proving very remunerative in a market, which although always competitive, is open to quality Jamaican material of sustainable quantities.

## **Research**

New information derived from research programmes could lay the foundation for the strategies to be employed in the rehabilitation exercises. A realistic land use strategy must be determined for all soils and agro-forestry systems, which will have to be the norm for some time. An allocation of half a million dollars per year for three years should yield very worthwhile results in three years (total J\$1.5M).

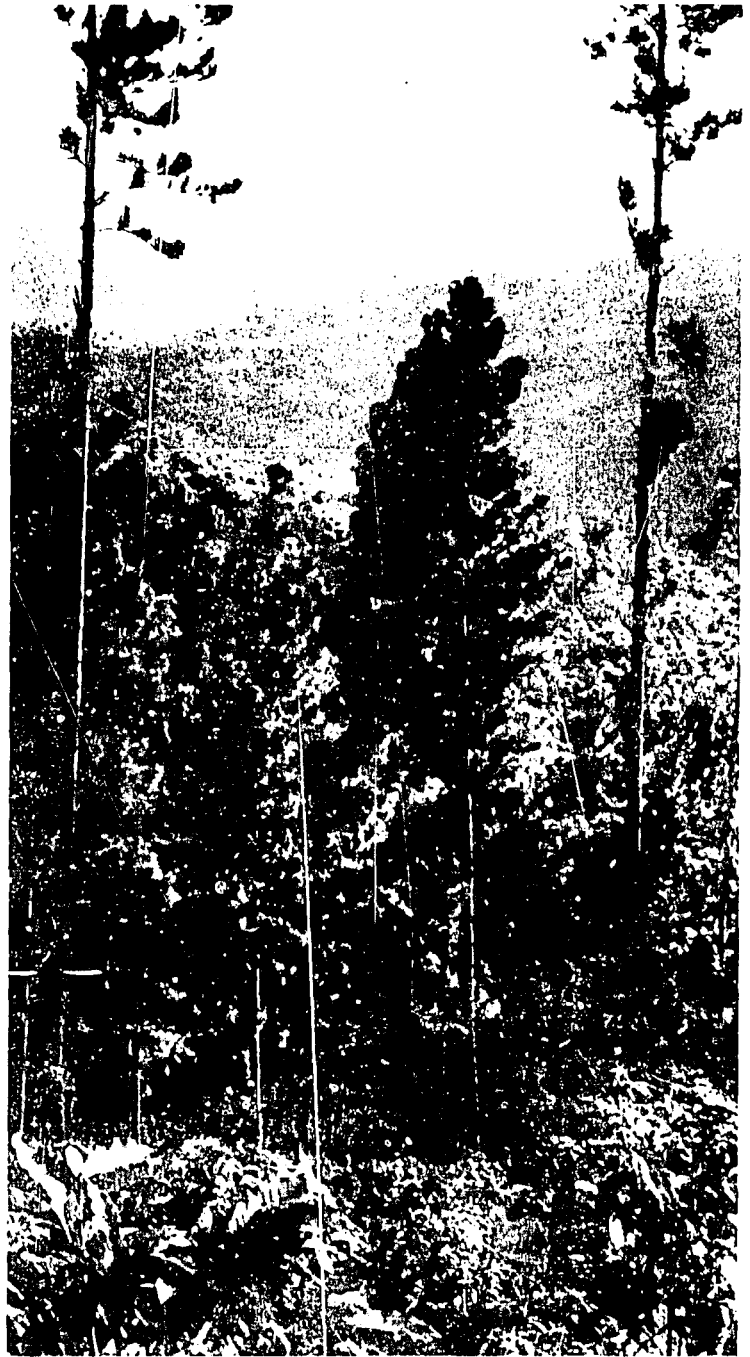


Plate 28 - A stand of Pine trees in the Blue Mountains.



Plate 29 - Schoolboys playing Karate.



Plate 30 - Cricket match in progress.



Plate 31 - Rafting in Portland.



## TOURISM AND RECREATION

---

### OVERVIEW OF TOURISM AND RECREATION

In both 1984 and 1985, tourism earned over US\$400 million for Jamaica. In 1985, the tourism industry was the largest source of Jamaica's foreign exchange earnings, accounting for over 33% of the country's hard currency receipts. This lucrative service industry depends on the island's natural beauty — pure air, abundant sunshine, and clean sandy beaches. This industry, in particular, is testimony to the close relationship between economic well-being and the quality of the natural environment.

#### Overview of Trends in the Tourism Industry

In spite of fluctuations in the international travel market, there has been steady growth in visitor arrivals to Jamaica over the years. The number of tourists coming to Jamaica almost doubled over the years 1971-1985, even though demand fell markedly at various points during the period. (See Figure 37.) Of the 846,716 visitors to Jamaica in 1985, over 67 percent were "stopover" guests; the remainder were cruise ship passengers and armed forces personnel. Between 1979 and 1985, visitor expenditures increased from 194.3 to 406.8 million US dollars.

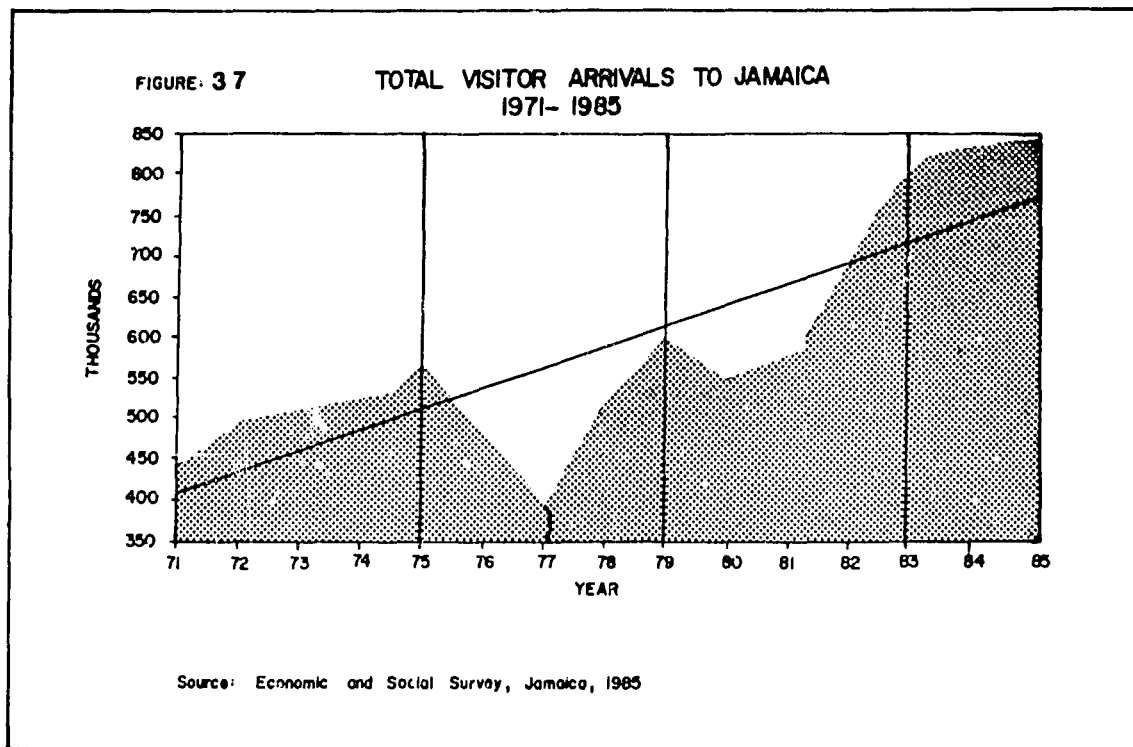
In 1985, 13,619 persons were directly employed in the accommodation subsector of the tourist

industry, an increase of 16 percent over the figure for 1979. The direct employment statistic does not indicate fully, however, the level of dependence on tourism earnings of entire communities in Jamaica whose residents provide goods and services for visitors.

Notwithstanding its economic primacy, the tourism industry is still relatively localized in spatial terms. Data compiled by the Ministry of Tourism list hotel rooms only for the following areas: Kingston/St. Andrew, Montego Bay, Ocho Rios, Port Antonio, Mandeville and Negril. Tourist accommodations along most of the south coast and in the interior of the island are minimal.

Table 56 indicates the changes in the number of hotel rooms in these various sub-regions of Jamaica from 1970 to 1985 (see also Figure 38). Although the island's hotel room capacity fluctuates, an increase in room capacity generally parallels the rise in visitor arrivals. The most spectacular increase has been at Negril, with other high, but relatively moderate increases in room capacity in Port Antonio, Montego Bay and Ocho Rios. Even more revealing of the density of visitor presence in each of the resort areas is the number of hotel bed-nights sold per year.

In this regard, figures published by the Ministry of Tourism indicate that while Ocho Rios



experienced a 46 percent increase in hotel room capacity from 1970 to 1985, their increase in bed-nights sold was 73 percent. Negril also experienced an even greater increase in bed-nights sold than in room capacity; in the case of Montego Bay, the two indices increased at a more equal rate. Mandeville and Kingston both experienced a significant decline in the number of bed-nights sold. (See Table 56.)

The pattern of growth shown in these tables (most dramatic in the case of Negril) demonstrates that the aspect of Jamaican tourism most attractive to visitors is still the combination of sea/sand/sunshine. Shorefront resources are being used more intensively than ever in Ocho Rios, Montego Bay and Negril. In the case of Montego Bay and Ocho Rios, greater cruise passenger traffic has also contributed to the increased use of local facilities.

What, if any, are the alternative natural resources that have been put to recreational use by the tourist industry? A survey of brochures published by 11 major inland tour operators registered with the Jamaica Tourist Board reveals that the following natural sites were listed among the tours offered: the Rio Grande and Martha Brae rivers (rafting), Non-such and Green Grotto Caves, Hope Botanical Gardens, Dunn's River Falls, Fern Gully, Magotty Waterfalls and Navy Island. One tour operator offers a trip through the Cockpit Country, while a number take passengers on scenic rides through the interior by train or coach.

A growing trend is the opening up of a number of farms and plantations to tours, allowing visitors to observe the growing and processing of coffee, sugar cane and other crops. Horseback riding, hiking, pond fishing and other recreational activities are also available. Among the farms and plantations listed by the tour operators surveyed were: Brimmer Hall, Friendship Farm, Pine Grove, Prospect Plantation, Appleton Estate and Chukka Cove Farm. Even though this trend is promising, a survey of available recreational facilities suggests that relatively few of the available natural sites have been developed as recreational attractions. While more and more privately-owned plantations are developing a visitor component to their businesses, many of the publicly-owned points of interest and natural beauty remain undeveloped and underutilized.

#### **Local Recreation Patterns**

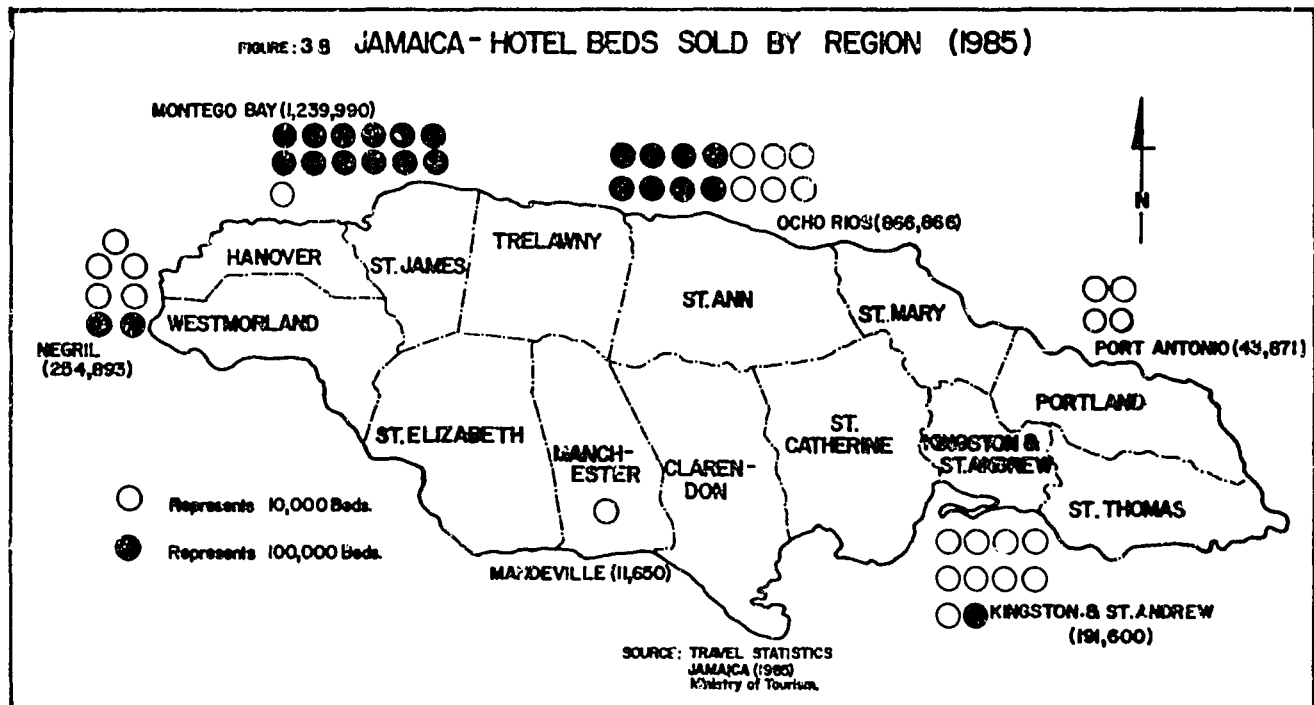
Although very little quantitative data exists on recreational patterns of local residents, it is apparent that, as with tourists, beaches are one of the most widely used natural resources. Public beaches, especially those that are well-equipped and maintained, have a steady number of users throughout the year and are heavily used on public holidays. The three developed mineral spas — Rockfort, Milk River and Bath — also depend largely on a local clientele. The statistics for local guests staying in hotels in Jamaica shows that, apart from Kingston, the figures are highest for the beach resort towns

**Table 56:**  
**Jamaica, Spatial Distribution of Hotel Rooms\***

	1974	1985	% Change
Kingston & St Andrew	1149	1439	25%
Montego Bay	2493	3586	44%
Ocho Rios	1547	2256	46%
Port Antonio	154	254	65%
Mandeville	129	55	-57%
Negril	136	567	317%

\* Information in Table 56 reflects the average number of rooms that were made available at any given time during the years under review.

Source: Travel Statistics 1974 and 1980; Jamaica Tourist Board, Ministry of Mining, Energy, and Tourism.



**Table 57:**  
**Jamaica, Hotel Bed-Nights Sold**

	1974*	1985	% Change
Kingston & St Andrew	278,675	191,600	-31%
Montego Bay	751,940	1,239,990	65%
Ocho Rios	500,680	866,866	73%
Port Antonio	22,054	43,871	99%
Mandeville	21,054	11,656	-45%
Negril (1975)	17,954	254,893	1320%

\*Revised estimates

Source: Travel Statistics 1974 and 1985; Jamaica Tourist Board, Ministry of Mining, Energy, and Tourism.

of Ocho Rios and Montego Bay. In 1985, there were over 35,000 local visitors staying over at Ocho Rios hotels, just over 27,000 for Montego Bay, and over 30,000 for Kingston. Port Antonio, with over 8,000 and Negril with more than 7,000, though increasingly attractive to local guests, are still less popular than Ocho Rios or Montego Bay.

The pattern of local usage of other recreational facilities is mixed, varying from overuse in some instances to underuse in others. Family and group excursion visits to the botanical gardens, particularly those at Hope and Castleton, are very popular. While there are no statistics available on visitor usage of these facilities, the Department of Public Gardens estimates that about 150,000 people visit the Hope Zoo each year and that the Hope Gardens are visited by an additional 100,000 persons annually. Hiking and camping trips to Blue Mountain peak, Hollywell, Newcastle and other scenic locations are also popular. Many of these are day rather than overnight trips, however. Figures obtained from the Forestry Department, which operates a number of cabins for overnight stay in the protected forest areas of the mountains, suggest that the few rental units that they run are underutilized. For the year April 1985 to March 1986, a total of 316 people occupied the three rental cabins at Hollywell; 156 people rented the unit at Portland Gap; 686 stayed over at

Blue Mountain; and 693 used the units at Clydesdale (a total of 1,851 paying stop-over visitors for all the units). Visits to museums run by the Institute of Jamaica also show considerable potential for increased usage. In 1984-85, there was a total of 32,867 visitors to all six museums of the Institute. Only 24,704 of these were Jamaicans, and of these the vast majority (17,642) were children, most of whom tour the facilities as part of organized student groups.

Apart from visits to the beaches and to the more popular botanical gardens, much of the recreational activity of local residents still centres on the home and the local community. Sports such as cricket and soccer, the occasional bicycle or push cart race, domino playing, dances and social drinking, tend to be the more popular pastimes of most Jamaicans. This is not to say, however, that Jamaicans would not use, or would be indifferent to, other kinds of facilities if they were made available. On the contrary, existing patterns point more to the fact that attractive recreational sites have either not existed or have been inaccessible because of cost or location. In spite of the high cost, the number of Jamaican stopover guests at local hotels is quite impressive. There is no reason to suppose that local residents would not respond positively to new recreational attractions.

## Resources for Tourism and Recreation

**Offshore Islands, Cays and Reefs.** Jamaica has about 28 significant offshore islands and cays, most of them off the island's south coast. The fragile environment of the cays precludes their intensive development for recreational purposes. Only Lime Cay off the coast of Port Royal is used as a recreational site for sunbathing and picnics. The long coral reef chains found off the north coast and along sections of the south coast provide habitat for numerous species of flora and fauna. They are excellent recreational sites for diving or for viewing from glass-bottomed boats.

**Beaches.** Wind and wave action, which grind down the offshore coral reefs, help develop and sustain the impressive white sand beaches of the island's north coast, where the principal resort areas are located. The beaches of the south coast are built up more by river sand, are typically brown, and are less stable than those of the north coast. Only 26½ miles of Jamaica's 490-mile coastline are used for recreational purposes. (See Table 58.) Table 59 lists the island's public bathing beaches and associated facilities.

**Mineral Springs.** Of the eight noteworthy hot and cold mineral springs in the island, only three are exploited for public recreational use — at Milk River, Bath and Rockfort. The springs are shown on Figure 39 and their significant features are summarized in Table 60.

**Waterfalls.** Several of Jamaica's swift-flowing rivers have scenic waterfalls appropriate for development as recreational attractions. To date, only Dunn's River Falls has been so developed. Managed by the Urban Development Corporation (UDC), the falls form the central point of a landscaped park, with a well-developed public bathing beach and craft shopping area. Visitors are encouraged to climb to the top of the waterfall with or without the assistance of park guides. Changing facilities and a large car park are available for guests. The falls are an important stop for many of the inland tour operators who transport cruise passengers and hotel guests about the island.

**Botanical Gardens.** The development of Jamaica's botanical gardens dates back to the late eighteenth century. Currently, there are five major botanical gardens, four of which are publicly-owned (Hope, St. Andrew; Castleton, St. Mary; Bath, St. Thomas; and Cinchona, Portland/St. Andrew), and one (Irvin, St. Thomas) is owned privately. The gardens are used both for recreational purposes and for botanical research.

Hope Gardens is the main recreational park for the Kingston metropolitan area and is a major stop on guided tours of the city. A zoo and amusement park are located in the Hope Gardens complex. Of the four publicly-owned gardens, Hope and Castleton are perhaps overutilized, while Bath and Cinchona, for reasons of relative inaccessibility, are underutilized.

**Table 58:**  
**Commercial and Recreational Usage of Jamaica's Coastline**

Type of Use	Number	Length of Foreshore (miles)
Hotels	54	4.50
Resort Cottages	180	4.75
Member & Proprietary Clubs	11	1.25
Commercial Recreational Beaches	23	0.50
Public Bathing Beaches	65	7.00
Public Fishing Beaches	78	8.50
	411	26.50

Source: NRCDC. Tourism and Recreation Sector Reconnaissance Report. Jamaica CEP.



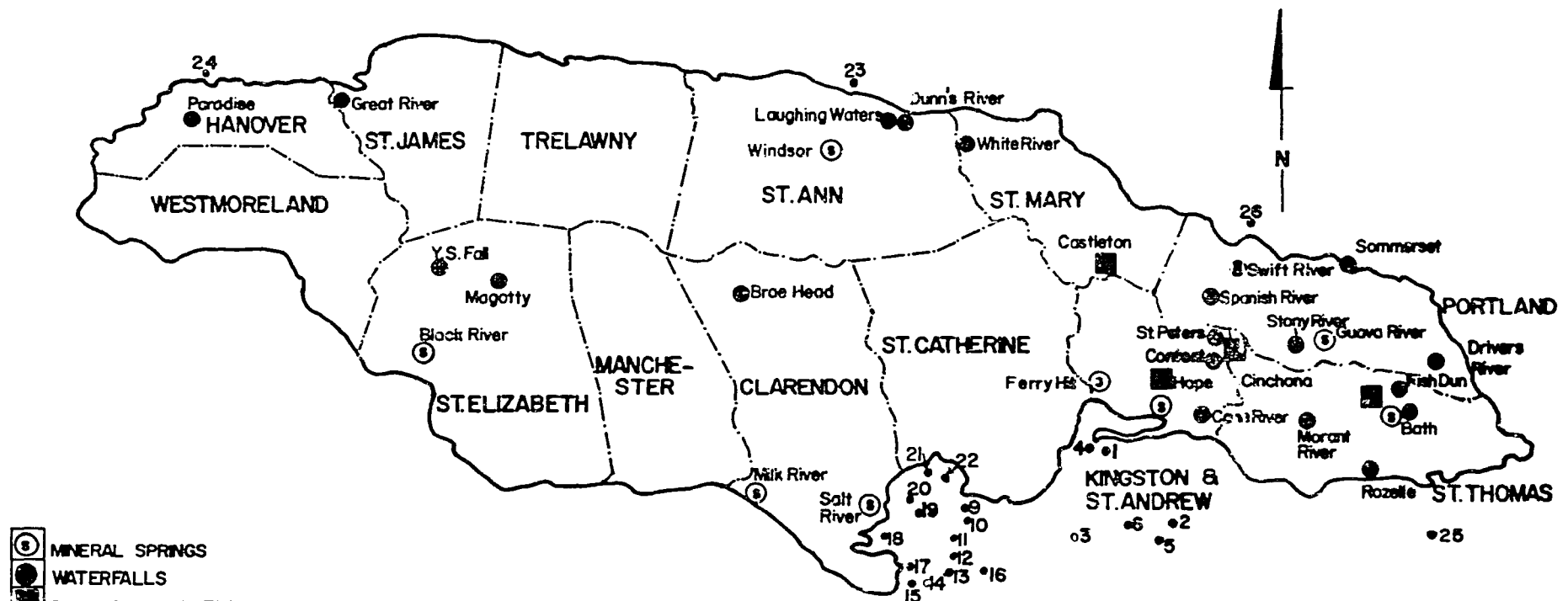
Table 59: continued

PARISH	BATHING BEACHES ACQUIRED OR RESERVED	FACILITIES	STATUS
St. James	Greenwood	-	Bathing Beach
	Rose Hall	-	Bathing Beach
	Coral Gardens	-	Bathing Beach
	Ironshore	-	Bathing Beach
	Mahoe Bay	-	Bathing Beach
	Part Providence Pen	A.B.C.D.E.F.G.H.I.	Bathing Beach
	Walter Fletcher	A.B.C.D.E.F.G.H.I.	Bathing Beach
	Doctor's Cave	A.B.C.D.E.F.G.H.I.	Bathing Beach
	Cornwall Beach	A.B.C.D.E.F.G.H.I.	Bathing Beach
	Montego Freeport	-	Bathing Beach
Spring Garden	C.F.G.	Seaside Park	
Hanover	Great River	-	Bathing Beach
	Orchard	-	Bathing Beach
	Tryall	-	Bathing Beach
	Watson-Taylor	A.B.C.D.E.F.G	Bathing Beach
	Lance's Bay	A.B.C.D.	Bathing Beach
	Bull's Bay	A.B.C.D.E.F.G	Bathing Beach
Westmoreland	Little Bay	-	-
	Whitchouse	A.	Bathing Beach
	Fort	A.B.C.D.E.F.G.H.I.	Bathing Beach
	Negril (NALA)	A.B.C.D.E.F.G.H.	Bathing Beach
	Negril NALA	A.B.C.D.E.F.	Bathing Beach
	Bluefield	B.C.	Bathing Beach
	Fonthill (Luana)	-	Bathing Beach
St. Elizabeth	Galleon	-	Bathing Beach
	Hodges	-	Seaside Park
	Crane	A.B.C.D.E.F.G	Bathing Beach
	Fullerswood	-	Bathing Beach
	Parottee	B.C.	Bathing Beach
	Fort Charles	-	Bathing Beach
	Billy's Bay	-	Bathing Beach
	Calabash Bay	-	Bathing Beach
	Great Bay	A.	Bathing Beach
Manchester	Alligator Pond	A.B.C.E.F.G.	Bathing Beach
	Calabash Bay	-	Bathing Beach
	Hudson Bay	-	Part Forest Reservation
	Gutt River	B.	Bathing Beach
Clarendon	Barnswell Dale	-	Part of Forest Reservation
	Jackson Bay	A.B.C.E.	Bathing Beach
	Rocky Point	-	Bathing Beach
	Farquhar's	A.B.C.	Bathing Beach
St. Catherine	Port Henderson	A.B.C.D.E.F.G.	Bathing Beach
	Marine Terminal	A.B.C.D.I.	Bathing Beach
	Hellshire	A.B.C.D.E.F.G.H.I.	Bathing Beach
	Fort Clarence	A.B.C.D.E.F.G.H.I.	Bathing Beach

Key: A = Change Room  
 B = Toilets  
 C = Showers  
 D = Shelter  
 E = Car Park  
 F = Fencing and Landscaping  
 G = Tables and Benches  
 H = Canteen  
 I = Lifeguard Stand

FIGURE: 39

## JAMAICA : OFFSHORE ISLANDS AND CAYS, MINERAL SPRINGS, WATERFALLS AND BOTANICAL GARDENS



- ⑤ MINERAL SPRINGS
- WATERFALLS
- BOTANICAL GARDENS
- ① LOCATIONS OF ISLANDS AND CAYS

SOURCE: ADAPTED FROM TABLES IN N.R.C.D., C.E.P.  
RECONNAISSANCE REPORT.

Note: Three islands/Cays cannot be located even though mentioned in text.

27  
*Pedro Cays*

- | No | ISLAND OR CAY      | No | ISLAND OR CAY        | No | ISLAND OR CAY     |
|----|--------------------|----|----------------------|----|-------------------|
| 1  | Lime Cay           | 11 | Pigeon Island        | 19 | Long Island       |
| 2  | South East Cay     | 12 | Little Half Moon Cay | 20 | Short Island      |
| 3  | Drunkenman Cay     | 13 | Big Half Moon Cay    | 21 | Carreering Island |
| 4  | Rockhams Cay       | 14 | Little Portland Cay  | 22 | Great Goat Island |
| 5  | South Cay          | 15 | Big Portland Cay     | 23 | Love Island       |
| 6  | Malden Cay         | 16 | Bare Bush Cay        | 24 | Green Island      |
| 9  | Big Pelican Cay    | 17 | Dolphin Island       | 25 | Morant Cays       |
| 10 | Little Pelican Cay | 18 | Salt Island          | 26 | Navy Island       |



**Table 60:  
Mineral Springs in Jamaica**

Bath, St Thomas	Residential Spa held in trust by Government	Temperature of water is 115° - 130°F
Milk River, Clarendon	Residential Spa	Temperature of water is 92°F
Salt River Spring, Clarendon	Unexploited	Temperature of water is 89°F
Rockfort Spring, St Andrew	Fed to public swimming pool and some family-type baths	Admixture of sea and fresh-water and mildly sulphurated
Black River Spring, St Elizabeth	Unexploited	Heavy growth of sulphur-loving algae and its sulphur content makes it potentially valuable for the treatment of skin disorders
Ferry Hill Springs, St Andrew	Unexploited	-
Windsor, St Ann	Unexploited	Water is extremely mineralized and has a very high content of dissolved solids. Methane gas bubbles are given off regularly
Guava River, Portland	Unexploited	Very remote - four hours walk from nearest driving road. Issues jets of hot water 132°F. Chemical composition is unknown

National Parks. As a result of a UNDP study commissioned in the late 1960's, the following areas were proposed to be designated as National Parks:

Blue Mountains and John Crow Mountains (St. Thomas and Portland)  
 Great Morass (St. Thomas)  
 Palisadoes (St. Andrew)  
 Hellshire (St. Catherine)  
 Portland Bight and Ridge (St. Catherine)  
 Canoe Valley (Clarendon/Manchester)  
 Cockpit Country (St. James/St. Elizabeth/Trelawny/Manchester)  
 Black River Lower Morass (St. Elizabeth)  
 Dolphin Head (Westmoreland)  
 Negri (Westmoreland/Hanover)  
 Ocho Rios Marine Park (St. Ann)  
 Montego Bay Marine Park (St. James)  
 Discovery Bay Marine Park (St. Ann)

Marine Parks. Two Marine Parks have so far been designated at Ocho Rios and Montego Bay. Eight other sites have also been proposed for designation as Marine Parks.

Mountain Hiking and Camping. There are major hiking trails both across the Blue Mountain range and across the Cockpit Country, as well as several other minor trails criss-crossing the peaks of the Blue Mountains. Some organized but limited camping facilities, maintained by the Forestry Department, are available in the Blue Mountains. The Jamaica Camping and Hiking Association has sought to develop these activities further, and offers guided hiking and camping trips for tourists and local residents.

Caves. Approximately 150 of the 952 known caves in Jamaica have been surveyed. Most

of the caves are found in areas with large limestone formations in the northern parishes of St. Ann, Trelawny and St. James. A similar concentration occurs in the bordering southern parishes of Clarendon and Manchester. A number of caves have unique historical and archaeological value, for example, those which contain prehistoric Arawak art work. Experienced cavers reportedly rate Jamaica's caves highly for exploration and research value.

National Monuments, Historical and Archaeological Sites. Some 323 important sites, including monuments, forts, statues, buildings of historic and architectural significance, churches and ruins, exist in Jamaica and fall under the protection of the National Heritage Trust. Twenty of these, both restored and unrestored, are open to visitors and plans exist for developing several more of these sites. The National Heritage Trust is convinced that, based on their experience with a few of the sites that have been developed so far, the potential exists to develop many of these sites into significant attractions.

Rivers. The principal rivers in Jamaica with recreational value emanate from the mountainous regions in the centre of the island, where many of the proposed national parks are located, and where watershed protection activities are most active. Some of these rivers are not navigable but, nevertheless, have recreational potential. The Black River, which is 44 miles long and is navigable for about 25 miles upstream, has the potential for accommodating increased boating and fishing activities and wildlife observation. Development would have to be very carefully controlled, possibly by instituting zoning regulations, for both of these recreational uses to be further developed. The Rio Grande in Portland, the Great River bordering Hanover and St. James, and the Martha Brae river in Trelawny are used for rafting and are major tourist attractions. Other rivers, such as the Swift and Spanish Rivers of Portland, the Rio Cobre of St. Catherine and the Milk River in Clarendon, have potential for canoeing, fishing, bathing and picnicking.

Other Attractions. There are numerous scenic routes around the countryside that could be developed and maintained as special attractions. In addition, tours of sugar factories, bauxite/alumina plants, and the like offers some potential for development as visitor attractions.

## **AGENCIES AND INSTITUTIONS**

This section describes the functions of the various public sector agencies responsible for policy and organization of the tourist industry and those responsible for planning and management of outdoor recreation areas.

### **The Ministry of Mining, Energy and Tourism**

The Ministry of Tourism is the main coordinating body for the activities of public sector agencies involved in the tourist industry. The Ministry's main tasks involve providing overall coordination and creating linkages between tourism and the wider economy and society. It is responsible for formulating policy and for overall development of the industry, and has various agencies responsible for carrying out these policies. The Ministry works at increasing foreign exchange earnings from tourism, increasing employment within the industry, creating linkages between the agricultural and industrial sectors of the economy and the tourist industry, and ensuring that Jamaican culture, in its manifold expressions, is an integral part of the tourism product. In addition, it administers various laws and regulations governing the industry, including investor incentive legislation, and the regulation of travel agencies. The Ministry also conducts market analysis and research, and provides liaison with regional, and international tourism related agencies. (See Annex 1 for a fuller presentation on the Ministry of Tourism.)

### **Jamaica Tourist Board**

The Jamaica Tourist Board (JTB) is primarily charged with promoting the tourism industry and with setting, monitoring and improving industry standards. Established under the Tourist Board Act, the JTB is responsible for promoting tourism through advertising and public relations activities, and by seeking to secure increased shipping and airline facilities for travel to Jamaica.

### **The Jamaica Attractions Development Company Ltd. (JADCo)**

JADCo, a subsidiary of the Tourist Board operating since the 1970's, is charged with

improving existing sites and developing new ones as tourist attractions. JADCo operates as a limited liability company, with powers to buy, sell and divest properties, as well as borrow, to undertake their development. Some of the attractions developed or upgraded by JADCo include the following:

- Evening on the Great River
- Cornwall Bathing Beach complex
- Jamaica Swamp Safari and Crocodile Sanctuary
- Martha Brae Rafting
- White River Evening
- Lime Cay development
- Rafting on the Rio Grande.

Most of the attractions developed have been divested to private investors.

JADCo works closely with other agencies such as the UDC, the NRCD, and the Jamaica National Trust to preserve the natural context and historic meaning of the sites and attractions it develops. JADCo's work has been severely curtailed, however, for lack of funding. There are several projects for which plans exist, but which cannot be started due to lack of funds.

#### **The River Rafting Authority (RRA)**

A subsidiary of the JTB, the RRA is responsible for rafting operations at the Rio Grande, the Great River, and the Martha Brae River. The Authority is governed by the River Rafting Act (1969).

#### **The Urban Development Corporation (UDC)**

The UDC is a major development arm of the government which undertakes projects, mostly large-scale ones, which private enterprise would find too risky or unprofitable, but which are vital to economic growth. The UDC, a statutory body created by the UDC Act of 1968, can acquire and dispose of land within (and sometimes outside) certain designated areas; undertake infrastructure development; and continue to manage projects which it has completed. A major subsidiary of the UDC, National Hotels and Properties, Ltd, has overall responsibility for the hotel properties owned by the UDC.

In addition to the major development of the Kingston waterfront, the UDC has also undertaken large-scale development projects in Montego Bay, Ocho Rios and Negril. These have served both to promote and to accommodate

the growth that has occurred in the tourist industry during the last two decades. In Montego Bay, about 57 acres of land were reclaimed on the waterfront, three white sand beaches were created, and roads and other infrastructure constructed. In Ocho Rios, there was a thrust to upgrade the town as a regional centre by constructing large buildings to accommodate the increased number of visitors. Forty acres of land were reclaimed on the waterfront in the early 1970's, a new beach created and a cruise ship pier put in. Construction projects included the Ocho Rios Commercial Centre, the Turtle Beach Condominium, the Sheraton and Americana Hotels, and a 158-unit Craft Park. In Negril, a 280 room hotel, Hedonism II, was constructed, the public beach area improved and Booby Cay off the Negril coast developed as a picnic area. The next phase of the Negril development will include completion of two more hotels and a condominium, as well as greater attention to housing construction for workers in the Negril area.

#### **Training Institutions in the Tourism Sector**

The University of the West Indies offers a three year degree programme in hotel management, the first year of which is completed in Jamaica and the remaining two years at the Bahamas campus. The College of Arts Science and Technology is about to initiate a diploma course in this field in collaboration with the University of South Carolina. Montego Bay Community College and the Brown's Town Community College offer courses in food and beverage management and hospitality management respectively, geared toward the tourist industry. In addition, the HEART Academy operates a school at Runaway Bay which specializes in providing skill training for the industry. The Housecraft Training Centre in Livingston and a couple of privately owned establishments also offer skill training for people wishing to enter the industry.

#### **Other Organizations**

Other public sector organizations involved in tourism include: National Hotels and Properties Ltd., which owns, operates, leases and markets hotels; Jamaica Vacations Ltd, responsible for the development of the air charter market; Jamaica Reservation Service, which supplies information on the availability of tourist facilities, and makes reservations on behalf of the accommodation and ground transportation

sectors; and National Hotel Supplies Ltd., which imports food and equipment for the industry.

### **Private Sector Organizations**

The Jamaica Hotel and Tourist Association, (JHTA), an umbrella organization with about 170 members, actively assists in promoting and expanding the tourist industry. Toward this end the Association works with government and international agencies as well as undertaking research and promotional activities on its own. Membership is open to hotels of 10 rooms or more, as well as to allied members who are involved in the tourism sector. The Jamaica Camping and Hiking Association has recently been formed and is active in helping to promote hiking and camping for tourists in the interior of the island.

### **National Resources Conservation Division (NRCD)**

The principal body charged with outdoor recreation planning in Jamaica is the Recreation and Conservation Division of the NRCD. It is responsible for the development and management of beaches and national parks (both terrestrial and marine) and for the conservation of these natural assets. The Recreation and Conservation Division is further sub-divided into a National Parks Branch and a Beaches Branch.

The National Parks Branch is charged with establishing national parks in appropriate areas of the country. These parks are expected to have both a conservation and recreational function and to help stimulate direct and indirect employment opportunities for people in the area. The Ecology Branch of the Resource Management Division (NRCD) assists the National Parks Branch in identifying and developing projects with a tourism component; providing information about fauna and floral resources and their management and use for tourism projects, as well as commenting on development proposals.

The Beaches Branch evolved out of the Beach Control Authority, established in 1955 as a pioneering body in the conservation field in Jamaica. It works in conjunction with the Oceanography Branch to develop public bathing and fishing beaches, preserve the scenic beauty of the coastal drive, and regulate the commercial use of the foreshore and seabed. The Division is also responsible for overall monitor-

ing and regulation of activities along the coastline and offshore areas in the public interest — ensuring access, controlling pollution, providing for sea defense measures, and the like. All developments up to one mile inshore have to be approved by the Beach Control Authority.

### **PLANS AND PROGRAMS**

Many public sector agencies have detailed project proposals drawn up for developing several of the resources mentioned above. There has been no lack of recognition of the potential that many of these facilities have for tourist development. Rather, the difficulty lies with the availability of funds for implementing these projects and with the actual mechanisms for realizing them. The following is a list of some of the existing project proposals that would, if implemented, have a significant impact on the tourism sector:

- o Restoration and reconstruction activities at Port Royal, Spanish Town and New Seville to deepen the cultural-historical base of Jamaica's tourism resource. The project has been evolving since the mid-1960's, and a feasibility study is now being conducted with the assistance of the IDB and UNESCO as a preliminary step to seeking funding for this ambitious project.
- o Construction of performing arts centres in Ocho Rios and Montego Bay.
- o Creation of a 12-acre bird sanctuary on the outskirts of Ocho Rios.
- o Development of several areas as recreational parks or national parks: Cane River Falls, Ocho Rios Marine Park, a Royal Palm Forest National Park at Negril, the Hellshire National Park, and the Portland Bight and Ridge National Park.
- o Development of a complex of craft workshops and simulation Arawak village at Oracabessa.
- o Development of proposed Marine Parks in collaboration with the Ministry of Tourism.

In addition to these new projects, there are plans for upgrading and improving existing facilities, such as mineral spas, botanical gardens and museums.

## KEY ISSUES AND PROBLEMS

Jamaica's visitor population has almost doubled in 15 years — to nearly half the size of its native, resident population. Although the impact is rather different if the transient population increases at this rate than if the permanent population does, an increase in the tourist population of this magnitude poses very similar challenges as any other kind of population increase. The preservation of the natural environment is one such factor that demands attention in both instances.

This is particularly the case in Jamaica and most other Caribbean islands, since it is because of certain perceived environmental advantages that tourists come in the first place. It is this visitor population that in turn brings in a major portion of the income to help the country take care of the needs of its own population. We recognize the need to spend some of these earnings from tourism to improve the amenities in resort areas, such as roads, street cleaning services and so on. But when it comes to the more permanent environmental base — air and water quality, beach stability, preserving the forest cover, maintaining the native population of birds and other animal and plant species, etc. — we have been far more negligent.

This negligence demands attention on two fronts. First, there is a need to take measures to protect the sand/sea/sunshine resources that have been Jamaica's main selling point for tourism. In this regard, it needs to be reiterated that other Caribbean islands, as well as Hawaii and parts of southern Europe, offer comparable attractions and are among Jamaica's direct competitors. Our losses from the neglect of these resources will be their gain. Secondly, there is the need to develop other natural resources, both as part of the management strategy to relieve pressure on existing, over-used scenic areas, and to provide alternatives so as to vary and further enhance the range of recreational opportunities available both to tourists and residents.

### Institutional Dilemmas

In view of the high density of visitor concentration in north coast resort areas (as mentioned above), as compared to the many natural attractions in other parts of the island that could be developed for recreational purposes, the urgency of spreading recreational facilities over a wider area becomes more evident. It is far less expensive, in terms of time and

initial capital outlay, to develop these alternative recreational amenities without accompanying hotel complexes. Visitors could then be transported to and from their hotels to points of interest, much as is done at present, except that there would be many more attractions to visit.

Even though the imperative of such a strategy seems clear, the mechanisms for achieving it are not without their difficulties. The Jamaica Attractions Development Company (JADCo), which could serve as a key agency to spearhead such development, is constrained by its dependence on government funding — funding which has been cut back considerably and forced JADCo to curtail plans on some 18 projects. The same has happened with the NRCD, the main agency with responsibility for the development of national parks and improvement of facilities at public bathing beaches. In the 1985-86 financial year, for instance, the Beaches Branch of NRCD proposed a total capital estimate of \$423,000, of which \$50,000 was for a public education campaign to reduce vandalism of beach facilities. Only \$90,000 of the total was granted, however. As a result, instead of working to develop 13 beaches as originally planned, only four will be included.

For some of the same reasons, Jamaica has been slow in developing national parks for conservation, watershed protection and recreational uses. There is still no enabling legislation of a kind similar to the Watershed Protection Act (1963), the Wildlife Protection Act (1944), or the Beach Control Act (1955) to allow protected national park areas to be established. The issue has not been seen as sufficiently important by the general public, and governments have been reluctant to release scarce resources for a project the value of which appears to bring benefit only in the long term.

There are other institutional problems with the development and administration of recreational facilities. In the case of public beaches, these have normally been handed over to local Parish Councils for management after they have been developed by the Beaches Branch of NRCD (the former Beach Control Authority). These local authorities have often been less than diligent in carrying out their responsibilities, and have been reluctant to impose user fees to provide revenue for beach maintenance. The issue of the control of beaches is a problem area that has not yet been resolved.

In other instances, the disjuncture between

various agencies of government is more fundamental. In the case of the Hellshire area, the UDC and the NRC D had somewhat divergent views as to how the area should be developed. The differences have now, happily, been resolved to accommodate both the interest in seeing the provision of more housing facilities and the provision of reserve areas for a national park to preserve the area's unique ecological character. The divergent views as to the preservation of the Negril Morass or its exploitation as an energy source provides another case in point.

One approach which might address some, though not all, of these issues that lead to bottlenecks in the development of new resources might be for government agencies to make lease agreements with private concerns to develop and operate certain alternate recreational facilities within the context of National Park development. The growing tendency for some private plantation owners to develop a recreational component to their estates suggests that investors may be willing to pursue this expanding opportunity. The cabins run by the Forestry Department, presently few in number and underutilized, could well be expanded in this way. The lease agreement would free government departments from the need to provide the necessary investment capital from their limited annual budgets. At the same time it would provide a source of revenue without the responsibility of management and promotion. The development of bird watching tours within proposed national parks might also be handled in this way.

### **Environmental Problems**

High visitor density has also contributed to many, though not all, of the environmental problems being experienced in parts of Jamaica.

Contamination of Swimming Waters. NRC D's water quality monitoring programme of north coast beaches, which started in 1975, has recorded higher than acceptable levels of fecal coliform for recreational swimming beach areas. In the Ocho Rios Bay area, the sewage treatment plant, which treats waste from the UDC-erected buildings in the area, does not treat much of the town's remaining domestic sewage. Questions have also been raised about sewage treated by the UDC plant and discharged by pipeline into the western end of the Bay. In addition to their direct effect on users of the Bay, these pollutants lead to the rapid growth of seaweed and can eventually cause damage

to the nearby coral reefs. The NRC D has collaborated with the UDC and the National Water Commission in evaluating the problem. Some corrective measures have been taken to improve the current flow in the Bay so as to more rapidly disburse effluent discharge out to sea.

Sewage disposal is a problem all around the island. While the large hotels have treatment plants, their effectiveness varies with the volume of waste being handled and the efficiency of the operators. Another example of water contamination is that of the Moneague Lake, at one time proposed for development as a recreational park. The lake is being polluted by caustic soda from the red mud lake on Mt. Diablo. The high pH level of the lake could prove harmful to people who come in contact with the water.

Dune Destruction. Jamaica's beaches were often backed (particularly on the south coast) by dunes of sand covered with vegetation. The dunes were formed above the high water mark by storm seas, each storm adding a little more sand, and the vegetation grew upwards through each successive deposit. An extensive root system bound the sand in such a way that when destructive storm seas struck the coast, the wave energy was absorbed and the dune barrier protected the land behind it from flooding and erosion. The elimination of the dune barrier by hotel or other construction, or by heavy use of a public beach, e.g., at Hellshire, results in the removal and deposition elsewhere of sand formerly held in place by the vegetation. This leads to accelerated erosion of many of the island's beaches. Groynes must then be erected for the protection of the beaches.

Regulating the Use of Beaches. There is need for the Beach Control Act to be updated in order to make both the public and the commercial beaches safer and more pleasant for users. Areas of concern include the use of motorcycles along the beaches and the reckless operation of motorboats close to shore.

There has also been a significant increase in the number and types of aquatic sporting facilities provided at beaches. There are so many new operators providing these services that there is need for better control and regulation of their activities. Regulations to control aquatic sports operations have already been passed by Parliament (Tourist Board Regulations, 1985).

Oil Pollution of Beaches. In the years 1979-

84, there were at least eight documented oil spills in Jamaica, releasing at least 200,000 gallons of oil. In addition, the NRC D has identified at least eight sites along the island's south coast that are regularly susceptible to oil pollution. The oil is washed onto the beaches from ships traveling within or close to Jamaica's territorial waters. The spillage affects crabs and other marine life and creates a nuisance for recreational users. The Office of Disaster Preparedness has an oil-spill contingency plan which relies on the collaboration of NRC D, the Coast Guard, and international agencies.

Degradation of Wildlife Habitat. The conflict between economic development goals and the need to preserve the natural habitat has arisen repeatedly in Jamaica. The Montego Freeport Scheme, for example, was developed on the site of former mangrove swamps and islands of coral and mud. Although a valuable contribution to the country's economic development, the project involved considerable dredging and landfilling, which all but destroyed the Bogue Islands and associated mangrove wetlands.

Similarly, an attempt, later abandoned, to develop a resort in Falmouth robbed the bioluminescent "Glistening Waters" lagoon of its uniqueness. Mangroves around the bay were removed to make way for road and building construction. This changed the course of the river through the swamp. Increased drainage affected nutrient loads and turbidity, destroying the organisms in the bay which produced the unique glistening water phenomenon. Although there has been some recovery of these dinoflagellate organisms, the once permanent luminous night scene now occurs only intermittently.

The craft industry which produces items for sale to tourists has also caused some habitat degradation. The industry has reduced black coral formation, and coral reefs have been pillaged for souvenirs.

Illicit Sand Removal. The removal of sand from beaches for the construction industry occurs in a wide area of the island's coast stretching from Savanna-la-mar to St. Ann's Bay. In one instance in St. James, the Providence Pen Beach was created by the removal of mangrove vegetation and filling with sand dredged offshore. The artificially constructed beach frontage has not stabilized, however, because of sand removal and the beach has therefore been abandoned. The Quarries Control Act (1983) was designed to curb this problem but it is yet too early to assess its effectiveness.

The growth potential of the tourist industry offers the most persuasive economic argument for a comprehensive environmental policy. But in pursuing a strategy of sound environmental management, care must be taken that it not be justified solely in terms of its beneficial effects for tourism. The seething resentment against the industry that, from time to time, manifests itself in such issues as access to beaches, alleged racial discrimination by hotels, or high prices of hotel services, could well begin to influence public attitudes toward programmes of environmental management. Tourists are only temporary beneficiaries of the recreational facilities of an environment-in-balance; the ultimate beneficiary is the nation as a whole.

## **DIRECTIONS FOR THE FUTURE**

1. Urgent action should be taken to develop a comprehensive programme to protect the sea/sand resources that form part of the package of services and product offered to visitors.
2. Identify and develop alternative locations as tourist attractions to relieve the pressure on current sites and widen the range of recreational facilities available to both tourists and local residents.
3. Development of a mechanism to effectively coordinate and manage all national recreational facilities that impact on the country's natural resource base.

## Annex 1: The Ministry of Tourism

The Ministry of Tourism is responsible for the overall development of Tourism in Jamaica. This responsibility embraces policy formulation as it relates to product development, promotion, marketing and all the other aspects of the industry.

### POLICY OBJECTIVES

The broad policy objectives of the Ministry are:

- o to secure maximum benefits to the Jamaican economy from tourism, particularly in terms of foreign exchange generation and employment creation;
- o to ensure expansion of the Tourist Industry;
- o the creation of an integrated Industry;
- o the co-ordination of the activities of public sector tourism agencies.

### SPECIFIC OBJECTIVES

The broad objectives listed above encompass:

- a. maximising gross and net foreign exchange earnings;
- b. increasing direct and indirect employment opportunities;
- c. forging greater inter-sectoral linkages with the economy especially in the area of domestic agriculture and industry;
- d. development of policy relating to import requirements of the Tourist Industry and ensuring the availability of foreign exchange to meet the import requirements of the Industry;
- e. formulating and monitoring the necessary promotional and educational programmes aimed at creating, among the Jamaican people, a full appreciation of the role of the Industry and its potential contribution to the country's economic development;
- f. development of Domestic Tourism;
- g. development of tourist attractions generally;
- h. development of the Cruise Shipping Industry;
- i. ensuring human resource development within the Tourist Industry: in this regard the aim is to accord Jamaicans the opportunity to participate at all levels of management and policy formulation;
- j. ensuring that the Jamaica culture as reflected in our song, dance, arts and crafts, cuisine, architecture and general life-style is an integral part of the tourism product;
- k. development and monitoring of ground transportation to service the Tourist Industry;
- l. ensuring budget support for the development of the Industry and assessing the cost effectiveness of expenditure in relation to visitor inflows and foreign exchange earnings;
- m. preparation, review and implementation of national tourism plans;
- n. undertaking market analysis and research;
- o. ensuring the processing, compilation and analysis of data relative to the Industry;
- p. assessment of investment proposals to determine the level of incentives to be granted under the Hotels Incentives and Resort Cottages Incentives Acts;
- q. reviewing Incentives Legislation;
- r. licensing of tourist accommodation, tourism enterprises, etc.;
- s. co-ordinating regional and international co-operation in terms of the Caribbean Tourism Association, Caribbean Tourism Research Centre, Organisation of American States (OAS), European Economic Community (EEC), the World Tourism Organisation (WTO), etc.;
- t. participating in joint commissions and developing technical assistance programmes with relevant international agencies;
- u. administration of the Travel Agencies Regulation Act, involving the registration and inspection of Travel Agencies;
- v. co-ordinating the activities, monitoring and assessing the operations of the tourism agencies falling under the purview of the Ministry.



## TOURISM RELATED AGENCIES UNDER THE PURVIEW OF THE MINISTRY OF TOURISM

1. The Jamaica Tourist Board - a statutory organisation established under the Tourist Board Act. The Board is responsible for promoting and marketing the tourism product both locally and overseas; the development and maintenance of standards of the product; licensing of tourist accommodation, tourism enterprise, operators, etc.
2. Jamaica Attractions Development Company  
This is a subsidiary of the Jamaica Tourist Board. It is responsible for the development and operation of attractions.
3. The River Rafting Authority  
This is a subsidiary of the Jamaican Tourist Board and is responsible for rafting operations on rivers; e.g., Rio Grande, Creat River, and Martha Brae River.
4. Jamaica Vacations Limited  
A company responsible for the development of the air charter market.
5. Jamaica Reservation Service  
A company which supplies information about the availability of tourism facilities - hotel accommodation, ground transportation, air seats. Reservations are made on behalf of the accommodation and ground transportation sub-sectors of the tourism industry.
6. Milk River Bath
7. Bath of St. Thomas the Apostle  
Government-owned spas.

## RELATIONSHIP WITH OTHER GOVERNMENT MINISTRIES, DEPARTMENTS AND STATUTORY BODIES

The Ministry works in close collaboration with the other Government, Ministries, Departments and Statutory Bodies to ensure inter alia:

- Security of visitors in resort areas;
- Work Permits for expatriates;
- Import Licences and availability of foreign exchange;
- Duty concessions as appropriate;
- Availability of air seats: this requires close co-ordination with Air Jamaica and Trans Jamaica;
- Adequate tourism infrastructure.

## LIAISON WITH PRIVATE SECTOR AGENCIES

The Ministry maintains a close liaison with the private sector organisations such as the Jamaica Hotel and Tourist Association and Jamaica Association of Villas and Apartments on matters pertaining to the development of the Tourist Industry. In the ground transportation sector liaison is similarly maintained with such organisations as the Jamaica U-Drive Association, the Jamaica Union of Travelers Association and the Jamaica Association of Tour Operators. In the area of aquatic sports, liaison is maintained with the Jamaica Association of Dive Operators.



Plate 32 - Bauxite Mining: Drag-line being used to load bauxite for transportation to plant stockpile.

## MINERALS AND MINING

---

### OVERVIEW OF MINING AND MINERALS

For a relatively small island, Jamaica has a fair bounty of non-renewable mineral resources. Although mining is a major source of foreign exchange earnings (together with tourism and agriculture), care must be exercised in the exploitation of these resources because of the direct and indirect impacts which mineral extraction and processing may have on other sectors of the economy.

#### Location and Extent of Resources

Bauxite is Jamaica's main mineral resource. Until three years ago, it contributed 70% of the foreign exchange earnings of the economy. Other mineral resources include gypsum, limestone, marble, silica sand, clay, peat, and to a lesser extent, lignite, black sands containing titanium, copper, lead, zinc and phosphates.

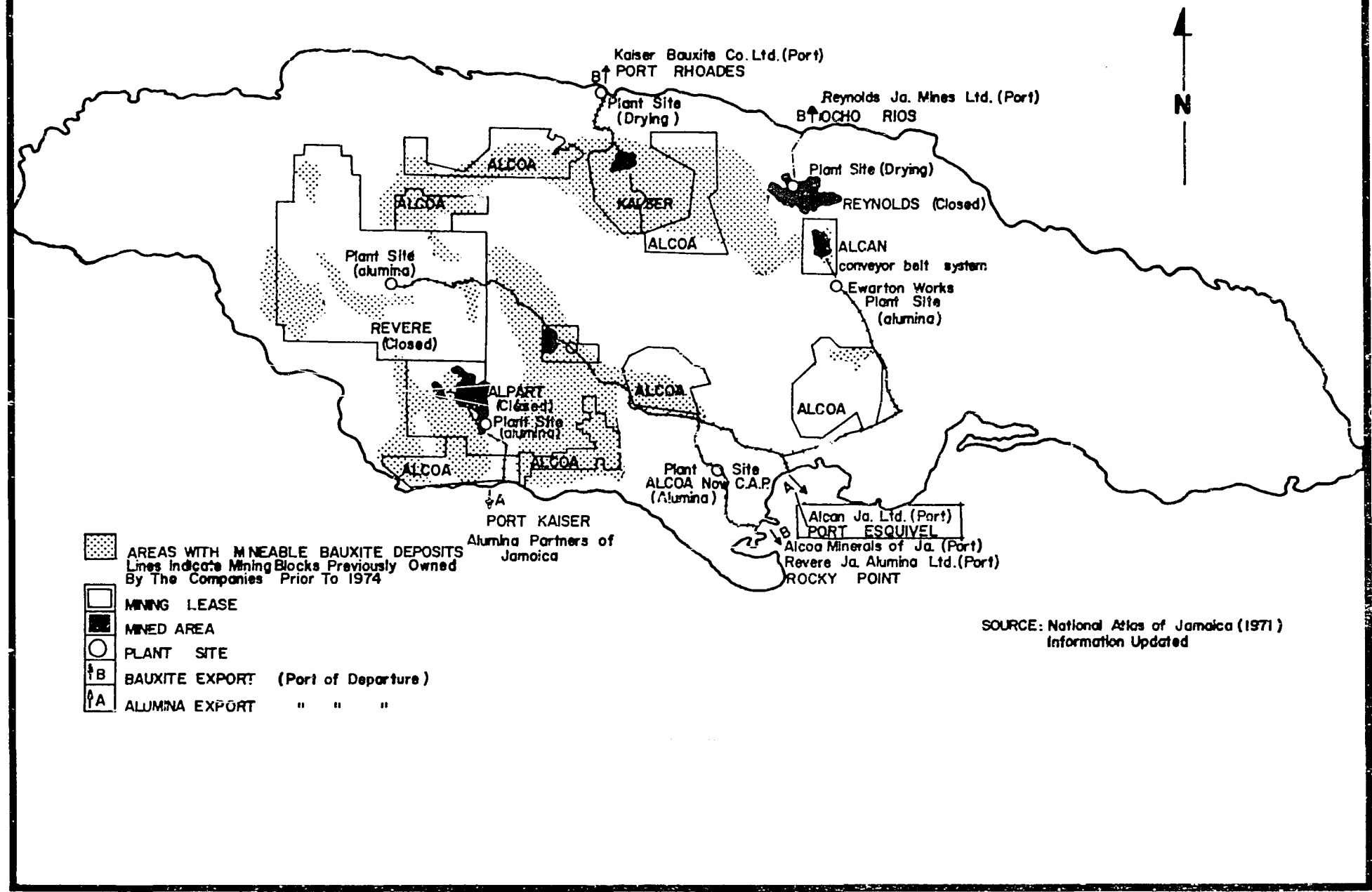
Bauxite. Reserves of commercial quality bauxite in Jamaica have been estimated at approximately two billion tons, of which some 1.75 billion tons can be economically mined under present conditions and technology. The mining of bauxite in Jamaica commenced in 1952, with an initial output of half a million tons per year

and increasing to a maximum output of 15 million tons by 1974. Given this capacity, Jamaica's bauxite reserves can last well beyond a century. (See Figure 40.)

At peak production (15 million tons per year), 48% of the bauxite was converted to alumina locally, in five alumina plants producing 2.8 million tons of alumina, all of which was exported. The balance of 52% of the bauxite produced was exported in the crude form to plants located in the U.S. Gulf Coast. Table 61 shows production levels of bauxite and alumina from 1972 to 1985.

At one time Jamaica was the premier producer of bauxite, accounting for approximately 25% of world production. The discovery of bauxite and development of the industry in other parts of the world led to a gradual lessening in global importance of Jamaica's bauxite. While production has fallen as low as 6 million tons in 1985, a recovery to even higher levels of production than previously reached is anticipated for the 1990's, based on national strategies now being put in place. Decreasing involvement of the transnationals (who have been the traditional operators) and increasing Governmental involvement, particularly in marketing, are foreseen.

FIGURE: 40 JAMAICAN BAUXITE RESOURCES



**Table 61:**  
**Jamaica's Bauxite Production, 1972-1985 (Metric Tons)**

Year	Bauxite Exported	Bauxite Equivalent of Alumina Exported	Total Bauxite Disposed of	Alumina Exported
1972	7,162,067	5,410,757	12,572,824	2,136,818
1973	7,390,298	6,210,169	13,600,467	2,416,917
1974	7,999,839	7,166,230	15,166,069	2,806,095
1975	5,482,680	5,897,229	11,379,909	2,374,886
1976	6,284,012	4,011,996	10,296,008	1,622,559
1977	6,355,163	5,078,502	11,433,665	2,035,993
1978	6,447,746	5,288,040	11,735,786	2,141,920
1979	6,400,047	5,105,057	11,505,104	2,074,165
1980	6,059,798	5,918,506	11,978,304	2,395,082
1981	5,294,090	6,311,930	11,606,020	2,549,855
1982	4,033,209	4,301,183	8,334,392	1,757,612
1983	3,009,724	4,673,412	7,683,136	1,907,009
1984	4,559,039	4,175,831	8,734,870	1,712,872
1985	2,325,380	3,913,908	6,239,288	1,622,221

Source: Economics Division, Jamaica Bauxite Institute. March, 1986.

Gypsum. Gypsum is Jamaica's second most significant mineral export. Deposits of gypsum are located in the southeastern part of the island. Mining operations commenced in 1948, and supplied both a small local market (7%) and a major U.S.-based market (93%)\*. The present production level is well below the 1958 peak level of 575,000 metric tons, while the rated annual production capacity is 250,000 metric tons\*. Actual production of gypsum in 1985 was 179,000 metric tons. (See Table 62.)

Local consumption is mainly by the cement industry and, to a lesser extent, by the manufacture of ceiling tiles for interior use. The capacity of the cement factory is due to be doubled — increasing from 400,000 metric tons per year to 800,000 metric tons per year.

\* In 1948, Belrock Caribbean mined and shipped gypsum from Jamaica. This company was succeeded by U.S. Gypsum Company which began operations in 1954.

\* The 1958 peak production of 575,000 metric tons represents a special case. At that time the quarry was being "raped" to fill overseas demands caused by closure of a quarry in the U.S.A. Such a situation could not be sustained so the figure referred to above is

not a true representation of a possible peak production using proper mining techniques. Also, the quality of the material fell below specifications (93% gypsum) and therefore was considered unsuitable for wallboard manufacture in the U.S. U.S. Gypsum ceased operations and was succeeded by Jamaica Gypsum Company which is presently exporting material (82% gypsum) and supplying the local market.

**Table 62:**  
**Gypsum Production, 1980-1985**

Year	Metric Tons '000
1980	105
1981	180
1982	107
1983	108
1984	180
1985	179

**Limestone.** Limestone covers approximately 75% of Jamaica's land area. The quality varies from a hard angular stone, which finds application in the building and road construction industries, to a softer material suitable for landfill. Few countries are better endowed with deposits of high quality limestone than Jamaica, a quality which finds ready acceptance in the chemical and metallurgical industries. The main source of supply comes from the white limestone group, covering almost two-thirds of the island, and attaining a thickness in excess of 9,000 feet.

Limestone is seen as replacing gypsum as Jamaica's second major mineral export after bauxite. During the past three years, trial shipments have been made to the U.S. and Trinidad in 10-20,000 ton cargoes. Private entrepreneurs are keenly interested in developing a five million tons per year export industry, which would add substantially to the current 3.5 million tons per year local industry. Extensive core drilling and physical and chemical testing work are now in progress.

Although the building and construction industry is the main user of limestone, it is the major constituent in the cement industry; serves as a flux in ceramics and metallurgical processes; filler in paints; for production in the manufacture of lime; for use in the alumina industry; for sugar refining; as a soil conditioner and water treatment; and as an abrasive in domestic scouring cleaners.

**Marble.** The known deposits of marble occur in the southeastern part of the island. (See Table 63.) At present, only a small amount of marble is being mined from quarries in the Bath area of St. Thomas. Annual production is estimated at 100 tons and the main application is in the terrazzo tile industry. Jamaican marble is of various colours — grey-green, pinkish grey, green and maroon types, and finds usage in internal building stones, table tops for general or ornamental use, specifically craft items. Indeed, a whole series of cottage-type artisan industries producing a wide variety of ornamentals has developed in recent years.

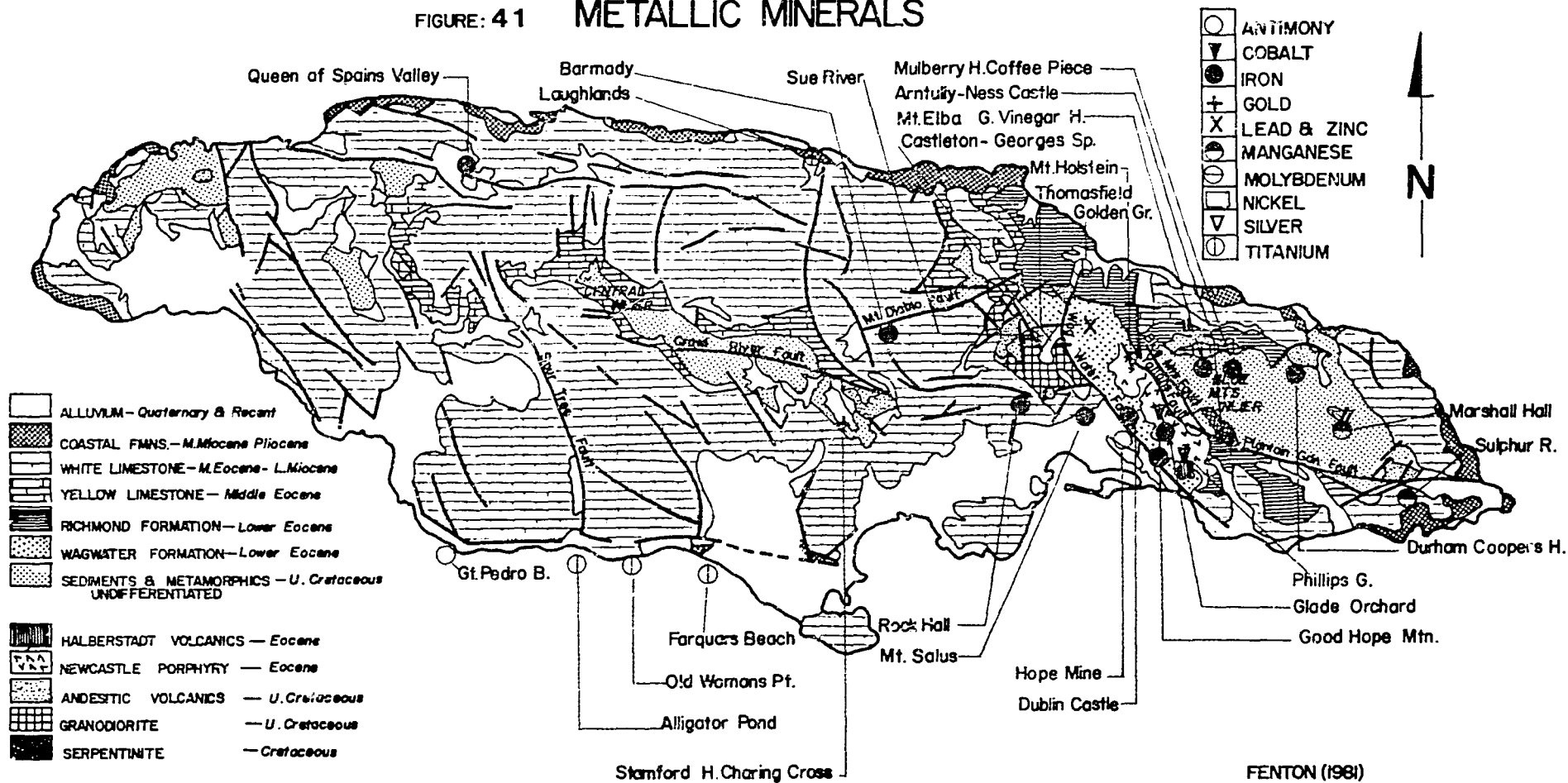
Marble emerged as a major industry in 1962 when Serge Island Jamaica Limited began making blocks, slabs and mosaic table tops. Mining operations ceased three years later, apparently because of the problems arising from insufficient knowledge of the geological aspect of the deposits, combined with a lack of quarrying and processing technology for dimension stone. Experts from other marble producing areas have concluded that Jamaica marbles compare favourably with those from Italy, Cuba and the USA with respect to richness of colour, attractive colour patterns and capacity to take a high polish.

**Table 63:**  
**Estimate of Marble Reserves**

Location	Reserves (m <sup>3</sup> )
Serge Island	206,550
Mount Hibernia	98,194
Garbrand Hall/Island	106,000,000
Bath/Friendship Gap	N/A

**Iron and Ferroalloy Minerals.** Three iron and ferroalloy minerals are found in Jamaica: iron, manganese and nickel. (See Figure 41.) Iron occurs in the greatest quantities, in the vicinity of the Blue Mountains in the parishes of Portland and St. Andrew. Manganese occurs at Marshalls Hall in Portland, but, thus far, the deposits are limited to small veins. Nickel deposits are located at New Castle in serpentine rock outcrops. However, the deposits are not considered of economic value.

FIGURE: 41 METALLIC MINERALS



**Base Metals.** Base metals include copper, lead and zinc. (See Figure 41.) Copper is the most common base metal. Mining was carried out on a small scale in the early part of the nineteenth century. Major outcrops are located in Upper Clarendon, Portland and adjoining parts of St. Catherine, Portland and St. Andrew. Hope Mine in St. Andrew contains the only significant deposit of lead and zinc. The mine is not in operation and recent investigations indicate low potential.

**Precious Metals and Minerals.** Gold, silver and platinum comprise Jamaica's precious metals. Gold and silver occur in association with copper, but the amount has not been significant to warrant exploitation as a secondary feature of a major copper mining operation. Platinum has been recorded in alluvial deposits in eastern Jamaica, but no intensive surveys have been conducted.

**Energy Minerals.** Oil, gas, peat and geothermal energy resources are being explored. Oil exploration in Jamaica has been on-going since 1952. (See Figure 42.) The Petroleum Corporation of Jamaica (PCJ) has drilled several wells, both on-shore and off-shore, but to date oil has not been found. Methane gas seepages have been located in the Windsor area of St. Ann, but drilling in the area has so far failed to locate any major gas source. Two major peat reserves have been located in the Black River Morass and the Great Morass. Reserves are estimated at 6.5 million tons (dry basis). According to Robinson (1980), these two sources represent enough material to fuel an 80 megawatt power plant for at least 30 years.

**Phosphates.** Phosphate is the only fertilizer mineral mined in Jamaica and is derived from bat droppings that accumulate in caves. Many of the caves have been depleted from past mining activities. Present recovery is less than 500 tons per year. (See Figure 43.)

**Silica Sand.** Extensive silica sand deposits are located in the Black river area of Hodges, St. Elizabeth. (See Figure 43.) The deposits support a glass making industry and an abrasive industry for the manufacture of cleaners. The glass industry is yet to penetrate the overseas market, with production increasing steadily during the last six years from under 8,000 metric tons per year in 1980 to nearly 16,000 metric tons in 1985 (See Table 64).

**Table 64:  
Silica Sand Production**

<u>Year</u>	<u>Metric Tons</u>
1980	7,600
1981	8,000
1982	9,800
1983	14,700
1984	14,040
1985	15,950

Source: Mines and Quarries Division,  
Ministry of Mining, Energy & Tourism.

### **Employment Opportunities in the Mining Sector**

The mining and minerals sector was a significant source of employment, reaching an all time high of approximately 10,000 persons in 1974. With a decline in both local and world economies, employment in the mining sector fell to just over 7,000 persons by 1984. However, with improvement in the local and global economies, the adoption of different marketing strategies, the growing interest in Jamaica as a major source of limestone, it is to be expected that future employment in the sector will surpass the levels of prior years.

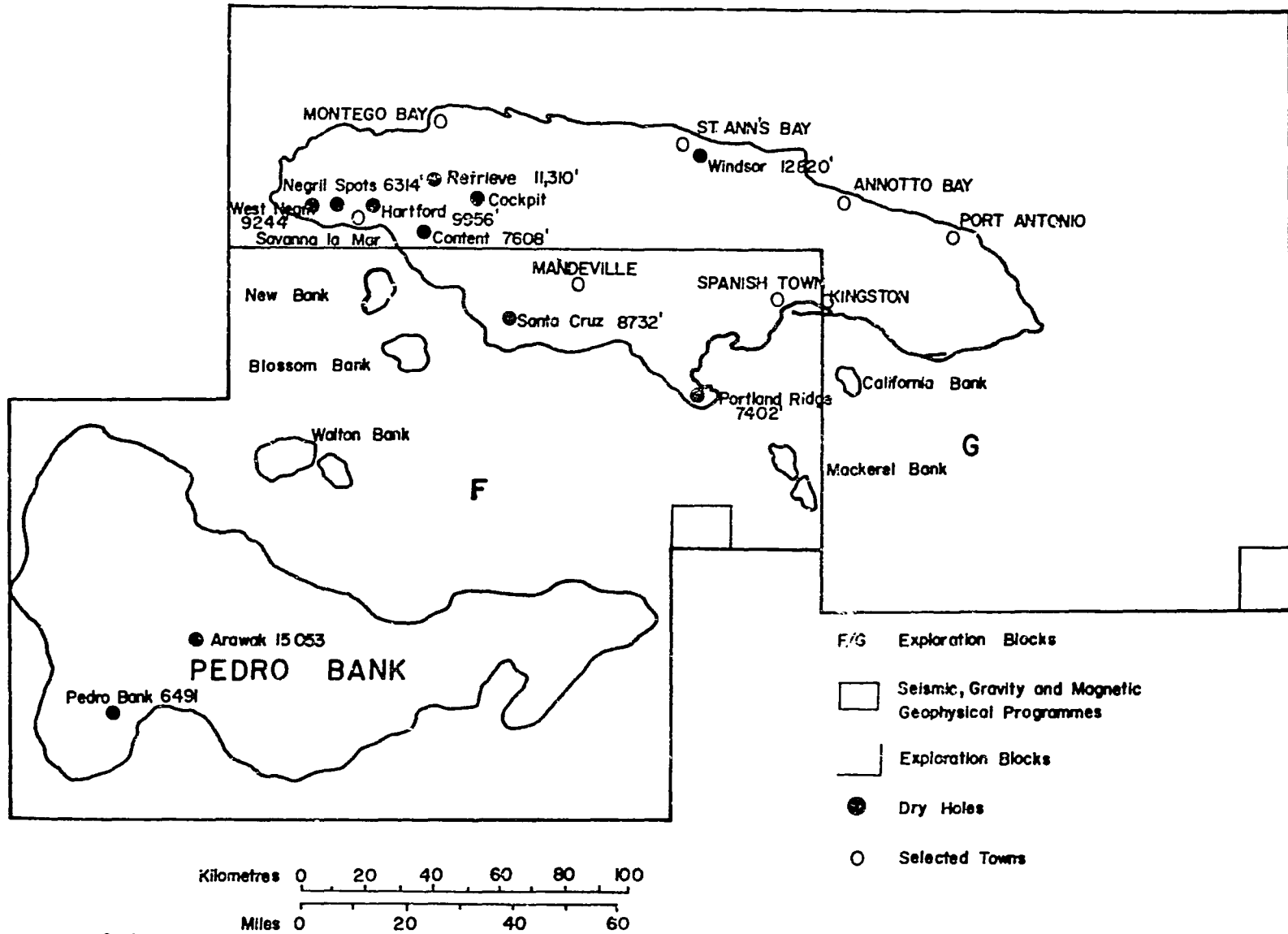
### **AGENCIES AND INSTITUTIONS**

#### **The Jamaica Bauxite Institute (JBI)**

JBI is a limited liability company established in 1976 to monitor and advise the Government on the bauxite industry. The mandate is multifold — exploration, research and development of technological improvements for the processing of bauxite; allocation of bauxite reserves; analysis of the economics of the global aluminum industry; and provision of advise for the Government on fiscal policies affecting the industry.

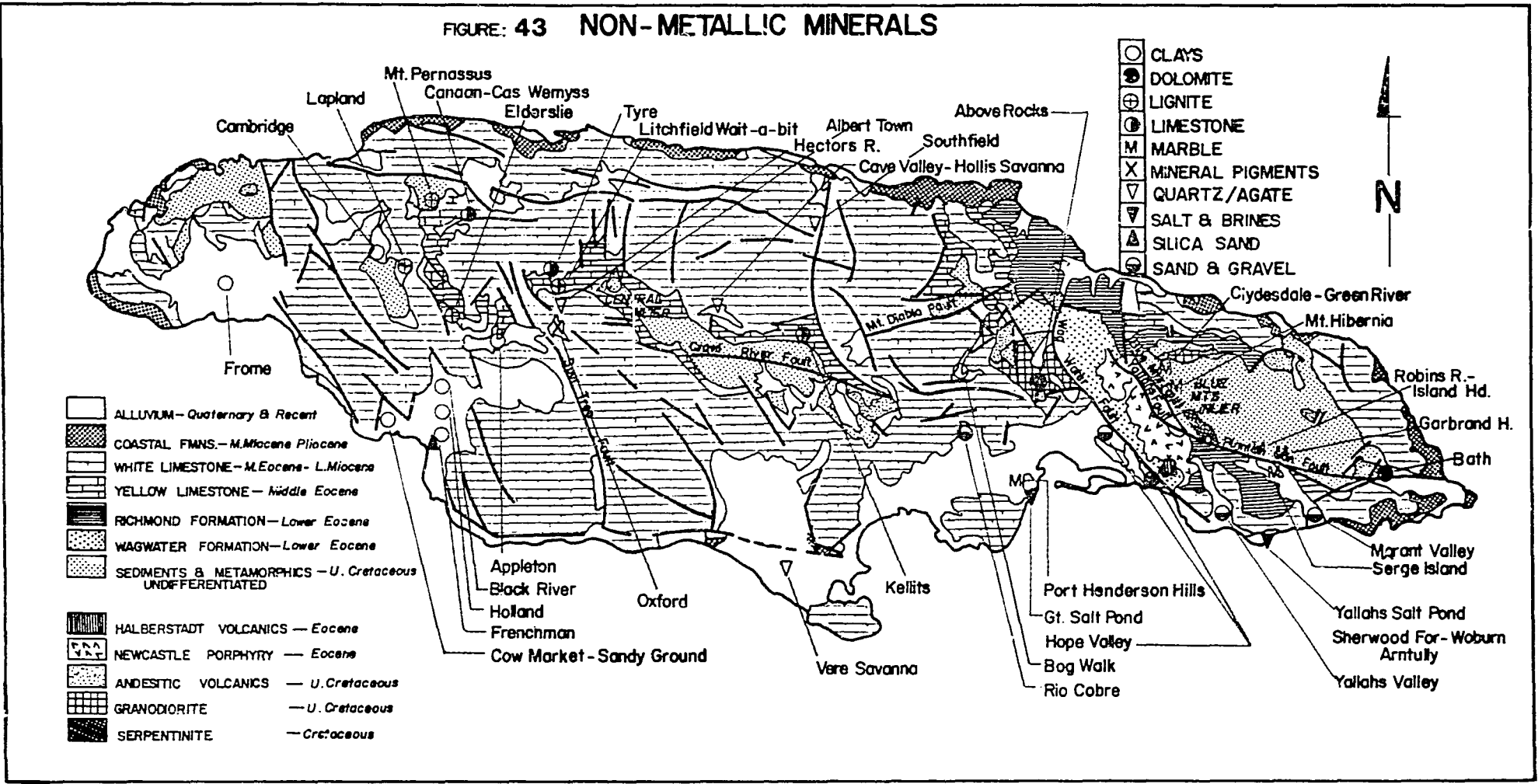


FIGURE: 42 PETROLEUM EXPLORATION STATUS 1984



Source: Petroleum Corporation of Jamaica

FIGURE: 43 NON-METALLIC MINERALS



### **Jamaica Bauxite Mining Limited (JBM)**

The Government of Jamaica has entered into a number of joint ventures and partnerships with trans-nationals within the bauxite industry, including Alcan, Alcoa, Kaiser and Reynolds. These investments are made through JBM, which manages such investments on Government's behalf.

### **Clarendon Alumina Production Limited (CAP)**

Following the closure of their Jamaican operations by Alcoa, a new company, CAP, was established by Government, which leased the plant and restarted the bauxite mining and alumina production and exporting operations.

### **Bauxite and Alumina Trading Company of Jamaica Limited (BATCO)**

Government trades actively in the bauxite/alumina/aluminum market. This is accomplished through Batco, a trading company established for this purpose. The Company marketed over 30% of the bauxite exported from Jamaica and over 40% of the alumina produced.

### **The Petroleum Corporation of Jamaica (PCJ)**

The PCJ is a statutory body empowered by the Petroleum Act (1979) to develop the country's petroleum, peat, and coal resources. The corporation has been financially self-sufficient since its inception in 1979. Its operations have been threefold: petroleum exploration, peat research and the operation of the Petrojam Refinery.

### **The Mines and Quarries Division of the Ministry of Mining and Energy (MQD)**

The MQD is funded by the Ministry of Mining and Energy, and is responsible for mining and quarrying operations in Jamaica. Its activities include:

- researching, processing and making recommendations to the Ministry on all the applications made under the Mining Act, and the Quarries Control Act;
- preparing, regulating and issuing statutory instruments;
- reviewing legislation on mining operations;
- assessing and collecting royalties;
- evaluating the work permits of foreign nationals involved in mining industries;

- monitoring bauxite/alumina production and export; and
- other monitoring activities such as mining techniques, health and safety of workers, rehabilitation of mined out areas, environmental impact of mining and processing operations, and investigation of complaints related to mining or quarrying activities in Jamaica.

### **Natural Resource Conservation Department (NRC D)**

The NRC D was established for the purpose of:

- increasing public understanding of the Island's ecological systems and to promote methods for the conservation and development of its natural resources;
- determining policy to be followed and standards to be maintained in the management of the Island's resources of land, water, fauna and flora;
- promoting and ensuring the proper use of the nation's natural resources by the establishment of an ecological review procedure for all relevant development proposals.

### **The University of the West Indies (UWI)**

The University's four departments concerned with mining and minerals are the departments of geology, physics, chemistry and geography. The Geology Department is presently conducting research on the black sand deposits in St. Elizabeth, the geochemistry of Hope lead/zinc deposits, and the geochemical survey of Jamaican soils. The Department is also conducting the Jamaica Radiogeologic Survey.

### **The Geological Survey Department (GSD)**

The GSD, which falls functionally and administratively within the Ministry of Mining and Energy, is the national geological research and development organization. Its primary objective is to develop an integrated, comprehensive and scientific understanding of the geology of Jamaica as a basis for mineral exploration and development.

The GSD is responsible for

- all geological mapping of Jamaica;
- assessment of all Jamaica's metallic (except bauxite) and non-metallic minerals;
- investigation of potential geological hazards; and
- providing engineering geological services.

## LEGISLATION AND REGULATIONS

There are sixteen Acts which regulate or influence mining activities in Jamaica.

### Acts Concerning Bauxite

- o The Bauxite and Alumina Industries Encouragement Act (1950/1967/1980) granted import concessions to recognized bauxite producers. These concessions include exemption from custom duties, as well as excise, tonnage and stamp duty.
- o The Bauxite and Alumina Special Provisions Act (1977/1982). This act made it possible to credit income tax against the production levy; the tax is payable in United States dollars.
- o The Bauxite Production Levy Act (1974) imposed a production tax on all laterites (e.g., bauxite).

### Acts Concerning Petroleum

- o The Petroleum and Oil, Fuel, Landing and Storage Act established the mechanism for licensing petroleum and fuel oil dealers.
- o The Petroleum Filling Station Regulations Act (1956/1982) established the Petroleum Filling Stations Board and is primarily concerned with deciding whether a particular site is suitable for the establishment of a petroleum filling station, a private fueling facility or an additional fueling facility.
- o The Petroleum Refinery Industry Encouragement Act (1962) grants concessions in respect of custom duty, income tax, and assistance to recognized refiners of oil out of the "Estimates of the Island".
- o The Petroleum Act (1979) is of great importance to the mining and minerals sector as it established the Petroleum Corporation of Jamaica (PCJ), and vested this corporation with the sole right to develop and manage petroleum resources, either alone or with a contractor. The corporation is entitled to exemptions from stamp and customs duties. Under the Compulsory Land Acquisition Act, the PCJ is authorized to acquire lands for exploration purposes. A 1984 amendment to the Petroleum Act empowered the PCJ with the right to import coal and the sole right to exploit and extract peat.

- o The Factories Act which is concerned with installations and works connected with handling storage and transportation of petroleum products.
- o The Trade Act which deals with petroleum price orders as well as orders governing the opening hours of petroleum filling stations.

### General Mining Acts

- o The Minerals Vesting Act (1947/1960) states that all minerals being in, on or under any land or water, whether territorial waters, rivers, or inland sea are vested in and are subject to the control of the Crown. Mining is regulated by the Crown and the payment of royalties goes to the Commission of Mines (located within the Mines and Quarries Division of the Ministry of Mining and Energy).
- o The Town and Country Planning Act (1957) is related to mining since it covers any change in land use which takes place on, in, under or over the land. Permission has to be granted for such changes.
- o The Clean Air Act (1964) applies to mineral extraction in that any discharge of fumes, smoke, dust or gases must be monitored by personnel designated by the Central Board of Health. The owners of each extraction operation can be subject to fines or prison terms if certain emission restrictions are not met.
- o The Mining Act (1947) controls mineral prospecting in specific locations and the leasing of land for mining, depending on the minerals being mined. The Act provides extraction right to persons holding such leases and provides various royalty regimes, depending on the mineral being mined. It is associated with the Health and Safety Regulations (1977) which provides regulations and standards for ensuring safe operations within the mining industry.
- o The Quarries Control Act (1983) established quarry zones and controls the licensing of all quarries. The Act established the Quarries Advisory Committee, a quarry tax, and quarry safety provisions. Additionally, it provides for the revocation of quarry licensing and the closing of operations in the event that certain environmental impacts are not controlled. Impacts include air pollution and effects on the character of the neighbourhood.

## Miscellaneous Acts

- o The Calcium Carbide Sale and Storage Act (1901) provides for the safe storage of calcium carbide and the licensing of dealers and storage facilities.
- o The Cement Industry Encouragement and Control Act (1948) provides for the licensing of producers of cement, and for exemptions from customs duty, tonnage taxes, relief from income taxes, and exemptions from royalties on minerals. It also prohibits the importation of cement.

## PROPOSED PLANS AND PROGRAMMES

### Public Sector Programmes

Petroleum Corporation of Jamaica (PCJ). The use of peat resources for energy is under study by the PCJ. Emphasis continues to be placed on geophysical work to identify potential sources of oil and gas.

Jamaica Bauxite Institute (JBI). JBI operates a pilot plant for the production of alumina from bauxite. This provides an excellent model for technological development in the treatment of some of the more complex bauxite ores as well as for training.

Mines and Quarries Division. The Mines and Quarries Division is collaborating on the establishment of quarry zones under the Quarries Control Act of 1983.

### Private Sector Programmes

Limestone. An extensive limestone exploration programme, including core drilling, is in progress with a view to developing a 3 to 4 million tonne/year limestone export operation from Ocho Rios. Limited shipments are already being made from deposits in eastern St. Andrew and central St. James via the deep water port at Harbour Head and the Montego Free Zone respectively. The programmes call for major increases in export volumes from these locations.\*

---

\* The programme is geared towards development of the limestone industry. Further information can be obtained from the Mines and Quarries Division as well as the Geological Survey Department.

Marble. Renewed interest has been shown in the marble deposits for the mining of dimensions stones. Private investors are examining the feasibility of developing the industry for export.

Salt. Results of investigations into the production of common salt in the south Clarendon areas have been very promising.

## PROBLEMS AND ISSUES

There are a number of key management issues within the mining and minerals sector which are receiving the attention of both the managers and the regulatory processes within the sector. These are discussed below.

### Illegal Limestone Quarrying

In the past there had been widespread quarrying of limestone in any location offering easy access to limestone material, and where there was a demand for its use in the building and construction industry — in particular the road construction industry. This created two major problems: the wanton scarring of the lush countryside, and unsafe operations. Through a strong regulatory process of zoning and licensing, these problems have been substantially mitigated.

### Disposal of Red Mud Waste

Jamaica has an alumina capacity of approximately three million tons per year. Each ton of alumina produced gives rise to approximately one ton of red mud waste or residue. Jamaica has a limited land mass for disposal of such volumes of waste material. This is further aggravated by the fact that the residue leaves the plant in association with large volumes of weak caustic soda solution. It is therefore a slurry containing about 20% solids.

The initial methods of red mud disposal were by pumping the material into mined-out orebodies and/or into dyked valleys. Both these methods created seepages of the weak caustic solution into the ground water system, thereby causing contamination of the aquifer.

A later approach was to build sealed ponds in which the interior of the ponds was lined with 12-14-inch clay sealant. These ponds, which were 100-120 acres in area, created other problems. A significant problem was that they

were constructed on highly arable lands. The ponds were designed to hold 5-7 years of mud storage. Furthermore, these ponds never dried out after they were full and consequently had to be abandoned. Furthermore, during the surface drying process, caustic dust particles formed and were wind-blown into neighbouring communities, creating a nuisance. Persons in these communities complained of burning sensations to eyes and skin. The surface of the ponds had to be kept constantly wet as a consequence.

A still later development in red mud disposal technology was a dry stacking approach, in which the mud is deposited in layers on specially constructed drying beds. Although referred to as dry stacking, the mud contains approximately 25-30% solids. A series of beds are created, and the thickened mud is deposited on these beds in series, allowing a sufficient time interval for solar drying. The final result is a blocky granular free-draining earth medium which is physically very similar to bauxite. The stacked mud is capable of supporting heavy weights and can be mechanically treated to increase its strength and stability. It is capable of being very easily loaded onto trucks and transported elsewhere for land fill or other desirable uses.

#### **Urban Spread Over Areas of Mineral Potential and Relocation of Population from Mining Sites**

Urban spread of the population over areas of bauxite deposits has sterilized substantial reserves. The town of Mandeville, for instance, is underlain by bauxite said to be valued at US \$300 million. There is a continuing spread of the urban areas to the south of the town into areas of high grade bauxite. Although the subdivision of lands and development of major housing complexes are controlled by the Planning Authorities, there is nothing to prevent the construction of individual residences on privately-owned bauxite lands. Acquisition of such developed holdings usually proves uneconomic, resulting in loss of bauxite reserves.

In addition, although major land purchases were carried out in the 1950's and onwards, there is still a very large number of small settlers residing and carrying out subsistence-level farming on bauxite lands. These persons are often established over the years in very tightly-knit communities and kinship groups. The process of acquiring their lands and relocating them elsewhere in new and strange surroundings often without community facilities is not with-

out a degree of trauma very often leading to the separation of family groups. More recently, attempts have been made to relocate larger numbers on larger subdivided holdings, in close proximity to established community facilities. The stage has not been reached in which small settlers are more willing to temporarily relocate while mining is being carried out on their lands, then return once the lands have been rehabilitated.

#### **Rehabilitation of Mined Lands**

Depending on the shape and depth of the orebody, a mined-out pit may end up with variations from a shallow saucer-shaped basin to a wide, deep hollow with vertical walls. The shallow basins are graded to a gentle slope ending at the approximate middle of the mined-out area or terraced to that point. Deeper deposits are graded to the toe of the vertical walls and serve as collection ponds for water. Although these pits are sometimes fenced, the collection ponds are dangerous. A synthetic or other form of sealant should be used on the bottoms and sides of these "holes" to form ponds that can be used and managed as water reservoirs.

There is an agreement among all the mining companies operating in Jamaica on the techniques which should be employed in rehabilitating mines of different sizes and shapes. The actual mining process begins by taking into account the need for rehabilitation later on so that the first 18 inches of top soil is carefully removed and stored for replacement later on once the mine becomes exhausted. Jamaica probably has one of the best records for rehabilitation of mined lands in the world, although it has fallen behind over the past eight years. Some of the companies (Reynolds and Kaiser) have been able to establish forest on the mined out land, e.g., mahoe, and, in addition, have been able to grow vegetables successfully as well as rear livestock, cattle and sheep.

#### **Exploitation of Peat Resources**

Exploitation of Jamaica's peat resources remains a contentious issue. While peat mining would enhance employment opportunities in those areas endowed with deposits of peat (and which currently have a high unemployment level), environmentalists are of the view that alterations would occur in the water balance as a result of saline intrusion, which would in

turn greatly alter the composition of mined wetlands. (Blackwood, 1984.)

Based on the inadequacy of the previous reports on peat, it cannot be stated emphatically that there will be environmental risk associated with the exploitation of this resource. Indeed, the need to explore renewable alternatives as comprehensively as non-renewable options should be encouraged. Furthermore, the extent and scale of the exploitation should be assessed.

### **Emphasis on Energy Conservation**

Over 95% of Jamaica's energy is generated by imported oil. The monthly oil bill, until recently, averaged US \$20 million per month. Through conservation measures, this has gradually been reduced to approximately US \$18 million per month. Although the recent fall in oil prices has helped considerably in reducing the oil bill, Jamaica cannot rely on falling oil prices while the Middle-Eastern territories remain volatile. The potential for hydro to contribute any significant amount to the energy needs for Jamaica is, at best, minimal. It remains necessary, therefore, for Jamaica to investigate alternative source of energy. In this regard, coal (anthracite) has been given very high priority.

### **DIRECTIONS FOR THE FUTURE**

1. Although considerable information on base metals occurrences exist, the data is very qualitative. Additional field work, including extensive drilling and reserves estimation, are required. Sampling of base metals has been completed. Analysis is expected to commence shortly.
2. The mineral sands along the south coast, between Gut River and Alligator Pond, offer tremendous potential for a light alloys manufacturing enterprise. However, the reserves need to be proven and certain improvements made in technological processes.
3. Jamaica has for too long relied on a single major mineral commodity — bauxite. Approximately 75-80% of the island is comprised of limestone of varying qualities, and "aggressive" marketing initiatives are required, notwithstanding the high bulk, low cost nature of the commodity.

4. Improvements have been made in the disposal of red mud from at least one plant. This process should be developed in other plants on the island. Uses of red mud, for other than landfill, should be thoroughly researched for eventual application on a commercial scale, such as in the building and construction industry.

5. Environmental studies should accompany the exploitation and development of peat deposits.



Plate 33 - Mining operations.

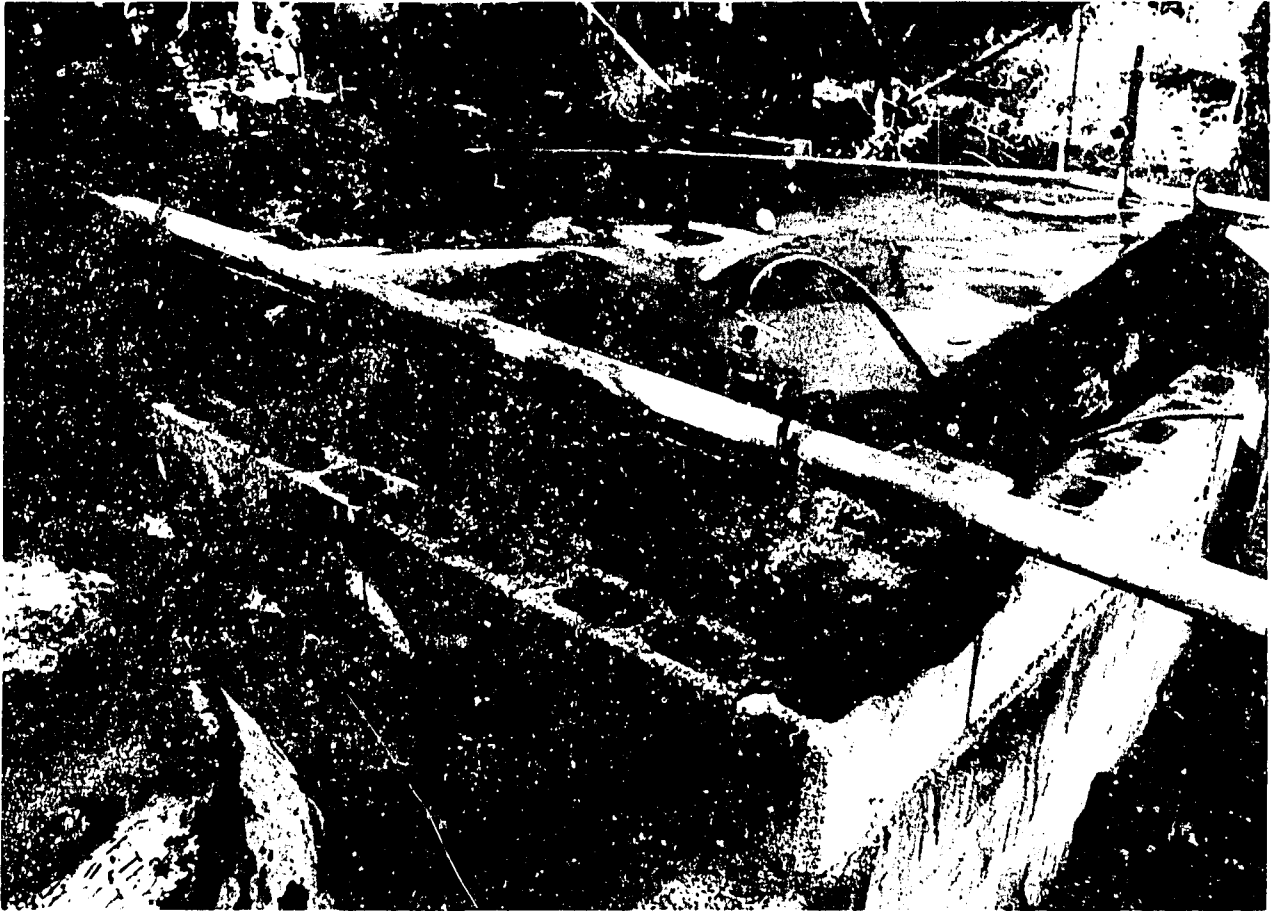


Plate 34 - Biogas Plant at Golden Spring.



## ENERGY RESOURCES

---

### OVERVIEW OF ENERGY RESOURCES

Jamaica, like all other oil-importing developing countries, was adversely affected by the dramatic increase in petroleum prices, particularly between 1973 and 1980. This created serious institutional, financial and social problems for the country. How the sharp reductions in the recent price of crude oil will affect the Jamaica economy remains to be seen. At minimum it will affect the economic feasibility of turning to alternative fuels, such as peat, for energy production.

Jamaica is almost totally dependent on imported petroleum, and thus, continues to be directly influenced by factors affecting the international petroleum market. Jamaica relies on oil imports for over 98% of its commercial energy requirements, while hydropower provides most of the remaining demand. If non-commercial energy sources — bagasse and fuel wood/charcoal — are also taken into account, Jamaica is still dependent on imported oil for over 90% of its energy requirements. These, and other indigenous energy resources, such as peat, may have the potential to contribute to Jamaica's energy supply, but their development will take time and high capital input.

Indigenous energy resources are not readily exploitable, and are limited in range and quality. Because of these limitations, future energy requirements will continue to be met largely through imported petroleum. Until the recent decline in crude oil prices, it was assumed that the cost of imported energy would continue to pose severe constraints to economic growth, as well as posing a threat to Jamaica's forests as a result of increasing fuel wood harvesting.

### Petroleum

Petroleum Imports. Jamaica's petroleum demand has steadily declined from a high of 20.5 million barrels in 1973 to a low of 12.2 million barrels in 1985, the lowest total since 1970. Under the San Jose Accord signed between Jamaica, Venezuela and Mexico in August 1980, Jamaica has imported most of its petroleum from Venezuela and Mexico, but also purchases spot cargoes when economical.

In 1982, the Government of Jamaica purchased the Esso West Indies Kingston refinery and organized Petrojam Limited to operate the refinery. Limitations in refinery design mean that it is difficult to match crude yields

precisely with market demand and, therefore, the refinery generally has deficits and/or surpluses of various products. It, therefore, has to import LPG, kerosene and gasoline to augment refinery production, and exports surplus fuel oil, diesel and asphalt. Figures released by the Petroleum Corporation of Jamaica (PCJ) indicate that 55 thousand barrels of lubricants and 16 thousand barrels of aviation fuel were imported outside the San Jose Accord by the oil marketing companies in 1985.

Additional imports of premium gasoline totalled 512 thousand barrels (34% of the 1985 gasoline demand). In addition, 283 thousand barrels of L.P.G. (75% of the national demand), 262 thousand barrels of kerosene (76% of the national demand), 25 thousand barrels of turbine kerosene, 1,015 thousand barrels of fuel oil (60% of demand), and 56 thousand barrels of lubricant and asphalt (53% of demand) were imported by the Petrojam refinery and the oil marketing and bauxite companies in 1985. (See Table 65.)

Petroleum Consumption by Product. According to PCJ, fuel oil demand in 1985 was 7.027 million barrels or 61.4% of the total petroleum

demand. Gasoline demand was 1.554 million barrels or 13.6% of the total petroleum demand. Automotive diesel oil (A.D.O.) and marine diesel oil (M.D.O.) demand was 1.308 million barrels or 11.4% of the total petroleum demand. The demand for aviation gasoline, aviation turbo fuel, kerosene, L.P.G., lubricants and asphalt accounted for the remaining 15.9% of the total petroleum demand in 1985.

Petroleum Consumption by Sector. The largest consumers of petroleum (by sector) are the bauxite/alumina industry, commercial power generation, and road and rail transportation. (See Table 66.) Energy requirements in the bauxite/alumina industry are dependent on production levels within the sector, which are influenced by global demand.

As a result, future energy requirements are difficult to forecast. Past attempts by PCJ and the Ministry of Mining, Energy and Tourism (MMET) to project energy demand in the bauxite/alumina industry confirm this. In 1980, the bauxite/alumina industry accounted for 52% (8.06 million barrels) of the country's total petroleum consumption of 15.5 million barrels. Lowered production levels over the following

**Table 65:**  
**Petroleum Consumption by Product, 1985**  
**(Volume in Million Barrels)**

Sector	Fuel Oil	A.D.O./ M.D.O.	Kerosene, Turbo Fuel, L.P.G. Lubricants, Asphalt	Gasolenes	Total
Aviation	—	—	0.986	0.012	0.998
Bunker	.026	0.062	—	—	0.088
Road/Rail Transportation	—	0.617	0.034	1.504	2.155
J.P.S.	2.710	.112	—	—	2.822
Bauxite/Alumina	3.741	0.136	0.006	—	3.883
Cement	0.239	0.056	—	—	0.295
Cooking & Lighting	—	—	0.721	—	0.721
Others	0.366	0.338	0.065	—	0.769
<b>TOTAL</b>	<b>7.082</b>	<b>1.321</b>	<b>1.312</b>	<b>1.516</b>	<b>11.731</b>

Sources: Petroleum Corporation of Jamaica; Ministry of Mining, Energy, and Tourism.

**Table 66:  
Petroleum Consumption by Sector, 1985**

Sector	Total Consumption (million barrels)	% of National Consumption
Bauxite/Alumina	3.890	33.2
Power generation (JPSCo.)	2.825	24.0
Road/Rail Transportation	2.156	18.4
Aviation	0.998	8.5
Cooking & Lighting	0.721	6.1
Cement	0.295	2.5
Bunker	0.088	0.8
Sugar Processing	0.080	0.7
Others	0.678	5.8
<b>TOTAL</b>	<b>11.731</b>	<b>100.0</b>

Sources: Petroleum Corporation of Jamaica; Ministry of Mining, Energy, and Tourism.

four years, however, reduced petroleum consumption by the industry to 3.890 million barrels, or 33% of the total petroleum demand in 1985.

The petroleum needs of the JPS for commercial power generation consisted of 2.825 million barrels in 1985 (24.1% of the total petroleum demand). Petroleum consumption for commercial power generation has remained relatively stable during 1973-1983, while consumption in most of the other sectors (except for aviation and cooking/lighting) declined. The improvements in generating efficiency, following the rehabilitation of major generating units, reduced the JPS petroleum demand in 1984 by 8% from the peak of 3 million barrels in 1983, despite the increased demand resulting from the steady growth in the number of customers. There was a further reduction of 8% in 1985.

Road and rail transport accounted for 2.156 million barrels of petroleum consumed in 1985 (18.4% of the total petroleum demand). Higher fuel prices, lower real incomes, and the decline in economic activity and vehicle purchases have all contributed to the reduced consumption of transportation fuels since 1976.

All other sectors combined accounted for close to 24% of demand. The aviation sector consumed 998,101 barrels of petroleum (8.5% of the total petroleum demand) in 1985, in contrast to 1.15 million barrels used in 1973. The reduction in the number of airlines operating in Jamaica, as well as the current trend toward refuelling outside of Jamaica, has caused this decline. The cooking and lighting sector consumed 720,608 barrels of petroleum (6.1% of total demand) in 1985. The cement sector consumed 294,991 barrels (2.5% of the total petroleum demand). Bunkering and sugar processing each accounted for less than one percent, while other industries consumed the remaining 679,000 barrels (5.8% of total petroleum demand in 1985).

#### **Hydroelectric Resources**

The first hydroplants in Jamaica were constructed in 1898. Additional plants were constructed during the mid-twentieth century, the latest in 1959. Today, installed hydroelectric capacity at five sites in Jamaica is 21.3MW on a name plate capacity basis, but effective derated capacity totals 15.2MW. According to MMET,

an additional 60 MW of hydropower potential has been identified for development. The MMET has attached first priority to the development of the country's hydropower resources, and has projected that approximately 96 MW could be in place by the year 2000. The energy currently generated by hydro resources provides 5.7% of peak electricity demand. Hydro-power is one of the cheapest sources of energy. The best projects have generating costs (including capital costs) of less than 5¢ per KWH.

### Bagasse Resources

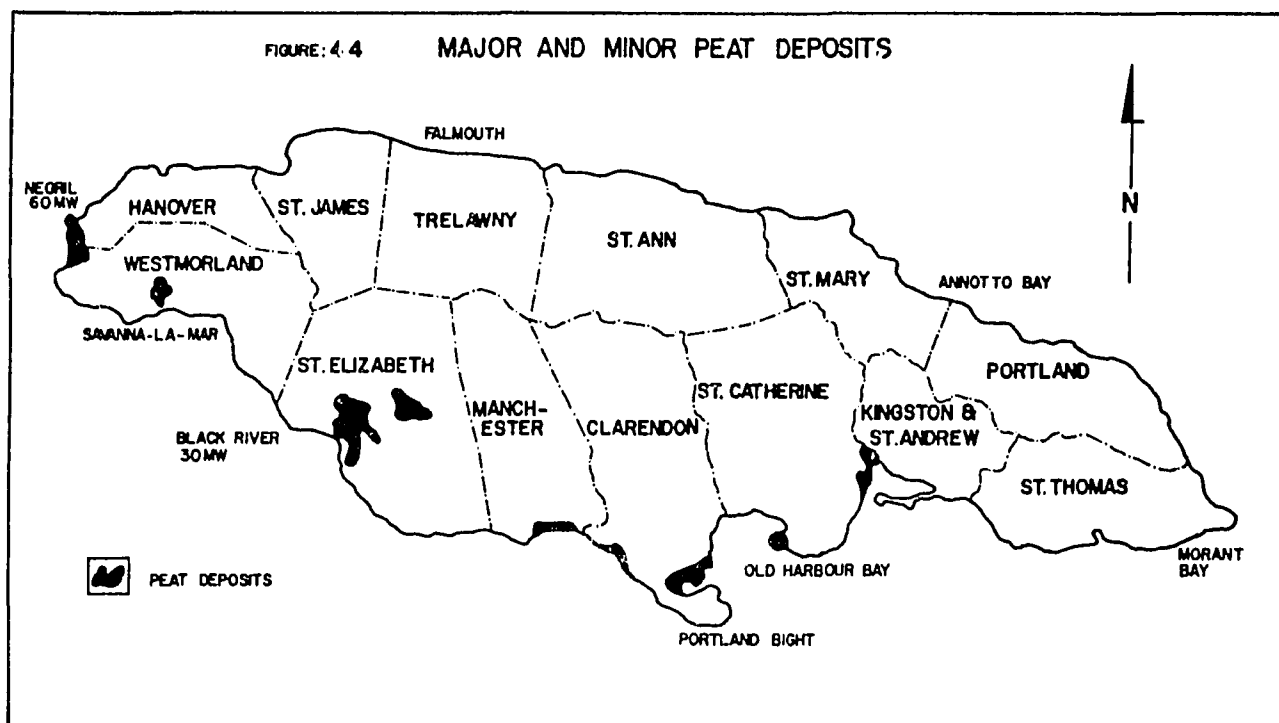
Bagasse, the residue of sugar cane refining, is used as an energy resource only in the sugar refining industry. In the past, the use of bagasse allowed the sugar industry to enjoy energy self-sufficiency, but a combination of outdated equipment and poor quality sugar cane has led to the increased use of fuel oil and wood. Bagasse provided about 85% of the sugar industry's energy requirements in 1984, rising from 79 percent in 1979. Over 6% of the nation's energy requirements was provided by bagasse in 1984.

### Peat Resources

Peat is organic matter derived from partially decomposed vegetation in a water-logged environment. When dried, it may be burned like coal to provide energy. Peat is currently not used as an energy resource, but the potential of the country's peat reserves for fuel was identified by the GOJ in 1976. These resources cover 7,300 acres in Negril and 12,000 acres in Black River. Smaller deposits exist in St. Thomas, St. Mary, Trelawny and Westmoreland. (See Figure 44.)

### Electric Generating Capacity

The combined electrical generating capacity of the JPS and private sector facilities was 613 MW in 1984, 74% of which was contributed by the JPS. The bauxite/alumina companies, the cement company, the sugar industry, Good Year Jamaica Limited, and other private companies and households contributed the remaining 26%. Of the 160 MW generating capacity of the private sector, the bauxite/ alumina companies contribute 122 MW or 77%. (See Table 67.)



At present the JPS operates solely on 50 Hertz (cycles/sec) whereas some private plants operate on 60 Hertz (cycles/sec). JPS generating facilities are shown in Figure 45 and Table 68. Figure 46 shows the location of JPS transmission lines and the location of the major private generating plants.

Total system generating capacity (based on normal Continuous Maximum Rate (CMR)) is

presently 481.0 MW. According to the JPS, however, the actual electric generating capacity differs from the installed and usable capacity, because the system cannot be operated on CMR permanently, and units must regularly be taken out of service for maintenance. According to the JPS, actual electric generating capacity was 265 MW in 1981; 269 MW in 1982; 358 MW in 1983; and 337 MW in 1984.

**Table 67:**  
**Electric Generating Capacity, 1981-1984**

	Installed and Usable Capacity, MW (based on normal C.M.R.)				Electricity Generated, G.W.H.			
	1981	1982	1983	1984	1981	1982	1983	1984
<b>J.P.S. Co.</b>	454.0	454.0	455.0	453.8	1281	1336	1458	1439
<b>Private</b>								
-Bauxite/Alumina	167.7	168.0	146.0	122.0	782.2	N/A	N/A	N/A
-Cement	14.0	14.0	15.0	17.0	22.6	"	"	"
-Sugar	30.2	30.2	21.7	20.1	23.4	"	"	"
-Others	0.45	0.45	0.49	0.49	0.02	"	"	"
<b>TOTAL</b>	<b>666.35</b>	<b>666.65</b>	<b>638.19</b>	<b>613.49</b>	<b>2109.22"</b>	<b>"</b>	<b>"</b>	
<b>% of Total Capacity</b>								
<b>J.P.S. Co.</b>	68.1	68.1	71.3	74.0	60.7	N/A	N/A	N/A
<b>Private</b>								
-Bauxite/Alumina	25.2	25.2	22.9	19.9	37.1	"	"	"
-Others	6.7	6.7	5.8	6.1	2.2	"	"	"
<b>% of Private Capacity</b>								
-Bauxite/Alumina	79.0	79.0	79.7	76.4	94.4	"	"	"
-Others	21.0	21.0	20.3	23.6	5.6	"	"	"

Source: Ministry of Mining, Energy, and Tourism (1985).

FIGURE: 4.5 JAMAICA PUBLIC SERVICE POWER STATIONS

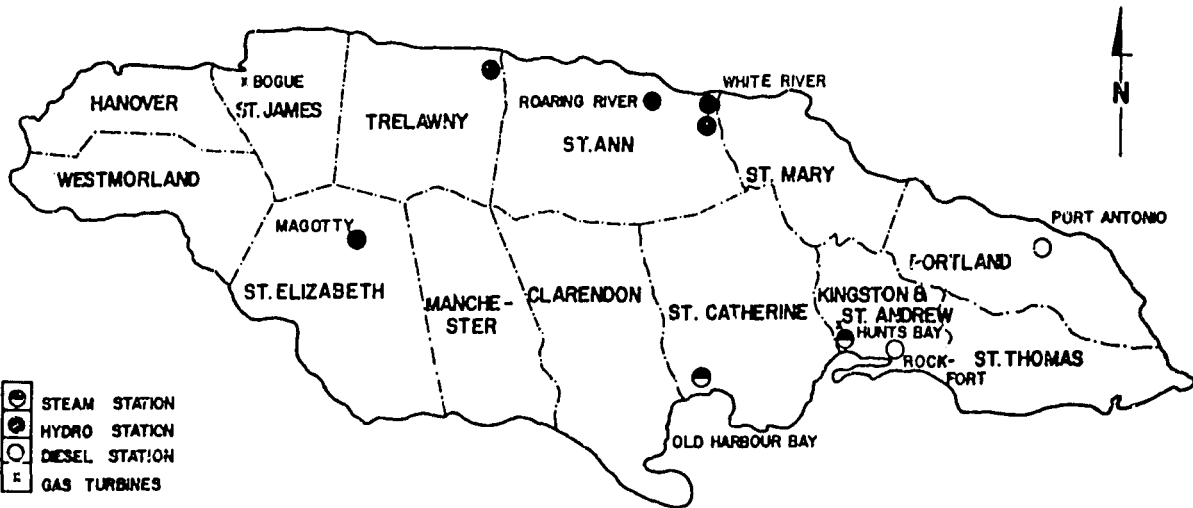


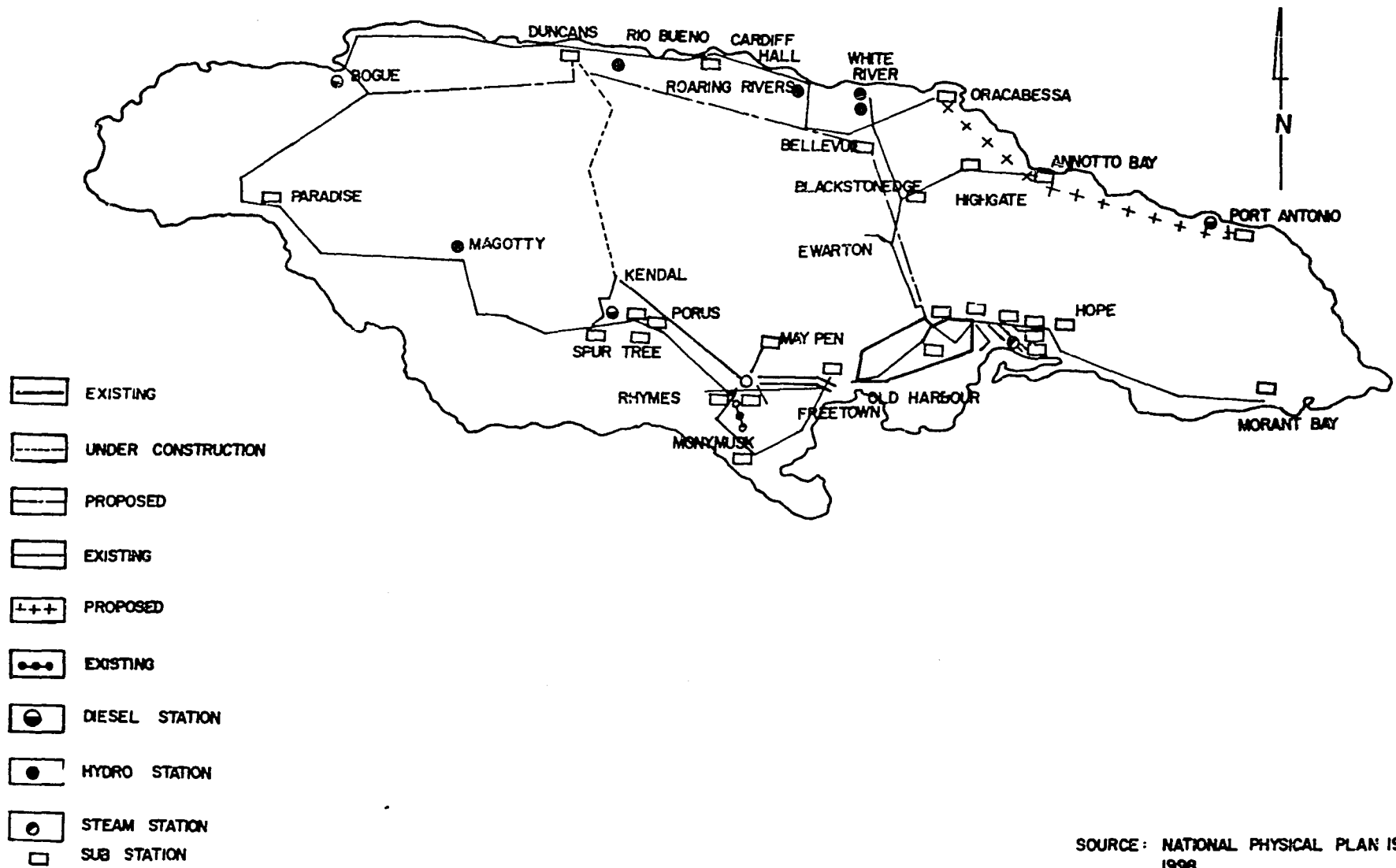
Table 68:  
Location, Type and Rating of JPSCo. Generating Facilities

Location	Unit	Type	Rating M.W.	Type Total
Old Harbour	1,2,3,4	Steam	213.5	333.0
Hunts Bay A	1,2,3,5,B6	Steam	119.5	
Hunts Bay B	GT 1,2,4,5	Gas	68.0	88.0
Bogue	GT3	Gas	20.0	
Bogue		Diesel	0.5	40.5
Rockfort		Diesel	40.0	
Magotty		Hydro	6.3	20.1
Lower & Upper White River		Hydro	7.3	
Roaring River		Hydro	4.0	
Rio Bueno		Hydro	2.5	
TOTAL			481.6	481.6

Source: Jamaica Public Service Company Ltd.

FIGURE 46

JAMAICA PUBLIC SERVICE MAJOR TRANSMISSION LINES ( DISTRIBUTION )



SOURCE: NATIONAL PHYSICAL PLAN 1978 - 1996

## Projected Demand for Energy Resources

The PCJ's forecast for 1985-1989 projects future petroleum demand based on two sets of assumptions. (See Table 69.) The first set (A1) assumes a low growth rate in gross petroleum demand (G.P.D.) and bauxite/alumina production, and the use of coal as an alternative to petroleum by the cement company between 1987-1989. The second set (A2) assumes low growth rate in G.P.D., but a higher growth rate in bauxite/alumina production and the use of coal as an alternative to petroleum by the cement company and the JPS. No significant change is projected in the country's petroleum demand for 1985-1989, using assumptions A1. Some demand fluctuation is expected, however, using assumptions A2.

The Energy Division of the Ministry of Mining, Energy and Tourism has projected that peak electricity demand will rise to 335 MW by the year 2000. At that time, it is expected that the development of peat resources will provide a net output of 60 MW, hydro-electricity 100-105 MW, and bagasse 45-50 MW.

## AGENCIES AND INSTITUTIONS

Until 1979 institutional responsibility in the energy sector was very fragmented. Among the many steps taken since that time to improve management and development of energy resources are: the name change of the principal Ministry from "Mining and Natural Resources" to "Mining and Energy"; the establishment of an Energy Division, an Energy Conservation Advisory Council, and an Inter-Ministerial Committee on Energy; and initiation of a major USAID/GOJ Project for energy development in Jamaica.

The Ministry of Mining, Energy and Tourism is the principal agency with responsibility for energy resources. Several other ministries have a significant impact on implementation of energy policies, and other institutions play a major role in energy research and development.

## Ministry of Mining, Energy and Tourism

The Ministry of Mining, Energy and Tourism (MMET) has overall responsibility for energy policy and sets the objectives for energy conservation and the development of indigenous energy resources. MMET also monitors and regulates the petroleum sub-sector, inclusive of the Petroleum Corporation of Jamaica (PCJ). MMET's functions include the evaluation of domestic energy potential, by conducting inventory studies and preliminary feasibility analyses.

In recent years, the core of the institutional responsibilities for energy has rested with the Energy Division of MMET, which is headed by a Director who reports to the Permanent Secretary. There are three Director posts below that of the Director of Energy — Alternative Energy, Conservation, and Economic Planning — who play specific roles in the administration of the energy sector. An indirect relationship exists between the Energy Division and the Economic Planning Unit of the Planning Institute of Jamaica (PIOJ), as well as with the National Advisory Committees on Energy.

Recently, the staff and functions of the Energy Division have been declining, and a relative scaling down of activities is evident.

Until 1984, legal responsibilities for environmental control also resided with MMET. Since

**Table 69:**  
**Jamaica's Petroleum Demand Forecast, 1985-1989**  
(thousand barrels)

Total Petroleum	1985	1986	1987	1988	1989	Average Annual % Change
Using A1	12,435	12,537	12,192	12,197	12,512	0.04
Using A2	12,975	12,903	13,140	11,969	12,486	0.11



that time, the responsibility has been transferred to the Natural Resources Conservation Division (NRCD) of the Ministry of Agriculture. NRCD is now responsible for monitoring the environmental effects of all energy activities.\*

### **Petroleum Corporation of Jamaica (PCJ)**

The PCJ is responsible for the research and development of energy resources, and has been playing an increasingly active role in both policy formulation and implementation. PCJ is also the sole importer of crude petroleum, implements medium to large scale energy projects, and has exclusive rights to explore and develop Jamaica's hydrocarbon resources.

### **Jamaica Public Service Company (JPS Co.)**

The JPS Co. under the Ministry of Public Utilities and Transport, is a limited liability company owned by the GOJ. Although it does not receive continuous support from the public budget, the government provides equity injections from time to time. At present the company enjoys a monopoly in the country's commercial electric generating sub-sector, and is the sole licensee for the distribution of electricity to the public.

### **Supporting Agencies and Institutions**

Three other ministries with policy-making and/or monitoring and regulatory capabilities have significant impacts on energy policies as designed by MMET:

- o The Ministry of Industry and Commerce is responsible for regulating importation of goods and equipment, and for administering Government's controls in respect to some petroleum by-products (e.g., cooking gas.)
- o The Ministry of Finance and Planning establishes overall taxation policy.
- o The Ministry of Construction, through the

Island Traffic Authority is responsible for motor vehicle inspections.

In addition to these ministries, other institutions play roles in energy research and development.

During the 1970's the GOJ began to expand its role in the development of bauxite - the country's most important resource. The Jamaica Bauxite Institute (JBI) was formed as the principal arm of the government in carrying out this policy. The JBI monitors activities of the bauxite/alumina industry, including the industry's energy consumption.

The Sugar Industry Research Institute (SIRI), a division of the Sugar Industry Authority (SIA), provides quality control, factory services and instrumentation, and research and development needed by the sugar industry. Through its factory service and instrumentation, the Institute exercises some control in the management of energy resources. Although individual factories manage their own resources, the SIRI recommends energy efficient devices, monitors the energy efficiency of individual factories, and carries out research relative to alternative energy resources, such as bagasse and energy cane.

The Scientific Research Council was established in June, 1960, under the Scientific Research Council Law, as a statutory body responsible to the Minister of Agriculture, Science & Technology. The Renewable Energy Division of the Scientific Research Council was established in the midst of the oil crisis to undertake, foster and co-ordinate research related to renewable energy resources and to apply such research to the exploitation and development of the country's energy resources. In particular, the Renewable Energy Division is directed to collect and review information concerning energy research schemes, coordinate such research and encourage persons engaged in energy-related industries to enter into research with the Division. The Division maintains an energy information centre and is authorized to advise the Minister on matters relating to the renewable energy resources of the country.

---

\* The Ministry of Health also has an Environmental Control Division (ECD), responsible for ensuring the implementation of environmental control programmes. The Office of Disaster Preparedness and Emergency Relief Co-ordination (ODP), the

JDF Coast Guard and the Marine Police are responsible for investigating marine and coastal spills together with the NRCD which takes samples for testing. Where legal action is necessary, the Harbour Master and the Attorney General are responsible.

## LEGISLATION AND REGULATIONS

Two major areas of energy legislation are electricity and petroleum, while several acts relating to the environment have direct implications for this sector.

The Acts relating to electricity are:

- Electric Lighting Act, May 1890
- Emergency (Lighting Control) Act 1939
- Electricity (Survey) Act, May 1956
- Electricity (Frequency Conversion) Act, May 1957
- Electricity Development Act, October 1958

The Acts relating to petroleum are:

- Petroleum and Oil Fuel (Landing and Storage) Act 1925 (updated 1979)
- Petroleum (Production) Act, May 1940
- Petroleum Filling Stations Regulations Act (1956)
- Petroleum Products Control (Prices) Order 1957
- Petroleum Refining Industry (Encouragement) Act, March 1961
- Petroleum Act 1979 (establishment of PCJ)

Relevant pieces of environmental legislation include the Harbours Act (1874); the Water Act (1922); the Forest Act (1937); the Factories Act (1943); the Wild Life Protection Act (1945); the Town and Country Planning Act (1950); the Clean Air Act (1964); the Public Health Act (1974); and the Litter Act (1986).

## PLANS AND PROGRAMMES

The major plans and programmes related to energy resources are concerned with energy conservation and supporting pricing mechanisms; reduction in electricity systems losses; and, the development and utilization of alternative energy resources.

### Upgrading of Facilities

In keeping with the Government's policy to reduce the country's dependence on imported petroleum, the bauxite/alumina industry has embarked on two programmes. The first is directed toward increasing the energy efficiency of mining operations. The second pro-

gramme involves feasibility studies to convert the existing alumina plants from oil to coal.

The JPS Co. has embarked on a programme for upgrading and rehabilitating its facilities. The more efficient units are being rehabilitated, and use of the less efficient diesel units and gas turbines is being reduced. As a result of this programme, the company was able to reduce its petroleum consumption in 1984 by 8%, while the quality of its stack emissions improved. (JPS has no formal system in place for monitoring pollutants.)

### Alternative Energy Resources

The criteria for selecting indigenous sources of alternative energy for development was outlined by the Minister of MME.T in 1985 and included the following:

- The source should be cheaper than imported oil.
- The reserves must be sufficient to have a significant impact on imported supplies.
- The resources should have no superior alternative use.
- The use of the resources should not impact negatively on the environment, but in fact should, where possible, improve and preserve the natural environment.
- The technology to be applied should be easily adaptable and transferable.

Based on the above criteria, hydropower and peat energy resources were assigned first and second priority, respectively, for development. In addition, programmes for bagasse, coal, biogas and solar energy have been established.

Hydropower. Several small-scale hydro projects are being studied and approximately fourteen of these are close to implementation. (See Table 70 and Figure 47.) Studies for these projects are being funded principally through German, Italian and Canadian government agencies and are being monitored by the Energy Division of the MME.T. The PCJ would be the implementing agency, with the JPS Co. operating the projects once they are completed.

Bagasse. In order for Jamaican sugar to remain competitive on international markets, the sugar industry must reduce its production costs. If the industry relies on imported petroleum, it

will not be able to remain competitive. As a result, increased use of bagasse is being pursued.

The MMET, in collaboration with the Sugar Industry Authority (SIA), is investigating the feasibility of introducing a high-fibre variety of sugar cane — called energy cane — which will produce a higher quality bagasse. The project will be initiated at three sugar estates — Monymusk, Frome and Appleton in the parishes of Clarendon, Westmoreland and St. Elizabeth, respectively, involving 10,000 acres of cane land.

Peat. Large peat deposits in the Negril Morass and the Black River Lower Morass have the potential to be utilized for electricity generation. After several years of research, the

Petroleum Corporation of Jamaica (PCJ) has determined that peat mining could be undertaken in these areas in an environmentally acceptable manner. The studies also indicated that the project would be economically feasible at the oil prices that prevailed in 1984. While the PCJ has projected various environmental and socio-economic benefits stemming from peat-to-energy development, others foresee adverse impacts on wetlands ecology and fisheries habitat.

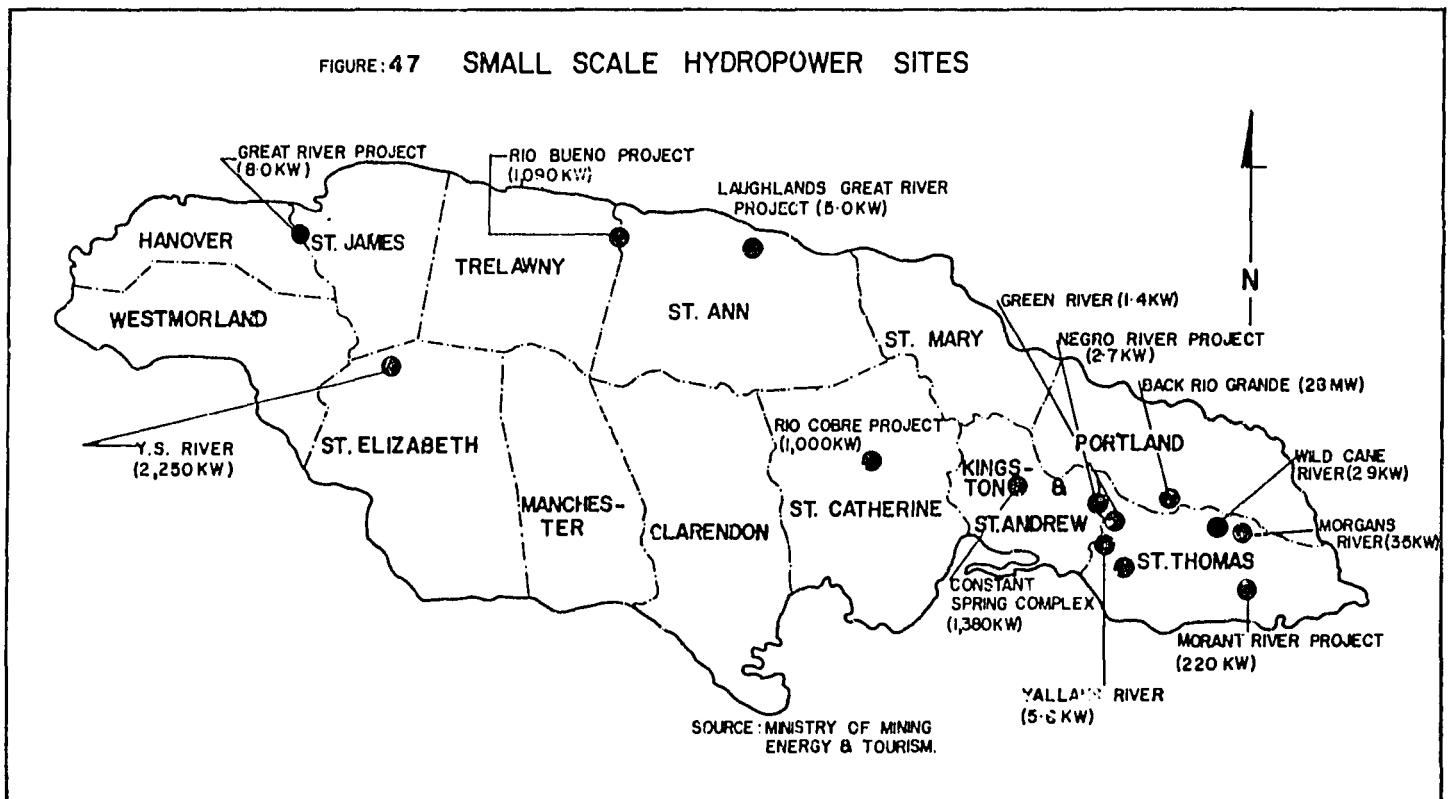
Studies conducted by the PCJ indicate that Negril's resources have a 60 MW potential, whereas Black River's potential is about 30 MW. (See Figure 44.) A power station burning peat for fuel could be operating at South West Point, Green Island, Negril by 1995. This power station would provide in excess of 15% of

**Table 70:  
Proposed Hydropower Projects**

<u>Project</u>	<u>Capacity (M.W.)</u>	<u>Cost - US\$ (1,000,000)</u>	<u>Status</u>
<u>German Supported</u>			
Constant Spring	1.4	3.43	Completion 1987
Rio Bueno	1.1	1.39	"
Laughlands Great River	5.0	3.90	Feasibility completed
Rio Cobre	1.0	1.91	"
Great River	8.0	12.94	"
<u>Italian Supported</u>			
Ys River	2.3	3.97	Final design 1987
<u>Canadian Supported</u>			
Morant River	2.3	1.30	Completion Dec. 1986
Yallahs River	3.6	4.82	Pre-investment studies
Morgans River	3.5	3.94	to be completed by 1988
Negro River #1	1.4	1.66	"
Negro River #2	1.3	1.98	"
Back Rio Grande	28.0	50.00	"
Wild Cane	2.9	3.63	"
Green River	1.4	1.87	"
<b>TOTAL</b>	<b>63.2</b>	<b>96.74</b>	

Source: Ministry of Mining, Energy and Tourism.

FIGURE: 47 SMALL SCALE HYDROPOWER SITES



current peak electricity demand, and be operated by the JPS.

**Coal.** The Energy Division of the MMET recently conducted feasibility studies on replacing all substitutable petroleum imports with coal. These studies have shown coal to be cheaper and, therefore, less of a burden on scarce foreign exchange earnings than petroleum imports. The JPS is considering plans to begin using coal as an alternative to some petroleum imports. The Cement Company plans to use about 80,000 tons of coal in 1987, gradually increasing to 100,000 by 1990. Similarly, the bauxite/alumina companies are presently conducting studies which should lead to some conversion from oil to coal. The coal will be imported, preferably from Columbia.

**Biogas.** Small-scale plants have been established for performance evaluation. The construction of nine household digesters in nine parishes was undertaken by the MMET with technical assistance from the Organisation for Latin American Development in Energy (OLADE), Food and Agriculture Organisation (FAO), and United Nations University. Additional digesters have been built by the SRC. The programme is an ongoing one with local, Guatemalan, Chinese and Mexican designs being used. The methane gas produced is used mainly for lighting and cooking.

**Solar Energy.** Several applied solar projects (e.g., water heating, crop drying, etc.) have been undertaken by the MMET in hospitals, infirmaries and academic institutions. In addition, several private companies have been assembling or manufacturing domestic hot water (DHW) systems for residential applications. Photovoltaic applications have been implemented at the Negril Lighthouse and in ocean buoys for the Port Authority. Other applications, such as use in microwave transmitters and for clinics in remote areas, are being pursued. Demonstration projects at the College of Arts, Science, & Technology (CAST) and the Scientific Research Council are constantly being pursued.

**Charcoal/Wood.** Thirty-four kilns, designed for the production of 1,056 tons of charcoal per year, have been constructed by the Forestry Department in cooperation with the MMET and SRC. In 1983, 1032.4 tons of charcoal were produced. Of this, 393.2 tons were produced by the Forestry Department, and 739.2 tons by private means. The objective is to develop a charcoal programme for the country, including the introduction of suitable fast growing trees for reforestation. Experimental tree plots have been established at the Gray's Inn Estate in St. Mary.

## PROBLEMS AND ISSUES

Many adverse environmental impacts are associated with the use of fossil fuels, including gaseous pollution, contributions to smog, and damages from oil spills. The use of imported petroleum also creates a significant drain on the foreign exchange resources of the country. Although it is vital for alternative energy sources — notably hydro, bagasse, coal and peat — to be developed and utilized, use of some of the indigenous energy resources may have environmental and social costs and, therefore, must be carefully evaluated and monitored. Other issues include the need for continued support of energy conservation, and the need for greater cooperation and collaboration among the various institutions in the energy sector.

### Impacts from the Use of Fossil Fuels

Pollution from the use of fossil fuels results from emissions from stationary sources, motor vehicles, and from spills.

JPSCo currently discharges cooling water into the sea at its major plants in Hunts Bay and Old Harbour.

The principal gaseous pollutants are the oxides of nitrogen, sulphur and carbon. (To these may be added particulates with the introduction of coal.) Many types of fuel oils have a high concentration of vanadium which is a biologically active element. Fuel oils with a high vanadium content may have long-term effects on agricultural productivity as a result of reduced mineralization rates in the soil.

Partially burned hydrocarbons from motor vehicle exhausts are principal contributors to smog. The most perilous pollutant from this source, however, is carbon monoxide, which is not now being monitored in Jamaica. The third major pollutant from automobiles is atmospheric lead. Lead free gasoline is not sold in Jamaica; hence, the levels of lead in the atmosphere may soon pose a problem.

Oil spills occur at sea from ships or on land from tanks or pipelines. The main effects at sea are coating of birds which dive for food, poisoning of fish, damage to nets, smothering of mangrove prop roots and turtle grass leaves as well as fish and shrimp living in coastal mangrove swamps. Coral reefs are also affected as their feeding mechanism is disrupted, resulting in erosion of the reef.

The deposition of oil on beaches adversely affects crabs and other animals, and creates a nuisance to beach users. Fishing boats are also affected, needing to be beached, cleaned, scraped and repainted. The fishing and tourist industries may therefore be directly affected by these spills. Spills on land may contaminate ground water sources and create fire hazards.

### Potential Impacts from Development of Alternative Energy Resources

Potential environmental impacts are associated principally with hydropower, peat, bagasse and coal utilization.

Hydropower. Preliminary environmental impact studies were carried out for all the hydropower projects being investigated. In the minor ones, negative environmental implications were not noted. However, in the case of the Ys River project, there were some indications that the reduced flow would affect the waterfalls, with possible impact on the tourist industry. In an effort to mitigate this impact, the MMET, Energy Division, is of the opinion that this facility could be operated principally at night with the flows allowed to return to normal levels during the daytime.

In the case of the Back Rio Grande Hydroelectric Development, however, a number of potential ecological and socio-economic impacts have been identified. The main ecological impact is the modification of the flow regimes of the area, resulting in considerable implications for the faunal (fish and shrimp) communities, as they migrate up and down the river during the course of their life cycle. With respect to the socio-economic impacts, the major concern which could result from the scheme would be the effect on the rafting activity on the Rio Grande, an activity which is currently a major contributor to the economic base of the area.

Peat. Peat contains a significant sulphur content, most of which will be converted to sulphur dioxide upon burning in the power plant. Sulphur dioxide, above certain atmospheric concentrations, is harmful to all oxygen breathing creatures.\*

---

\* According to the United States Environmental Protection Agency (EPA), sulphur dioxide ground level concentration (GLC) should not exceed  $365 \text{ pgm}^{-3}$  over a 24-hour averaging period (one  $\text{pgm}$  equals  $10^{-6}$  grammes).

In addition to the environmental impact studies by G. Rose and R. Anderson, several other environmental studies have addressed the Negril and Black River peat proposals and have resulted in several inconsistent conclusions. These include the Natural Resources Conservation Department/Traverse Group Inc. (TGI) study, the study conducted by Bjork (1983) for the PCJ and the Maltby Report (1985) prepared for the International Union for Conservation of Nature (IUCN).

A major issue raised surrounds the investigation of only one basic technique for wetland management by the PCJ/Bjork team, i.e., the removal of peat to create a lacustrine ecosystem. Another issue is the assumption made by the PCJ that the ecosystem resulting from peat mining will possess greater ecological viability than the present one. It has been suggested that this assumption is made without sufficient information relating to the lower plants and other animal groups (e.g., insects, mollusks, reptiles, amphibians, etc.). In addition, previous studies have not been successful in establishing the value of wetland functions to the marine ecosystem, and there are doubts as to the ability to effectively manage stack discharges and thermal effluent.

Bagasse. The ash currently generated by bagasse-fired boilers is significant in quantity and most bagasse boilers in the sugar industry do not have ash collectors. This results in a dust hazard on and near factory sites, as at the Bernard Lodge in St. Catherine.

Coal. The Cement Company has a coal fired plant under construction. Ashes, smoke and gases may contaminate the atmosphere, while streams and wells may be polluted from the discharge of water used for cooling. The final disposal of residual products could also present serious problems. The burning of coal for fuel will result in the production of ash and dust. Ash collectors will be used, however, thereby minimizing atmospheric pollution. The systems of ash disposal considered will have to be carefully evaluated to assess potential environmental effects. It must also be ensured that the necessary anti-pollution equipment is installed to control stack emissions.

Solar. Solar energy is abundant and there are no negative environmental issues connected with its collection and use. It is expected that its use for water heating will continue to be expanded especially in the commercial and public sectors.

Bio-Energy. There are no negative environmental considerations in the utilization of biological material for the production of energy and organic fertilizer. The use of animal waste to feed digesters for biogas production enhances the physical environment on farms and rural villages.

Municipal Solid Wastes (MSW). The use of garbage for steam production would improve environmental conditions in addition to creating employment. Since garbage is now being effectively collected in most municipalities, it may prove worthwhile to reexamine the feasibility of MSW systems.

### **Legislative Needs**

Environmental legislation as it relates to the energy sector needs to be strengthened. The Wildlife Protection Act (Section II) for example, has regulations relating to noxious materials, but is non-specific. The Clean Air Act lists a number of prohibited pollutants and bans the emission of various materials from stationary sources. There is, however, no system of monitoring the presence of pollutants on a continuous basis. In addition, the outright ban, rather than the setting of tolerable levels, would tend to make investigators reluctant to press action in view of the high costs of achieving zero or near-zero discharge.

### **Institutional Needs**

The roles of the NRC and the ECD need to be effectively coordinated to ensure proper environmental monitoring and controls. This is especially so in the areas relating to stack emissions from stationary power plants and the necessary control equipment to effectively reduce pollutants.

### **Manpower and Resource Needs**

All the institutions involved in the monitoring and control of our environmental resources are constrained by economic factors and insufficient manpower. The cost of proper monitoring and control may appear significant in the short term but pale in comparison to the disastrous long term effects that could result if controls are not put in place early.

## DIRECTIONS FOR THE FUTURE

1. An environmental evaluating and monitoring system needs to be established for the energy sector, preferably within the NRCD.
2. A widespread public awareness programme for energy conservation is required to enhance public appreciation of energy conservation and its benefits, particularly the benefits of a well-tuned engine and the environmental hazards caused by neglect.
3. Institutions need to ensure that professional and technical staff is properly motivated; and administrators must pursue policy issues until they are implemented.
4. The JPS Co. should continue its preventive maintenance programme and develop monitoring systems for pollutants from its power stations.
5. The MMET should ensure that incentives are legislated to support its energy conservation programme. MMET should also encourage more rapid development by the private sector of non-polluting sources of energy such as solar and biogas. Currently, tariffs act as a disincentive to the importation of the necessary materials for solar energy development.
6. Now that garbage collection systems are operating with remarkable efficiency in most towns, the feasibility of constructing managed solid waste systems should be re-examined.
7. Current legislation relating to the environment needs to be strengthened.
8. The charcoal programme should continue to be closely linked to the reforestation programme, while informal producers should be guided to adhere to the objectives of the programme.



Plate 35 - Burning charcoal: traditional method.



Plate 36 - Burning charcoal using a kiln.



Plate 37 - Reaping Sweet Peppers planted on rehabilitated land: Kaiser Bauxite Project.



## AGRICULTURAL RESOURCES

---

### OVERVIEW OF AGRICULTURE

#### Summary of Recent Trends

During the past two decades, agriculture has continued to be a mainstay of the Jamaican economy, employing between 20-35% of the labour force. (See Table 71.) The agricultural sector (including fisheries, forestry and pasture) also dominates the Jamaican landscape, occupying 1,489,188 of the island's 2,720,000 acres.

Jamaica's agricultural sector can be divided into sub-sectors as follows:

- (a) export crops — sugar cane, bananas, coffee, cocoa, citrus, pimento and tobacco;
- (b) crops for local consumption — root crops, vegetables, fruits, and pulses;
- (c) livestock products — meat, milk, eggs;
- (d) fish and sea food; and
- (e) commercial forestry.

Between 1977 and 1986, agricultural performance was adversely affected by high import costs, marketing problems, water supply short-

ages affecting irrigation, rural emigration, inadequate technological inputs including agrochemicals, machinery and equipment (due to foreign exchange scarcity), as well as by a decline in the number and size of farms. These factors resulted in lowered farm productivity, stagnating or falling farm income and, by the early 1980's, culminated in a fall-off in Jamaica's capacity to meet market demands for banana exports to the United Kingdom.

The deterioration in the balance of trade in agricultural products from the mid-1970's well into the 1980's, and the resulting dependence on imported supplies of dairy products, fish, and especially cereals such as corn and rice, were direct consequences of the foregoing factors. (Resulting changes in GDP are given in Tables 72 and 73.)

Despite these conditions, Jamaican agriculture has continued to respond to overseas demands, with small farms supplying export markets with tubers and plantains, and large farms exporting vegetables, condiments and fruits.

**Table 71:**  
**Agricultural Employment (as of October 1982)**

	<u>Number of Persons</u>
Total Employed Population	756,300
<u>Agriculture, Forestry, Fishing and Mining</u>	268,100
Professional, Technical, Administration Executive Maintenance and related Occupations	1,700
Clerical and Sales Occupations	2,200
Service Occupations	1,600
Craftsmen, Production, Processing and Operations Occupations	4,900
Self Employed and Independent	201,300
Unskilled Manual and General Occupations	56,400
Occupied - not specified	-
STATIN 1983c	

### Historical Background

Although the original inhabitants of Jamaica — the Arawaks — were predominantly hunters, they did engage in limited cultivation of cassava, sweet potatoes, corn and cotton on the coastal slopes. The Spanish colonists, who first arrived in 1494, initially used the island as a base for raids on the North American mainland and had no interest in farming. At a later date, they introduced citrus, bananas, coconuts, cocoa and swine which, in addition to satisfying local needs, produced a surplus for ships which called regularly for supplies.

By 1655, the Arawaks had been decimated by the introduction of European diseases against which they had no immunity. As a result, African slaves were introduced to work the plantations when the British took control of the country from Spain. Plantation farming of sugar cane, citrus, banana, and cocoa began, as did the production of rum, which helped spread the fame and prosperity of the island. Indigo, dyewood, tobacco, ginger, cotton, annatto, and breadfruit were introduced during this period. Following the abolition of slavery in 1838, the plantation system, unable to obtain cheap labour, began to decline, despite the introduction of indentured Indians and Chinese in 1865.

The island's physical configuration and social structure has significantly influenced cropping patterns and farming practices. These, in turn, affected settlement patterns that can be traced as far back as emancipation in 1838. Small-scale farming of cash/mixed crops (mainly root crops, vegetable, plantains) developed on the boundaries of the large plantations. These farms required a good supply of water and dependable sources could be found in the hills of conglomerate and shale. Hence, many small farmers and farming settlements were created, and are maintained to date, linked to towns and villages by an extensive road network.

Since independence in 1962, cropping systems in Jamaica have been highly variable. They include traditional monoculture, such as sugar cane or cotton production; permanent intercropping, for example, pasture under coconut or pimento; mixed annuals and perennials, such as corn, peas or potato planted through citrus, or cocoyam through banana; mixed annuals, for example, corn and dried beans planted together; and multiple tiered systems, such as breadfruit over coffee over yam.

Monoculture cropping systems usually occur on flat, prime agricultural lands. Since the introduction of AGRO-21 in 1983, agricultural development has focused on stimulating the produc-

**Table 72:**  
**GDP at Current and Constant Prices (Annual Percentage Change)**

Year GDP	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
GDP at current prices	25.3	20.4	3.7	9.6	26.5	14.4	11.1	11.0	11.0	19.7	33.9	20.1
GDP at constant prices	-3.9	-0.3	-6.5	-2.4	0.5	-1.8	-5.8	2.5	1.0	2.0	-0.4	-3.7
GDP at constant prices per capita	-	-1.9	-7.6	-3.4	-0.7	2.9	-6.7	1.3	-0.6	0.5	-0.22	-6.3

Source: STATIN National Income and Product (1985)

**Table 73:**  
**Changes in GDP at Constant Prices (Annual Percentage Change)**

Year Origin	1977	1978	1979	1980	1981	1982	1983	1984	1985
Agriculture, Forestry and Fisheries	3.2	9.6	-9.7	-6.3	2.3	-7.9	7.2	10.0	-3.4
Export Agriculture	-17.9	12.7	-18.5	-12.1	1.2	-1.6	-3.7	3.8	-3.3
Domestic Agriculture	11.8	19.9	-10.4	-5.5	3.6	-12.0	8.7	15.7	-1.3
GDP at constant prices	-1.7	-0.4	-1.5	-5.4	2.5	1.0	2.0	-0.4	-3.7

Source: Economic and Social Survey Jamaica. PIOJ

tion of a number of export crops including winter vegetables, horticultural crops, and animal enterprises with joint venture partners. The Ministry of Agriculture has placed increasing emphasis on livestock production as an integral part of Jamaica's farm economy.

### Agricultural Land Classification Systems

Land use surveys and the development of a land capability classification are basic to development planning. (See Table 74). Once the soils are identified, characterized and classified, their suitability for the cultivation of different crops has to be assessed. This is done by matching the crop requirements with soil characteristics. On this basis, the various land capability classes are derived.

Land capability classification is the first step towards proper use and conservation of the land. There is a major difference between land capability classification and land use planning, including conservation farm planning. Capability classification of land depends mainly on the extent to which "permanent limitations" result in "safe use limits". Slope, for example, is a major limiting factor. Soil depth is another important one. In fact, land capability classification rests mainly on physical properties of the land, whereas land use planning and

conservation farm planning consider cropping systems, economics, costs and returns, management, and farmer preferences.

Jamaica has completed an islandwide soil survey. In the soil survey report of each parish, lands have been divided into seven capability classes and 16 sub-classes (Sheng and Stennett, 1975). (See Table 75.) This classification scheme is similar to that used in the United States. Lands are classified into two major categories, i.e., Suitable for Cultivation (I, II, III); and, Not Suitable for Cultivation (V, VI, VII). Class IV land is marginal, suitable only for limited cultivation.

Agro-Economic Patterns. Jamaican agriculture has also been mapped and analyzed by crop pattern and farm size as, for example, monoculture and mixed farming. Monocultures are further subdivided by crop — sugar cane, banana, citrus, cocoa, coffee and tobacco. This is probably the most common classification that has been used in the mapping of Jamaica's agricultural land.

Another classification, discussed by Stone (1974), defines two principal farm groups:

1. Large-scale commercial farms (usually over 5,000 acres). These represent approximately 0.1% of all Jamaican farms and occupy 45% of all agricultural lands; and

**Table 74:**  
**Land Use Distribution 1978/79**

Type of Land	Acres	%
Total	2,720,000	100.0
Forestry	660,000	24.3
Other Woodland	538,000	19.7
Agriculture (incl. 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

Source: Statistical Institute of Jamaica, 1978/79 Census.

**Table 75:  
Jamaica's Agricultural Capability Classes**

Capability Class	Limitations or Risks	Suitable Use
I	No.	Cultivation
II	Moderate limitations due to erosion, wetness or soil.	Cultivation
III	Strong limitations due to erosion, wetness, soil or climate.	Cultivation
IV	Extreme danger of erosion, or extreme limitation of soil.	Marginal for cultivation but for tree crops, or grasslands.
V	Extreme danger of erosion, or adverse soil factors.	Tree crops, food or forest trees.
VI	Adverse factors of erosion, soil or climate.	Should never be cleared of its natural vegetation.
VII	Rock, outcrops, riverwash, etc.	Wildlife.

**Table 76:  
Number of Farms by Income-Earning Activity**

	No. of Farms	%	Acreage	%	Average Acreage
Export Crops	56,723	30.8	567,018	42.7	90.2
Domestic Crops	86,803	47.2	266,204	20.1	3.1
Mixed Crops	15,703	8.5	106,400	8.9	6.8
Livestock and Poultry	10,699	5.8	307,150	23.1	28.7
Other	6,505	3.5	36,108	2.7	5.6
None	7,585	4.1	44,165	3.3	5.8
<b>TOTAL</b>	<b>183,988</b>	<b>100.0</b>	<b>1,327,045</b>	<b>100.0</b>	<b>7.2</b>

Source: STATIN, 1978/79 Census, Vol. 1.

2. Small-scale subsistence farms which are further subdivided into three groups: well-to-do middle peasants who employ farm labour; small peasants with less than five acres who hire occasional labour; and displaced peasants who are semi-employed or unemployed.

The STATIN report (1978/79) has presented another classification which is used extensively in the Agricultural Census 1978-1979. This organizes information on farms by major income earning activity. Table 76, for example, shows that the traditional export crops (monocultures) occupy the largest acreage and represent the largest average farm size. On the other hand, domestic crops are cultivated on the largest number of farms.

### **Agricultural Land Utilization**

The present pattern of agricultural land use in Jamaica still approximates the pattern shown in the 1971 Atlas of Jamaica, although urban sprawl has increased.\* (See Figure 48.) Although much of Jamaica's land area is suitable for some form of agriculture, productivity limitations are imposed by steep slopes, imperfect drainage and lack of water. (See Figure 49.)

Jamaica's land surface consists of plains, plateaus and mountains, a topographical structure with serious constraints for agricultural activities because of steep slopes and resultant soil erosion problems. However, despite these physical constraints, Table 77 shows that about 1.5 million of the island's 2.7 million acres of land are used for agriculture. Table 77 also shows that almost 98% of the farms are less than 25 acres, whereas 2% are in the size group 25-500 acres or more. In terms of acreage, the two groups occupy about 37% and 63%, respectively, of all farm lands.

Likewise, Table 78 shows that although attempts have been made over the years to diversify cropping patterns, the patterns have not varied greatly. This can be verified by the relatively constant ratio of sugar to the value of total exports; with sugar accounting for 55.6-61.0% during the period 1980-1985. It is also indicative of the large work force associated with agriculture which would be displaced if cropping patterns were to change rapidly. In examining Table 78, it should be kept in mind that, although the value of some of the export crops increases progressively from

1980-1985, rising from \$169,350,000 to \$440,002,000, much of this increase is due to fluctuations in foreign exchange values, particularly the devaluation of the Jamaican dollar.

Adjusting for currency fluctuations, exports and production were fairly constant from 1980 through 1985. (See Tables 78 and 79). Although earnings increased largely due to devaluation, any net benefits were offset by increases in the cost of such inputs as pesticides and fertilizer almost all of which must be imported.

### **Agricultural Land Tenure**

There are 178,007 single holder farmers in Jamaica. (See Table 80.) Single holders occupy 99.1% of the farms (compared to partnerships) and 66.25% of the acreage.

Table 81 indicates that 67% of all farmers operate 19% of Jamaica's farm land which is in holdings of five acres or less. Most of the farm land (69%) is owned by farmers operating farms greater than 50 acres.

Table 82 indicates that landless farmers are primarily active in livestock production rather than crop cultivation. Table 83 shows that farmers operating on acreages of 1 to 5 acres produce for both the export and domestic markets, primarily root crops, legumes and plantains. On the larger acreages, 50 acres and above, the farmers specialize in export crops, mainly winter vegetables, fruit crops and condiments, and produce very little for the domestic market.

Landholders with 500 acres or more (Table 83) are primarily exporters, specializing in the production of crops such as sugar, coffee, cocoa, orchards, bananas, tree crops such as citrus, and livestock.

---

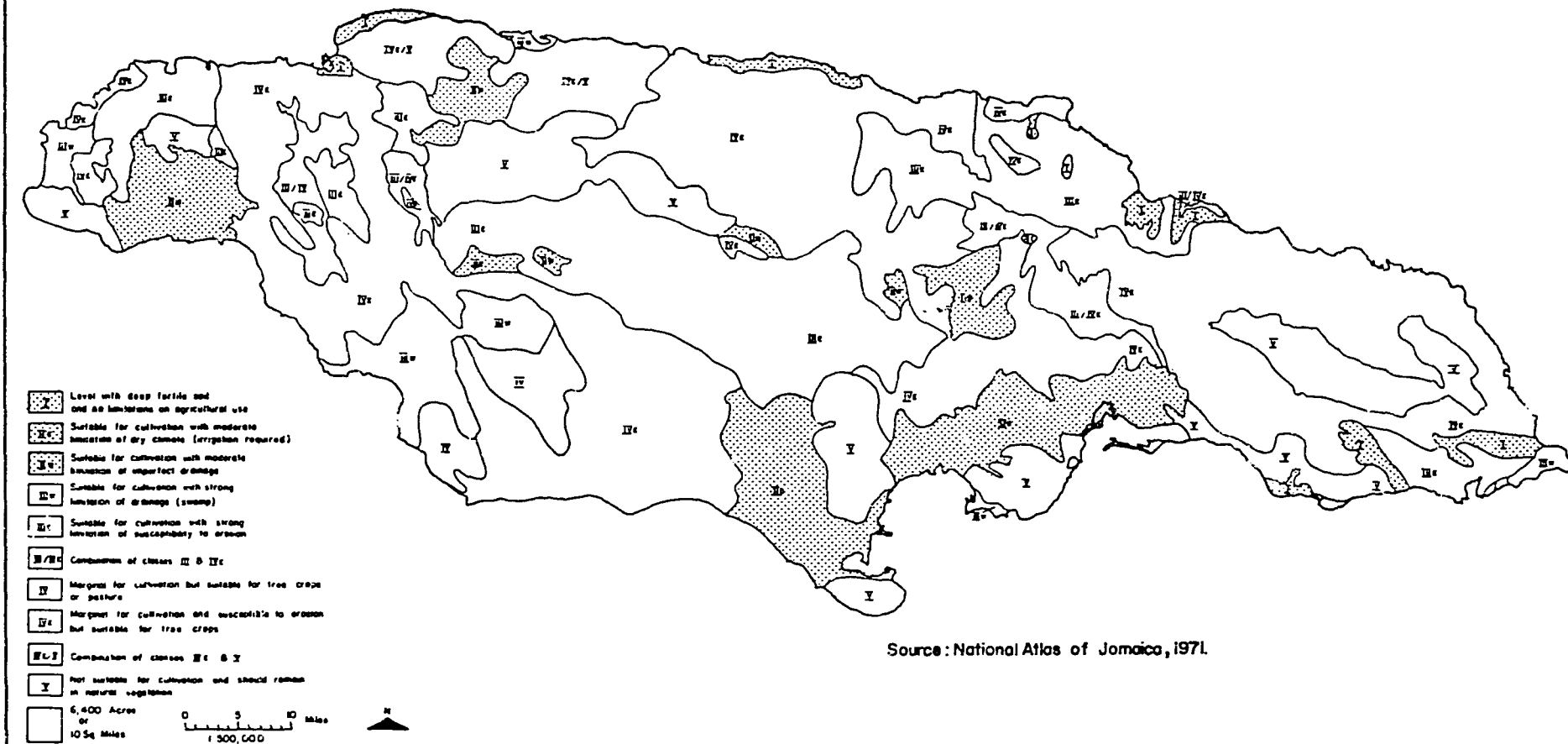
\*This map has since been upgraded using 1:50,000 black and white aerial photographs taken in 1980, and another update is underway (1:50,000) using colour infra-red photos. A mapping project of the Rural Physical Planning Unit (Ministry of Agriculture) will produce an updated 1:500,000 sheet of Jamaica similar to Figure 48.

FIGURE: 48

LAND USE MAP OF JAMAICA



FIGURE : 49 **AGRICULTURAL LAND CAPABILITY**



Source: National Atlas of Jamaica, 1971.



SIZE GROUP ACRES	FARMERS		LAND IN FARMS	
	NUMBER	PERCENT	ACREAGE	PERCENT
TOTAL	967,577	100.00	1,489,188	100.00
Landless	4,768	2.47	-	-
< 1	52,969	27.40	22,736	1.53
1 < 5	93,961	48.58	206,480	13.87
5 < 10	25,237	13.05	165,905	11.14
10 < 25	12,370	6.40	174,852	11.74
25 < 50	2,280	1.18	74,718	5.01
50 < 100	775	0.40	52,490	3.52
100 < 200	379	0.20	51,116	3.44
200 < 500	320	0.17	96,932	6.51
> 500	293	0.15	643,959	43.24

Source: Production and Marketing of Milk in the Smallholder Sector of the Western Region/  
Jamaica, 1984.

ITEM	1980 <sup>1</sup>	1981 <sup>1</sup>	(J\$'000) 1982 <sup>1</sup>	1983 <sup>1</sup>	1984 <sup>1</sup>	1985 *
Sugar	97,447	82,776	87,400	103,190	226,220	245,489
Bananas	18,691	7,577	8,326	13,222	4,229	20,543
Citrus (Fresh Fruit)	3,015	1,746	1,671	1,592	4,247	7,932
Spices	7,759	8,469	8,904	17,489	27,688	33,253
Cocoa	8,015	8,977	5,203	10,737	15,909	22,136
Coffee	9,692	10,086	13,475	19,744	34,672	37,059
Rum	17,086	19,794	19,334	18,024	29,968	43,719
Molasses	1,295	7	320	2,144	1,339	15
Root Crops	6,350	9,430	9,820	15,707	21,327	29,856
Total	169,350	148,862	154,392	201,849	365,669	440,002

<sup>1</sup> - Revised J\$1.78 = US\$1.00  
\* - J\$4.93 = US\$1.00

Source: Economic and Social Survey, Jamaica - PIOJ 1985

Table 79:  
Volume of Major Agricultural Commodities Produced, 1980-1985

ITEM	UNIT OF MEASURE	1980	1981	1982	1983	1984+	1985
Sugar Cane	('000 tons)	2,726	2,414	2,482	2,286	2,384	2,234
Sugar (Commercial)	('000 long tons)	242	198	196	193	190	203
Banana*	('000 tons)	33	19	22	23.1	11	13
Citrus**	('000 boxes)	1,117	883	933	676	570	754
Spices	(long tons)/‡	1,255	3,490	2,188	2,666	3,691	3,216
Cocoa‡	(long tons)	1,369	1,814	1,426	2,738	2,710	2,604
Coffee**	('000 boxes)	288	300	359	298	326	222
Molasses	('000 long tons)	101	91	100	93	93	80
Copra	(short tons)	1,738	887	1,429	2,373	1,487	2,689
Meat	(million lbs.)	109	108	102	119	114	93
Fish	(million lbs.)	36	32	18	18	19	19
Eggs	(million)	102	55	84	100	106	78
Milk	(million quarts)	n.a.	n.a.	41‡	42	42	n.a.
Domestic Food Crops	('000 short tons)	319	395	351	419	515	492

\* Export

+ Preliminary

\*\* Deliveries to packaging and processing plants

‡ Revised

Note: Production figures for citrus, cocoa, bananas, spices, sugar and coffee are for the crop year.

SOURCE: Ministry of Agriculture and the Commodity Organizations.  
Planning Institute of Jamaica (PIOJ) 1983

**Table 80:**  
**Total Number of Farms by Size and Acreage,**  
**By Legal Status Holder**

Legal Status	Number of Farms	Acreage
<u>Total</u>	<u>179,702</u>	<u>1,319,012</u>
Single Holder	178,007	825,089
Partnership	1,229	99,515
Corporation	79	129,746
Cooperative	110	102,348
Government	136	122,079
Other	141	40,236

Source: STATIN Vol. 1, 1978/79

### Domestic Marketing

Small farmers (1-5 acres, see Table 83), constitute the most important group of producers of domestically consumed foods. These small producers are located on the hills; cultivate lands that are highly erodible and inherently infertile; practice low technology agriculture; and depend entirely on rainfall for crop production.

Most of the agricultural produce coming from these farms is marketed through the higglering system. The higgler trade has expanded from the urban centers to the rural townships and is strongly supported by the consuming public. The system consists of a group of about 20,000 partially organized individuals acting as intermediary agricultural marketing agents who operate between the farmer and the consumer.

To facilitate the marketing of agricultural products, several market depots have been established by the Government of Jamaica, as well as by private concerns (supermarkets), and producer organizations.

### Agricultural Technology

The data (see Tables 82-85) indicates that the application and use of farm machinery, irrigation, and agro-chemicals varies inversely with the size of the farm. Farms of less than five acres have access to approximately 8% of the farm machinery and 71% of the mechanically and hand-operated equipment such as forks, hand pumps, etc. Furthermore, less than one-half of the small farms have machinery available to them. This is partly due to their location on hillsides and rough terrain, and the traditional use of family labour. On the other hand, farms of 550 acres and more, have access to 62% of the tractors used on agricultural lands, and account for only 2% of the mechanically or hand operated equipment. These large farms do not use mechanical or hand operated equipment to any extent, but rely on energy powered machinery and equipment. The 1978/79 Agricultural Census indicates that 22.68% of all farms use farm machinery. (See Table 84.)

**Table 81:  
Acreage of Farms by Tenure of Land, By Size Group**

Tenure of Land	Total	Under 1 Acre	1 Acre to under 5 acres	5 Acres to under 10 acres	10 Acres to under 25 acres	25 Acres to under 50 acres	50 Acres to under 100 acres	100 Acres to under 200 acres	200 Acres to under 500 acres	500 Acres and over
Owned	1,108,207	11,229	110,965	89,150	90,461	41,135	50,371	58,542	99,617	556,737
Rented in	50,424	2,800	21,024	9,123	5,536	1,234	358	294	885	9,170
Leased under 5 years	30,358	578	8,509	4,870	3,256	1,558	1,132	1,498	3,016	5,941
Leased 5 years or more	93,429	957	18,317	16,734	9,881	6,043	4,296	3,533	3,968	29,700
Rent Free	71,297	4,420	23,607	13,787	11,606	4,767	3,440	2,959	1,310	5,401
Squatted	9,414	1,033	5,307	1,886	931	137	120	-	-	-
Other	8,242	238	1,673	1,271	1,458	693	717	615	993	584
Total Owned and/or operated	1,371,371	21,255	189,402	136,821	123,129	55,567	60,434	67,441	109,789	607,533
Land Rented Out	52,297	571	2,380	4,198	2,831	3,022	4,077	4,063	9,263	21,892
Acreage Operated	1,319,074	20,684	187,022	132,623	120,298	52,545	56,357	63,378	100,526	585,641

Source: STATIN 1978/79 Census, Vol. 1

**Table 82:**  
**Total Number of Farms by Major Income Earning Agricultural Activity,**  
**By Size Group of Farm, By Legal Status holder**

Major Income Earning Agricultural Activity	Total	Landless	Under 1 Acre	1 Acre to under 10 Acres	5 Acres to under 10 Acres	10 Acres to under 25 Acres	25 Acres to under 50 Acres	50 Acres to under 100 Acres	100 Acres to under 200 Acres	200 Acres to under 500 Acres	500 Acres and over
NUMBER OF FARMS											
TOTAL	179,699	7,621	50,130	88,490	21,217	8,695	1,589	851	474	337	295
Exports	56,212	-	11,008	31,107	9,072	3,696	610	285	169	130	135
Domestic Crops	83,387	-	28,813	42,685	8,061	3,074	460	191	62	31	10
Mixed Crops	16,083	-	3,683	8,696	2,557	864	171	47	32	14	19
Pig Rearing	2,377	1,065	483	565	131	74	14	17	3	5	-
Dairy Cattle	933	256	77	162	95	143	80	34	34	32	20
Beef Cattle	3,239	634	257	745	492	490	180	177	108	75	81
Poultry	3,924	2,044	785	725	193	115	27	19	10	4	2
Other	6,433	2,880	1,324	1,603	356	162	29	36	16	21	6
None	7,109	722	3,700	2,202	260	77	18	45	38	25	22

Source: STATIN Vol. 1, 1978/79

**Table 83:**  
**Total acreage of Farms by Major Income Earning Agricultural Activity,**  
**by Size Group of Farm, by Legal Status Holder**

Major Income Earning Agricultural Activity	Total	Landless	Under 1 Acre	1 Acre to under 5 Acres	5 Acres to under 10 Acres	10 Acres to under 25 Acres	25 Acres to under 50 Acres	50 Acres to Under 100 Acres	100 Acres to under 200 Acres	200 Acres to under 500 Acres	500 Acres and over
ACREAGE OF FARMS											
TOTAL	1,319,014	-	20,684	187,022	132,623	120,353	52,491	56,407	63,278	100,526	585,630
Exports	570,940	-	4,971	70,006	58,204	50,749	20,683	18,858	22,347	38,068	287,054
Domestic Crops	247,673	-	11,631	86,308	51,069	42,528	15,085	12,384	8,136	9,045	11,487
Mixed Crops	108,241	-	1,616	18,622	13,119	10,820	3,847	2,640	4,192	3,670	49,715
Pig Rearing	6,651	-	181	1,132	888	1,131	562	1,125	496	1,135	-
Dairy Cattle	24,998	-	30	399	661	2,269	2,818	2,383	4,705	9,552	62,181
Beef Cattle	196,337	-	110	1,776	3,355	7,459	6,459	12,248	14,304	23,493	127,099
Poultry	14,895	-	262	1,455	1,305	1,914	1,120	1,098	1,381	1,369	4,991
Other	29,045	-	504	3,308	2,286	2,394	1,152	2,641	2,541	6,721	7,498
None	60,234	-	1,379	4,016	1,736	1,089	731	3,030	5,176	7,472	35,605

Source: STATIN Vol. 1, 1978/79

**Table 84:**  
**Number of Farms with Farm Machinery and Equipment**  
**Available, by Size Group of the Farm**

Machinery and Equipment Available	Total Farms*	FARM SIZE			
		1 Acre to under 5 Acres	5 Acres to under 50 Acres	50 Acres to under 100 Acres	Greater than 100 Acres
Total	42,833	29,893	11,371	458	1,062
Tractor Drawn Ploughs	7,088	4,653	2,127	117	185
Other Ploughs	1,985	1,386	511	24	62
Tractors	4,609	2,468	1,467	95	208
Trailers	1,046	736	290	17	90
Trucks, Vans, Station Wagons	9,403	7,071	2,461	74	156
Animal Drawn Vehicles	1,152	927	276	9	21
Mechanical Spray pumps	5,668	4,092	1,458	37	93
Hand Operated Pumps	9,451	6,769	2,168	60	96
Mechanical Reapers	208	114	90	5	26
Mechanical Loaders	382	229	174	9	49
Other Machinery and Equipment	1,841	1,159	349	11	72

\* A farm is counted for each item of machinery and/or equipment which is being utilized by that farm. As a result, there is an element of double-counting in the total number of farms.

Source: STATIN Vol. 1, 1978/79

The contribution of pesticides in increasing the world's food production cannot be questioned. In recent years, the use of pesticides in the developing countries has increased at a faster rate than in the more developed countries (Furtick, 1973). The increase in the use of pesticides in Jamaica in the 1970's is reflected in the following data from Gooding (1981).

Year	Pesticides	Amount Imported (Kg.)
1972	Insecticide/Nematocide	846,838
	Fungicide	207,826
	Herbicide	557,685
1976	Insecticide/Nematocide	895,664
	Fungicide	4,667,759
	Herbicide	188,840

In the Caribbean, Jamaica ranks fourth in the use of pesticides (701 kg/km<sup>2</sup>/year) following Barbados, Grenada and St. Vincent. The

application of these chemicals usually follows the manufacturer's recommendations, but without any significant local research on their suitability, desirability and environmental impacts (Mansingh, 1985). Table 85 reveals that pesticide use is widespread, including on farms of from 1-5 acres. However, the greater volume is applied on farms of 500 acres or more, particularly on sugar cane and citrus farms.

Since dieldin's commercial availability in the 1950's, it has been used extensively in Jamaica to combat the citrus root weevil and other soil pests, but without any field or laboratory analysis of its efficacy. The presence of residues of the organochlorine insecticides in the soil, food, potable waters, rivers, coastal waters, aquatic and soil fauna of Jamaica is now well documented (Singh, 1985; Anderson, 1986; Miyata, et.al., 1987).

**Table 85:**  
**Number of Farms with Specified Crops and Size**  
**Utilizing Fertilizer and Pesticides**

<u>Crop</u>	<u>Total</u>	<u>Under 1 Acre</u>	<u>1 Acre to under 5 acres</u>	<u>5 Acres to under 10 acres</u>	<u>10 Acres to under 25 acres</u>	<u>25 Acres to under 50 acres</u>	<u>50 Acres to under 100 acres</u>	<u>100 Acres to under 200 acres</u>	<u>200 Acres to under 500 acres</u>	<u>500 Acres and over</u>
Sugar Cane	1202	99	518	241	164	48	34	27	16	55
Citrus	615	74	229	121	97	25	16	15	19	19
Bananas	1798	389	903	286	132	26	14	13	21	14
Coffee	479	25	257	112	50	11	6	2	9	7
Cocoa	299	19	150	67	36	6	9	3	7	2
Coconuts	496	66	226	86	53	14	11	8	16	16
Pimento	176	15	73	35	18	7	6	5	10	7
Food Forest	818	156	406	132	77	16	5	6	14	6
Root Crop	2499	654	1290	317	154	26	18	15	17	8
Vegetables	1646	488	777	204	99	22	10	22	14	10
Legumes	1403	367	715	171	84	15	11	16	12	10
Ginger	31	6	18	5	1	1	-	-	-	-
Turmeric	90	17	54	10	6	1	-	-	-	-

**NB:** Farms for which there was no indication of the use of fertilizer and pesticides are excluded.

**SOURCE:** STATIN 1978/9

### Farming Practices

Establishment of a Cropping Site. Small farmers practice land clearing with cutlass or burning\* , while the larger farmers may use a bush cutter attached to a tractor or application of herbicides such as gramaxone. The practice employed, however, will depend on factors such as slope and existing vegetation.

Planting. On small farms planting is done manually, using tools such as the machete, fork and hoe. The more experienced and better trained small farmers (especially those under the influence of the technical officers of the Extension Services) may construct terraces, mounds, or ridges, depending upon the type of crop, slope category or the method of irrigation to be used. Farmers with less training may use individual mounds on the slopes, or ridges not necessarily parallel to the contour of the land.

Crop Maintenance. Weeding is usually done manually with the machete, with the frequency

depending on the number of plots which the small farmer oversees, and their distance from the house site. Dunkley (1985), reporting on farmers in the Frankfield area of Clarendon and in southern St. Elizabeth, indicated that mulching with dried guinea grass is a very important technique used in retaining soil moisture. On the larger estates, crop maintenance is also done manually, though it may vary with the crop involved.

---

\*Some small farmers in the Constitution Hill area of St. Andrews regard burning as unproductive, as it removes humus and dries out the soil. These farmers use the machete instead. Other small farmers reported that they use fire as it was quick and left rich ashes on the ground. Some farmers cut a fire break around the areas to be cleared as a precautionary measure, while others, usually squatters, do not take such care; and, in several instances the fires get out of control.



Some manual maintenance is also done on large estates. This includes hand weeding and backpack spraying for insect and disease control.

However, mechanical and chemical methods are more commonly employed for weeding and moulding, using tractor-drawn attachments on inter-row cultivation. Crop protection and weed control is also done using motorised sprayers or tractor-drawn boom sprayers.

Harvesting. Harvesting techniques vary with crop, as well as with the level of technology on the holding. On small acreages, harvesting is almost always done manually (i.e., forks to reap yams and potatoes etc., coffee beans picked by hand; sugar cane by cutlass). But even on the larger estates, wage labour is employed at harvest time. Cane, for example, is cut and loaded manually, although some estates use mechanical harvesters.

Crop Rotation and Fallow. On small farms, where there are generally several plots and multi-cropping is employed, a grass fallow may be used every four to five years, depending on pressure to use the land. In shifting cultivation employing "slash and burn" practices, the five-year fallow period is shortened to two years, as in the Constitution Hill area of St. Andrew. Animal manure is also used to maintain soil fertility. On the larger estates, fertility is maintained by using artificial fertilizers, and there may be a grass fallow every ten years.

### **Agricultural Yields**

Overall productivity per acre is higher on the small subsistence farms where the crops are intensively farmed. On the large-scale farms there tends to be more extensive cropping, with up to 10% of the cultivable area kept out of production (Blustein, 1981). It is difficult to determine yields where mixed and multi-cropping systems prevail, as in small-scale agriculture. On these farms, reaping takes place throughout the year and production to maintain the family may consume a significant percentage of output.

Table 86 provides some indication of production levels in short tons for selected crops over the period 1972-1980. Annual increases reflect the application of more advanced technology — fertilizer, pesticide and irrigation inputs; decreases reflect reduced plantings and/or poor conditions during growing seasons.

### **Livestock Industry**

Overview. The livestock industry must be regarded as one of the stabilizing forces within the Jamaican economy. The industry is a steady contributor to the G.D.F. and also provides steady all-year employment. The industry has benefitted from over seven decades of research in tropical livestock production and has the potential for contributing to the development of profitable industries in related areas. Livestock assets, particularly beef and dairy cattle, beside representing incrementally increasing investment value, provide a steady source of Jamaica's requirements for animal protein. Livestock husbandry also employs a significant proportion of the rural population, and has important agro-industry linkages.

Beef and dairy cattle constitute a stable, though not an expanding production base. Other livestock and animal resources have received less attention with respect to exploiting their economic potential. The country possesses the physical resources for rapid economic development of the livestock and animal husbandry sector if it were pursued in a consistent and systematic manner. In planning to achieve higher levels of development in the agricultural sector, key areas and activities must be accorded priority attention.

Livestock Production. Jamaica offers an excellent environment for the profitable production of livestock and livestock products. The livestock component of Jamaica's agriculture is also a major source of domestically available animal protein. This contribution varies according to livestock category.

The majority of farms, particularly small and medium-sized farms, differ in the species of livestock they maintain, and likewise, differ in the intensity of livestock production, depending upon whether they produce for market or home consumption. While cattle are raised primarily on large farms, goats, swine, poultry and sheep are produced mainly on small farms.

The major local source of animal protein is poultry. Census figures from 1968/69 suggest the number of poultry to be about four million head. Statistics indicate that production has tripled since 1968. On the other hand, egg production shows a steady decline. This reflects the change in structure of the poultry industry, from small family flocks to broiler operations.

**Table 86:**  
**Domestic Food and Livestock Production**  
**(1981-1985)**

Particulars	Unit of Measurement	1981	1982	1983	1984	1985 <sup>P</sup>
<b>1. Livestock Slaughter</b>	<b>Heads</b>					
Cattle		60,582	60,940	68,237	70,661	65,636
Hogs		135,284	118,430	112,720	121,314	127,656
Goats		36,434	39,789	45,789	56,726	56,583
Sheep		n.a.	671	732	823	703
<b>2. Meat, Fish and Dairy Production</b>						
Beef and Veal*	'000 lbs.	25,917	26,923	30,991	32,024	28,043
Goats Flesh*	" "	911	1,058	1,198	1,580	1,565
Pork*	" "	16,234	16,021	14,557	15,760	13,400
Mutton*	" "	n.a.	24	35	35	24
Poultry	" "	65,235	58,651	72,007	65,460	50,178
Fish**	million lbs.	32	18	18.2	18.5	19.1
Egg	million	95	82.2	99.5	105.6	78.1
Milk**	million qrts.	n.a.	41	42	42	n.a.
<b>3. Domestic Food Crops</b>	<b>Short Tons</b>	<b>395,598</b>	<b>351,131</b>	<b>419,166</b>	<b>514,656</b>	<b>491,557</b>
<b>a) Legumes</b>		<b>11,066</b>	<b>9,776</b>	<b>10,564</b>	<b>11,445</b>	<b>11,973</b>
Gungo Peas		2,803	2,435	2,319	2,370	2,358
Red Peas		4,724	3,722	3,989	4,731	4,629
Peanut		2,298	2,459	2,862	2,792	3,545
Other Legumes		1,241	1,162	1,394	1,552	1,441
<b>b) Vegetables</b>		<b>120,414</b>	<b>107,294</b>	<b>123,788</b>	<b>151,479</b>	<b>128,500</b>
Cabbage		17,358	17,960	18,907	19,791	17,773
Callaloo		13,449	11,446	11,253	12,981	12,222
Carrot		16,043	16,318	17,267	19,439	16,072
Cho Cho		5,714	4,910	4,801	6,649	5,384
Cucumber		6,603	5,648	7,150	7,865	13,097
Lettuce		1,412	1,616	2,304	2,472	2,237
Okra		1,450	1,680	1,697	42,997	1,467
Pumpkin		30,445	25,702	35,795	32,561	33,459
Tomato		24,841	18,774	21,222	6,724	21,495
Other Vegetables		3,099	3,240	3,492		5,293
<b>c) Condiments</b>		<b>11,445</b>	<b>7,182</b>	<b>10,675</b>	<b>16,696</b>	<b>16,938</b>
Escallion		6,290	2,645	4,378	4,984	3,813
Onion		1,733	1,572	2,035	4,223	4,443
Hot Pepper		1,335	1,099	2,180	3,205	2,415
Sweet Pepper		1,381	1,064	1,417	3,453	5,407
Other Condiments		706	802	665	831	860
<b>Sub-Total</b>		<b>142,925</b>	<b>124,254</b>	<b>145,027</b>	<b>179,620</b>	<b>157,411</b>
<b>d) Fruits</b>	<b>Short Tons</b>	<b>12,867</b>	<b>14,065</b>	<b>12,642</b>	<b>17,251</b>	<b>13,192</b>
Pawpaw		2,130	1,832	1,821	2,345	2,293
Pineapple		5,368	9,031	6,973	8,823	8,170
Watermelon		5,369	3,202	3,838	6,083	2,729
<b>e) Cereals</b>	<b>Short Tons</b>	<b>7,056</b>	<b>5,104</b>	<b>7,761</b>	<b>9,969</b>	<b>8,987</b>
Corn		5,006	3,411	4,027	4,056	4,291
Rice		2,050	1,693	3,734	5,913	4,696
<b>f) Plantain</b>	<b>Short Tons</b>	<b>26,613</b>	<b>31,315</b>	<b>27,669</b>	<b>33,698</b>	<b>33,514</b>
Horse Plantain		18,208	22,049	19,448	24,562	25,434
Other Plantain		8,405	9,266	8,221	9,136	8,080
<b>g) Yams</b>	<b>Short Tons</b>	<b>150,367</b>	<b>128,947</b>	<b>143,999</b>	<b>164,311</b>	<b>180,518</b>
Luca		15,767	13,304	13,304	14,578	19,059
Negro		26,809	20,538	20,903	22,063	26,677
Renta		25,958	23,370	25,221	27,274	29,460
St. Vincent		11,191	10,736	12,430	13,184	13,453
Tau		10,056	6,076	6,819	8,357	8,443
Yellow		48,330	43,420	52,746	64,817	68,474
Other		12,256	11,503	12,576	14,038	14,952
<b>h) Other Tubers</b>	<b>Short Tons</b>	<b>55,210</b>	<b>46,905</b>	<b>46,493</b>	<b>55,894</b>	<b>54,335</b>
Bitter Cassava		14,513	11,034	11,061	11,279	10,771
Sweet Cassava		9,605	7,658	7,886	10,411	8,910
Coco		14,303	13,323	12,971	13,387	15,132
Dasheen		16,789	14,890	14,575	17,817	19,522
<b>i) Sorrel</b>	<b>Short Tons</b>	<b>560</b>	<b>541</b>	<b>640</b>	<b>774</b>	<b>884</b>
<b>j) Potatoes</b>	<b>Short Tons</b>	<b>n.a.</b>	<b>n.a.</b>	<b>34,935</b>	<b>53,139</b>	<b>42,716</b>
Irish		n.a.	n.a.	8,381	13,569	7,799
Sweet		n.a.	n.a.	26,554	39,570	34,917

p - Preliminary \* - Includes edible offal \*\* - Estimated \*\*\* - Estimates based on 1981 Fishing Survey  
Source: Ministry of Agriculture

Goats and pigs are reared throughout Jamaica. Goats provide a major source of meat, particularly in rural areas. Although no accurate records of goat production are available, they exceed the number and importance of pigs. The goat population was estimated at 300,000 in 1980, while the island's pig population was assessed at 218,000 in 1956 and 255,000 in 1980.

Sheep production is not widely popular in Jamaica and its share of total meat production is almost negligible. Based on a variety of sources, including the Agricultural Development Corporation (ADC), the sheep population was estimated to range in size from 3,000-6,000 head in 1981.

As far as cattle is concerned, the national population was estimated at 290,000 head in 1980. According to various sources, most cattle is used for beef, which is second in importance in terms of locally produced animal protein.

The number of different breeds is not known. Neither are there accurate data on cattle categories and herd size. It is believed that roughly 100,000 cattle are kept on commercially operated farms, while 190,000 head are distributed in different numbers on small farm units with varying degrees of production intensity.

For beef production, three breeds — the Jamaican Brahman, the Jamaica Red Poll, and the Jamaica Black — have been created by crossbreeding, upgrading and selection. While these purebreds are usually kept on large, commercial beef farms, the majority of small and subsistence farms use crossbreeds with European and North American breeds, such as Charolais, Brown Swiss, Santa Gertrudis, Simmental, Limousin and Hereford.

With regard to milk production, research has been conducted on European dairy cattle in Jamaica. The breeding work revealed, however, that well known breeds of dairy cattle, such as Jersey, Brown Swiss, Guernsey and Holstein, were unable to maintain the high level of performance and productivity under conventional management systems in a tropical environment. Consequently, a native dairy breed, the Jamaica Hope, was developed by the selective mating of animals with a high degree of adaptability to tropical conditions combined with a capacity for high levels of production.

The breeding work was started by the "Father of the Jamaica Hope", Dr. T.P. Lecky, in the early '50's. The Jamaica Hope derives its origin

from the Jersey, the Sahiwal and the Holstein and has about 80%, 15%, and 5% of their genetic makeup, respectively. With a high productivity and tolerance of stress, the Jamaica Hope is believed to be the optimal breed for local dairy farming. Given its success in Jamaica, the breed has attracted attention from many other tropical countries.

National consumption figures for 1975-1985 (see Table 87), indicate that self-sufficiency in fish and meat is possible, with appropriate financial and political support. The poultry industry, which has long been vertically integrated, contributes 43% of the meat supply (51.14 m lb); beef only 26% (29.85 m lb); fish 16% (in 1977, only 4,840 lb; in 1985, 2 m lb); and pork 14% (16.01 m lb). An unsatisfactorily organized goat industry provided only 1.0% (1.47m lb) to the national diet in 1985.

Rather than importing expensive feed grains, dairy and beef cattle, sheep, goats and rabbits could be more extensively and more economically maintained on local pasture/forages, which abound and are underutilized. Rising market prices (which have doubled in the ten-year period, 1975-1985) should provide further incentive to the industry, as long as markets can be assured. (Only egg prices have lagged, rising from 1.31c lb in 1975 to a paltry 1.95c lb. in 1985.)

Despite rising prices, large amounts of livestock products are imported, and attempts to increase local production have been disappointing even though conditions for such production are very favourable. This results from several factors: high development costs, slow returns due to the long-term nature of the enterprise, and the time consuming and high-risk nature of livestock production.

Domestic Production of Fresh Milk. For the period 1951-1978, milk production shows no appreciable change, with an annual output of 40-44 million quarts for 1971-78. This estimate is based on the Ministry of Agriculture's estimate of a population of 36,000 dairy cows, two-thirds of which are in milk at any one time, with a daily milk yield of 3.5 - 7.5 qts/cow. The quantity of the milk supplied to the processors does not exceed 16 million quarts per year, leaving a residual quantity of 26 million quarts per year, which is used on the farms and/or is sold on the local markets directly to consumers. Milk is produced on approximately 145 large and 2,600 small dairy farms.

Table 87: Total Meat and Fish Consumed Meat Production and Imports of All Types of Meat, 1975-1985			
YEAR	MILLION (LBS.)		
	TOTAL	PRODUCTION	IMPORTS
1975	232.7	120.0	112.7
1976	236.2	120.1	116.1
1977	223.1	128.9	94.2
1978	246.4	128.7	117.7
1979	216.0	132.2	83.8
1980	218.7	129.8	88.9
1981	233.6	125.5	108.1
1982	243.0	120.3	122.7
1983	223.4	136.8	86.6
1984	230.3	133.4	96.9
1985	210.1	117.7	92.4

Source: Livestock and Feed Statistics (Formerly "Meat Statistics") 1975-1985 by Data Bank and Evaluation Division, Ministry of Agriculture (MOA) Jamaica.

Imports of Milk Products. The major imported dairy items are skim milk powder and butter oil, both accounting for J\$31 million (three-fourths of the total) for use in the reconstitution of milk either for canned products or for liquid milk and ice cream. Other important dairy products such as butter, cheese and curd are imported mainly for direct consumption. Table 88 gives information on quantities and values of imported dairy products for the period 1978-1981.

#### Imports and Exports

Both imports and exports of agricultural products have fluctuated widely over the years. This pattern has resulted from lack of a sustained, cohesive plan to increase local production and reduce imports. (See Tables 89 and 90.) (The following products — wheat, corn, and rice — although included in Table 89 and referred to as Agricultural Commodity Imports, are the responsibility of the Ministry of Foreign Affairs, Trade, and Industry and, hence, are not elaborated upon under the Agricultural Sector.)



Plate 38 - Yams planted on flats; no contour necessary.

**Table 88:**  
**Imports of Main Milk Products**

Product	1979		1980		1981	
	Quantity (long tons)	Value (J\$)'000	Quantity (long tons)	Value (J\$)'000	Quantity (long tons)	Value (J\$)'000
Powders mainly skim (including whey) powder	11027	14960	11591	17308	11206	24385
Butter oil	2097	5545	2521	7625	1619	7994
Butter, (fresh or salted)	822	2354	709	2937	814	3592
Cheese	166	275	328	1147	-	-
Cheese and curd	1909	6100	1057	3924	1658	6226
<b>TOTAL</b>		<b>29234</b>		<b>32942</b>		<b>42197</b>

Source: Serge Island Dairies Ltd.

**Table 89:**  
**Imports of Selected Foodstuffs, 1981-1985**  
**('000 Kilos)**

Commodity	1981	1982	1983	1984	1985
<b>Cereals:</b>					
Rice	42,771	39,146	50,669	52,135	55,171
Maize	225,935	151,300	166,333	202,535	147,052
Baking Flour	13,860	13,784	12,895	10,159	4,580
Counter Flour	69,396	60,235	52,173	29,800	5,235
<b>Vegetables:</b>					
Beans, Peas (dry or preserved)	744	793	887	362	265
Onions (fresh and preserved)	802	1,185	891	231	268
Vegetables (fresh, chilled or preserved)	203	511	289	238	283
Potatoes	1,100	229	2	1,288	
<b>Meat, Fish and Crustaceans:</b>					
Beef and Veal	1,516	1,589	1,093	964	269
Mutton and Goat Meat	572	795	577	208	314
Pork	16	-	18	71	-
Poultry Parts	24,822	29,425	22,024	20,160 <sup>r</sup>	25,107
Beef and Veal (smoked or salted and dried)	378	135	70	46	26
Canned Corned Beef	2,192	2,861	2,417	2,820	2,325
Salted Pork	456	101	161	71	30
Edible Offals of Animals	2,579	3,459	2,800	785	1,441
Fish (fresh, frozen or chilled)	5,278	5,003	1,765	1,055	1,919
Herring (salted or dried)	225	122	51	248	39
Herring (canned)	1,517	484	98	937	464
Mackerel (salted and dried)	28	580	-	226	214
Mackerel (canned)	3,943	3,596	3,335	5,936	3,147
Sardines (canned)	2,129	2,461	1,718	2,184	2,400
Other prepared or preserved (smoked and dried)	14	197	49	2,170	20
Codfish (dried, smoked, salted)	3,414	4,564	5,644	3,711	949
Shrimp	31	74	14	15	22
<b>Dairy Products:</b>					
Milk and Cream (dry)	11,396	10,685	8,192	11,155	10,529
Milk and Cream (sweetened)	-	249	-	-	858
Whey	-	39	70	-	-
Butter (include Butterfat)	2,474	2,776	3,548	10,446	4,079
Cheese and Curd	1,686	2,778	1,853	2,306	2,566

r - Revised

Source: Compiled from data provided by the Statistical Institute of Jamaica

**Table 90:**  
**Selected Traditional Export Crops**  
**(1981-1985)**

Particulars	Unit	1981	1982	1983	1984	1985
<b>1. Bananas</b>						
Purchases	'000 Tonnes	27	27	25	11.9	12.81
Exports	'000 Tonnes	31	21	23	11	12.74
Exports (Net Sales) <sup>r</sup>	J\$ Million	7.6	8.3	13.2	6.1	23.30
Average Green Boat Price	J\$/Tonne	1,025	1,086	1,190 <sup>r</sup>	2,299	3,732
<b>2. Citrus</b>						
a) Deliveries to Packaging <sup>c</sup> and Processing Plant	'000 Boxes	883	933	676	570	754
- Sweet Orange	'000 Boxes	329	384	319	281	458
- Marsh/Duncan Grapefruit	" "	487	468	301	230	220
- Ortanques	" "	52	48	55	56	60
- Sweet-seeded Grapefruit	" "	14	31	5	0	14
- Bitter Oranges	" "	1	2	5	3	3
b) Export of Citrus and Selected Citrus Products	J\$'000	8,743	9,036	5,171		
Fresh Fruit - Volume	'000 Kilo	1,446	1,510	1,248	2,994	6,425
- Value	J\$'000	1,746	1,671	1,592	4,236 <sup>r</sup>	8,614
Fruit Juice - Volume	'000 Litres	4,203	3,360	1,185	2,795 <sup>r</sup>	2,794
- Value	J\$'000	6,851	7,152	2,390	15,563 <sup>r</sup>	19,589
Marmalade - Volume	'000 Kilo	79	99	442	137	48
- Value	J\$'000	146	213	1,189	570	268
<b>3. Coffee</b>						
a) Deliveries to the Coffee Industry Board <sup>c</sup>	'000 Boxes	288	300	359	325	222
- Out-turn of Clean Coffee <sup>c</sup>	Tons	1,200	1,250	1,470	1,447	1,080
- Sales of Green Coffee <sup>c</sup>	lb.	2,762	3,078	3,615	3,788	3,056
- Local Processors <sup>c</sup>	"	1,118	909	1,380	1,427	1,271
- Exports <sup>c</sup>	"	1,644	2,169	2,235	2,361	1,785
b) Total Coffee Exports (Industry-wide)						
Unroasted - Volume	'000 Kilo	837	1,067	1,066	1,326	802
- Value	J\$'000	9,712	12,726	18,448	32,152	37,495
Free of Caffeine - Volume	'000 Kilo	2	-	n.a.	0.008	1.2
- Value	J\$'000	7	-	n.a.	1,100	1.1
Roasted (including ground)						
- Volume	'000 Kilo	23	21	29	45	64
- Value	'000 Kilo	308	315	848	1,877	3,741
Coffee Extracts, Essences, etc.						
- Volume	'000 Kilo	2	16	14	13	3
- Value	J\$'000	59	434	448	642	208
c) Coffee Prices <sup>c</sup>						
Price to Growers (Lowland)	J\$/box <sup>r</sup>	20.82	1.02	22.00	40.88	51.88
Average Export Price	J\$/lb.	4.71	4.99	5.66	6.20	11.49
<b>4. Cocoa</b>						
a) Production <sup>c</sup>	Long Tons	1,814	1,426	2,738	2,710	2,604
b) Export Cocoa Beans - Volume	'000 Kilo	1,564	1,260	1,964	1,910	1,886
- Value	J\$'000	8,977	5,203	9,291	15,130	74,754
<b>5. Export of Pimento (Calendar Year)</b>						
- Volume	'000 Kilo	2,306	2,257	3,185	1,612	2,784
- Value	J\$'000	8,469	8,904	17,489	27,137	36,975
<b>6. Coconut</b>						
a) (Production expressed as Copra Equivalent Weights)						
Total	Short Tons	17,000	18,000	17,350	19,168	20,221
Used for Copra		887	1,429	2,373	1,487	2,689
Used for planting and processing		121	188	219	138	209
Used for dry and water coconuts		15,992	16,383	14,748	17,543	17,323
b) Imports of Coconut Oil						
- Volume	'000 Litres	2,910	2,550	2,817	1,635	3,896
- Value	J\$'000	4,427	5,405	8,421	11.6	15,213

c - Crop Year  
r - Revised

Source: Commodity Organizations, Statistical Institute of Jamaica

## AGENCIES AND INSTITUTIONS

### Ministry of Agriculture

The Ministry of Agriculture (MOA) has played a more dynamic role in national agricultural policy and programmes since Independence in 1962. The MOA carries out all the normal functions of such an organization, except where certain responsibilities have been delegated to statutory boards, such as the Banana Company and the Coffee Industry Board. A statutory board, the Agricultural Development Corporation, went through a phase of consolidation into the Ministry of Agriculture from 1981 through 1986, and now functions within the Research and Development Division.

Some of the important departments, agencies and divisions providing technical services within the MOA are: Science, Technology and Research (inclusive of livestock research and improvement, plant protection, and crop care), the Natural Resources Conservation Division, Economic Planning and Policy, Data Bank and Evaluation, Production and Extension, Training, Rural Physical Planning, Veterinary, Land, Title and Survey, etc.

The MOA, through the Data Bank and Evaluation Division, is mandated to provide relevant and retrievable information, to indicate as early as possible whether a project is "on course", so that where problems arise, corrective measures can be appropriately implemented. A functional monitoring system is in place. The system is capable of ensuring maximum performance that enables project management to respond in meeting programme objectives and levels of performance. Three principal agencies utilizing these monitoring procedures include the Project Monitoring and Analysis Company (PAMCO), the Planning Institute of Jamaica (PIOJ), both of which are statutory arms of the Ministry of Finance and Planning; and, the Data Bank and Evaluation Division of the Ministry of Agriculture.

### AGRO 21 Corporation Limited

In 1983, the Agro 21 programme was launched, with three main areas targeted for improvement:

- Agro-business and processing;
- Export marketing of winter fruits and vegetables to the U.S.; and

- Self-sufficiency programmes in livestock (dairy and beef primarily), aquaculture (fish and shrimp), and grains and cassava.

The AGRO 21 Corporation Limited (formerly AGRO 21 Secretariat) is a statutory body, funded by the GOJ and the U.S. Agency for International Development (AID), which seeks to restructure Jamaica's agriculture. After ten years of decline in the sector, AGRO 21 was given the prime responsibility to re-establish agriculture's contribution to the economy. The programme is focused on: putting 200,000 acres of idle land into use in its first four years of operation; rationalization of crop production by eliminating inefficient agricultural production systems; introduction of new crops; and introduction of new markets in North America and Europe. AGRO 21 provides technical advice and expertise, on a non-profit basis, to investors in Jamaica's agricultural sector. The Corporation does not hold equity in any of the projects.

### Supporting Agencies and Institutions

Numerous growers organizations and commodity boards play a supporting role in Jamaican agriculture. These include:

Jamaica Agricultural Society. The JAS, which was founded in 1895, consists of 1,015 branches islandwide with a membership of 30,490. The Agricultural Society represents the small farmers of Jamaica and has considerable influence on small farming. The Society receives an annual subvention from Government to mobilize farmers to receive agricultural information from extension officers.

The JAS Coffee Growers Cooperative Federation of the JAS is made up of 19 local, registered societies with a membership of 75,000 coffee growers.

The Cocoa Growers' Cooperative Federation of the JAS is made up of ten cocoa and four coffee cooperative societies, with 356 district branches and 25,000 cocoa growers. The cooperative has also been greatly involved in educational activities for its members. The JAS Cattle Insurance Cooperative Society has a total of 2,520 shareholders.

Commodity Boards and Associations. Numerous associations and boards have been established for development and expansion of specific export crops/commodities.

- The All-Island Jamaica Cane Farmers' Association is the largest commodity association in the island with a membership of 23,568 registered farmers (ALJCFA, 1984) and a staff of 27. One of its major programmes is the replacement of sugar cane in areas which have been out of production. The research and development aspects of sugar cane cultivation and sugar production are addressed by the Sugar Industry Research Institute (SIRI).
- The Coconut Industry Board is comprised of four persons appointed by the Ministry of Agriculture, and five selected from registered growers. Seedlings for islandwide distribution are produced by the Board, and the Board maintains a Windstorm Insurance Fund. The Board has the responsibility to establish and maintain coconut nurseries for the distribution to farmers throughout the year. It also maintains an advisory and extension service which transmits the results of research and development to the farmers.
- The All-Island Banana Growers Association. There are approximately 12,000 banana growers, of which one-third are active members of this association, functioning within 86 active branches and operating 20,213 acres of banana producing lands. The Association is financed from both the Ministry of Agriculture, and membership subscriptions and donations. The main responsibility of the Association is to assist in the distribution of fertilizers, pesticides and sleeves to farmers at subsidized rates, and dissemination of information to the farmers.
- The Jamaican Livestock Association Limited is a limited liability company having 7,286 shareholders and 112 employees in six branches islandwide. The Association has interests in beef and dairy cattle as well as small livestock (pigs, goats, sheep) and poultry.
- Citrus Growers Association. The citrus industry, through the Citrus Growers Association, plays a major role in the economy of Jamaica. The industry contributes approximately \$4 million in foreign exchange earnings. It is estimated that some 30,000 people are employed in the industry. It provides a fair quantity of the nutrient needs of the population and is a good source of farm income.
- Cocoa Industry Board. In 1951, the cocoa export trade was completely controlled by the Government, resulting in the establish-

ment of a Cocoa Marketing Board to purchase only good quality cocoa from produce dealers, and the establishment of several central fermentaries. The Cocoa Marketing Board was replaced by the Cocoa Industry Board in 1957, and consists of seven members appointed by the Minister of Agriculture. Between 1957 and 1962, the Board established four fermentaries serving all cocoa growing areas, subsidized expansion projects and developed millions of hybrid potted seedlings which are distributed to the farmers. Furthermore, the Board has carried out a massive rehabilitation Programme aimed at increasing cocoa production.

- Coffee Industry Board. The Coffee Industry Board was organised in 1948 and mandated in 1950 to resuscitate the declining coffee industry. The Board consists of a chairman and members constituted from the Coffee Growers, nominees of the Jamaica Agricultural Society (JAS) Coffee Growers, and unofficial Government representatives.

In addition, the industry is augmented by several joint venture projects through the auspices of the Jamaica National Investment Promotion (JNIP) agencies and several Japanese entrepreneurs. However, the major thrust in coffee production and expansion is by the Coffee Industry Development Company (CIDCO), a statutory agency funded by several international organisations. In order to increase the acreage in coffee production CIDCO has entered into a memorandum of understanding, for the utilization of certain lands, with the Forest Industries Development Company (FIDCO). Through this and other measures, CIDCO aims to increase coffee acreage, establish stable prices, expand productivity, raise quality, and augment the foreign exchange potential of the coffee industry.

Caribbean Agricultural Research and Development Institute. CARDI is a research organization. It is funded from a CARICOM subvention (supplied by member countries) as well as through its participation in national projects. The Jamaica unit is involved in several projects, including the monitoring and evaluation of the National Coffee Berry Borer Control Programme (CIDCO/CIB/CARDI Project), the World Bank Pest Programme evaluating pesticide safety, and the Peanut Collaboration Research Support Programme. Research is also being conducted in root crops, vegetables and agricultural engineering.



## LEGISLATION AND REGULATIONS

Legislation exists covering all aspects of agriculture. There are 32 acts which deal with or have implications for agricultural development, research, and marketing. These can be subdivided into four broad groups:

- Fifteen acts which establish boards, organizations, corporations or banks to service the particular needs of the agricultural sector;
- Four acts dealing with regulation of various sectors of the agricultural economy;
- Ten acts related to the environment and its preservation; and
- A group of miscellaneous acts covering research and development, crop protection and land tenure.

Acts for the Establishment of Agricultural Organizations. These include seven acts related to the establishment of boards and corporations and eight acts establishing financial and insurance organizations:

- o The Agricultural Development Corporation Act of 1952 was established for the promotion of research and development of agriculture and for the creation of development-oriented organizations.
- o The Agricultural Marketing Act of 1944 provides for the establishment of the Agricultural Marketing Corporation (AMC). In December 1983 the AMC ceased operations in its original form and became a regulatory and promotional body for all crops not covered by existing commodity boards. These new functions include operation of a wholesale marketing authority, export promotion, and implementation of an Agricultural Stabilization Fund.
- o Acts for the Establishment of Commodity Boards. These are all very similar in that they are intended to promote the efficiency and development of their respective industries, secure the most favorable conditions for producers, and promotion of commodity-specific research. These commodity boards are largely financed from central government allocations, and were established by the following statutes:
  - Sugar Cane Farmers Act (1941)
  - Coffee Industry Regulation Act (1948)
  - Coconut Industry Control Act (1949)

- Banana Board Act (1953)
- Cocoa Industry Board Act (1957)

- o Acts establishing financial and insurance organizations for the promulgation of financial and insurance regulations include:
  - Coconut Industry Aid Act (1932)
  - Banana Insurance Act (1946)
  - Coconut Insurance Act (1946)
  - Sugar Reserve Funds Act (1947)
  - Agricultural Credit Board Act (1961)
  - Farm Loans Act (1965)
  - Agricultural Incentives Act (1972)

The first three acts listed were put in place on different occasions to provide for insurance of crops against different types of hazards.

The Sugar Reserve Funds Act (1947) created five funds for the benefit of workers and others involved in the sugar industry.

The Agricultural Credit Board Act (1961) was to provide loans of up to \$20,000 to persons or organizations for agricultural needs, family needs, post-natural disaster rehabilitation; and to improve, maintain or repair farm equipment, house or water supply systems. Through the Farms Loans Act (1965), Central Government simply sought to guarantee loans made to farmers by commercial banks.

The Agricultural Incentives Act (1972) promoted a system of income tax benefits to the producer so as to encourage investment in agriculture. This has been one of the main attractions of the Jamaica National Investment Promotions (JNIP), and of the Agro 21 campaign to revitalize Jamaica's agriculture.

Regulation of the Industries. Four laws are intended to control critical areas within particular industries.

- o The Agricultural Produce Act (1962) established a system of licenses for places of trade, and for vehicles carrying agricultural produce; it also sought to establish and regularize the trade of agricultural produce.
- o The Fertilizers and Feeding Stuffs Act (1942) attempted to regulate the quality of agricultural fertilizers and animal feeds sold on the local market.
- o The Sugar Industry Control Act (1937) and the Tobacco Industry Control Act (1970) had

similar objectives. They established the respective authorities which are responsible for: advising and overseeing of the respective industries; examination of stock and quality control; licensing of imports and exports of the two commodities by issuing quotas to producers and manufacturers, the fixing of prices, and the registration of farmers, dealers, nurseries and factories.

Environmental Legislation. These Acts all seek to regulate and/or protect aspects of the natural environment which may be threatened by agricultural activities. They are:

- Animal Diseases and Importation Act
- Bark of Trees (Sale Prevention) Act
- Fishing Industry Act
- Forestry Act
- Swine and Goats Act
- Underground Water Control Act
- Water Supply Act
- Watershed Protection Act
- Wildlife Protection Act
- Country Fires Act

Miscellaneous. The following p of five acts seeks to take care of ne previously addressed:

- o The Agricultural Small Holdings Act (1946) provides guidelines for the more efficient administration of small holdings to the benefit of owners.
- o The Animals (Artificial Insemination) Control Act provides guidelines enabling the proper use of material (semen) which could adversely affect future generations of livestock.
- o The Animals Control of Experiments Act seeks to regulate/control the experimentation and breeding of animals, and the development of herds of stock.
- o The Caribbean Agricultural Development Institute (CARDI) Act (1982) established a Commonwealth Caribbean-Wide Research Institute to promote, develop and disseminate agricultural technology through research activities.
- o The Praedial Larceny (Prevention) Act (1982) was intended to establish a cadre of agricultural wardens to assist in the prevention of crimes dealing specially with theft and destruction of crops and animals.

## PLANS AND PROGRAMMES

### Watershed Management Project

A project between the GOJ and the UNDP involves work on five watersheds - Rio Pedro, Upper and Lower Yallahs, Wagwater and Hope watersheds. Approximately 85,000 acres, and a population of 50,000 people are affected. The basic objective of the project is to increase crop production of some 2,000-3,000 farmers within a larger population of 6,500 full-time farmers. The project seeks to emphasize export crop production, and subsidizes the installation of soil conservation structures. The cost of this project is estimated at US\$8 million with a 53% foreign exchange component (NRCD, 1983).

### USAID

The USAID has co-funded a number of projects with the Ministry of Agriculture which impact upon agricultural development in Jamaica. A few of these projects are:

- o The Agriculture Planning Project has created and upgraded the capability of the computerized data processing system within the MOA.
- o The Jamaica Resources Assessment Project Data Base Design Phase III (CRIES), which is an upgrading of the Resource Information System.
- o The Hillside Agriculture Project, beginning in 1987, will promote the profitable production of perennial crops by small hillside farmers primarily in the Rio Minho and Rio Cobre watershed areas. Working mostly with coffee and cocoa, the project seeks to emphasize cultural practices that will make tree cropping a viable alternative to the continued cultivation of annual crops on the steep hillsides in the interior of the island.

### AGRO-21

In 1983, when the AGRO 21 Project was established, many projects were identified, but to date few have reached the stage of implementation. The lands identified for the winter vegetable project include some 10,000 acres in

the St. Catherine/Clarendon plains previously used for cane cultivation. The PIOJ is now undertaking a downward revision of this self-sufficiency programme for rice, soybeans, cassava, fish and winter vegetables.

## **UNEP**

The United Nations Environmental Programme (UNEP) is working with NRCO, FSCD and UNESCO on a 36-month programme which seeks to improve domestic water flows and farm production in the Hope River watershed. It also seeks to benefit the urban population served by the Mona reservoir. The Hope River watershed supplies the Mona reservoir, the largest of the two impoundments of potable water for the KMA. Activities identified for special emphasis include revegetation, flood protection, and a public information and awareness component.

## **Other International Organizations**

The International Institute for Tropical Agriculture (IITA) participates in agricultural projects, such as rapid multiplication techniques, and yam miniset technology. The Interamerican Institute for Cooperation in Agriculture (IICA) assists in cropping systems research, which impinges upon farming systems particularly located in Guyshill and Watermount in St. Catherine. Results in research there reveal an upgrading and improvement in the production volume of Irish potatoes to twice the national average.

## **PROBLEMS AND ISSUES**

Agriculture has four main ecological impacts on the Jamaica environment: soil erosion, depletion of forest resources, ground water contamination, and reduced stream flows.

### **Soil Erosion**

Most of the land occupied by small farmers is on very steep slopes subject to high rainfall. The use of poor farming practices results in extensive soil erosion. In addition, soil loss has been known to occur where insufficient attention has been given to land clearing on relatively flat areas. On-going studies being conducted at the Smithfield Research Plot on a 17° slope demonstrate soil losses under various

farming systems using different crops. The conclusion is that farming on steep slopes with little or no soil conservation methods results in high soil loss. This, in turn, leads to high sedimentation in rivers and siltation in dams and reservoirs (Douglas, 1983). Those effects were substantiated in a study of the Liver River-Hermitage Dam area of St. Andrew. The same problems can be generalized to areas throughout the country where similar conditions are present.

Over 400,000 acres, representing 16% of the country's land area, are seriously eroded — losing, on average, 40 to 50 tons of topsoil per acre per year (NRCO 1984). Remedial work is proceeding in the nine most seriously eroded watersheds, which are also areas of high population density: Plantain Garden, Rio Cobre, Wagwater, Rio Minho, Yallahs Valley, Hope River, Cabaritta River, Great River, and Montego River watersheds.

Those watersheds supplying the Kingston Metropolitan Area (i.e., Wagwater, Hope and Yallahs) warrant urgent attention.\* These areas are under severe pressure resulting from bad hillside farming practices, reservoir siltation, and irregular streamflow.

### **Depletion of Forest Resources**

The two most important considerations affecting forest resources are: slash and burn clearing of the forest for agricultural purposes; and, charcoal burning with the resulting change in the forest cover from mixed hardwood forest species to one of pure-stand conifers.

Further studies are to be undertaken by the UWI Geography Department and NRCO on the extent and impact of charcoal burning, which is recognized as having a severe impact on the ecology of the hills around the Kingston Metropolitan Area (KMA).

---

\*Sheng (1968) contended that the watershed/drainage basin unit is ideal for the management of environmental problems. As the objectives of watershed management have implications for water supply, he supported the idea that watershed protection, rehabilitation and improvement should be given priority in reservoir watersheds.

The impact of plantation forestry is disputed in that although the pine forests of the Forest Industry Development Company (FIDCO) provide valuable protection similar to that of the hardwood forest, the harvesting practice of clear-felling does create much environmental disruption (1984/85 Geography Dept. Project), including post-harvest soil loss.

### **Ground Water Contamination**

Jamaica has extensive supplies of ground water, but contamination has occurred from pesticide use (Blue Mountain and Clarendon areas), overuse of the ground water supply (St. Catherine plains), and improper waste disposal. (See Figure 50.) The problem of pesticide residues in the soil, food, potable water, rivers, coastal waters, and fauna of Jamaica is of growing concern.

Pesticide Use. Dunkley (1985) has shown that dieldrin is one of the more common pesticides that had been used in the Clarendon area. Although this poison has been banned in Jamaica, Anderson and Mansingh (1979) reported that dieldrin remains active in the soil longer than most other pesticides. Further research is being conducted by both CARDI and UWI on such residues. Gromoxone (Paraquat) a deadly poison, is a commonly used herbicide which can cause widespread problems if it is not properly applied. Similarly, the disposal of pesticide containers must be addressed.

Overuse of Ground Water. The use of ground water, particularly in the St. Catherine plains, has resulted in saline intrusion and contamination of valuable ground water supplies. For example, areas of the St. Catherine underground water supplies have been subject to salt water migration inland as a result of overpumping for irrigation purposes.

Waste Disposal. Improper waste disposal takes two forms: sewage, where water toilets in urban areas contaminate ground water resources in the Liguanea plain; and dumping of garbage and industrial waste into sink holes and water bodies. Disposal of effluents, such as the red mud tailings from the Ewarton bauxite plant in St. Catherine, has led to the contamination of water resources in those areas, although techniques have been worked out to mitigate such impacts. Surface water supplies have also been contaminated by the disposal of dunder in the Appleton area from the sugar distillery in St. Elizabeth.

### **Reduced Stream Flow**

As the ground cover is reduced and surface water loss exceeds downward percolation, the volume of stream flow is curtailed and underground water resources are diminished.

## **DIRECTIONS FOR THE FUTURE**

### **Watershed Projects**

Work on the nine badly eroded watersheds (especially for the Kingston Metropolitan Area) should be undertaken with urgency. Specific areas of emphasis include:

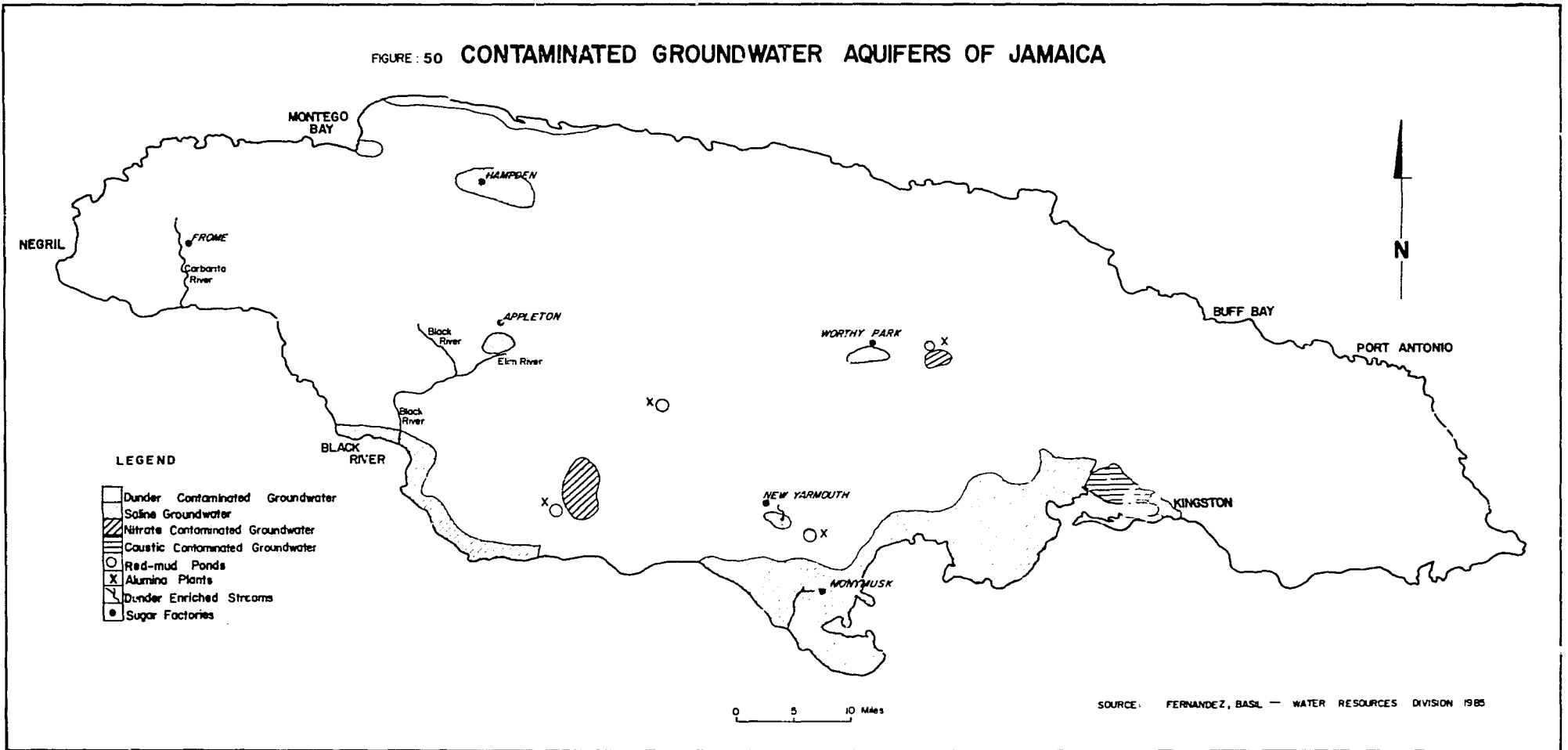
1. UNDP watershed management project in five watersheds (Rio Pedro, Upper and Lower Yallahs, the Wagwater and Hope) covering 85,000 acres and affecting 50,000 people. Initiation of the Hope River Watershed Project should help to get this programme off the ground, assuming adequate input of technical expertise and experience. This is an important project, as the economic viability of farming rests on the restoration of these watersheds.
2. Continued efforts are needed in the remaining 24 badly eroded watersheds. This could be primarily a planting programme sponsored by many organizations for recreation and/or profit; both local and foreign inputs should be solicited to effect the necessary improvements.
3. There is an urgent need for integrated watershed management planning. The Watershed Protection Commission should be an integral part of such planning efforts.

### **Soil and Water Conservation**

Monitoring and assistance should be provided to several projects which are currently underway:

1. Monitoring of pesticide and fertilizer leachate into underground water systems, and studies for the reversal of saline intrusion need to be continued.
2. Further study on the effects of charcoal burning and shifting cultivation needs to be scientifically examined by NRCD and the

FIGURE 50 CONTAMINATED GROUNDWATER AQUIFERS OF JAMAICA



Geography Department of the UWI to identify how these can be reduced or eliminated by providing alternatives.

3. Continued work is required in the other 24 watersheds — encouraging farming practices and implementing engineering and structural changes which will lead to reductions in the levels of soil loss.
4. The impacts of forest harvesting and road construction as well as the environmental and social impacts of large-scale projects, such as those initiated by AGRO 21, CIDCO and FIDCO, should be carefully monitored.
5. Restoration of adequate tree cover in critical watersheds and hillsides, and in reducing soil erosion to manageable proportions, in order to achieve an adequate water balance for urban settlement and agriculture within 50 years.

The above recommendations address both short- and long-term needs with respect to hillside farmers while attempting to strike a sound environmental balance against the loss of soil and water resources. Some of the basic information is to be obtained through the CRIES system of land classification, which, when used with other basic data on crop requirements, will assist in developing appropriate crop zones.

There is a continuing need for improving farming practices and for bringing about higher crop yields and productivity.

### **Land Use Policy**

A comprehensive national land use policy is urgently required to address, among other things, more efficient use of land, crop zoning and actual and potential conflicts between land for agriculture and other sectors. A semblance of this is now occurring in AGRO 21, but this effort stops short of targeting national self-sufficiency first, with clear market opportunities (quotas), and a reasonable pricing system. The absence of integrated planning and sound implementation, along with insufficient response and participation, have resulted in a need to revamp AGRO 21's targets.

### **Pesticide Monitoring**

A sound policy for the management of pesticides in Jamaica's island ecosystem is long overdue,

and needs implementation (Mansingh, 1985; Anderson, 1986). Recognizing the gravity of the situation, FAO (1981) recommended that a "reappraisal of the properties of the persistent pesticides would be conducted under conditions closely proximating their use in tropical and sub-tropical climates..." For example, dieldrin persistence in soils in temperate climates approximates 5-40 years, while in Jamaican soils, its chemical persistence is 6-months (Singh, 1985) and biologically, 122-364 days (Anderson, 1986).

### **Assessment of Coffee Interforestry Cropping System**

Information is needed to assess the real value of the coffee interforestry cropping system. The most important issue is whether the right mixture of crops is being used? Is pine suitable for growing with coffee; should preference be given to a crop with a longer rotation? There is the question of shading the coffee by forest trees throughout its rotation. Should this be reduced, and how will it affect coffee yields and the final crop of forest trees? Finally, how will interforestry impact upon the watershed and its effect on soil erosion?

### **Self Sufficiency Programmes**

Self sufficiency programmes are needed, especially with respect to rice, corn, cassava, sorghum, fish, etc., in order to reduce the import bill, develop the country's food security programme, and protect the natural environment.



Plate 39 - Yams being reaped; Hillside farming in Trelawny.



Plate 40 - Sugar Cane being mechanically reaped and loaded.



Plate 41 - Cattle on rehabilitated Bauxite land.

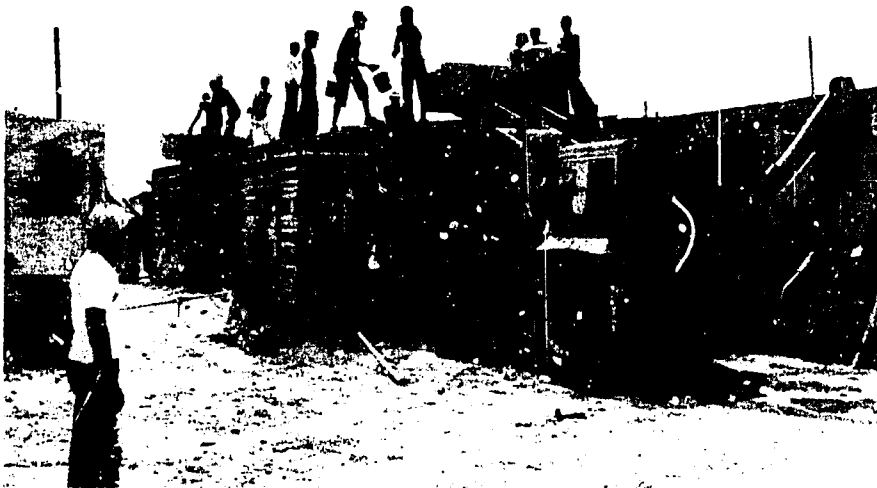
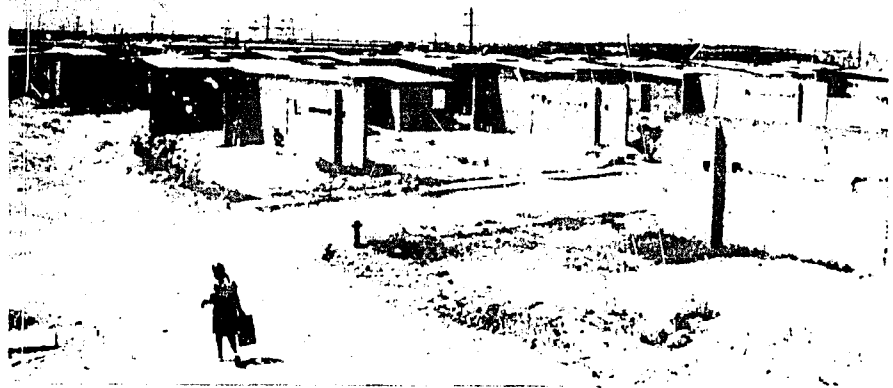


Plate 42a & b - Construction of houses, using prefabricated sides, at Seaview Gardens.



## URBAN AND RURAL INFRASTRUCTURE

---

### OVERVIEW OF URBAN AND RURAL INFRASTRUCTURE

#### Historical Background

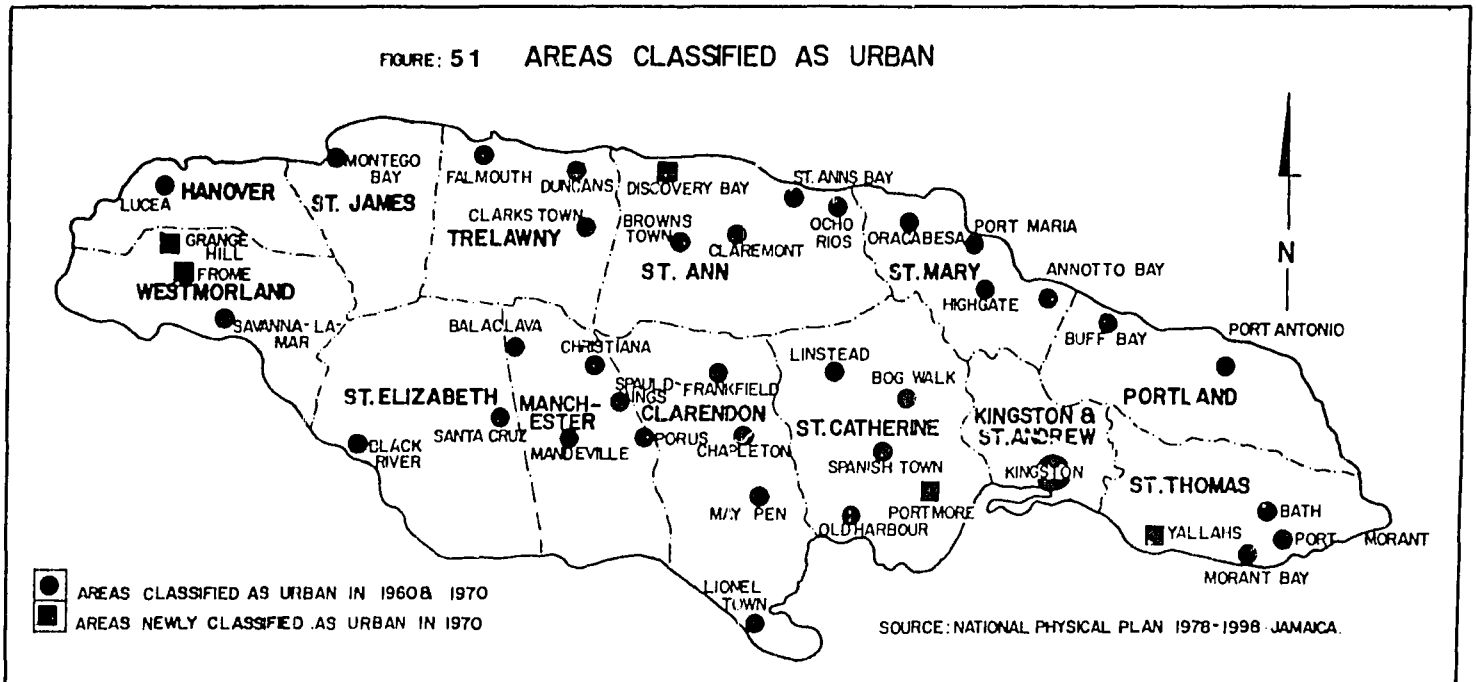
The development of the island's physical and social infrastructure has been significantly influenced by settlement patterns which emerged following the emancipation of slaves in 1838. Many of the freed slaves settled in remote and hilly areas of the Island where crop cultivation was difficult. Even small-scale farming required a good supply of water, and a dependable source could be found in the hills of conglomerates and shale. Hence, many small, scattered settlements were created in these areas, linked to other cities, towns and villages by a road network of about 9,200 miles. Some of these settlements have existed for a long time without proper access, urban facilities or amenities, and very often, with only one or two shops to support small population enclaves — as few as 100 inhabitants in some locations.

Instead of following a policy of settlement consolidation to optimize the need for roads, utilities, and other infrastructure requirements, Government's approach had been to upgrade the existing infrastructure network. It was not

until the 1960's, that a change in the development process was recognized as being in the best interests of the country. As a result, the first National Physical Plan (1970-1990) sought to delineate areas of intensive development, so as to reduce infrastructure needs. From 1,150 settlements islandwide, 215 were selected for initial development emphasis, based on their size, their importance as service centres to the surrounding hinterland and on related development factors.

This earlier plan evolved to become the National Physical Plan, 1978-1998. It provided for the comprehensive development of cities and towns throughout the country in order to relieve population pressures in Kingston, offer a greater choice of urban living environments throughout the country, provide a higher level of service to rural areas, and promote integrated rural development. An urban structure was designated, consisting of Kingston and six regional centres: Port Antonio, Mandeville, Montego Bay, Ocho Rios, St. Ann's Bay and May Pen. In order to create a hierarchy of settlements, 17 sub-regional centres and 96 district centres were also designated. These centres were to be the foci of urban and rural development efforts. (See Figure 51.)

FIGURE: 51 AREAS CLASSIFIED AS URBAN



### Classification and Description of Infrastructure

Physical infrastructure is defined to include such facilities as water, electricity, roadways, transport including railways, telephone, sewerage disposal and other waste disposal facilities. Social infrastructure covers educational and health facilities, post offices, police and fire services, libraries, public housing, recreation and other community facilities.

#### Physical Infrastructure

1. Water Supply. The main source of water supply for the Kingston Metropolitan Area (KMA) are the Hope, Wag Water and Yallahs Rivers. Rural supplies are principally from wells, rivers, and springs. Until recently, the city of Kingston suffered from inadequate water supply. (In fact, the entire city was subject to very serious drought during periods of low rainfall.) Of some 517,000 households in Jamaica, only 121,175 (or 23.4%) have any public water supply piped into their dwellings. The situation is worse in the rural areas, where an estimated 8.3% of households have a piped water supply.

2. Electricity. The Island is reasonably well covered by the electrical distribution network, and there is a continuous programme to upgrade the supply of electrical power. The Jamaica Public Service Company (JPSCo) provides 60% of all electricity consumed on the Island. The remaining 40% is privately

generated by the bauxite companies, Good-year, the Cement Company and the sugar companies (PIOJ 1985).

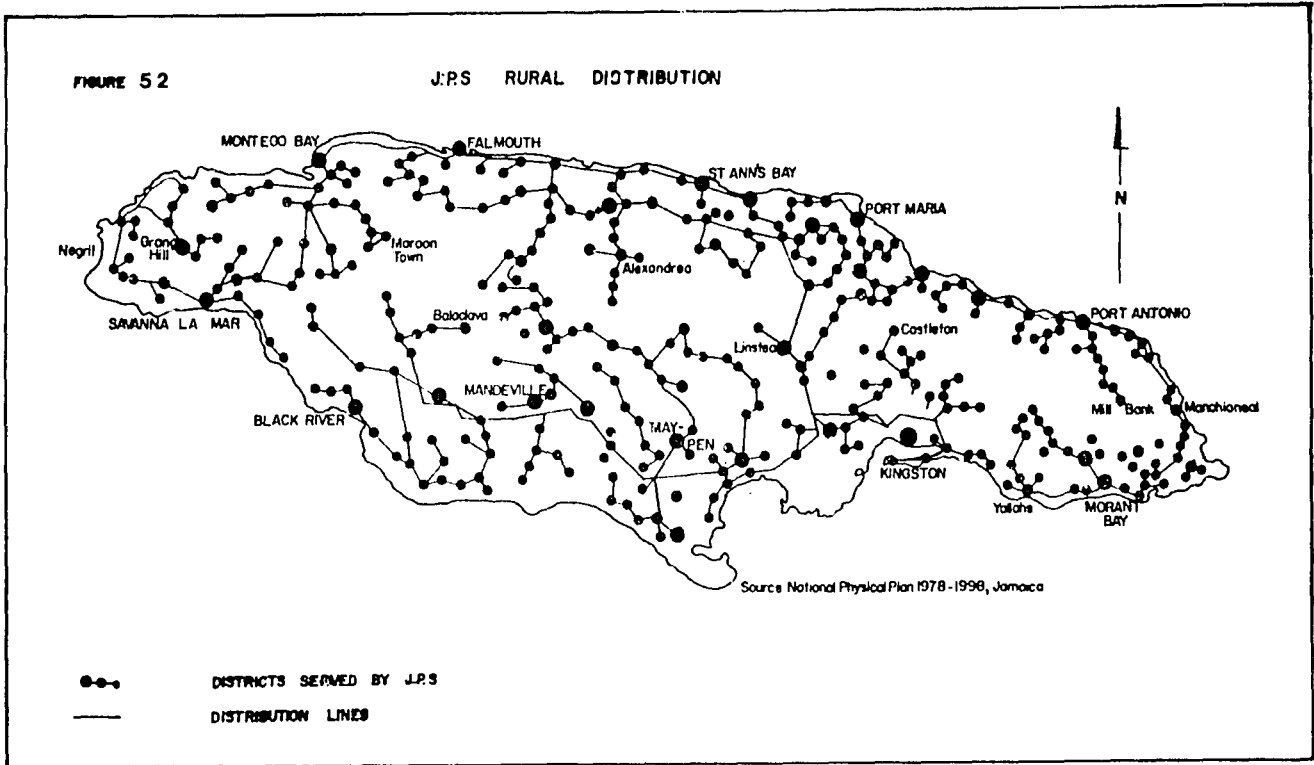
Approximately 48.6% of the households in Jamaica are supplied with electrical power. As with public water supply, there is a great disparity between the KMA and rural areas; 75.2% of KMA households have electrical lighting, compared to 30.4% in rural households. The JPSCo diesel power barge at Rockfort, completed in 1985, has increased the Island's electricity generating capacity by 40 megawatts which significantly increases the Island's ability to meet power needs. (See Figure 52.)

3. Roadways. Due to the Island's historical development, there is a substantial network of roadways. In addition, there are many other access routes, such as rights-of-way and tracks. There are still some homes in Jamaica that cannot be reached except by foot, or by donkey or mule. The Island's total road network consists of some 2,700 miles of main roads, 4,500 miles of parochial roads, and 2,000 miles of rights-of-way and tracks (footpaths), giving an average of about 1.6 motorable miles per square mile of land.

Most of the network, however, is characterised by the need for very low operating speeds and long travel times, even over short distances. Mountainous terrain, increasingly heavy traffic, and poor road construction

FIGURE 52

J.P.S. RURAL DISTRIBUTION



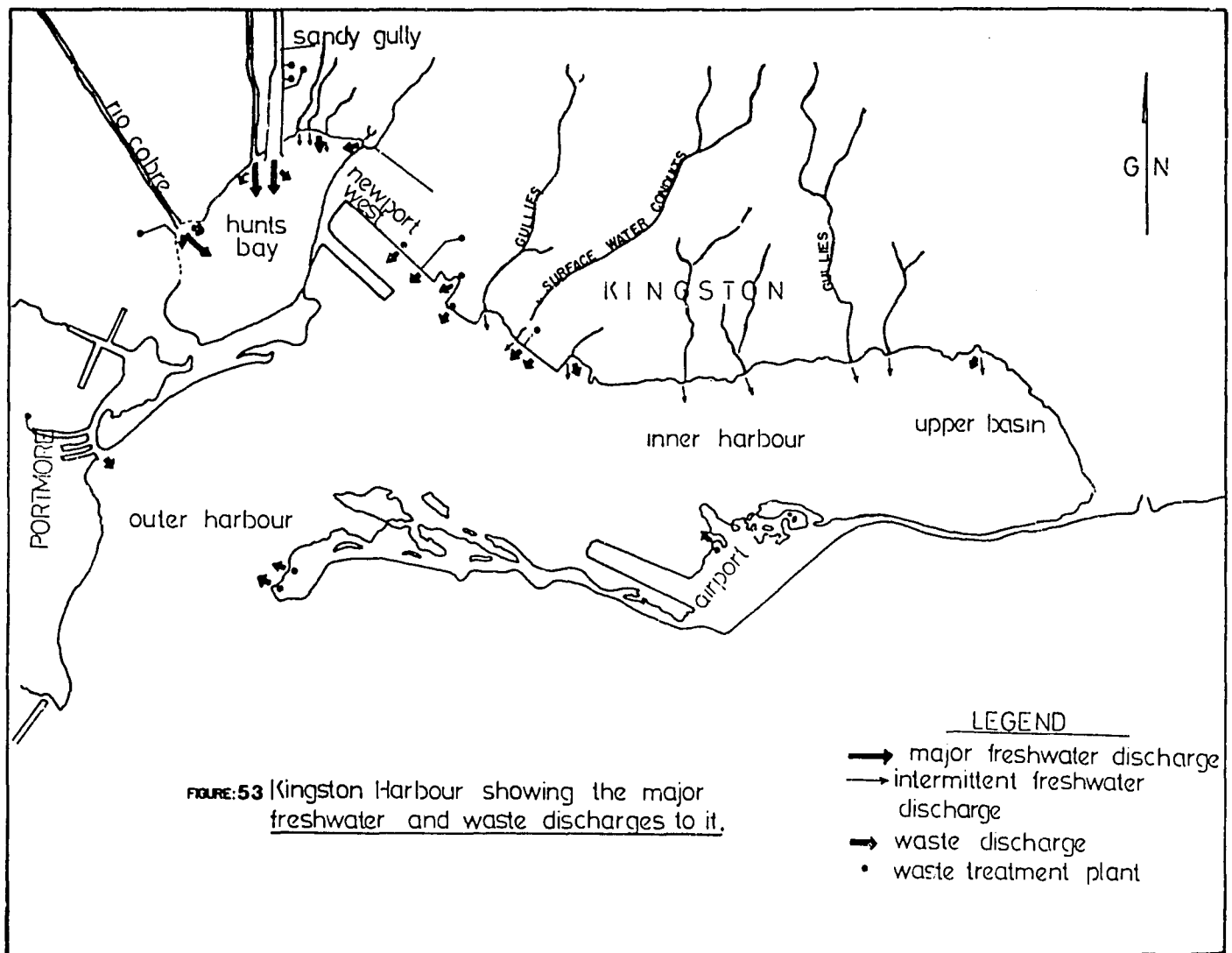
standards have all contributed to the deterioration of road surfaces. In recent years, there has been very little road improvement or maintenance. There is a need to determine the full extent of deterioration of the roadway network. Several arterials, sub-arterial and district roadways are in very poor condition, even within the KMA. (A \$200M roadway rehabilitation programme has recently been announced.)

4. Railways. The Government-owned railway system consists of a total length of about 200 miles of single-track rail, constructed in some instances 140 years ago and in others some 60 years ago. About 50% of the system is characterized by severe curves, passing over mountainous terrain on steep slopes, through several tunnels, resulting in exceptionally high operating and maintenance costs. Passenger traffic for the railway has not grown significantly since the 1950's, non-mineral freight has almost entirely disappeared, and the rail transport of bananas, sugar, citrus and canes ceased since 1969. Although the railway has never exploited its full potential and the corporation has not operated at a profit since 1938, the railway system can be used to provide low value, high volume transport for passenger and freight due to its efficient use of energy. Some private spurs and branch lines (not connected to the main system) provide transportation links for bauxite mining operations and ports shipment.

5. Telephone. Telephone distribution and facilities are inadequate throughout the Island. Although there is a continuous programme to upgrade the telephone system, difficulties in obtaining telephone facilities, even in some areas in Kingston and St. Andrew, remain. About 140,000 telephones are distributed throughout the Island, and there is a programme to make the supply more adequate and technologically more advanced, including conversion of the existing facilities to a digital system.

6. Sewage and Waste Disposal Facilities. Sewage disposal facilities throughout the island are grossly inadequate. Only in some areas where development is increasing and in which population densities are rising are some sewage facilities available. Although studies and plans have been prepared, the installation of sewerage networks in newly developing urban areas has been very slow.

According to the 1982 population census, of 517,292 households in the island, 47.7% still used "pit toilet" facilities, 16.6% use water closets linked to a sewer system, and 18.4% use water closets not linked to a sewer system. The KMA has a larger percentage of its households (35.6%) connected to sewerage systems. Sewage is taken by gravity flow to either the Greenwich Sewage Treatment Works or Western Treatment Works, where it is "treated" and discharged in the Kingston



Harbour.\* (See Figure 53.) Part of the sewerage system is publicly-owned and run by the National Water Commission (NWC), while the rest of the system consists of 21 small privately-run package plants, connected to clusters of housing schemes.

7. Transportation. The Government owns and operates two international airports - the Norman Manley Airport near Kingston and the Donald Sangster Airport near Montego Bay. In addition, there are some 29 privately-owned airstrips, mostly operated by sugar estates, bauxite companies and the Jamaica Defence Force. Air traffic in both passengers and goods has rapidly increased beyond projections during recent years, and is expected to grow at an accelerated rate in the future. Because tourism will continue to play an important role in the national economy, the airports must be continually improved to maintain reasonably good standards.

There are 15 functional ports, ten of which can be described as active. Kingston and Montego Bay handle general cargo, while the remainder provide for the handling of specialised products, e.g., sugar, bananas, bauxite and alumina. Kingston is the chief port, and one of the best natural harbours in the world. With the provision of a new container/transshipment terminal, it is now capable of handling both containerised and non-containerised cargo.

It is anticipated that such transshipment facilities and other port facilities will be in great demand in the future because of Jamaica's favorable geographical location and

\* The treatment is considered inadequate as it does not reach the secondary stage.

the expected increase in international trade and domestic exports. Specialised facilities have already been provided to accommodate cruise ships, including modern cruise ship piers in the Kingston Harbour, Ocho Rios and the Montego Freeport.

The only ferry service in the island is the one from Port Royal to Kingston, which is heavily used by commuters and school children.

### Social Infrastructure

#### 1. Educational Facilities. Educational facilities throughout the island include:

- Primary: 815 primary schools;
- Secondary: 78 new secondary, 46 government-aided secondary high, 5 comprehensive high, 13 vocational trade training centres, 6 technical high schools; and
- Tertiary: 7 teachers colleges, EXED Community College, College of Arts, Science & Technology (CAST), West Indies College, Passley Gardens College of Agriculture, G.C. Foster College of Physical Education and Sport, Cultural Training Centre (CTC), University of the West Indies, Mona (UWI).
- Others: Maritime Training Institute, Vocational Training Institutes, Human Employment and Resource Training (HEART), and Jamaica Movement for Advancement of Literacy (JAMAL).

Educational facilities are inadequate to serve the needs of the population — especially at the primary and secondary levels — and many of those in existence require extensive repairs and maintenance. (See Figure 54.) In 1985, the number of teacher's colleges was reduced by one as a result of the Government's rationalisation of the teacher education programme. Another area of concern is the shortage of school space in the new secondary group. This has been temporarily resolved by the introduction of the "double shift system", significantly increasing the number of places available to eligible children. However, space needs still exceeds available supply.

#### 2. Health Services. Health Centres are located in areas where the population concentration is great enough to justify such services. (See Figures 55 and 56.) In 1983, there were 26 hospitals with 6,049 beds. Up to 1985, at least one general hospital was located in each parish. Reorganisation of the health services has resulted in the upgrading of the functions of some hospitals and the downgrading of others.

Health centres are classified into five types and offer major specialised services such as maternal and child health, curative services, etc. Of 382 centres, the majority (56) are located in the KMA, and the least per parish (19) located in Portland (PIOJ 1985). There are eight specialist hospitals in the island for mental, maternity, chest, polio, mentally handicapped, children, leprosy and cancer

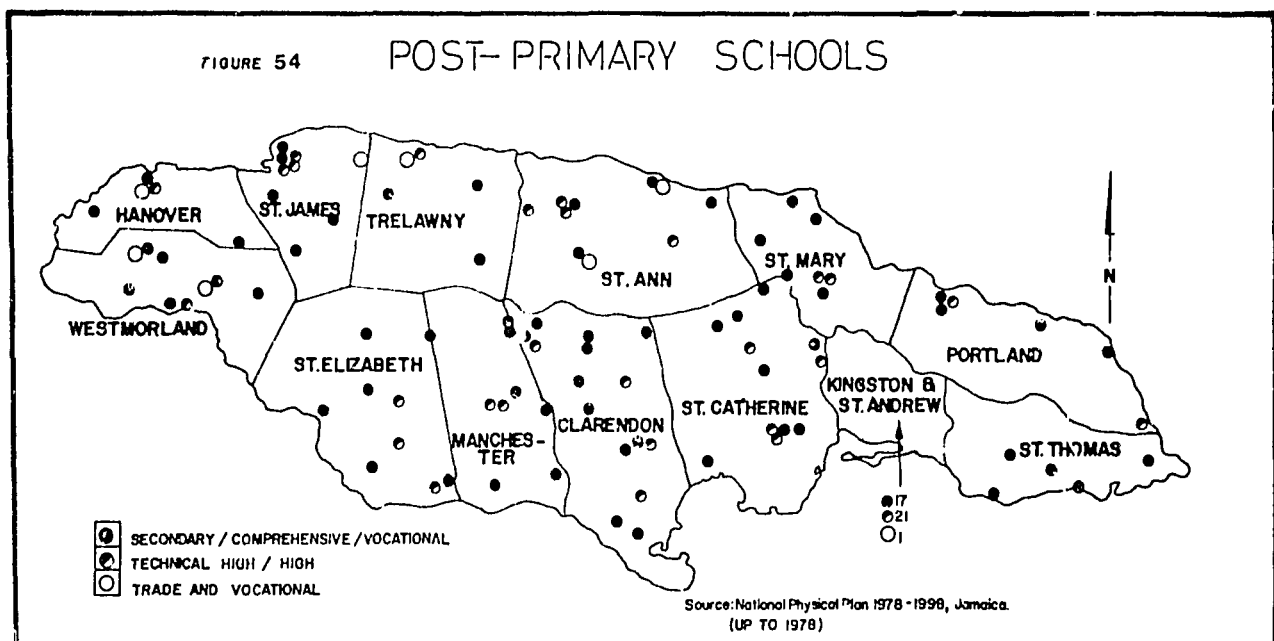
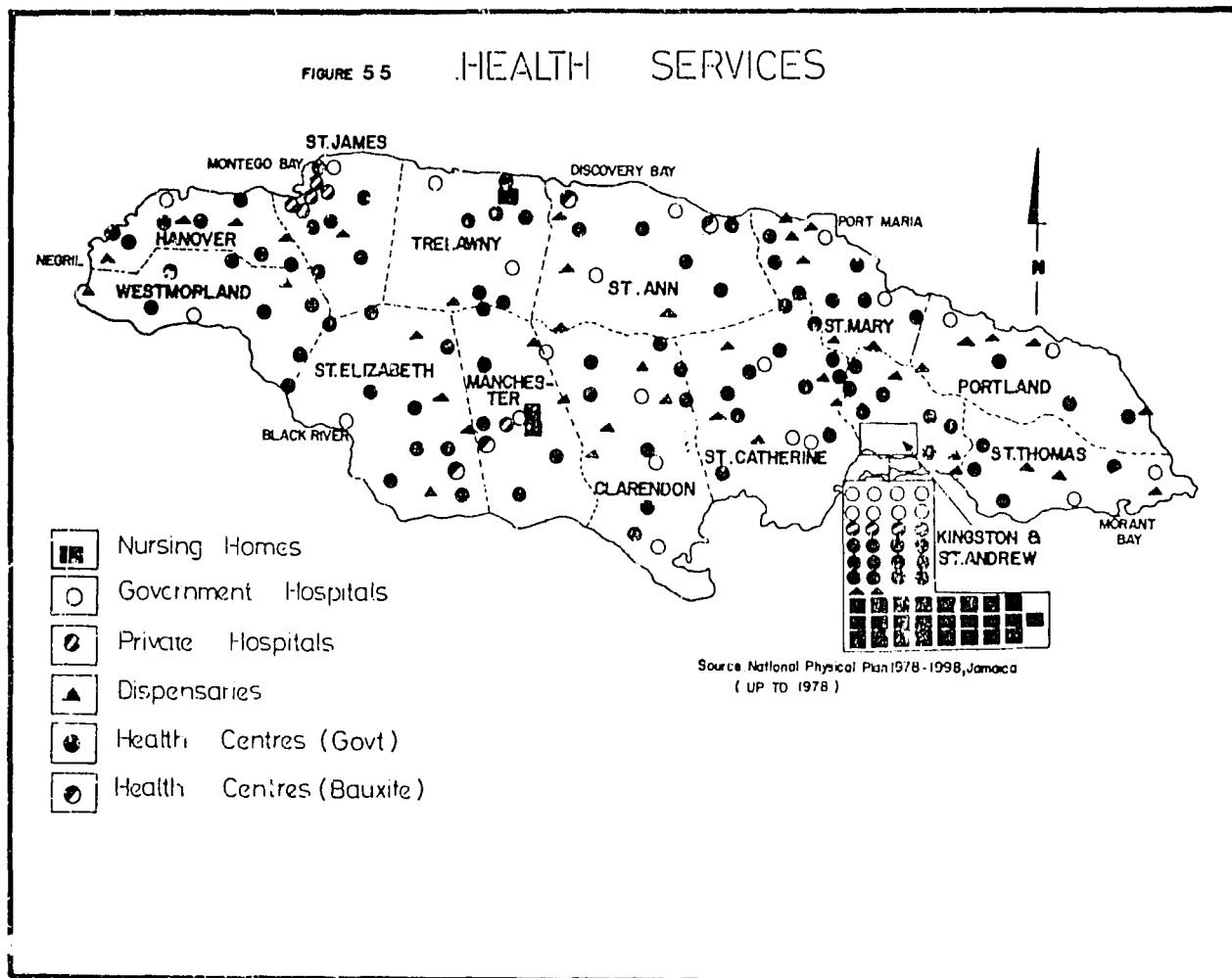


FIGURE 55 HEALTH SERVICES



care. Bed capacity amounts to some 4,059, of which 3,115 are at the mental hospitals. The present ratio of beds per population is 1.3 per 1000 - a provision that is grossly inadequate, since the ideal ratio is 1.8 to 2.0 hospital beds per 1000 population. Future demands will depend on the emphasis given to preventative and curative medicine, and to primary health care. There are 29 privately operated nursing homes and homes for the aged, of which 25 are located in the corporate area. The Government assists in the operation of the Jamaica Legion Home for ex-servicemen.

3. Post and Telegraph Services. There are 318 post offices and 504 postal agencies and sub-agencies providing postal services in over one-half of the towns and villages throughout the country. (Postal agencies are classified in different grades, with daily hours of service depending on the grade. Postal sub-agencies are delivery and collection points only.) Post and telegraph services, which are now under the Jamaica Telephone Company, are generally adequate at present, al-

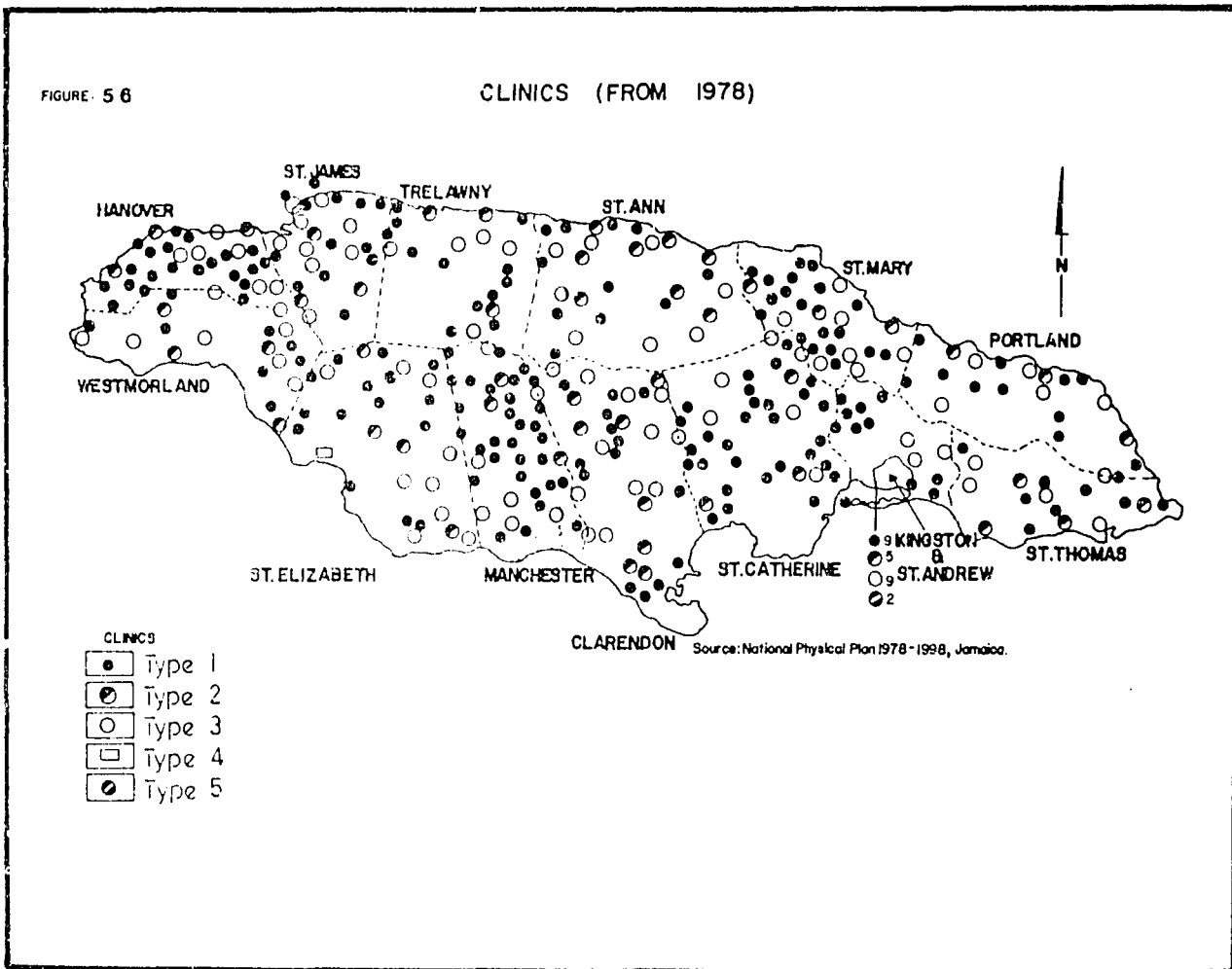
though modernisation will be needed, both to make existing service more efficient and to keep pace with increases in demand.

Two radio stations and one television station operate in Jamaica, with sufficient transmitting stations and power to give islandwide reception. Battery operated radios have become popular and radio is now an important communications medium throughout the country.

4. Police Stations and Fire Services. Police training is conducted at the Police Academy in Twickenham Park with complementary on-the-job training in other locations in the KMA. Other stations and facilities islandwide consist of 184 police stations, one headquarters and several specialist facilities, including marine stations, forensic laboratory, mobile patrol, passport office, special operations, mobile reserve, telecommunications and transport and repairs. There are attempts at continuous upgrading and review of training procedures, including "cross training" with the Jamaica Defence Force.

FIGURE 5 6

CLINICS (FROM 1978)



Fire protection for each parish is the responsibility of the parish council. There are 30 stations responsible for protecting an area of 4,411 square miles, or 163 square miles per station. Most stations are inadequate for providing protection for their own parishes due to inoperable units or to operating at 50% strength in equipment and manpower. The reduction of vehicles and wide spatial distribution of stations have seriously affected the quality of service provided.

5. Public Housing and Other Community Facilities. The provision of housing at all levels and in all sectors of the society is an essential contribution to development. Low and middle income housing is provided by public sector agencies, while the private sector caters to the upper-middle and upper income groups. Five public sector agencies are responsible for providing housing directly: the Ministry of Housing, the National Housing Corporation, Urban Development Corporation, Ministry of Agriculture and Ministry of Local Government. (See Figure 57.)

Inadequate housing is one of the most critical problems facing Jamaica. Rapid population growth and the dramatic shift of population from rural to urban areas have produced a severe shortage of shelter in our towns and cities. In addition, the sector is plagued with problems of scarcity of long term financing, the resultant low levels of investment in housing, the massive increases in building costs, the lack of proper construction management and high interest rates. Against the background of the current and projected housing requirements, the performance of the housing sector over the last decade has been inadequate in terms of meeting the demand. Between 1972 and 1985, approximately 56,013 units were constructed by the formal sector, representing an annual average rate of production of 4,307 units. Of this number, approximately 75% were constructed by the public sector and 25% by the private sector.

6. Libraries. The Jamaica Library Service operates 444 library service points, including: 13 parish (main) libraries, 104 part-time

branch libraries, 46 full-time branch libraries, 43 book centres, and 238 bookmobile points. This has resulted in nearly 2 million books in circulation and an increase in readers to 500,000. The island is served on a regional basis, each centred on a parish library and served by a bookmobile. The centres are Kingston, Montego Bay, Mandeville, St. Ann's Bay, and Port Antonio. Libraries are also provided in the Institute of Jamaica, the University of the West Indies, colleges and schools throughout the island.

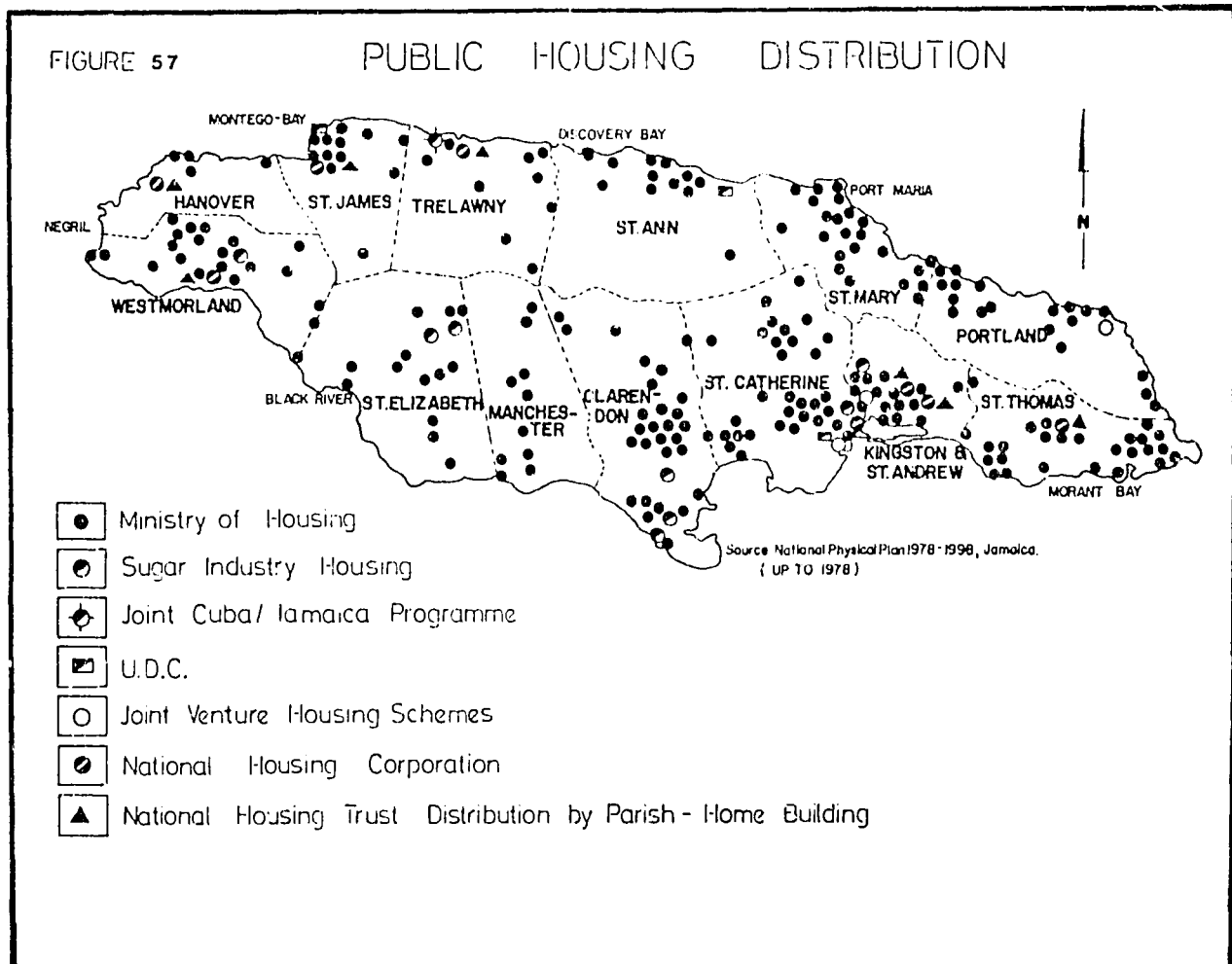
### Physical Infrastructure

1. Water Supply. Imbalances between rural and urban areas were exemplified in 1977 when daily average demand in the KMA was 36 MIG, compared to 38.8 MIG in the rest of the island. The projected demand for water in KMA for the year 2000 is 93.9 Mm<sup>3</sup>/yr - 57 MIGD and 107.2 Mm<sup>3</sup>/yr - 65 MIGD. Although the Yallahs Pipeline Project has resulted in an inflow of 20 MGD, provision is required for increasing the storage capacity in the KMA to supply increased population densities. Several rural projects require implementation to cope with inadequate supplies.

### **Current and Projected Demand for Infrastructure**

Current and projected demand for infrastructure is a function of population growth, disposable income, national development plans and government policy. Following is a summary of current and projected infrastructure demands.

2. Electricity. In 1984, 1168.2 thousand per megawatt hours (mwh) was generated compared to 1173.6 in 1983. However, this is an indication of the effect of conservation methods rather than a reduction in demand.





Improvement in the generating system has been realized through the installation of slow speed diesel operated generating units. A regular programme of maintenance should ensure good supply to the KMA.

3. Telephone Services. During 1984, the number of applicants for telephones increased to 58,377 or 13.9% over 1983. The demand is greatest in the residential sector. The projected demand in 1985 was 32,700 in the rural areas and 79,100 in the KMA. By the year 2000, total demand is projected at 145,000 (TPD 1978).

4. Sewage Disposal. The provision of sewage disposal facilities is expected to continue to improve in order to reduce the flow of untreated sewage into the Kingston Harbour. The three alternatives proposed (Oswald 1978) are: an ocean outfall disposal scheme; facultative ponding; and integrated ponding, employing various ponding methods. (See below.)

#### Social Infrastructure

1. Public Housing. According to the 1982 population census, Jamaica's housing stock stood at 508,700 units in 1982. The housing backlog, new family formation and replacement of obsolescent housing present a formidable housing need. Recent estimates by the Ministry of Construction (Housing) concluded that the housing stock in Jamaica would deteriorate further unless it was increased by 12,000 units, annually.

2. Health Services. Supply of health service facilities has kept pace with demand. However, Government's rationalisation of these services has included a reduction in the number of facilities due to severe economic constraints. Hospital beds have been reduced from 5,662 in 1984 to 5,639 in 1985.

### **AGENCIES AND INSTITUTIONS**

#### **Key Agencies**

Key agencies involved in infrastructure planning and development are:

- the National Water Commission (NWC)
- the Urban Development Corporation (UDC)
- the Underground Water Authority, Ministry of Agriculture

- the Town Planning Department (TPD), Ministry of Finance
- the Jamaica Public Service Co. Ltd. (JPSCo), Ministry of Public Utilities and Transport
- the Ministry of Construction (Housing & Works).

The National Water Commission (NWC). Established in 1963, the NWC is a corporate body, whose functions are: to develop and coordinate an economic water supply system; to maintain water quality and reliability of the water supply system; to promote and provide water supply services islandwide; and to maintain and operate water supply services. The KSAC and Parish Councils responsibilities have been transferred to the NWC.

The Urban Development Corporation (UDC). Established in 1968, the UDC is mandated to plan and develop areas which they own or intend to acquire, and to undertake development and redevelopment activities within designated areas. The UDC's function of acquisition and disposal of designated areas involves the provision of water supply to these areas. The Metropolitan Parks and Markets Company (MPM) was recently formed by the GOJ as a subsidiary of the UDC to organise and administer parks and gardens and to oversee the public sanitation of the KMA.

The Underground Water Authority (UWA). The UWA was established in 1962 as a corporate body with responsibility to promote the conservation and proper use of underground water resources. The Authority has rights of inspection and power to control the drilling of wells.

The Town Planning Department (TPD). The Department, established in 1951, is primarily an advisory agency on matters relating to land use planning. In this regard, the Kingston and St. Andrew Corporation and the Parish Councils are required to forward subdivision applications to the Department for its technical advice. Development applications are also submitted for comments. In addition, the Department provides technical advice to the Town and Country Planning Authority which administers the Town and Country Planning Act, 1957.

The Jamaica Public Service Company (JPSCo.). Established in 1923 as a private sector company, JPSCo was bought out by the GOJ in 1970. The Company's primary objective is to provide electric power throughout Jamaica on the broadest basis, at the lowest possible cost to

consumers, and with the greatest reliability.

The Ministry of Construction (Housing & Works). This Ministry is responsible for the planning, development and maintenance of major transportation routes, public buildings, public sector housing, slum clearance and rehabilitation and upgrading of settlements.

### **Boards and Authorities**

In addition to the key agencies, a number of Boards and Authorities are associated with infrastructural development.

Road Traffic Control Authority and Traffic Area Authorities. The major function of these agencies is to control traffic movement, vehicle inspection and monitoring, and control of accidents.

Public Passenger Control Board. This Board has the authority to fix fare rates, routes, frequency of trips and record the location of accidents.

Marine Board. This Board controls the movement of ships, inspection and charging, collection of berthing fees, and maintains aids to navigation.

Building Authority. The main function of the Authority is the control of setbacks from public roads, and regulate the minimum building size, minimum distance between buildings and building bulk. Related infrastructural development is also regulated by the Authority. The Authority operates within the confines of the Kingston and St. Andrew Corporation.

## **LEGISLATION AND REGULATIONS**

### **Physical Infrastructure**

Water Supply. Six acts are related to the provision and regulation of water supplies:

- Parochial Water Works Charges Act (1913): enables the Parish Councils to charge for water supplied to consumers in a Parish.
- Kingston and St. Andrew Water Supply Act (1911): authorizes the NWC to construct dams and other structures for the purpose of

collecting water from the Ferry River and its tributaries.

- Water Act (1958): established the right to use water on one's own land; established Water Boards and Water Courts.
- Water Supply Act (1958): made it possible for persons to enter into contractual arrangements to supply water to others.
- Underground Water Control Act (1961): established the Underground Water Authority, a corporate body to promote conservation and the proper use of underground water resources.
- National Water Commission Act (1963): established the NWC as a corporate body to coordinate the Island's water supply system.

Electricity. Two acts control the provision of electricity:

- Electric Lighting Act (1890): provides for the issuing of licences for the supply of electricity.
- Emergency Lighting Act (1939): gives the Governor General or his delegate, special powers in time of an emergency or public danger, including the power to either partially or totally shut down the lighting services.

Road and Transport. Five acts deal with roads and ground transportation, and three deal with the harbours and their usage:

- Parochial Roads Act (1932): created the post of Superintendent of Roads and Works, with responsibility for alterations or construction of roads, buildings or works in the parishes and maintenance of mile markers and guide posts.
- Main Roads Act (1932): empowers the Ministry of Roads and Works, now the Ministry of Construction (Works), to declare and manage all "main roads".
- Road Protection Act (1937): prohibits the damage and destruction of roads.
- Road Traffic Act (1938): gives the Minister of Transport the power to grant exclusive transport licences within and throughout the Corporate Area.
- Public Passenger Transport (1970): authorizes

the granting of an exclusive license to an area defined by the Minister of Transport.

- Harbours Act (1874): established the extent of Kingston Harbour; empowered the Minister to declare any bay as a harbour; created the post of Harbour Master; and established a Marine Board.
- Harbour Fees Act (1927): authorizes the regulation and payment of fees for the use of harbours.
- Harbour Lights and Lighthouse Act (1900): stipulated that lighthouses are visited by the Commissioner of Lands and are in the care and management of the Chief Technical Director, Ministry of Construction (Works), under the Main Roads Act.

Telephone. Three laws govern the provision of telegraph and telephone services:

- Telegraph Act (1879): placed the control of telegraphic services under the portfolio of the Postmaster General who also has the authority to fix rates.
- Telephone Act (1893): stipulated that telephone lines and works were to be licensed.
- Telephone Service Tax Act (1977): stipulated that anyone in Jamaica using a telephone must pay a service tax with the exception of the U.W.L, Post Offices, the JRC and "Coinbox" telephones, and any others so specified.

### **Social Infrastructure**

Housing. Two acts are directly concerned with public housing construction and five others are related to building and amenities:

- Housing Act (1969): authorizes the Minister to declare any area as a Housing Area and to initiate slum clearance schemes if, in his opinion, the area merits such action.
- National Housing Trust Act (1979): created a corporate body with a mandate to provide and finance housing projects.
- Kingston and St. Andrew Building Act (1883): regulates new building alterations, additions and divisions of old buildings, and specifies the setback from the centre of the road for buildings in the corporate area.

- Town Nuisance Prevention Act (1887): specifies that land or buildings may be declared a public nuisance if dilapidated and thought to be dangerous to the public.
- Kingston Improvements Act (1890): empowers the KSAC to control the sewage system and its development, with power of inspection to the Medical Officer of Health, Public Health Inspectors and Sanitation Officers.
- Town and Country Planning Act (1957): created the Town and Country Planning Authority with responsibility for the orderly and progressive development of towns and cities and for the making of Development Orders to effect such control.
- Local Improvements (Community Amenities) Act: enacted to enable the relevant Ministry and Department to upgrade squatter areas and spontaneous settlements by providing or improving facilities.

### **Multi-Purpose Acts**

Five multi-purpose acts also affect infrastructure:

- Parish Council Act (1901): provides for the election of Parish Council representatives and gives them the power to acquire land and to define the limits of towns.
- Public Utility Protection Act (1928): specifies that any person tampering with any public utility is liable to prosecution in the Resident Magistrate's Court.
- Public Utility Commission Act (1967): established the Public Utility Commission, whose responsibility is to ensure that the utility undertaken by a specific organisation or company is efficiently operated and that its charges are reasonable.
- Urban Development Corporation Act (1968): established the UDC, which is the government agency responsible for urban development and/or redevelopment in areas designated for this purpose.
- National Housing Corporation Act: established the National Housing Corporation (NHC) to develop certain categories of housing schemes on government-owned lands.

## PROPOSED PLANS AND PROGRAMMES

Proposed plans and programmes involve the continuation of some on-going projects, as well as the initiation of others.

### Physical Infrastructure

Water Supply. Water supply projects include:

- The Castleton Water Supply Scheme, originally due to be completed in 1985;
- Expansion and upgrading of the Constant Spring and Hope Filter plants;
- Feasibility studies completed in 1985 on four water supply projects are being considered for financing and construction; and
- The NWC is in the process of taking over all water systems operated by Parish Councils.

Sewage. In order to reduce the amount of sewage flowing into the Kingston Harbour, Oswald (1978) has proposed three alternatives:

- An ocean outfall disposal scheme with sewage dumped out beyond Palisadoes;
- Facultative ponding where sewage is decomposed by aerobic and anaerobic bacteria; and
- Integrated ponding, which is the use of a mixture of the various sewage treatment methods such as maturation pond and aerated lagoons. (Reid Crowther and Partners Limited, 1980 and 1983, have proposed the "Flow West Project", a scheme of integrated ponds whereby Kingston sewage will be treated and reused for irrigation and groundwater discharge on the St. Catherine Plains.)

Electricity. Efficiency in electricity generation is to be improved with the introduction of slow speed generating units.

Roads and Transportation. The following projects are being undertaken by the Ministry of Construction (Works):

- Kingston and Urban St. Andrew Road Improvement Programme;
- Main Roads Programme, the improvement of arterial and secondary main roads;
- Rural Road Improvement Programme, the upgrading of Parish Council roads; and,
- Implementation of the Rural Towns Programme for the improvement of roads within rural towns.

## Social Infrastructure

Public Housing. Public housing projects include:

- Settlement Upgrading Programme being undertaken by the Ministry of Construction (Housing), through the Estate Development Company (EDCo) with USAID funding, seeks to upgrade urban and rural settlements.
- Starter Home Programme of the Ministry of Construction (Housing) involves the construction of units either on individual plots or within schemes. These schemes usually consist of a mixture of two bedroom units and core units. A core unit is a standard house type offering basic sanitary facilities, essential services and modest living/sleeping area but so designed as to facilitate its expansion by the purchaser to meet his ultimate requirements.
- Build-On-Own-Land Programme of the Ministry of Construction (Housing) offers completed units and starter houses to be built on land already owned by the purchaser. Starter homes are erected by small contractors who are contracted and monitored by the Ministry of Construction (Housing).

Health Services. The rationalization programme for health services includes:

- Small hospitals are converted to rural maternity centres, which provide only emergency medical services;
- Admission of patients to these facilities for a maximum of 24 hours;
- Underutilized space in small hospitals for use in outpatient care; and
- Introduction of fees in all hospitals.

Education. Programmes for educational facilities include:

- Government of Jamaica (GOJ) Primary School Construction Programme, through which 42 more primary schools are to be constructed;
- Inter-American Development Bank/GOJ Project, including construction of 42 primary school buildings and 18 teacher's cottages;
- Netherlands/GOJ Special Education Projects involving construction of classroom blocks for handicapped students; and,
- CAST is to become the Island's second University.

## Other Proposed Plans and Programmes

The objective of the Settlement Strategy programme, developed by the TPD, is to close the gap in the standard of living between rural and urban areas in order to arrest rural/urban drift. In addition to the provision of social facilities and amenities according to three types of centres (regional, sub-regional, and district), all centres will be provided with a post office, electricity, telephones and telegraph service, potable water, and asphalted roads. As a pilot project, four centres have been selected under the comprehensive rural township development programme: Hayes and Kellits in Clarendon, Mavis Bank in St. Andrew, Cascade in Hanover, and Elim and New Market in St. Elizabeth.

## **PROBLEMS AND ISSUES**

### **General Trends Impacting Urban and Rural Infrastructure**

The general trends impacting urban and rural infrastructure include the rapid population growth in some urban centres (such as Portmore, Spanish Town, May Pen and Montego Bay) and a high rate of unemployment — 25.4% in 1984 (PIOJ, 1984). These trends create an imbalance between social need and effective demand. The inability to pay for electrical supply, telephone services, water supply, and housing does not obviate the need. Structural adjustments of the Jamaican economy due to economic constraints has meant a reduction in the number of some institutions, such as teacher's colleges and general hospitals. Rationalization of services has resulted from these constraints; for example, the downgrading of some general hospitals to health clinics and a reduced level of school maintenance.

Development pressures in urban centres impact on the social environment. Problems include over-crowding, inadequate water supply, and illegal dumping of wastes. Very often, rural areas are given only minimal attention as far as infrastructure development is concerned.

### **Priority Problems**

The main problem in the provision of infrastructure is the lack of financial resources. In addition, there are other problems of major concern.

Water Supply. The inadequate supply of water becomes chronic during the summer months when water restrictions are imposed within the KMR.

Disposal of Liquid Waste. The disposal of liquid wastes remains a pressing problem due to the harmful effects on animal and plant life when effluent is deposited in the Kingston Harbour and other coastal locations.

Inadequate Refuse Collection. Physical facilities for refuse collection are inadequate. Seventy percent of the refuse generated is not systematically disposed of. Dumping at landfill sites is also uncontrolled and needs to be properly planned and administered.

Road Maintenance. Maintenance of roads islandwide and in the KMR in particular is inadequate. The frequent development of potholes and tardiness in remedying the situation is undesirable.

Demand for Middle and Low Income Housing. Many of the housing projects are beyond the reach of those for whom they were intended. This reflects the fact that while the demand for housing is real and identifiable, the effectiveness of that demand is determined by purchasing power rather than the need for housing. Increased building costs have tended to create a widening gap between the cost of housing programmes being offered and the purchasing power of target groups.

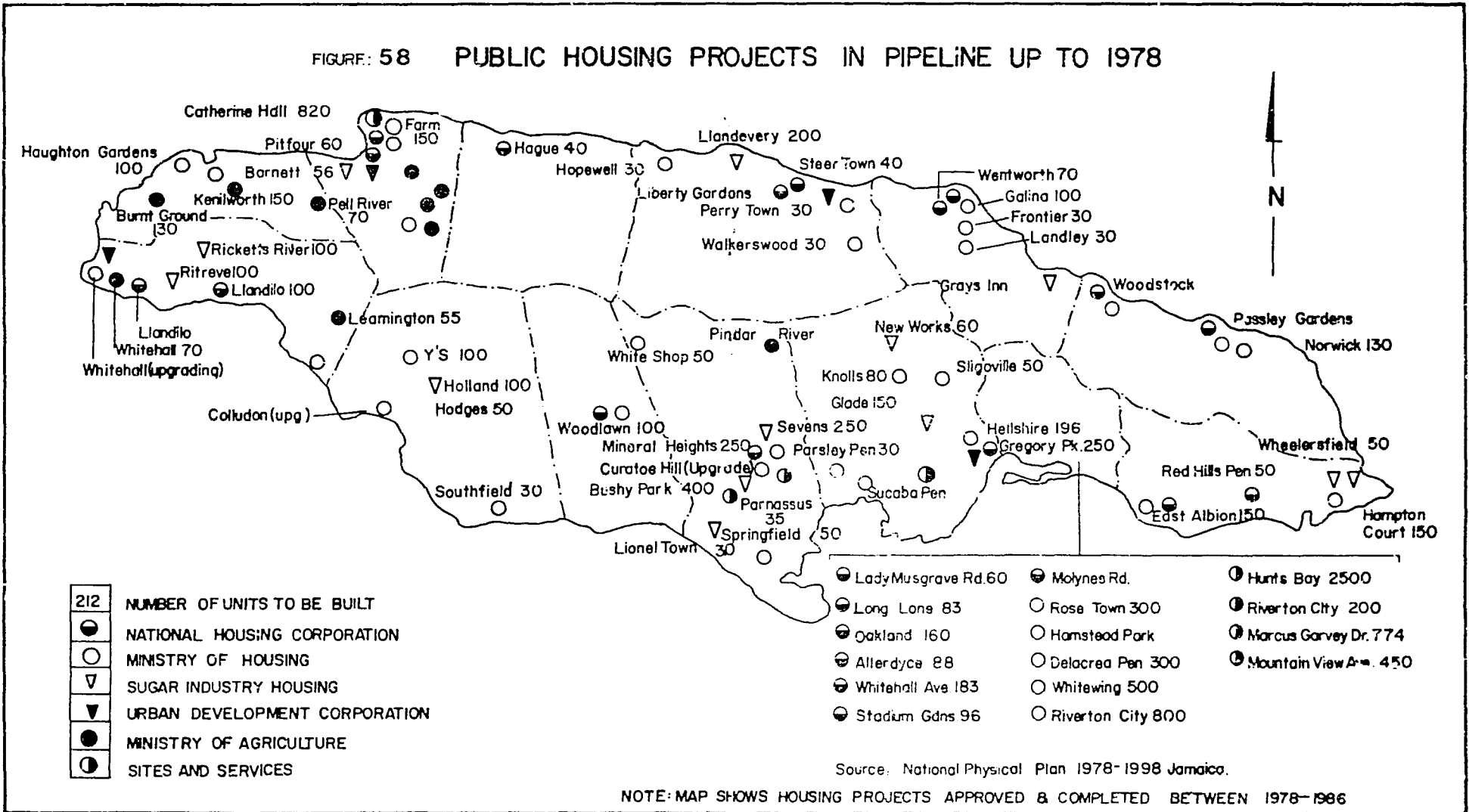
## **DIRECTIONS FOR THE FUTURE**

### **Updating of Physical Plans**

As noted above, there is a paucity of physical and social facilities in most of the island's urbanized areas. The pressures are being increased because of the ad hoc approach to planning and development. Time and attention are often concentrated on developing economic and monetary strategies, without ensuring that there is integration with physical development plans and programmes.

The need for an updated National Physical Plan is urgent. It is strongly recommended that such a plan incorporate a national strategy for the comprehensive, integrated, orderly and progressive development of all sectors.

FIGURE 58 PUBLIC HOUSING PROJECTS IN PIPELINE UP TO 1978



## Recommended Projects

Recommended projects to reach short and medium term goals include:

1. The development of a policy and programme for disposal of liquid effluent. An assessment of the impact of sewage disposal on the Kingston Harbour and on affected beaches is urgently needed. Clearly defined strategies should be instituted to adequately manage this problem in the short term, until a national system of sewage disposal has been developed.

Tasks to be Undertaken: A scientific assessment through experimentation of the impact of liquid effluent on marine flora and fauna and on beaches.

Responsible Organisations: National Water Commission, Town Planning Department, National Resource Conservation Division, and Underground Water Authority (UWA) who will have responsibility for licensing of effluent discharge under the New Water Resources Act.

2. Implementing Recommendations of Various Studies on Solid Waste Disposal. This project will provide information to assess the suitability of present sites for disposal of solid waste and sewerage sludge. The end result should be an identification of the best sites for such use.

Tasks to be undertaken: Scientific experimentation at relevant coastal locations to determine how such areas are affected by leachates. A study of alternative disposal methods such as substituting incineration for the use of landfill.

Responsible Organisations: Urban Development Corporation (UDC), Town Planning Department (TPD), National Resource Conservation Division (NRCD).

3. A study of heavy metals (lead) disposed in the environment by vehicles using leaded fuels. The effect of lead in the atmosphere can be harmful to both plants and animals. This study should be undertaken especially within urban areas and on plants in areas where there is a concentration of heavy vehicular traffic.

Tasks to be undertaken: Scientific experimentation will determine the quantity of lead and other heavy metals within the atmos-

phere, the rate at which it is absorbed by plants and animals, the varying effects at different levels of concentration, and recommendations on how to improve environmental quality with respect to the concentration of heavy metals.

Responsible Organisations: NRCD, Ministry of Health (MCH).

4. A study of the effects of the rationalization of the health services. This study will determine the extent to which the rationalization of health services impacts rural communities relevant to the transfer of some major hospital functions.

Tasks to be Undertaken: Survey of selected communities, interviews, comparative analyses of alternate health services arrangements.

Responsible Organisations: Ministry of Health (MOH).

5. Strict enforcement of the Anti-litter Law. This can only be effective if accompanied by a public education campaign using all the available forms of mass communication, as well as through the participation of service clubs and civic groups. Organised competitions should also be considered.

Tasks to be Undertaken: Formation of a committee to coordinate advertising through the print and electronic media, preparation of posters, organisation of competitions, talks to students at various levels.

Responsible Organisations: Jamaica Information Service (JIS), Ministry of Justice, Kiwanis, Lions, Rotary Clubs, and Metropolitan Parks and Markets.

6. Proper maintenance of roads. The lack of road maintenance is particularly chronic within the KMR. Proper maintenance is essential for main roads and farm roads. People as well as goods and services must be able to move freely and unimpeded in order to promote economic development. Most urgent attention should be paid to rural farm roads which are unpaved or which have fallen into disrepair.

Tasks to be Undertaken: Survey to determine areas in need of immediate attention to develop a programme of road construction and repair which will identify the location of roads and type of jobs to be done.

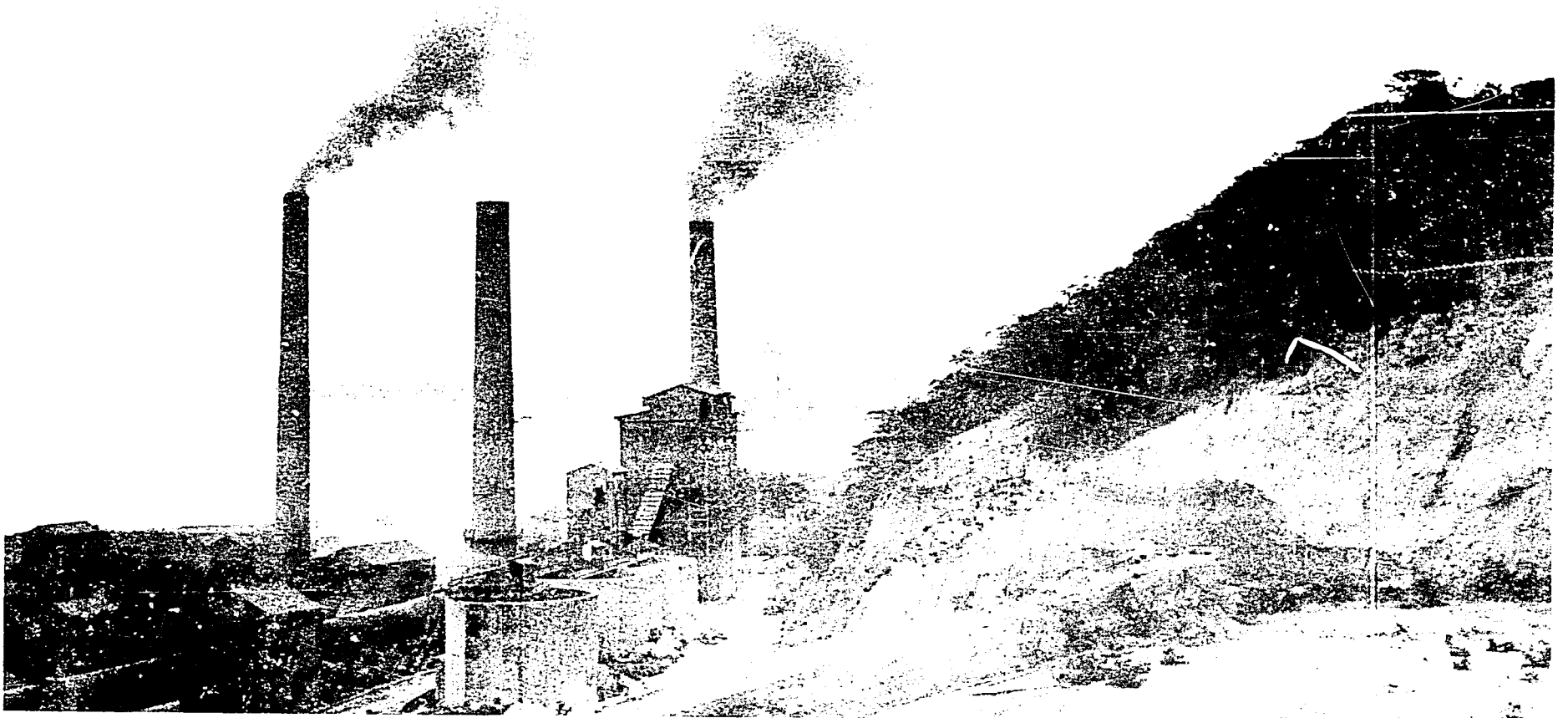


Plate 43 - Atmospheric pollution from factory.



## INDUSTRY AND INDUSTRIAL POLLUTION

---

### OVERVIEW OF INDUSTRY AND INDUSTRIAL POLLUTION

Jamaica's island environment is characterised by a variety of micro-climates, sharply contrasting landforms, and fragile ecosystems. Together with relatively limited soil and mineral resources, these characteristics set limits on Jamaica's capacity for industrial development that can occur without substantial environmental damage. To date, however, the drive for industrial development has been pursued with little regard for its potential impact on the natural environment. Indeed, many of the impacts resulting from industrialization have neither been documented nor quantified with any degree of rigor. Very few environmental assessments have been conducted prior to the establishment of new industries. Further, there is an absence of enforceable environmental standards, worker health and safety standards, and strong institutions for monitoring the impacts of industry on the environment.

While there are a large number of small manufacturing and processing plants, as well as utility installations that contribute to pollution, the sugar and bauxite-alumina industries are the major sources of industrial pollution in Jamaica.

### Sugar Industry

Jamaica's industrialization began over 300 years ago with the production of sugar, rum and molasses. Extensive sugar cane plantations were developed and manned by imported slave labour, and later supplemented with indentured labourers from India and China. The industry grew in response to the strong demand for sugar in Europe, and, prior to the abolition of slavery, peaked at 200,000 tons of sugar per year. Subsequently, it attained a maximum of just over 500,000 tons per year. In more recent times, the industry has struggled to meet its export quotas, and the level of production has been consistently around 200,000 tons/year. Table 91 illustrates production trends in the sugar industry over the period 1963 to 1985.

The sugar industry is important to the Jamaican economy for several reasons:

- It accounts for the direct employment of 60,000 persons annually and an estimated 500,000 persons indirectly. It is directly linked with other sectors of the economy, such as lime production, the food processing industry, the animal feeds industry, and the distilled, blended spirits and spirits bottling industry.

**Table 91:  
Sugar Production, 1963 - 1985**

<u>Year</u>	<u>Sugar Produced</u>	<u>Year</u>	<u>Sugar Produced</u>
1963	484,865	1975	360,624
1964	481,466	1976	359,742
1965	514,825	1977	291,154
1966	488,054	1978	300,762
1967	465,915	1979	265,903
1968	461,051	1980	246,716
1969	367,672	1981	201,649
1970	373,901	1982	199,011
1971	369,693	1983	196,920
1972	383,288	1984	192,820
1973	341,898	1985	206,707
1974	377,302		

Source: Derived from data obtained from the Statistical Division, Sugar Industry Authority.

- It is the country's fourth largest earner of foreign exchange. (See Table 92.)
- It is the largest monoculture in Jamaican agriculture, and has strong linkages with other sectors of the economy.

The operation of sugar factories has contributed heavily to water and air pollution. The sugar industry is the largest single source of organic biodegradable effluent, from the fermentation of molasses in rum production. Commonly called dunder, this effluent is discharged into waterways adjacent to the factories. It bears a noxious and objectionable odour, and because of its high Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) causes anoxic conditions, disrupting ecosystems and causing deleterious effects on the biota (including fish kills in some instances). Figure 59 shows the locations of sugar factories and related activities. (Figure 50 in the Agriculture sector shows areas contaminated by dunder.)

Air pollution from the sugar industry takes the form of particulate ash produced during the burning of bagasse. Impacts on the environment from the ash are generally site-specific, affecting mainly the sugar factories themselves and areas within an approximate radius of two miles from the plant.

The large sugar cane plantations are prone to certain infestations which must be controlled by pesticides. Further, there is the potential for transport of fertilizer residue to ponds and other water bodies, which may give rise to eutrophication. In addition, sugar cane is burnt in the fields prior to harvesting to facilitate reaping. Although short-term, this practice has the effect of generating carbonaceous dust particles and smoke, particularly during periods of poor atmospheric ventilation. A more lasting effect of sugar cane burning is the depletion of the organic content of the soil.

### **Bauxite/Alumina Industry**

Since the advent of sugar processing, which has both backward and forward linkages with the minerals and food processing industries, a number of other industries have emerged in Jamaica. In fact, the past 30 years has been a period of relatively intensive industrialization to meet domestic needs for manufactured goods, as well as to supply international markets.

Bauxite mining and refining is unquestionably the most significant industrial development that has occurred in Jamaica during this century. The discovery of this non-renewable mineral

**Table 92:**  
**Jamaica: Gross Foreign Exchange Earnings 1981-85**  
**(U.S. \$M)**

Year	<u>SECTOR</u>			
	Bauxite	Alumina	Sugar	Tourism*
1981	172,069	588,061	46,466	284,300
1982	170,265	344,275	49,101	337,600
1983	109,209	314,589	57,287	399,200
1984	159,656	283,818	66,032	406,600
1985	77,470	212,192	49,795	406,800

\* Estimated Gross Visitor Expenditure - based on yearly survey of visitor expenditure patterns conducted by the Ministry of Mining, Energy and Tourism.

Sources: Planning Institute of Jamaica Economic and Social Surveys;  
Ministry of Mining, Energy and Tourism.

resource was made during the 1940's, and its exploitation begun shortly thereafter (1950), with Reynolds Jamaica Mines Limited making its first shipment of bauxite from its port at Ocho Rios. Since then, several mining operations were established and five alumina plants constructed (Alcan, Kirkvine Works and Ewarton, Alpart, Alcoa and Revere). It is currently estimated that the island has a reserve of 2 billion tons, of which 1.75 billion tons are proven to be commercially mineable.

Between 1950 and 1974, the period of most intensive activity and growth in this sector, Jamaica became the world's leading supplier of bauxite, with a peak production of 15 million tons/year in 1974. Until 1983, this sector continued to be Jamaica's leading source of foreign exchange earnings. At that time, the global economy was plagued with several problems which substantially reduced demand for bauxite/alumina. The Jamaican industry was so adversely affected that production has declined to the level of 7 million tons/year. Reduction in demand also brought about the closure of the Reynolds, Revere, Alpart and Alcoa Plants. (Alcoa was subsequently reopened and is now being run by the Government of Jamaica. Figure 60 shows the location of bauxite operations. Production trends in Jamaica's bauxite industry are reviewed in the Mining Sector.)

Despite the decline in production, the bauxite/-alumina industry is still one of the major source of environmental pollution in Jamaica. Its operations have quantitatively and qualitatively impacted the quality of land, air and water. For this reason, the bauxite industry has made the largest investments in pollution abatement and control. The major pollutant is the alkaline effluent, commonly called red mud (a complex multi-component micro-crystalline substance): It takes the form of a slurry, which is usually 20% solids with the liquid component causing the total effluent discharged to be on the order of 15,000,000 tons/year.

The impacts of red mud slurry range from visual blight and noxious odour, to the sequestering of land for upwards of 50 years, and the contamination of aquifers, streams and rivers with caustic soda and other dissolved impurities, which affect the quality of potable water supplies. (In some instances, the concentration of sodium (Na<sup>+</sup>) exceeds standards set by the World Health Organization.

The topography, geology and water resources of the island, coupled with the physio-chemical properties of the slurry, have made the management of this pollutant a formidable and costly task. Recently, however, intensive research has led to the development of an improved method for the impoundment and solar drying

FIG 59: SUGAR PRODUCTION IN JAMAICA

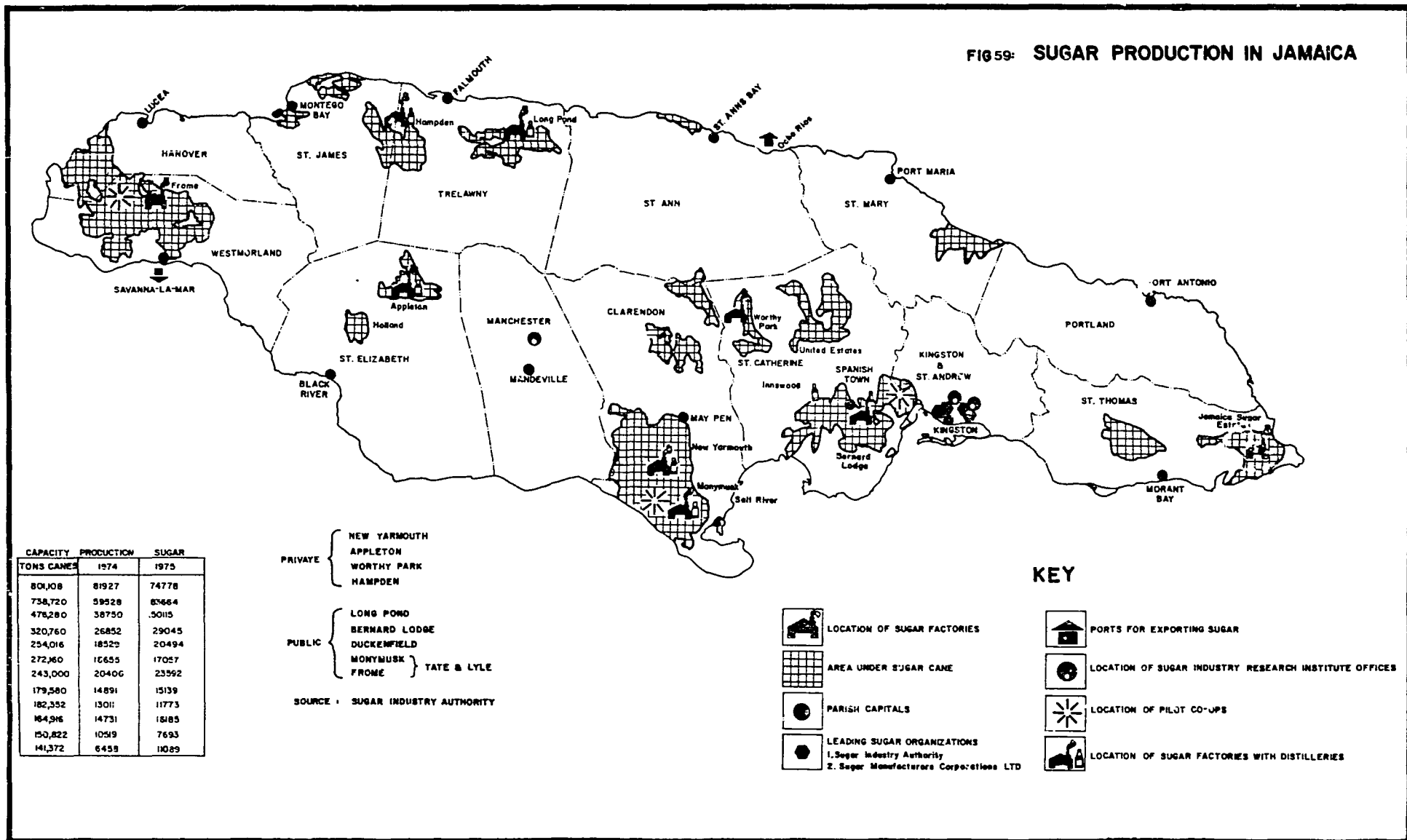
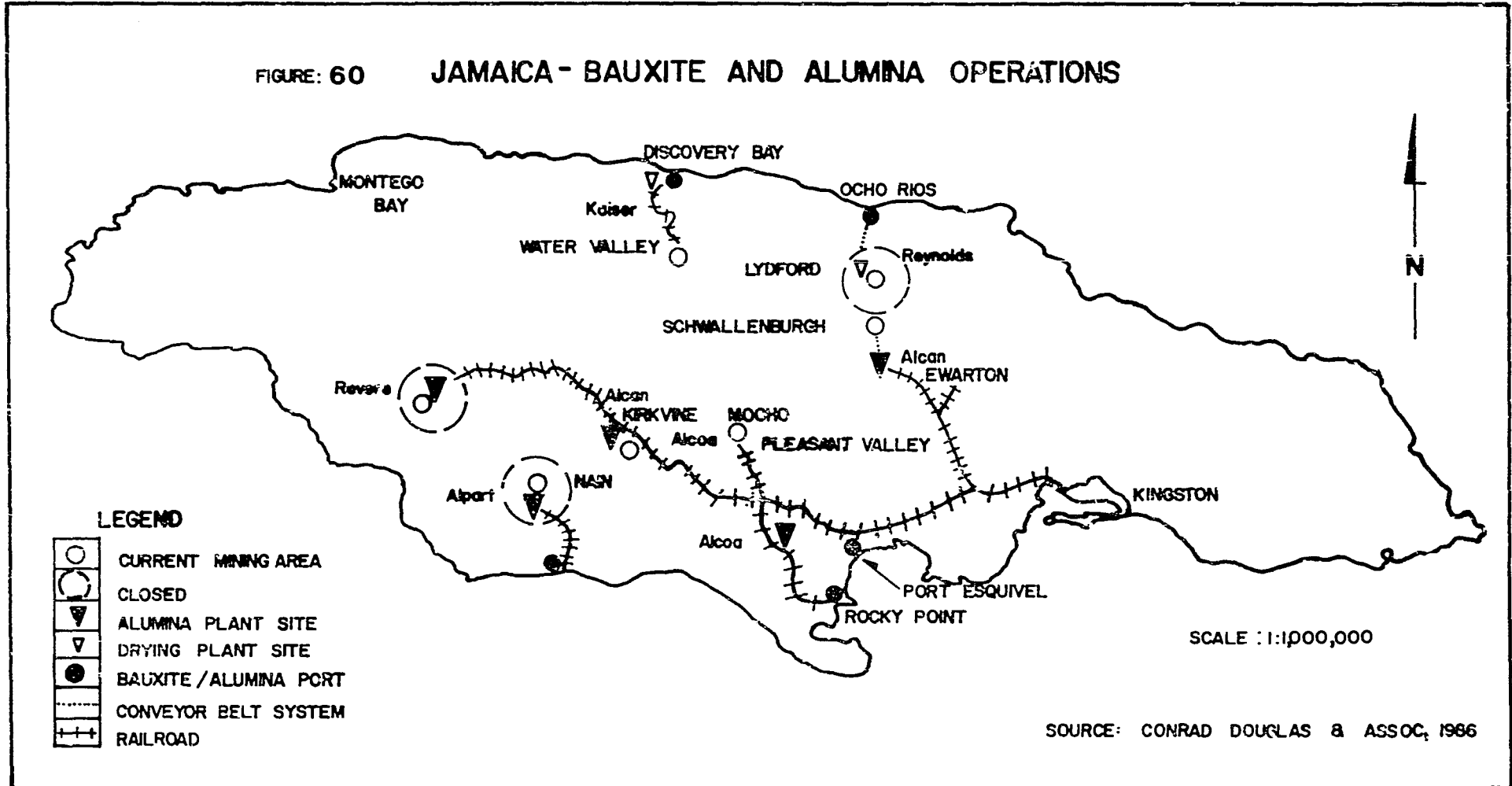


FIGURE: 60 JAMAICA - BAUXITE AND ALUMINA OPERATIONS



of this waste, which also holds some potential for the economic exploitation of red mud residue.

Problems in the bauxite/alumina industry other than red mud slurry include:

- Relocation of communities from settlements on bauxite lands; with its attendant socio-economic dislocations and problems;
- Need for land rehabilitation of mined-out areas;
- Bauxite dust and noise;
- Extensive road building and dust formation;
- Creation of lime dust (an atmospheric pollutant) as a result of the production of burnt limestone ( $\text{CaO}$ ), used for controlling impurities in the processing of bauxite;

- Generation of fine alumina particles (alumina dust) in the calcination operation of the plant, which despite controls, still creates a problem within alumina plants, neighbouring communities, and at loading stations at ports;
- Generation of particulates and gases from power plants and calcination stacks which are dispersed in the immediate environment and impact areas within a five-mile radius of the plants.

Figure 61 illustrates a cross section of an unsealed red mud pond. Figure 62 shows the location of red mud disposal sites in Jamaica. Figure 63 shows the Alpart plant, associated red mud lakes, wells and aquifer areas contaminated by red mud effluent. Table 93 shows the composition of red mud.

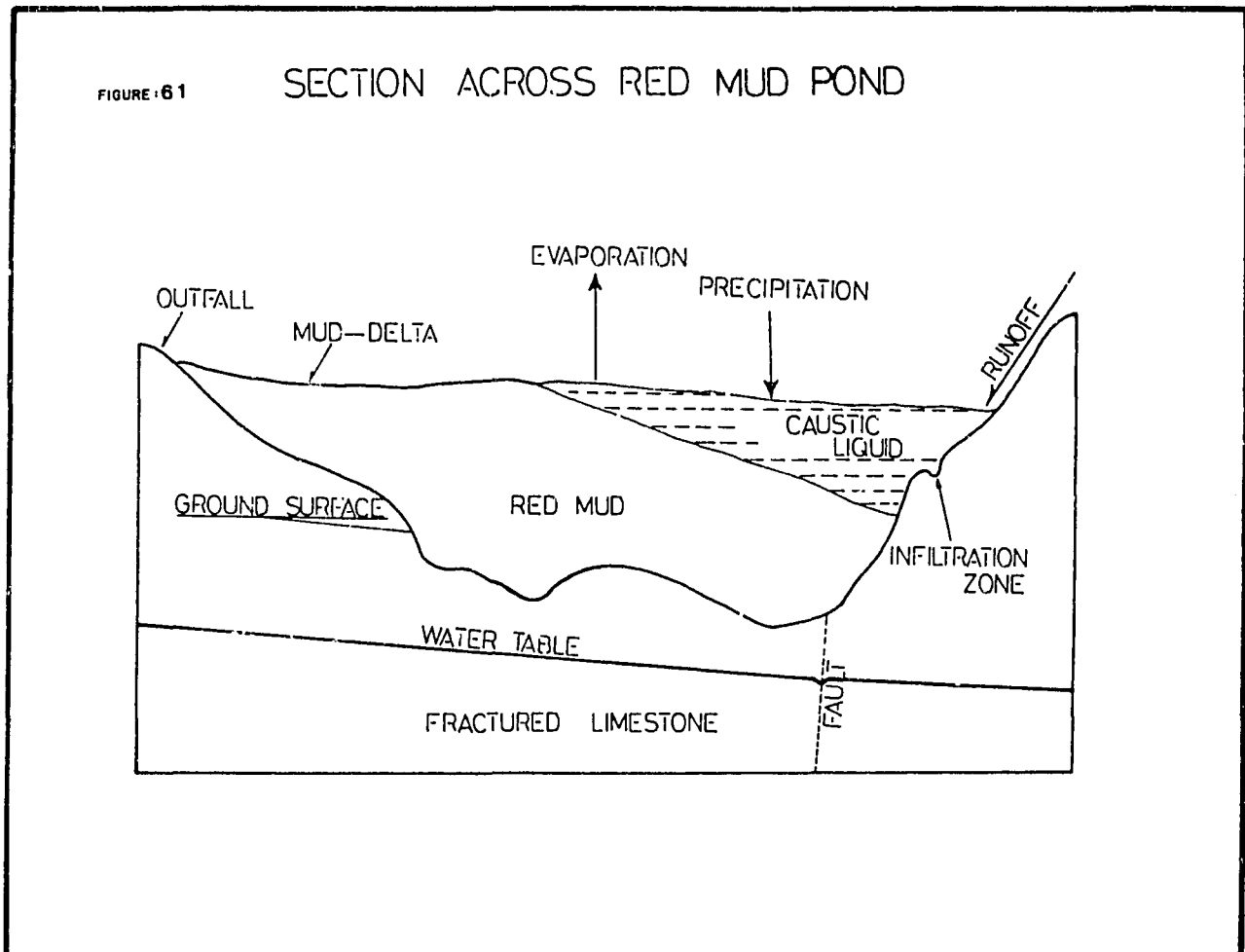
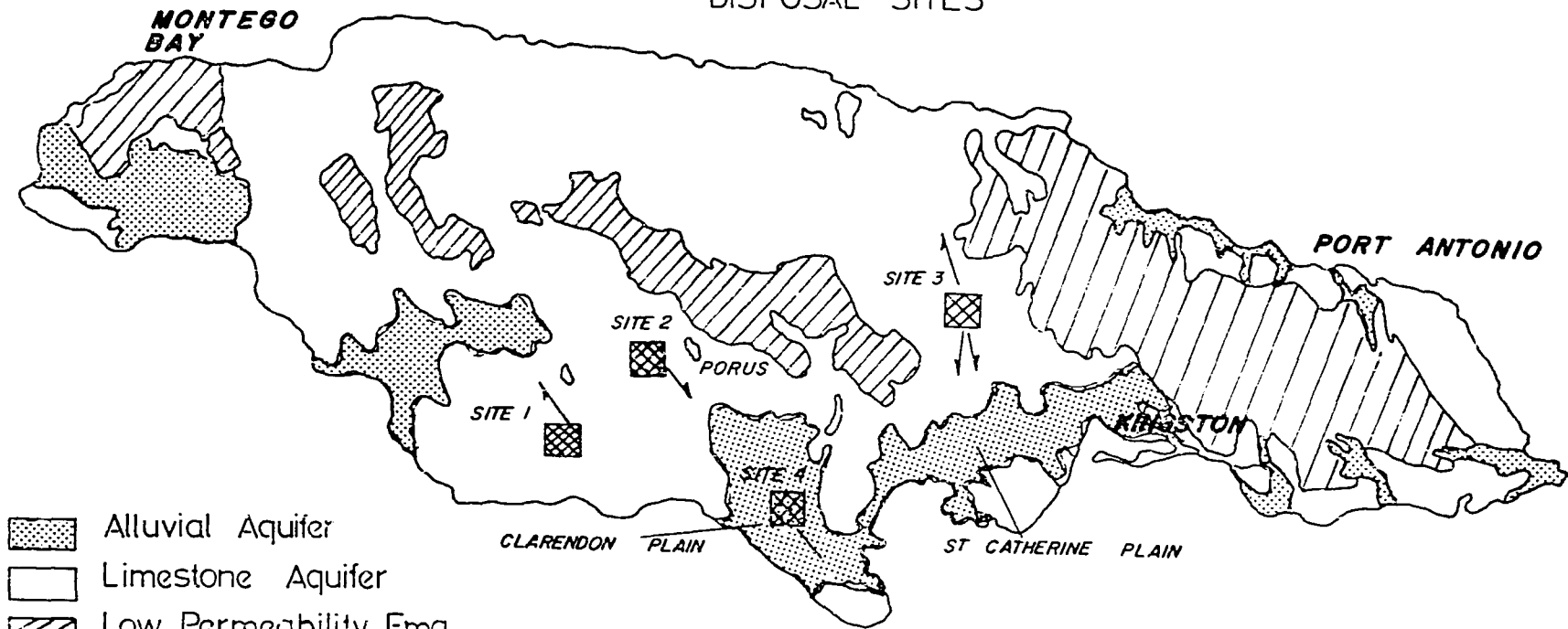





FIGURE 62 SIMPLIFIED GEOLOGICAL MAP OF JAMAICA SHOWING RED MUD DISPOSAL SITES



-  Alluvial Aquifer
-  Limestone Aquifer
-  Low Permeability Fm.
- Site 1 Alpart (Essex Valley)
- Site 2 Alcan (Kirkvine)
- Site 3 Alcan (Ewarton)
- Site 4 Alcoa (Halse Hall)
- Ground water flow direction

SOURCE: CONRAD DOUGLAS & ASSOC., 1985

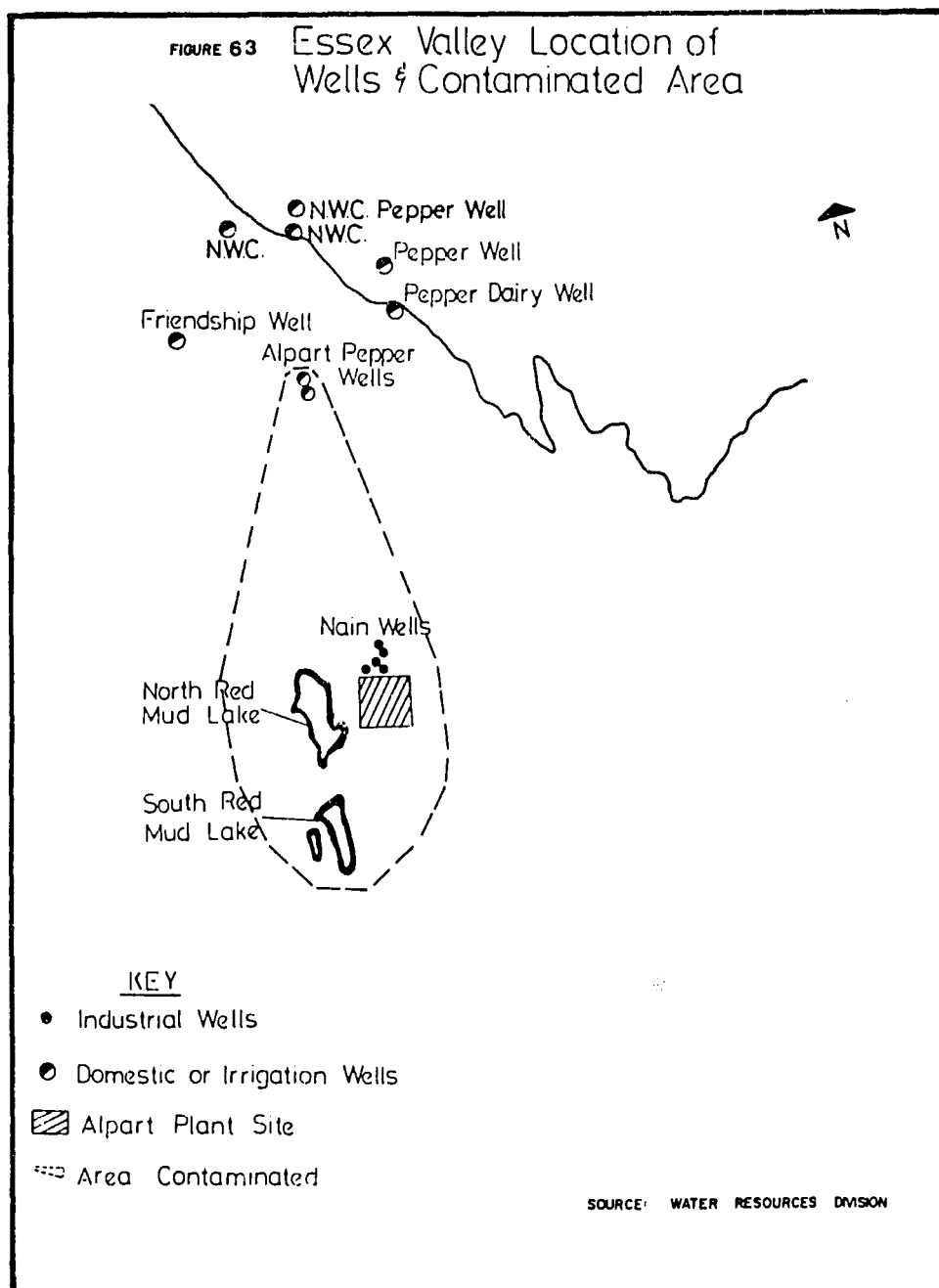
**Table 93:  
Composition of Red Mud**

Compound	Formula	Concentration Range (%)
Hematite	$Fe_2O_3$	2.0 - 50.0*
Goethite	$Fe_2O_3 \cdot H_2O$	2.0 - 50.0*
Gibbsite	$Al_2O_3 \cdot 3H_2O$	0.3 - 0.5
Boehmite	$Al_2O_3 \cdot H_2O$	2.5
Anatase	$TiO_2$	2.0 - 6.0
Quartz	$SiO_2$	1.0 - 2.0
Manganese	$MnO$	0.5 - 2.0
Bayer Sodalite	$3(Na_2O \cdot Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O)Na_2X$	2.0 - 4.0
Cancrinite	$3(Na_2O \cdot Al_2O_3 \cdot 2SiO_2) \cdot 2Na_2(CO_3SO_4)$	.001 - 2.0
Carbonate Apatite	$(Ca,Na)_5(PO_4,CO_3OH)OH$	2.0 - 5.0
Tricalcium Aluminium Silicate	$(3Ca) \cdot Al_2O_3SiO_2$	<5.0
Tricalcium Aluminium Hexahydrate	$3CaO \cdot Al_2O_3 \cdot 6H_2O$	<5.0
Tricalcium Aluminium Monocarbonate	$3CaO \cdot Al_2O_3CaCO_3 \cdot 11H_2O$	<5.0

\*The iron content in Jamaican red mud averages about 50%. Of this, the hematite or goethite content varies, depending on the iron mineralogy of the bauxite processed and the processing conditions.

Source: Douglas, Conrad C. Ph.D. Thesis, University of the West Indies, 1975.





### Bulk Chemical and Other Industries

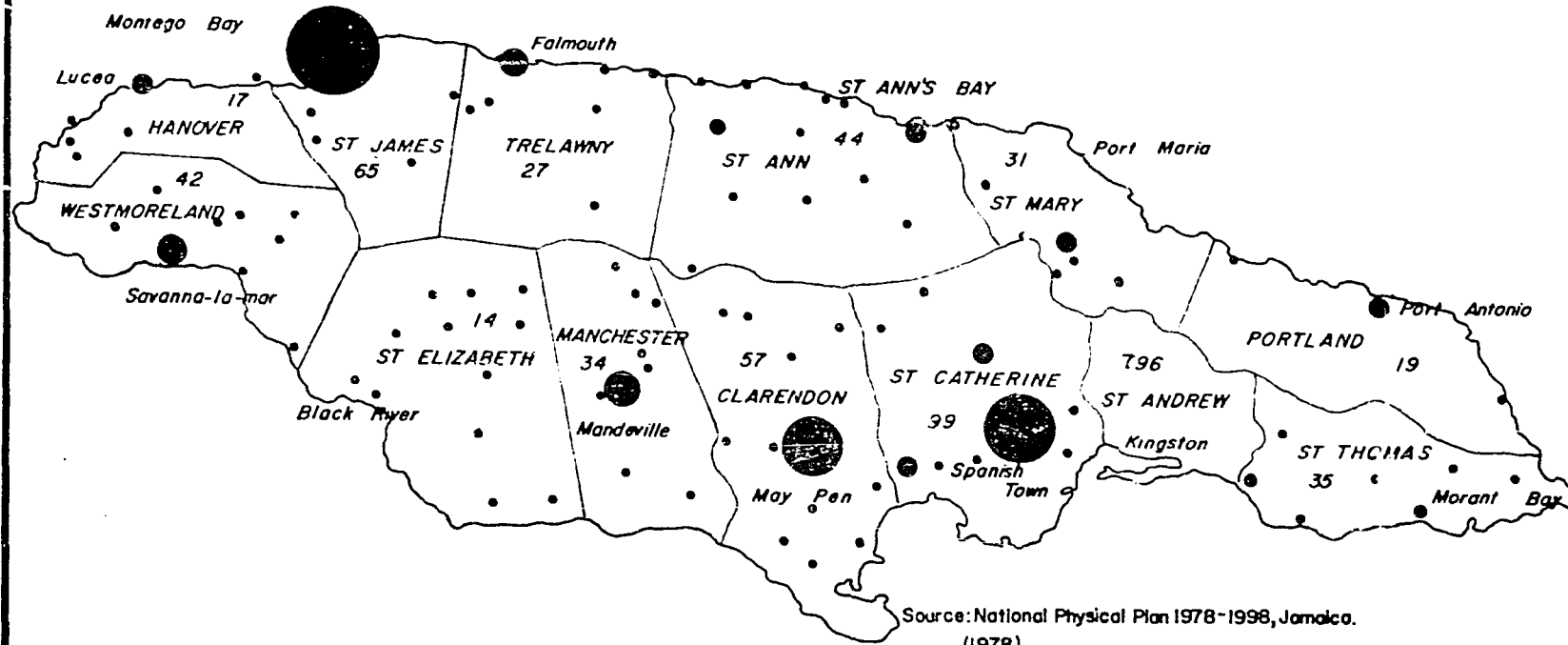
Although the sugar and bauxite-alumina industries are the major sources of industrial pollution in Jamaica, there are several other industrial activities which are current or potential sources of pollution. As illustrated in Figure 64, these are located throughout the island, but are concentrated in the Kingston Metropolitan Area (Kingston and St. Andrew), St. Catherine (Spanish Town), Clarendon (May Pen), Manchester (Mandeville), and St. James (Montego Bay).

The environmental impacts exerted by various other industries may range from minor to severe. Those which exert severe deleterious impacts on the environment are discussed below. However, in combination with other plants, the

cumulative impacts have severely disrupted ecosystems in Jamaica. Foremost among the water bodies adversely impacted is Kingston Harbour.

Bulk chemical industries operating in the island include: the limestone industry, the sulphuric and sulphonic acid industries, the aluminum sulphate industry, salt refining industry, the cement industry, the detergent industry, edible fats and oils, and petroleum refining. Unlike the sugar and bauxite-alumina industries, which are located mainly in rural areas, these industries are located in densely populated urban centres. In some instances, their establishment has influenced the urbanization of adjacent areas, leading to other types of environmental pressures.

FIGURE : 64 DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS



Source: National Physical Plan 1978-1998, Jamaica. (1978)

NOTE: The dot sizes denote the extent of distribution

**The Limestone Industry.** Jamaica has an abundance of limestone of all varieties. It is the island's principal mineral resource. As a result of its many uses (e.g., in the cement, road and building construction industries), the deposits are quarried extensively. (The impact on the environment is more fully described in the Mining and Minerals Sector.) Lime (CaO) is produced on an industrial scale by the bauxite-alumina industry, which operates its own kilns, and is used for the control of impurities and as precoat/filter aid in alumina production. Because the alumina industry is the largest consumer of lime, there is a strong correlation between industrial lime production and the level of bauxite production. In addition to the alumina plants, one factory — Chippenham Park Ltd. located in Brown's Town, St. Ann — produces lime for various consumers.

The aspect of the limestone industry which is of particular concern is the production of burnt limestone (CaO) for metallurgical and other applications. In addition to the environmental problems associated with the quarrying of limestone, the production of burnt lime is usually accompanied by particulate dust, which is emitted with the kiln stack gases. The dust settles in neighbouring communities and creates a nuisance. In addition, because of the highly reactive and corrosive nature of lime dust, it is important that workers in and around lime production plants wear eye protection goggles and respirators.

Because of the abundance of high quality limestone deposits in Jamaica and the potential for its economic development (now underway), it is urgent and critical that guidelines be developed for the management and control of this industry.

**Cement Industry.** There is one cement manufacturing plant in Jamaica which is located at Rockfort in Kingston. The government-owned plant has a production capacity of 400,000 tons/year, which is now being increased to 800,000 tons/year. Table 94 illustrates the production of cement in Jamaica over the period 1983 to 1985. The generally low capacity utilization over the period reflects modifications taking place at the plant and a decline in activities in the construction industry.

The cement industry pollutes the environment in various ways. Thermal pollution results from the discharge of cooling water at a temperature of about 43°C to the sea (Kingston Harbour). Dust pollution which originates from the open stockpiling of clinker (and which will be mitiga-

ted by storage in covered silos), dust emitted from calcination stacks, transfer points, packing operations and grinding of clinker. Despite the installation of dust collectors at these points, fugitive dust continues to pose a nuisance problem to residents in neighbouring communities although the frequency of complaints is substantially less than in the past. The kiln dust collected (a non-toxic mixture of CaO, K<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub> and traces of sodium, phosphorus, manganese and magnesium) is dumped into the sea. There are no documented impacts on the receiving waters.

The Caribbean Cement Company is now in the process of converting its primary fuel source from oil to coal. In anticipation of the potential problems associated with this change, the company has selected the most technologically advanced pollution abatement equipment available and states that its stack gas emission will meet the most stringent international environmental standards. This is critical since, during the day, the winds blow in a westerly direction toward the city of Kingston and atmospheric pollution could have a devastating effect on its environs. In addition, various measures will be taken to mitigate potential problems from coal storage and transfer, including the sprinkling of stockpiles, drainage into settling ponds, recycling of the collected dust, and hooding of the coal conveyor systems. Nevertheless, it will be necessary to design and implement an environmental monitoring and management system.

**Table 94:  
Cement Production in Jamaica  
1981 - 1985**

Year	Production (1000 tons)
1981	161.0
1982	208.0
1983	273.0
1984	257.0
1985	333.8

Source: Caribbean Cement Co.

Gypsum. The gypsum industry is among Jamaica's most developed industrial minerals industries. Large deposits are located in Bull Bay in St. Thomas and are actively mined for supplying the cement industry with raw material, the gypsum products manufacturing industry (e.g., gypsum tiles), and for export.

The environmental impacts caused by the mining of this mineral are: scarification of hillsides, loss of habitats, soil erosion, and sedimentation of waters during heavy rainfalls.

Metals Recycling Industries. Recycling of lead is carried out by Jamaica Metal Refining Ltd. in Spanish Town, St. Catherine. The primary source of raw material is spent lead acid batteries and other sources of scrap lead (Davis). In environmental studies carried out in 1979 (Thomas and Davis), it was determined from the soil enrichment factor, that airborne lead was emitted by the refining operations. Further, elevated lead values in areas adjacent to the plant have been reflected in blood studies done on residents in nearby communities. Elevated lead levels in blood were particularly pronounced in children. The highest enrichment factor was calculated for a sample station located at the plant site, which indicates the occupational hazards of the industry and the need for occupationally exposed workers to exercise the greatest care in utilizing protective equipment at all times.

The Sulphuric Acid, Sulphonic Acid, Aluminum Sulphate and Salt Industries. These industries are operated by Industrial Chemical Company (ICC) at their processing facilities located in Spanish Town, St. Catherine.

o Sulphuric acid is produced from imported sulphur and is supplied to several end users, including the bauxite/alumina industry, battery manufacturers, fine chemical manufacturers and other industries in which it is used as a cleansing and descaling agent. The major environmental impact associated with the production of sulphuric acid is the corrosion of roofs and other metallic objects by the SO<sub>2</sub> produced in the process. Complaints lodged from time to time by residents in areas adjacent to the plant have resulted in mitigating action (increasing the height of the stacks) being taken by the owners of the plant.\*

\* Increased stack height might prove to be a temporary solution in areas close to the plants. However, this practice only serves to transfer the problem from one area another.

Over the past 5-8 years, the intensity of complaints has decreased. Nevertheless, this is one of the cases in which an area zoned for industrial development has experienced the incursion of 'squatters' and subsequent uncontrolled development of human settlements.

- o Sulphonic acid is manufactured for the detergents industry. The environmental problems caused by this industry are similar to those cited in the production of sulphuric acid.
- o Aluminum sulphate is manufactured by reacting alumina trihydrate with sulphuric acid. Except for dust pollution in the working environment, which is abated by wearing respirators, there are no environmental problems associated with the production of this chemical.
- o Imported salt is refined and packaged for the food industry and domestic household use. No environmental problems are associated with salt refining, apart from the corrosive environment created in the immediate vicinity of the plant.

Detergent Industry. Sulphonic acid is reacted with vegetable oils to produce liquid and powdered detergent. Traces of non-biodegradable sulphates in the tailings from this operation leave the plant as an effluent and contribute to the pollution of Kingston Harbour.

Industrial and Domestic Gases. Three companies are engaged in the production of gases for domestic cooking, health, and industrial use. Except for Shell Co., Ltd. which bottles only propane gas for cooking purposes, Industrial Gases Ltd. and Jamaica Oxygen and Acetylene produce a greater variety of gases. Jamaica Oxygen and Acetylene produces oxygen, acetylene, nitrogen, carbon dioxide (from fractional distillation of air and from the fermentaries in the sugar industry), as well as the rare gases. Industrial Gases Ltd. produces acetylene and propane. The gases are bottled in steel and aluminum cylinders and transported to various consumers, including domestic households, hospitals, steel fabrication works other industrial plants and agricultural operations.

The gas manufacturing industry is essentially pollution free, with the production and disposal of calcium carbide sludge being the major effluent from these plants. In the case of Jamaica Oxygen and Acetylene, the sludge is stockpiled at the plant, while in the case of

Industrial Gases Ltd., it is collected in settling chambers and periodically removed in tankers and transported to disposal sites. This sludge, depending on the method of disposal, may be transported to waterways particularly during heavy rainfall.

The internal environmental problems are those common to the safe storage and handling of violently reactive calcium carbide and working under conditions in which gases are stored at high pressures. Industrial hygiene and safety codes and practices are carefully documented and meticulously monitored in these plants. The handling of calcium carbide is covered by legislation.

The Petroleum Refining Industry. One petroleum refining plant - Petrojam Ltd. - is operated by the GOJ. Located in Kingston and formerly owned by Esso, the plant produces a wide range of petroleum products. Apart from the accidental spillage of crude oil from oil tankers which has a devastating impact on water bodies, the major potential problems of the industry are the hazards within the limits of the plant. These pertain to the safe handling and storage of toxic gases and liquids, such as tetra-ethyl lead which is used as an anti-knocking agent in petrol.

### **Agro-Industry**

Jamaica's agro-industry is based on the processing of local produce and imported raw materials. Some of the industries which fall in the latter category are: the animal feeds industry, brewing and beverage industry, and flour industry. Traditionally, the greater portion of the crops produced are exported unprocessed, except for packaging and fumigation for pest control. However, there are several small-scale agro-industrial activities which consume relatively small fractions of the island's agricultural production.

In general, apart from the sugar industry, there is no major environmental problem from agro-industrial activities in Jamaica. Nevertheless, there are a few highly site-specific problems which, in combination with effluents from other industries, have the potential for impacting negatively on specific resources and ecosystems. These are described below.

Brewing and Beverage Industry. The main potential problem in this industry concerns the discharge of effluents from the production of

beer from Desnoes and Geddes brewery located in Kingston. Effluent from the plant is discharged into a natural mangrove lagoon which is connected to the sea.

The by-products of the brewing process are spent grain, trub and yeast. The spent grain, which is removed from the mash filter or lauder tub, has a moisture content of about 65% obtained from pressing prior to drying. The pressed liquor is of primary concern in the effluent discharge. The surplus yeast also has a high percentage of moisture. It is dried in a rotary steam dryer and packaged as animal feed. The filtration during the process results in the generation of filter powder, excess yeast and beer residue which goes into the drainage system. Other sources of waste from the brewing process include spillage, wash and rinse water, cleaning agents and alkali.

Tests have been carried out on flow rates, pH, COD, BOD, and suspended solids. Variations in these parameters were observed to correlate with peak flows during brewing, at transfer points, and during cleaning operations (U.W.L, Chemistry Dept.). No studies have yet been undertaken to assess the impacts, if any, on the environment.

Citrus Processing. The processing of oranges and limes is carried out in plants located at Bog Walk in St. Catherine and May Pen in Clarendon. The products are orange and lime juice, with orange and lime oil as principal by-products. The solid waste (peel and pulp) is used in the production of animal feed. In the case of the plant in Bog Walk, it has been reported that effluents from the factory (mainly wash water containing cleansing agents, caustic soda, and organic compounds) affected water quality in nearby tributaries of the Rio Cobre (White).

Essential Oils. Pimento berry, pimento leaf, ginger and lime oils are produced in several relatively small steam distillation plants located in St. Ann, Portland, Clarendon, Westmoreland, Kingston and St. Catherine. Wood is used as fuel in the smaller, less developed plants, while diesel oil is used in the larger plants. The environmental impacts of these operations are yet to be assessed. However, the major effluent from these plants is hot steam condensate, which contains traces of essential oils. The effluents are discharged directly into rivers and streams.

## **Other Industries**

There are numerous other types of industries, several of them concentrated in industrial estates and others randomly scattered throughout the island. Among these are: food processing\*, tanning, ceramics, earthenware and glass, coffee processing, textiles, paper recycling, slaughter houses, footwear, garment, furniture, electronics, marble, gas, aluminum and iron refining, paint, plastics, ethanol refining, extrusion forms, and industries engaged in the supply of blocks, tiles and bricks for the construction industry.

All of these industries are important contributors to the national economy: they employ labour, manufacture products which substitute for imports and save foreign exchange, and provide critical goods to various sectors. With some exceptions, the environmental problems associated with these industries are limited to the internal working environment. Their impacts are predominantly of the occupational hazards/industrial hygiene type which may affect worker health and safety.

Those industries which do have impacts on the external environment (e.g., battery manufacturers) affect the quality of air, water and land. In some cases, emissions from point sources associated with some of these plants are known to cause damage to properties. In addition, the combined effects of some of these industries in certain locations have severely disrupted important ecosystems, notably Kingston Harbour.

## **Waste Water and Sewage Treatment**

The intensive urbanization and industrialization of the Kingston Metropolitan Region (KMR) has occasioned the need for the installation of waste water and sewage treatment plants in an attempt to preserve the quality of ground water and to mitigate the impacts of waste water disposal to waterways and water bodies such as Kingston Harbour. This has also become necessary in other urban centres throughout the island which are experiencing rapid development and growth.

Some of the waste water and sewage treatment plants — none of which go to the tertiary treatment stage — are privately-owned and operated by industry, while the others are owned and operated by the National Water Commission (NWC). Figure 65 shows the location of the treatment plants in the KMR, their type, ownership, design capacities and present levels of flow.

The treated liquid effluent is discharged into gullies and rivers which flow into Kingston Harbour. This practice has severely impacted water quality in the Harbour. In combination with effluents discharged to the Harbour from other industrial plants, it has caused some nearshore areas to become abiotic. Furthermore, the coliform count in some areas of Kingston Harbour is now above acceptable levels stipulated by such bodies as the World Health Organization. It must be noted that important recreational centres such as public bathing beaches are located along Kingston Harbour.

The devastation of Kingston Harbour continues unabated from waste water effluent originating from primary and secondary treatment plants. Rehabilitation of the Harbour will require a major project, coupled with legislation aimed at more stringent treatment of effluents at point sources.

## **AGENCIES AND INSTITUTIONS**

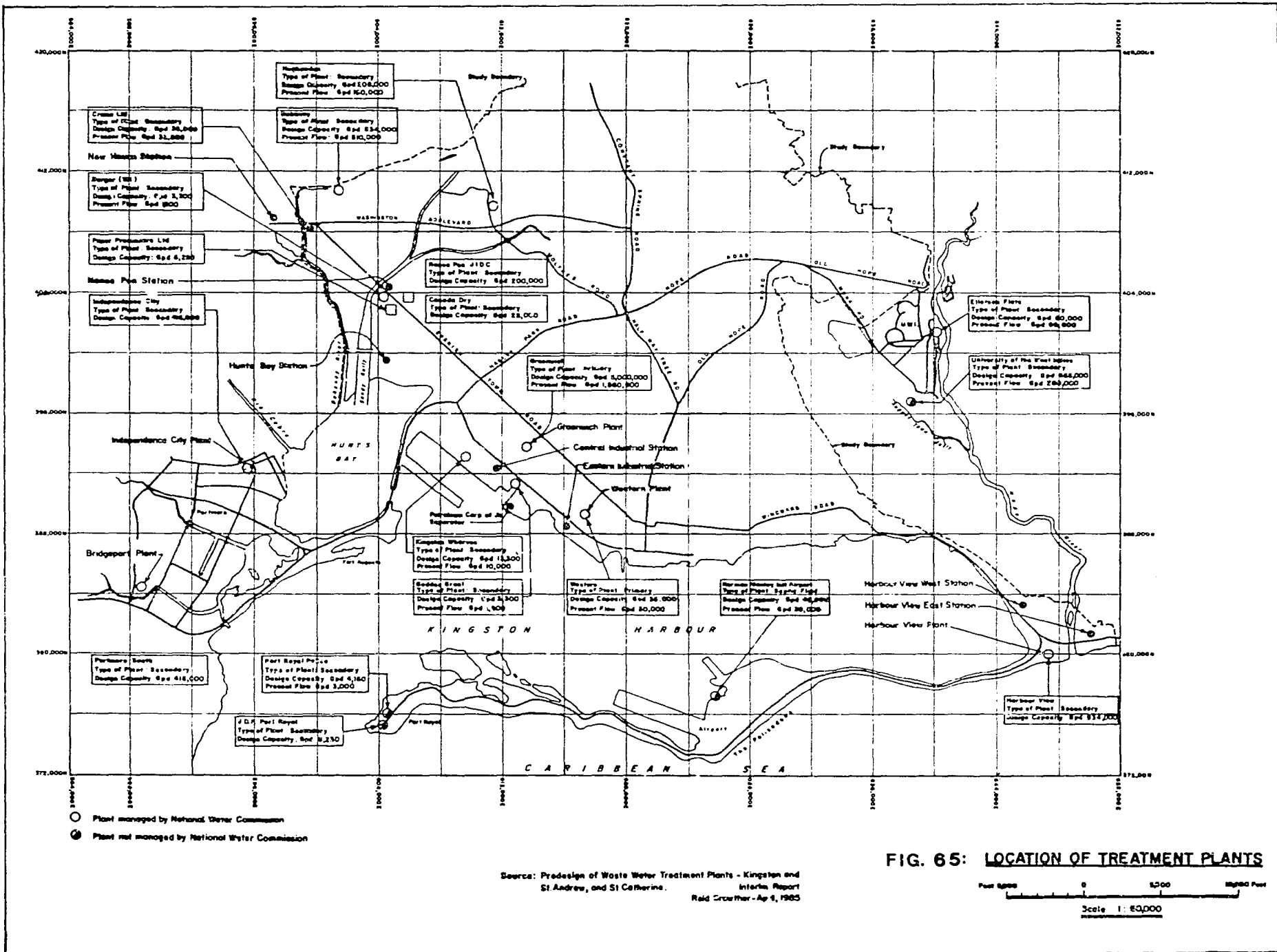
Several agencies of the GOJ are concerned with the country's industrial development. The key agencies are described briefly below.

### **Jamaica Industrial Development Corporation (JIDC)**

JIDC is a statutory body under the Ministry of Industry and Commerce and functions mainly to ensure that the government's industrial development objectives are met. Some of its many activities include: project implementation, provision of technical and managerial services, preparation of feasibility studies, training, promotion of industrial joint ventures locally and overseas, development of factory space, maintenance of an industrial registry profile, and the administration of several industrial incentive laws. The JIDC also operates eight industrial estates and several small manufacturing complexes.

---

\* Excludes processing activities discussed under Agro-Industry.



**FIG. 65: LOCATION OF TREATMENT PLANTS**

## **Jamaica National Investment Promotions Ltd. (JNIP)**

The JNIP was established in 1981 to foster and promote investment in Jamaica by providing various services to potential investors. It also administers the Industrial Incentives Act of 1958. JNIP frequently consults with the Natural Resources Conservation Division on project activities.

## **Jamaica National Export Corporation (JNEC)**

The JNEC is responsible for the development, promotion and expansion of Jamaica's non-traditional products on the international market. It provides information on external markets and organizes trade missions and seminars to assist exporters to break into the export market.

## **Jamaica Exporters Association (JEA)**

The JEA functions primarily in promoting exports in developing non-traditional areas. In doing so, it maintains international contacts with CARICOM and other regional and international organizations representing export companies. The JEA also provides substantial inputs to National Export Policy.

## **Jamaica Manufacturers Association (JMA)**

The JMA was established in 1947 as a limited liability company in response to increased industrial activity which followed World War II. It provides various services to members, such as promotion of local products, providing information on improved manufacturing methods, securing local and export markets, arranging trade fairs, and providing representation to the government on legislative and regulatory matters affecting its members. It also participates in policy making.

## **Bureau of Standards**

The Chemistry, Microbiology, and Quality Audit Department of the Bureau of Standards tests a wide range of industrial commodities and provides technical assistance to industry on the design and implementation of quality assessment systems. The Food, Science and Agricultural Commodities Department is concerned with standards and inspection for agricultural com-

modities and food permits. The Bureau also monitors industrial safety standards.

## **Small Business Association of Jamaica (SBA)**

The SBA is a non-profit organization which was established in 1974 and represents the small business sector in Jamaica.

## **LEGISLATION AND REGULATIONS**

### **Industrial Incentives Laws**

The JNIP administers the Industrial Incentives Act of 1958, which was designed to grant fiscal incentives to present and potential manufacturers and processors whose primary interest is in the local market as well as other CARICOM regions. Benefits include full exemption from income tax liability for up to nine years, exemption from customs and duties on imported equipment and machinery, and exemptions from customs duty on raw materials.

The JIDC administers several other industrial incentive laws:

- Export Industry Encouragement Law, Law 49 of 1956
- Special Export Scheme
- Factory Construction Act, Law 9 of 1961
- Special Employment Scheme for the Garment Industry
- Motion Picture Industry Encouragement Act, Law 34 of 1948.

The Export Industry Encouragement Act was specifically aimed at manufacturers producing goods for export outside the local and CARICOM regions. Benefits include exemption from income tax payments for a period of up to 10 years and exemption from import duties on basic raw materials, machinery, equipment and from tax on dividends to shareholders as prescribed under the Industrial Incentives Act.

The Factory Construction Act provides incentives and relief for companies approved under the Industrial Incentives Act or the Export Industries Encouragement Act. For the establishment of a factory, an approved builder is granted certain exemptions from import duties as well as income tax relief for a period of 15 years.



## **Regulation of Industry and Environmental Protection**

Several laws are concerned with regulation of industry and control of the impacts of industrial development and operation.

Town Planning Department (TPD). The Town and Country Planning Act of 1957 and the Local Improvement Act are the two main statutes which control the development and subdivision of land. In accordance with these laws, plans for industrial development are reviewed by TPD. The planning decision is based on several factors, including the location of the development, the nature of the industrial process to be carried on, the land-use and zoning, the effect of the proposal on amenities, traffic implications, etc. Specific conditions may be imposed on approved plans.

Bureau of Standards. The Bureau administers three acts and their attendant regulations: the Standards Act (1968), the Processed Food Act (1959), and the Weights and Measures Act (1976).

Natural Resources Conservation Division (NRCD). There is no specific legislation relevant to the policies and activities of the Aquatic Resources Division of the NRCD.

Environmental Control Division (ECD). There is no specific legislation which guides ECD's activities. The ECD operates under the Public Health Act which was revised in 1974, but did not become operational until early 1985.

Underground Water Authority (UWA). The UWA is in the final stages of discussion of the draft Water Resources Act, which will require that all effluent discharges be subjected to license, and will formulate a National Water Quality Plan.

## **PLANS AND PROGRAMMES**

### **Jamaica Bauxite Institute (JBI)**

The JBI is in the process of preparing a project to index bauxite lands throughout the country. In 1976, the Government began to acquire over 500,000 acres of bauxite lands from the bauxite companies, and implementation of agreements for the acquisition of these lands is now almost complete. The Bauxite Index Map (a cadastral index) is the vehicle used for recording all such

land matters. The Bauxite Index Map is to be used for the following purposes:

- To calculate dedication fees;
- To enable ready identification of privately-owned lands which fall within special mining lease areas;
- To facilitate the supervisory duties of Government Land Officers by enabling easy identification of the land parcel;
- To assist the Commissioner of Lands and the JBI in processing lease applications for bauxite lands;
- To facilitate the Government's Land Valuation Division reevaluation efforts;
- To aid the Collector General's Department in the collection of property tax on the basis of total acreage of land within a Mining Plan; and
- To provide a base for computerization of all bauxite land data.

In addition, this series of maps will be a contribution to the National Cadastral Series being prepared by the Survey Department. The project will be funded by the International Research Development Centre (IRDC) of Canada and will cost approximately US\$100,000.

### **Jamaica National Investment Promotions (JNIP)**

As noted above, the JNIP encourages industrial growth through specific strategies to assist the investor. The JNIP is currently involved in a Parish Investment Programme, which is aimed at stimulating economic development of parishes islandwide. The programme calls for an objective and scientific approach, through which a parish economic development plan is developed based on the parish's human, natural and physical resources. Committees have just been formed; no plans have yet been formulated. The JNIP is also involved in a joint Factory Building Program with the JIDC.

### **Jamaica Industrial Development Corporation (JIDC)**

Factory Building Programme. The New Construction Department of JIDC's Industrial Estate Division is currently involved in a National Fac-

tory Building Programme, which was started in the 1984-1985 year and will continue over a 3-year period. The JIDC has plans to obtain some of the Tryall Estate lands in Hanover for light manufacturing industry (e.g., garments, stationery and office supplies, and cosmetics). Also, an additional 100,000 sq. ft. for light manufacturing industry is planned to be built in the Montego Bay Freeport. The Constant Spring small industry complex is to be built on the Percy Junor Lands, and will be designed solely for small, light industries and include an entertainment complex.

Funding for this programme is through a loan from the Caribbean Development Bank of US\$6.8 million (70-80% funding), commercial bank loans, divestment of assets, and rental income from existing factories. The overall cost of the programme is approximately J\$90 million.

Factory Upgrading Programme. The JIDC is undertaking an inventory of existing factory space and upgrading, and refurbishing work is taking place in three main areas: (1) Individual Factories (Industrial Estates): 892,000 sq. ft. in 45 factories are being upgraded; (2) Small Industry Complexes: 298,000 sq. ft. in 9 locations with over 100 tenants being upgraded; and (3) Industrial Trade Training Centres island-wide are being refurbished to provide 181,000 sq. ft. of space.

The potential environmental impacts from these programmes are expected to be minimal. An integrated development programme is being pursued to lay out new factory space, which include physical infrastructure for proper disposal of effluents (e.g., road drains, sanitation facilities and incinerators for garbage disposal). With the additional factory space, the current number of factory employees (over 12,000) is expected to double, assuming favourable economic trends.

### **Research Programmes**

Several organizations are engaged in research on industrial activities:

- University of the West Indies (UWI), Physics, Chemistry, Zoology, Geography and Botany Departments; Nuclear Center;
- Jamaica Bauxite Institute;
- Alcan Jamaica Ltd.
- Scientific Research Council.

The projects being pursued by these institutions, which have the best equipped facilities for research in the island, include:

- Study of red mud utilization in building construction — Physics Department, UWI;
- Use of red mud as a filler/extender in plastics — Jamaica Bauxite Institute — JBI;
- Improvement in the dry stacking of red mud — Alcan Jamaica Limited;
- An air pollution survey of the Jamaica Public Service (JPS), Hunts Bay Power Station — Chemistry Department, UWI;
- Trace metals in soils — Chemistry Department, UWI; and
- Monitoring and modeling of water quality of Kingston Harbour in the vicinity of major outfalls — Chemistry Department, UWI.

## **PROBLEMS AND ISSUES**

### **Development Pressures Affecting Industry and Industrial Pollution**

Current development policy is aimed at increased economic activity in tourism, agriculture, agro-industry and light manufacturing, the bauxite-alumina industry, and exploitation of the country's limestone resources.

- o Increased tourism activities will increase the demand for local goods and services, as well as exerting direct and indirect impacts on the country's natural resources, particularly those coastal and nearshore waters used for recreational activities.
- o Agricultural and agro-industrial activities will bring more idle land into production, and will require the increased use of pesticides and irrigation water, at the same time generating more effluents from processing activities.
- o Light manufacturing activities will increase in response to the demands of better and larger markets made possible through the Caribbean Basin Initiative (CBI), CARIBCAN, and the LOME-EEC Convention.
- o Reduced interest rates (globally) and a reduction in the price of fuel oil has resulted in an increase in demand for bauxite and alumina. The likely trend will be towards greater output and increased environmental pressures.
- o Jamaica's limestone industry has been largely underdeveloped, although the country has a range of high grade limestone which is suitable for a variety of end uses. Limestone accounts for more than 66% of the island's mineral resource and 80% of its total surface

coverage. It is found throughout the island. Hence, without the development of guidelines and regulations for the management of its exploitation, environmental impacts from expansion of the limestone industry can be diverse and far-reaching.

The combined effects of these activities will be for greater competition for land and other resources with a concomitant increase in the potential for impacting the environment.

### **Priority Problems and Key Issues**

There are several problems and issues concerning the environmental impacts of industrial activities which need to be addressed in a policy framework. The most critical problems are as follows:

Inadequate Legislation. Existing legislation is, by far, inadequate for dealing effectively with the environmental problems caused by industry. A comprehensive review of existing legislation is necessary to guide industrial development, regulate, abate and control the environmental impacts caused by industry.

Lack of Enforcement. The monitoring and enforcement of legislation needs to be assessed and evaluated. Substantially more monitoring is needed, and greater authority given to the NRC and ECD for enforcing the law where breaches occur.

Lack of EIA prior to Establishment of Industries. As a matter of policy, all new industries should be required to prepare and submit an EIA as part of any development proposal.

Inadequate Financial Resources for Institutions and Agencies to Perform their Functions Effectively. The lack of financial resources has severely hampered the activities of the NRC and the ECD. There is a great need to fill vacant positions in both organizations and to acquire basic equipment.

In addition to these policy and institutional problems, there are other problems related to specific impacts on the environment.

Contamination of Aquifers and Other Water Bodies. The lack of treatment prior to the discharge of liquid effluents from the alumina and sugar industries has resulted in severe contamination of the country's water resources. In several cases, red mud effluent and dunder

have caused the concentration of sodium and other pollutants to be above the minimum requirements for domestic and agricultural water use. Specifically:

- o Kingston Harbour is now seriously polluted by effluents discharged from slaughter houses, gullies, the fats and edible oil industry, and sewage treatment plants. Once an important fishing ground and recreational centre, the Harbour is now abiotic in several places, and the coliform count is unacceptably high in the harbour in general and at public bathing beaches.
- o The Cabaritta and Black rivers have been affected by the discharge from sugar factories (dunder) and by eutrophication resulting from transportation of fertilizers to these waterways.
- o The Rio Cobre is intermittently affected by caustic soda (used as a cleansing agent) discharged from factories in the St. Catherine area.
- o Water used for washing/beneficiation of limestone at quarries is also discharged untreated into waterways, the effects of which have not been evaluated.

Atmospheric Pollution. Gaseous and particulate emissions from the bauxite-alumina, sugar, sulphuric acid, limestone quarrying industries, lead refining and power plants need to be addressed. Although efforts have been made by companies in these industries to control emissions, there are still regular complaints from residents in neighbouring communities. These emissions should be critically assessed and evaluated, and standards established to regulate emission levels. In most cases, these environmental impacts are at the nuisance level only. However, in others, corrosion and fumigation have been experienced by residents.

Industrial Zoning. Despite efforts to locate industries in specific zones, there are still incursions, with the consequence of displaced human settlements within industrial areas. Strict enforcement is needed to curtail these violations.

Environmental Control Standards. There is a need to characterise the effluents from industrial plants and to develop physical and chemical standards for their regulation and control.

Worker Safety and Health. Although this is addressed by the Public Health Act, specific

situations exists in various plants which need to be addressed, in respect to heat, noise, the handling of toxic and corrosive chemicals, dust levels, and overall worker safety and hygiene.

Waste Treatment and Recycling. Very little attention is paid to this matter, although substantial cost-savings and benefits to various plants, as well as alleviation of the pressures on the environment, could be realized.

## **DIRECTIONS FOR THE FUTURE**

The following actions should be undertaken with urgency, for short to mid-term implementation, in order to restore a balance between the environment and industrial activities.

1. A comprehensive review of the legislation for environmental control needs to be carried out.
2. Emission standards, based on the characterization and assessment of the potential impacts of various industrial effluents, should be developed. Companies should be required to keep records which would be monitored on an ongoing basis. Penalties should be applied when standards are exceeded.
3. Environmental impact studies should be required as a part of all development proposals.
4. The institutions involved in environmental control and monitoring should be strengthened and vested with the necessary means and authority to monitor and enforce breaches of environmental control.
5. An education programme needs to be launched within industry to build awareness among plant operators on the effects of effluents on the environment, methods for controlling them, and the potential (direct and indirect) benefits of mitigating those impacts.
6. Strict enforcement of industrial zoning needs to be practiced in order to avoid haphazard, chaotic urban development.
7. Special programmes/projects should be undertaken to restore seriously affected natural resources and ecosystems.
8. The laws governing worker safety and health should be reviewed in light of new industrial developments and epidemiological findings reported in other countries.



Plate 44 - Burnt out slopes; foot hills of the Blue Mountains.



Plate 45 - Soil Erosion along beach.



Plate 46 - Simulation Airport Rescue Operations, organised by the Office of Disaster Preparedness.



Plate 47 - Rescue operations by the Jamaica Defence Force, following '79 Flood Rains.

## ENVIRONMENTAL HAZARDS

---

### OVERVIEW OF HAZARDS AND THEIR IMPACTS

Jamaica, like other Caribbean island states, is vulnerable to a large number of natural and technological hazards. The consequences of these hazards have frequently included loss of life, personal injury, and damage to property, including crop destruction.

The major natural hazards to which Jamaica is vulnerable — earthquakes and hurricanes — have exerted a severe impact on natural systems over the years. The severity of the impact is often exacerbated by the activities of man. Unlike natural hazards, technological or environmental hazards give rise to events of relatively short duration, but which can create emergency conditions and which may severely impact natural resources or processes.

Development activities often create the potential for adverse environmental impacts due to transportation mishaps (e.g., oil spills), industrial accidents (e.g., release of chemicals), and nuclear accidents. Fires and plant and animal diseases may be caused by a combination of man-made and natural factors.

Drought and famine, influenced by both natural and man-induced causes, are excluded from this review as they are, with few exceptions, considered to be of secondary importance within the context of the Caribbean Region.

### Flooding

Flooding is the major natural hazard affecting Jamaica. Information about floodprone areas is greater than for any other type of hazard because of the frequency and magnitude of the flooding problem. Correspondingly, there is greater knowledge, more effective techniques, and more reliable data for identifying and coping with floods than with other natural hazards.

Flooding may be riverine, coastal (due to storm surge), or flash floods induced by intense rains in the upper catchments of Jamaica's watersheds.

Riverine Flooding. Areas subject to riverine flooding include: (1) those areas at risk due to their proximity to natural channels (rivers and streams) and artificial channels (mainly gullies); and (2) those areas at risk due to runoff from steep slopes and poorly drained areas.

Coastal Flooding. Coastal flooding, though uncommon, is largely the result of hurricane induced storm surge. It may also result from seismic activity caused by large-scale movement of the ocean floor. Tsunamis have been recorded several times along the north coast, in the vicinity of Annotto Bay, Hope Bay, St. Margaret's Bay, and Port Antonio

Table 95 records the instances of flooding due to storm surge. Figure 66 shows the locations designated as high risk areas. The Kingston Harbour Area (including Palisadoes and Portmore) is particularly vulnerable to coastal flooding due to increased population densities and expanding commercial development along the waterfront.

Figure 67 describes the results of a 1968 study on potential storm surge associated with hurricanes affecting Kingston Harbour. A more recent study conducted by the Jamaica Public Service Co. (JPS) indicates that risk to storm surge in the Harbour Area exceeds the 1968 calculations.

**Table 95: Recorded Instances of Coastal Flooding Due to Storm Surge**

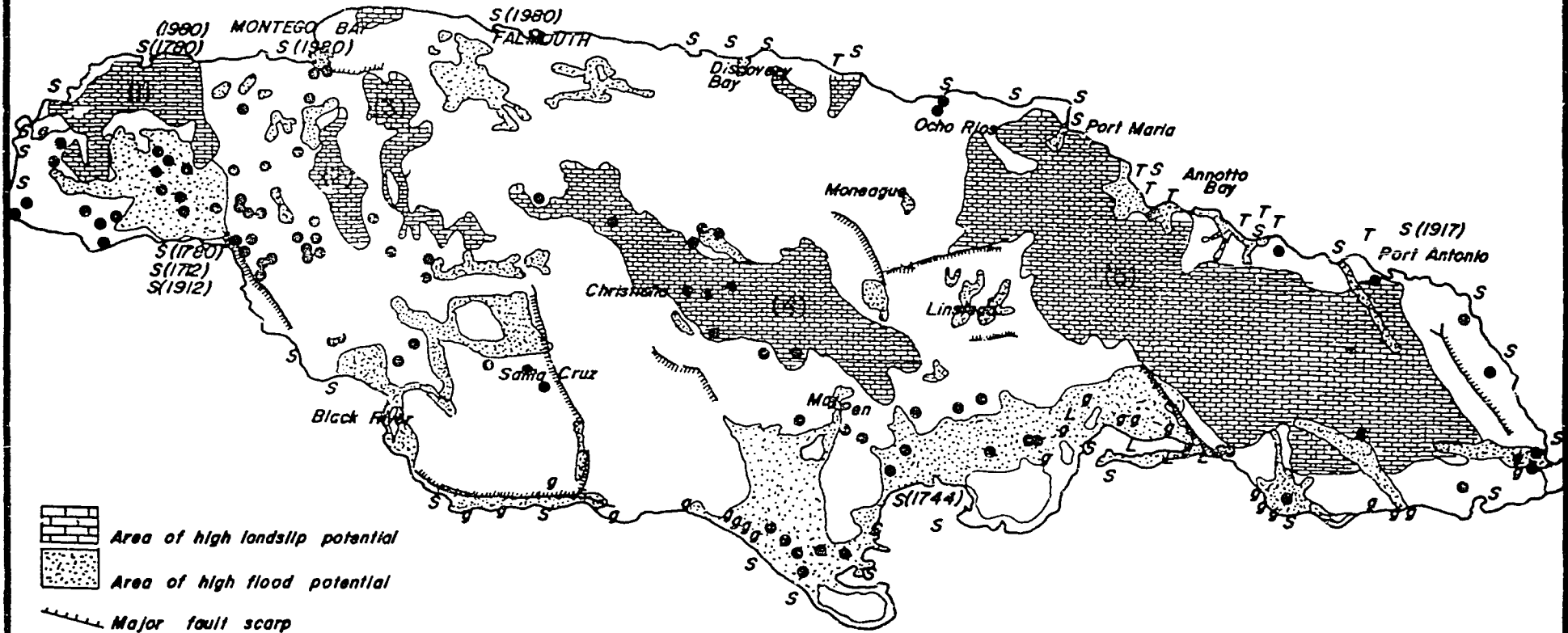
<u>Location</u>	<u>Year of Recorded Flooding</u>
Savanna-la-mar	1780, 1712, 1912
Negril	1780
Lucea	1780, 1980
Montego Bay	1980
Falmouth	1980
Rio Bueno	1980
Discovery Bay	1980
Runaway Bay	1980
St. Anns Bay	1980
Ocho Rios	1980
Oracabessa	1980
Galina	1980
Annotto Bay	1950, 1980
Buff Bay	1980
Hope Bay	1930
St. Margaret's Bay	1903, 1980
Port Antonio	1917, 1980
Boston Bay	1980
Long Bay	1980
Manchioneal	1917, 1980
Holland Bay	1980
Port Morant	1980
Morant Bay	1980
Poor Man's Corner	1980
Kingston/Palisadoes	1722, 1744, 1815, 1874
Old Harbour Bay	1744
Black River	
Whitehouse	




Source: Geological Survey Department (GSD), Preliminary Map of High Risk Areas, undated.



FIGURE 66

PRELIMINARY MAP OF HIGH RISK AREAS - JAMAICA

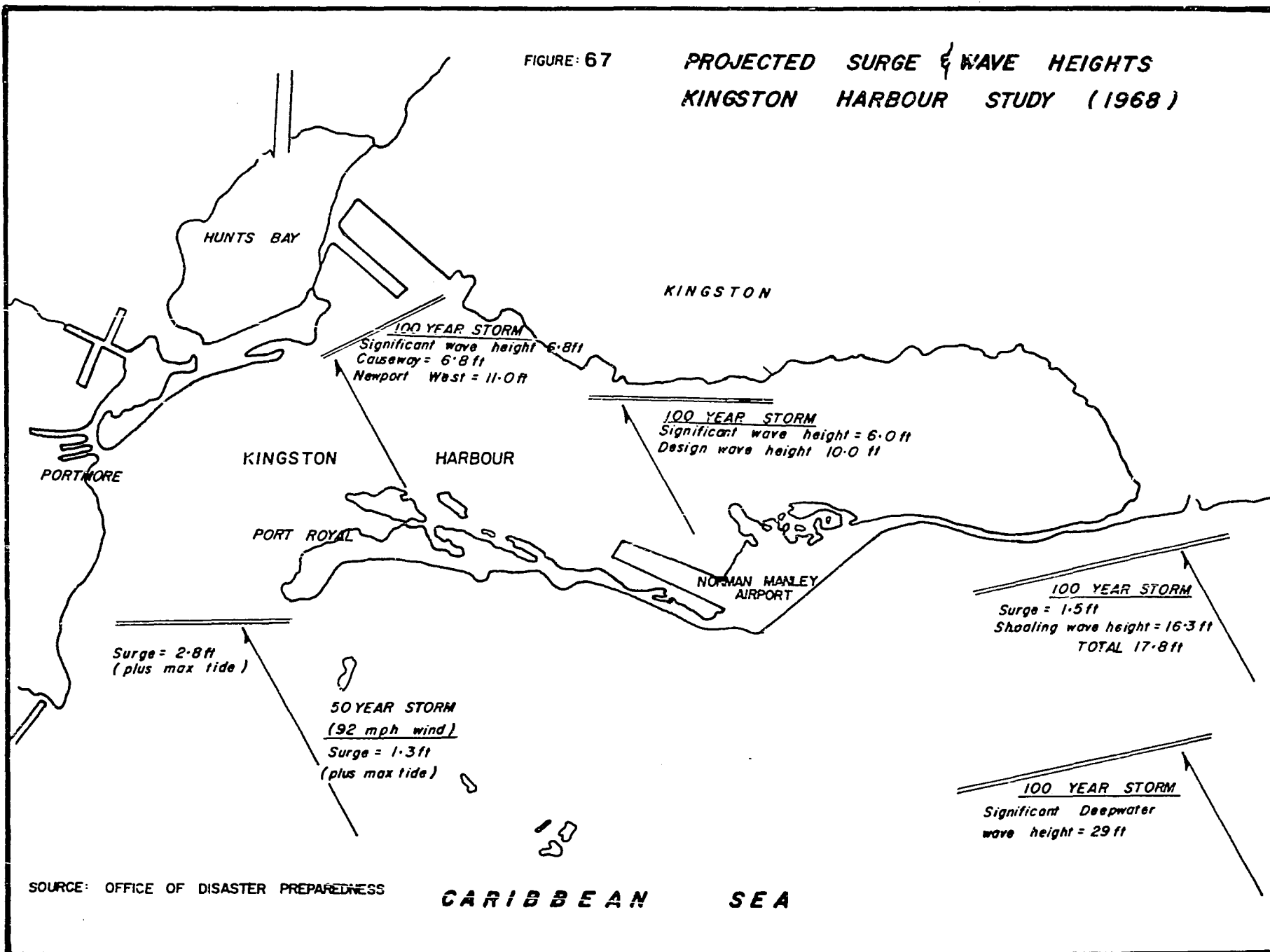


-  Area of high landslide potential
-  Area of high flood potential
-  Major fault scarp
- S* Destructive storm surge potential
- g* High liquefaction potential
- T* Historical record of tsunami
- L* Historical record of liquefaction effects
- Record flood events

SOURCE: GEOLOGICAL SURVEY DEPARTMENT

FIGURE: 67

# PROJECTED SURGE & WAVE HEIGHTS KINGSTON HARBOUR STUDY (1968)



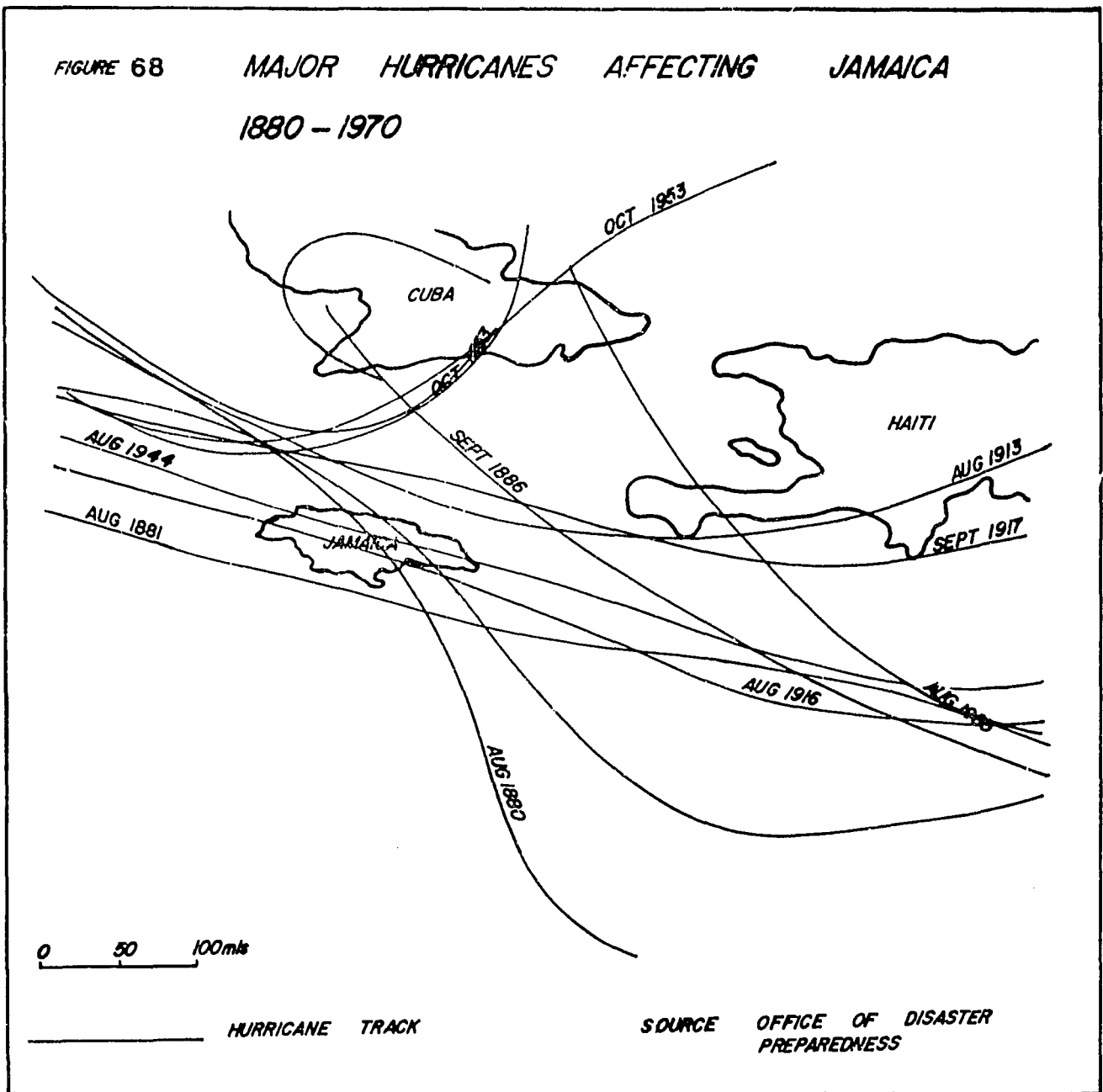
SOURCE: OFFICE OF DISASTER PREPAREDNESS

CARIBBEAN SEA

Underdeveloped coastal stretches are also subject to coastal flooding. These include sites between Old Harbour Bay and Black River, between Morant Bay and Poor Man's Corner on the south coast, and between Annotto Bay and Buff Bay on the north coast.

Hurricanes pose the greatest threat from coastal flooding in Jamaica. Figure 68 shows the tracks of the major hurricanes affecting Jamaica between 1880 and 1970. The number

of hurricane tracks passing through or in close proximity to the island is an indication of the level of risk of coastal sites to hurricane-induced flooding. Most of the hurricanes which have passed directly over Jamaica have made landfall in close proximity to Kingston, hence, the priority attached to Kingston in current mitigation planning. In addition to hurricanes, severe tropical storms also pose the threat of coastal flooding.



## Seismic Risk Areas

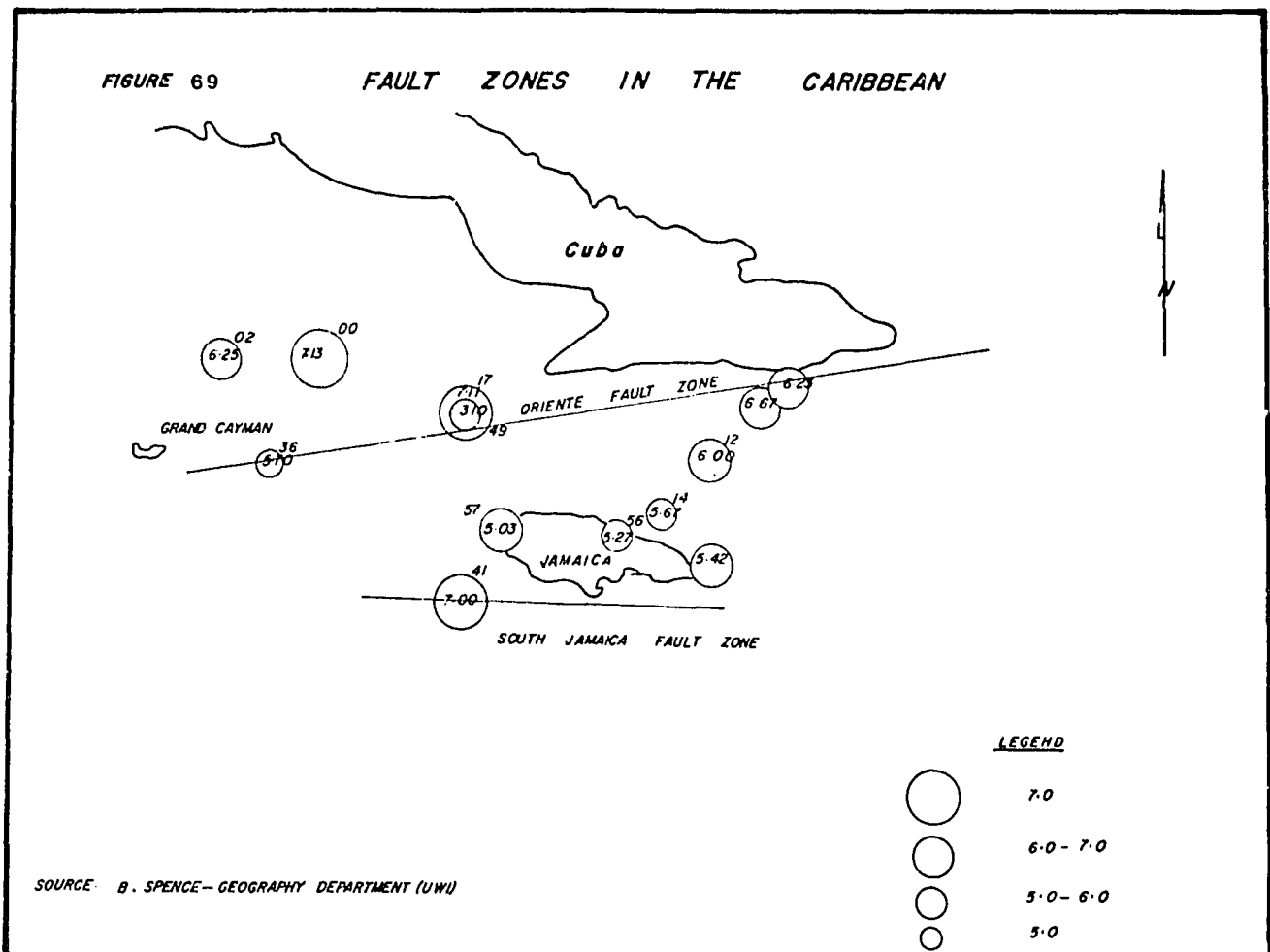
Because Jamaica is situated only 90 miles south of the Cayman Fault (see Figure 69), which forms the boundary between the Caribbean and North American plates, it lies within one of the world's highest seismic risk areas (Spence, 1982). Past damaging earthquakes affecting the island, however, have not been attributed to activities in the Cayman Fault, but rather to secondary faults in close proximity to the north and east coasts. Generally, these secondary faults appear less active than major fault zones along the plate boundaries but have produced earthquakes of intensity VII and X in 1941 and 1692, respectively (Periera 1962).

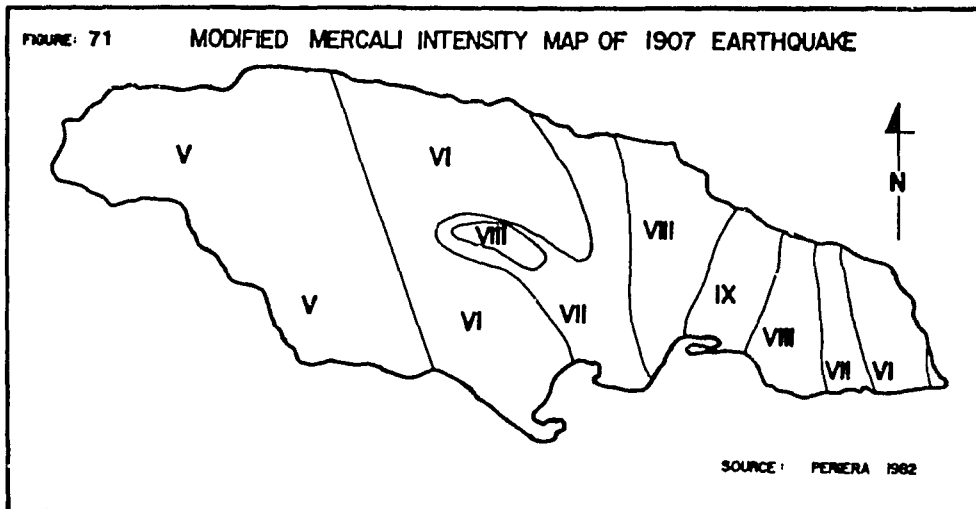
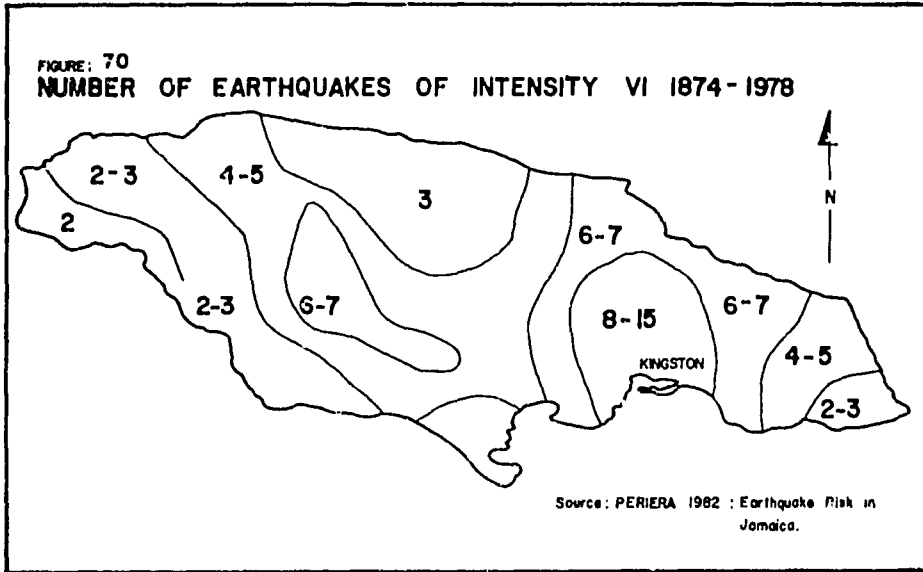
Seismic events of intensity VI and above are classified as damaging according to the Modified Mercalli Intensity Scale. Figure 70 shows the frequency of earthquakes of intensity VI in Jamaica for the period 1874 - 1978. The Kingston Metropolitan Area (KMA), which includes the newly urbanized sections of south St. Catherine (Portmore), has the highest population density on the island. It has also experienced the highest frequency of seismic events, as well as the greatest intensities of

such events. (See Figures 70 and 71.) Return periods for specific Modified Mercalli intensities have been computed for the KMA, (Shepard, 1971); and the return periods of the earthquakes along with their potential effects are shown on Table 96.

Based on the degree of material consolidation and the depth of ground water, the KMA (especially unconsolidated sites, such as the Palisadoes, and recently filled areas of the Kingston Waterfront and Portmore), is regarded as a high risk area. In recent years, vulnerability has increased measurably as the result of construction of high rise structures, especially on the waterfront, and in New Kingston, and along the north coast.

Several highrise resort areas on the north coast, such as those in Ocho Rios and Montego Bay, are also considered high risk. Earthquake frequency and intensity along the coastal strip from Ocho Rios to Port Antonio compares with that of the KMA. Historically, earthquake frequency and intensity on the north coast has been less than in the KMA. Nevertheless, low intensity earthquakes in these areas may cause considerable structural damage to high rise buildings.





**Table 96: Return Periods for Modified Mercalli (M.M.) Intensities and Anticipated Effects.**

<u>Return Periods</u>	<u>Examples of Occurrence</u>	<u>Modified Mercalli Intensity</u>	<u>Effects</u>
7 Years	1945 1956	VI	Broken dishes, windows, glassware, plaster cracked.
38 Years	1824 1918	VII	Fail of plaster, loose bricks, difficult to stand
87 Years	1812	VIII	No structural damage to buildings built to withstand earthquake, some nonstructural damage, cracks in reinforcement.
137 Years	1907	IX	Possible damage to earthquake resistant structures, pipes broken, general panic.
273 Years	1692	X-IX	Reinforced structures destroyed; significant damage to most structures; serious damage to earthquake resistant structures

Source: Perierra, J. (1982). Earthquake Risk in Jamaica (using Gumbel 1958 equation).

Ground failure during seismic events is related to site geology, a feature which must be considered in assessing natural hazards (Spence, 1982). In addition to possible effects on structures, ground response has significant implications for liquefaction,\* and especially in the Kingston Waterfront, Portmore and Palisadoes areas.

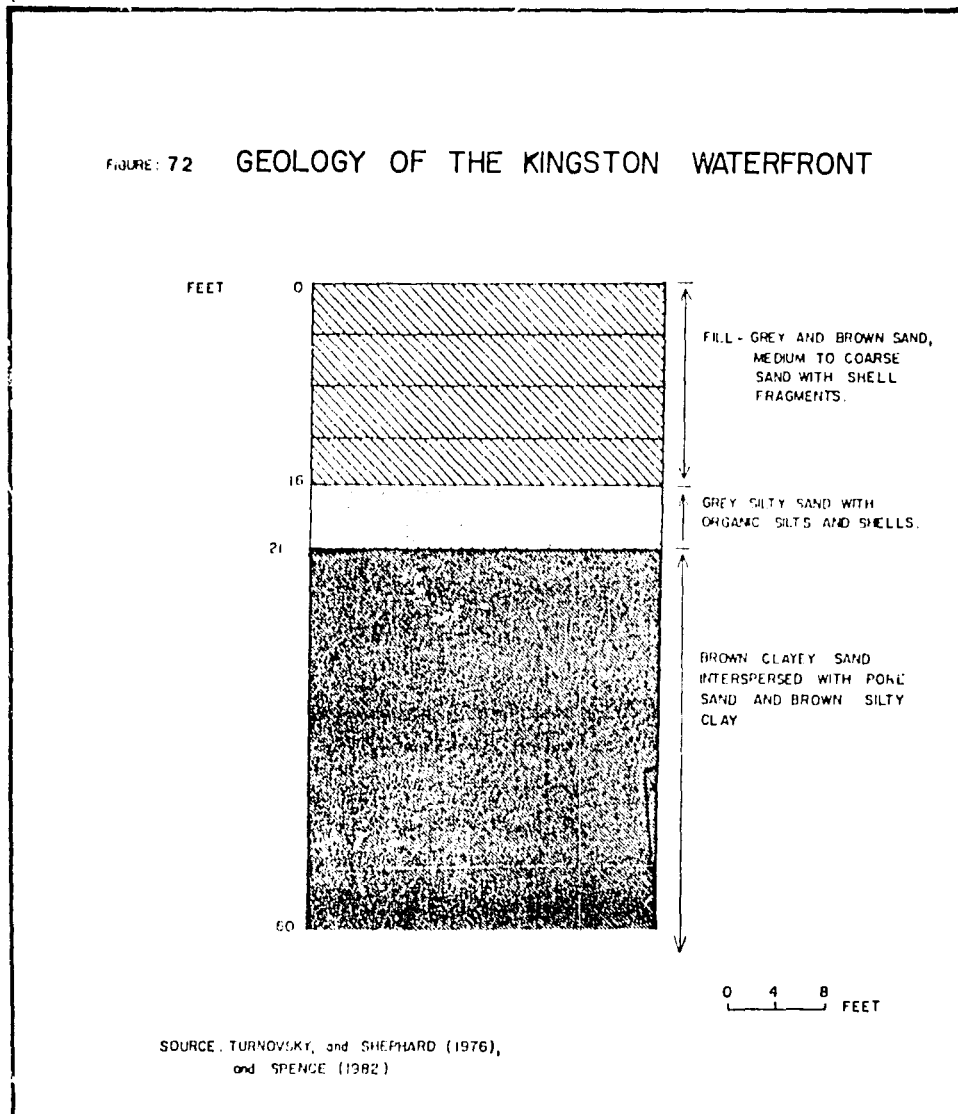
Near-surface geology, based on soil borings at the site of the Petrojam Oil Refinery in 1962 (Turnovsky and Shepherd, 1976), reveals a layer of fill to a depth of 16 feet (see Figure 72). Figure 73 shows the near surface geology for the Portmore area. In both areas, wetland areas have been reclaimed by land-filling and the water table is high. These conditions of near-surface geology have serious implications

for ground response and seismic vulnerability during earthquakes.

---

\* Liquefaction occurs when the pore pressure in the soil exceeds the containing pressure, causing a total loss of shear strength and in effect causing the substrate to behave like a liquid. In 1692, the ground is reported to have liquified spontaneously around the Port Henderson Hill and Dawkins Pond - the site of the present day Edgewater and Bridgeport developments in Portmore. Waterspouts which were generated, flowed copiously for nearly 24 hours after the earthquake, which must have caused ground subsidence (Shephard, 1971).

FIGURE 72 GEOLOGY OF THE KINGSTON WATERFRONT



SOURCE: TURNOVSKY, and SHEPHARD (1976),  
and SPENCE (1982)

### Landslip Risk Areas

Landslips have occurred throughout the island. Some of the areas which have experienced recurring landslips are:

- Junction Road
- Central and Northern St. Mary
- North St. Andrews, Jacks Hill, Mavis Bank, and Newcastle
- Mountainous areas of St. Thomas

In addition to areas where landslips have occurred, the Geological Survey Division has identified and mapped areas of high landslip potential. (See Figure 66.) In compiling the landslip potential map for Jamaica, the GSD has considered a number of physical parameters, including: slope angle; vegetation cover; rainfall; soil permeability; and geo-technical grouping of earth material at the site of investigation. Based on these parameters, three landslip groupings have been delineated: areas of low, moderate, and high landslip potential.

Five geo-technical groupings of earth material are considered susceptible to landslip in Jamaica: Alluvium; Wagwater Formation; Newcastle Volcanic Formation; Yellow Limestone and Richmond Formation.

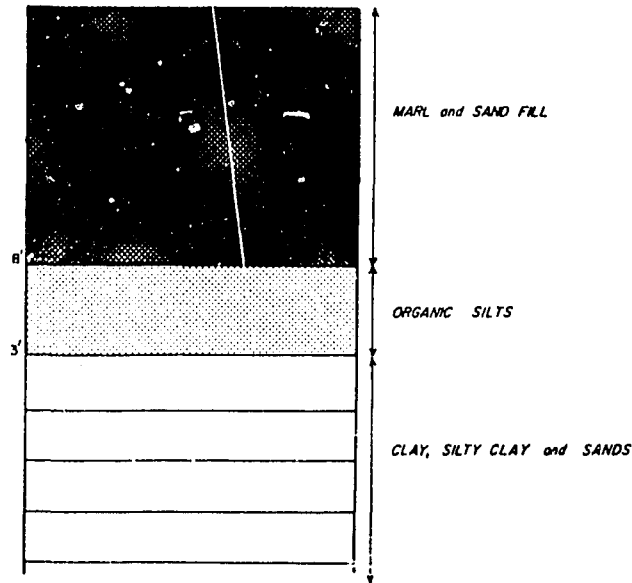
Alluvium. Although the alluvium group is generally considered to have a low landslip potential, it is increased when alluvial sites are developed. Slope angle of areas in this geo-technical group are low, rarely exceeding 5 degrees. Slope stability is, however, dependent on soil strength, particularly cohesion. Alluvium is the common material in the lower valleys of major rivers in Jamaica, including the following areas;

- Georges Plain of Westmoreland, in the Cabarritta and Sweet River Valleys;
- Lower Rio Minho Valley - Vere Plains;
- Lower Rio Cobre Valley;
- Lower Plantain Garden Valley;
- Middle and Lower Valleys of the Montego and Martha Brae Rivers; and

GEOLOGY OF PORTMORE

FIGURE 73

(CROSS SECTION)



SOURCE TURNOVSKY and SHEPHARD (1976),  
and SPENCE (1982)

- Middle to Low Rio Grande and Spanish River Valleys.

Wagwater Formation and Newcastle Volcanic Formation. Found mainly in the southern and south western sections of Region (5) in Figure 66, and also in sections of Region (1), these formations have moderate to high landslip potential. Relief in these regions ranges from 4,000 to 6,000 feet, with slope angles averaging between 15 and 25 degrees. Slope stability in these areas is a function of slope angle, the degree of consolidation of earth material, and near-surface soil moisture content, which tends to be high. Slope instability is often aggravated in these regions by forest clearing for small-scale farming, fuelwood harvesting and,

in recent years, for plantation agriculture (mainly coffee). Also, the construction of access roads (especially for forestry) in some areas has accentuated slope angles and reduced rainfall percolation, thus encouraging the down-slope movement of earth material.

Yellow Limestone and Richmond Formation. These are widely distributed throughout the island, but are concentrated in St. Mary, the northern section of the Central Inlier, and in the southern and northern section of Region (5) shown in Figure 66. These are the island's highest landslip potential areas, and have been the focus of GSD's landslip potential assessment and site-specific mitigation projects.



In addition to earth materials which influence landslip potential, seismic events are also known to have triggered landslides in Jamaica. In 1957, for example, at least one person was killed by a landslide which was triggered by an earthquake (Simpson, 1981). Judgement Cliff in St. Thomas is thought to have been formed as a result of the largest recorded earthquake on the island, the Port Royal earthquake of 1692.

### **Areas Susceptible to Multiple Hazards**

A number of locations have historically been vulnerable to more than one hazard. These major, multiple risk areas are listed in Table 97. Because of its population density and susceptibility to multiple hazards, the KMA has been assigned the highest priority in disaster and hazard mitigation planning by the Office of Disaster Preparedness. Some of the priority areas for hazard mitigation within the KMA are shown in Figure 74.

## **INSTITUTIONS AND LEGISLATION**

Numerous government agencies and private organizations in Jamaica administer programs or conduct activities which affect natural hazards management. (See Table 98.) The functions of key agencies are briefly described below.

### **Lead Agencies**

Office of Disaster Preparedness and Emergency Relief Coordination (ODP). ODP, which is within the Ministry of Construction (Works), has principal responsibility for hazards management. ODP was established in July, 1980, following the devastating floods of June 1979, which affected much of western Jamaica. Establishment of ODP was recommended following a joint review by the UN Disaster Relief Office (UNDRO), and the League of Red Cross Societies, of Jamaica's vulnerability and the status of national emergency preparedness and response capabilities. ODP's responsibilities are:

- To formulate, promote, implement and co-ordinate pre- and post-disaster contingency plans designed to reduce the adverse effects of natural and man-made disaster events.

- To prepare and maintain specific mitigation plans and programs for identified high risk areas and potentially hazardous conditions.
- To ensure that development and resource management policies incorporate hazard and loss reduction components.
- To develop and implement public information programmes designed to ensure the awareness of the population to disaster threats and the appropriate corrective and remedial measures.
- To encourage appropriate public response to actual disaster and emergency events.
- To mobilize public agencies and private organizations to undertake comprehensive response in the event of a disaster.
- To facilitate the rapid return to normality after a disaster.
- To develop and maintain appropriate emergency contingency plans and disaster response capability, particularly in the emergency services and critical industries.
- To develop and maintain, in co-ordination with other agencies, adequate telecommunications systems and resources to ensure the effective coordination of emergency response.
- To complete the selection and establishment of effective national and local emergency operation centres to be used in the event of disasters.
- To develop the capability of local officials and agencies to cope with disaster, through parish disaster committees and related organizations.

Town and Country Planning Department (TPD). The TPD, within the Ministry of Finance and Planning has several hazards management related functions:

- Assists in post disaster assessments and prepares post disaster studies and plans, including mitigation recommendations.
- Prepares development suitability maps including overlays of hazardous parcels.

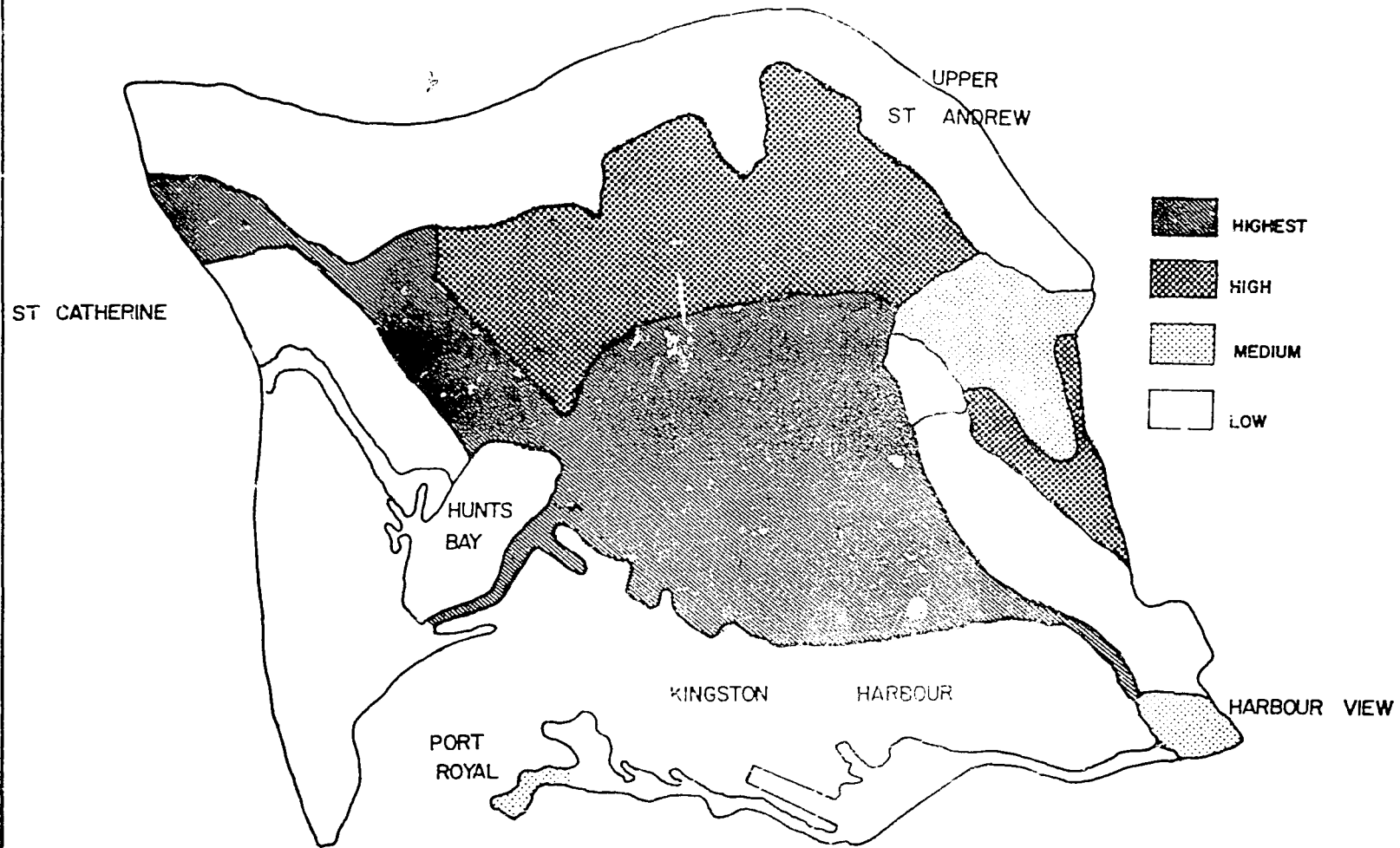
**Table 97: Major Risk Areas Vulnerable to Multiple Hazards**

<u>Hazard Site</u>	<u>Types of Hazards</u>	<u>Recorded Events</u>
Palisadoes	Storm Surge Earthquake	1722, 1813, 1874 1692, 1907
Kingston	Flooding Earthquake Storm surge	All high magnitude rainfall events 1692, 1907, 1957 1744, 1813, 1874, 1722
Portmore (Dawkins Pond)*	Flooding Earthquake Storm Surge	Frequently 1692, 1907, 1957 1744, 1813, 1874, 1722
Old Harbour	Flooding Surge	Frequently 1744
Rocky Point	Flooding Storm Surge	Frequently Dates unknown
Savanna-la-mar	Flooding Storm Surge	Frequently 1712, 1780
Green Island	Flooding Storm Surge	1780
Lucea	Flooding Storm Surge	1780, 1980
Montego Bay	Flooding Storm Surge	Frequently 1980
Falmouth	Flooding Storm Surge	Frequently 1980
St. Anns Bay	Landslip Storm Surge	Frequently 1980
Port Maria	Flooding Landslip Storm Surge	Frequently High potential (Frequent) 1980
Annotto Bay	Tsunamis Storm Surge	At least 3 times 1980
Hope Bay	Tsunamis Storm Surge	At least once 1980
St. Margaret's Bay	Tsunamis Storm Surge Flooding	At least once 1980 Frequently
Port Antonio	Tsunamis Storm Surge Landslide	At least once 1980 Frequently
Holland Bay	Flooding Storm Surge	Frequently 1980, 1917
Morant Bay	Flooding Storm Surge	Frequently 1980

\* Queenstown which was situated at the present location of Edgewater in Portmore was completely devastated by storm surge in 1722. The area around the site also liquified spectacularly in 1692 after the Port Royal Earthquake. (Spence, 1982).

FIGURE: 74

# AREAS HAVING PRIORITY FOR MITIGATION IN THE KINGSTON METROPOLITAN REGION



SOURCE: OFFICE OF DISASTER PREPAREDNESS

**Table 98: Key Government Agencies & Private Organizations  
With Programs and Activities Affecting Natural Hazards Management**

**CENTRAL GOVERNMENT**

**Economic Planning & Investment**

Planning Institute of Jamaica  
(M. of Finance & Planning)

Jamaica National Investment Co. Ltd.  
Jamaica National Investment Promotion  
Ltd. (M. of Finance & Planning)

Superintendent of Insurance  
(M. of Finance & Planning)

National Housing Trust  
(M. of Finance & Planning)

Jamaica Mortgage Bank  
(M. of Finance & Planning)

**Resource Planning & Management**

Town & Country Planning Authority  
(M. of Finance & Planning)

Town Planning Department  
(M. of Finance & Planning)

Natural Resources Conservation Division  
Science, Technology & Research Dept.  
(M. of Agriculture)

Ministry of Agriculture  
- Forestry Department  
- Rural Physical Planning Division of  
Forestry Department  
- Statutory Bodies

National Water Commission  
(M. of Public Utilities & Transport)

Office of Disaster Preparedness  
(M. of Environment)

Ministry of Health  
- Environmental Control Division  
- Public Health Division

**Technical Information Collection,  
Analysis & Dissemination**

Geological Survey Division  
(M. of Mining & Energy)

Meteorological Office  
(M. of Public Utilities & Transport)

Water Resources Division  
(M. of Local Government)

Survey Department  
(M. of Agriculture)

Bureau of Standards  
(M. of Industry & Commerce)

Office of Land Valuation & Taxation  
(M. of Finance & Planning)

Jamaica Information Service  
(M. of Finance & Planning)

University of West Indies  
- Geography Department  
- Seismic Research Unit

**Building and Construction**

Works Division of  
M. of Construction

Housing Division of  
M. of Construction

Urban Development Corporation  
(M. of Finance & Planning)

Estates Development, Ltd.  
(M. of Construction (Housing))

National Housing Corporation  
(M. of Const. & M. of Finance)

Sugar Industry Housing, Ltd.  
(M. of Agriculture)

Jamaica Public Service, Ltd.  
(Public Company reporting to M. of Public  
Utilities & Transport)

**LOCAL GOVERNMENT**

Ministry of Local Government  
Parish Councils Roads & Works Depts./KSAC Planning & Engineering Dept.  
Parish Councils & KSAC

**PRIVATE SECTOR**

Insurers/Jamaica Insurance Advisory Council  
Building Societies/Banks/Mortgage Lenders  
Professional Societies  
Private Developers

- Recommends public policies on land use and development and establishes general standards (e.g. density, open space) for land development.
- Coordinates review of subdivision applications (Subdivision Section) and reviews development plans for consistency with general land use standards (Development Control Section).

Geological Survey Department (GSD). The GSD has a major role in collecting and providing technical information for hazards management:

- Assesses and reports on hazard events and affected areas.
- Prepares reports and maps of disaster - prone and affected areas.
- Reviews development and subdivision plans referred by TPD regarding physical factors and participates in feasibility studies for major construction works.
- Provides technical support and input to codes, regulations and other development guidance (such as TPD Manual for Development) relative to seismic design standards.
- Provides information on landslip potential (e.g., identifies and maps landslip areas, makes mitigation recommendations for farming or other projects threatened by landslips).

Water Resources Division (WRD). The WRD, within the Ministry of Local Government, has a key role in technical support for hazards management:

- Collects stream flow and tidal data and identifies critical water levels and high water contours.
- Provides technical information and support (e.g., in the formulation of design standards for drainage works) to other agencies.

Meteorological Office. Located within the Ministry of Public Utilities and Transportation, this agency:

- Issues warnings of flash flooding, hurricanes, and other severe weather conditions.
- Collects and analyses meteorological data such as rainfall and wind speed.
- Provides technical support to other units of

government engaged in the preparation of codes and regulations (e.g. relative to wind resistant design standards).

Ministry of Construction (Works). The Ministry of Construction (Works) is the agency with primary responsibility for constructing public facilities, including flood control works:

- Builds and maintains drainage, flood control, river training and sea defense projects.
- Repairs and improves public facilities, including roads and bridges.
- Identifies flood prone areas for flood control projects, and prepares proposals for flood plain mapping.
- Reviews building and subdivision applications relative to drainage and engineering aspects.
- Provides technical assistance (e.g. input to building codes).

Survey Department. Located within the Ministry of Agriculture, the Survey Department prepares and updates islandwide maps (including topographic maps) and aerial photos.

### **Key Legislation**

Among the key laws and regulations affecting natural hazards management are the Town and Country Planning Act, the Local Improvements Act, the Flood Water Control Act, and the KSAC Building Act. Since these laws and regulations all address natural hazards to some extent, they provide significant opportunities for strengthening hazard mitigation efforts in Jamaica. Details of many of these acts appear in other sector profiles (e.g., See Urban and Rural Infrastructure for provisions under the Town and Country Planning Act).

### **PROPOSED PLANS AND PROGRAMMES AFFECTING HAZARD AREAS**

Several government agencies are conducting ongoing studies or have prepared projects affecting hazard areas. These include:

#### **Water Resources Division**

- o Technical investigations of potential storm surge in the Kingston Harbour.

- o In cooperation with NRC D, investigations of potential storm surge and wave hazards in the Portmore area, using parameters associated with 1916, 1944, 1951 and 1980 hurricanes.

- Lucea Inlier (i.e., the Lucea area): data collection and analysis; and
- St. Mary Parish: data analysis and specific site studies.

### **Ministry of Construction (Works)**

- o Design of sea defense to protect Norman Manley Airport based on a calculated 100-year wave height of 30 feet.

### Proposed Projects

- Analysis of storm surge potential in Morant Bay, Portmore, and Port Antonio.

### **Office of Disaster Preparedness**

- o Design of disaster/mitigation plans for priority hazard prone areas. A comprehensive evacuation plan for the Portmore area has been prepared. Plans for other priority areas are in preparation, including Kingston waterfront and the Hope River Valley (Hope Tavern). Plans are also being prepared to address Montego Bay's South Gully, North Gully and the Creek; and the Flankers and Catherine Hall areas in St. James.

## **KEY ISSUES AND PROBLEMS**

### **Islandwide Trends**

Foremost among the issues and problems concerning the identification, use and protection of hazard prone areas in Jamaica are those related to the conflict between protecting sensitive sites on the one hand, and pursuing development objectives on the other. For example, efforts to guide new development away from hazardous areas and to preserve sensitive resource areas in their natural state are often perceived as impeding development.

### Proposed Projects

To attain the benefits of development, pressures to ignore hazard considerations are often intense. Adding to this is the current rapid population increase in Jamaica's urban centres (particularly Kingston). This has caused land prices to spiral upward, particularly for "safe" sites (that is, for non-flood prone lands and areas of geological stability). The high cost of land on safe sites has precluded large segments of the population from many housing opportunities, and has increased development pressure on unsafe sites and so-called marginal lands. Efforts to assess the development suitability of these marginal lands are often influenced by short-term goals and immediate needs, rather than longer term considerations of vulnerability to natural hazards or impacts on ecological processes.

- o Intensive floodplain mapping throughout the island as a basis for comprehensive planning of floodprone areas.
- o Identification of problematic rivers, especially those on which flash-flooding is common, in order to initiate early warning systems.

### **Town Planning Department**

- o Delineation of flood prone areas along the south coast.

### Proposed Projects

- o Preparation of legislation pertaining to building on hazardous sites.

### **Specific Hazard Areas Under Pressure**

### **Geological Survey Division**

- o Assessment of hazard potential for landslips and storm surge. The Division has, in the past, undertaken projects related to the assessment of earthquake, flood-risk and tsunami potentials. These include several landslip projects:

Coastal Floodplains. Of the various types of hazard prone areas, coastal flood plains are probably under the greatest pressure — for development to meet housing needs, industrial and agricultural development, tourism, and, possibly large-scale peat mining in some locations. Coastal sites (especially reclaimed wetlands) have been increasingly used for middle and low income housing developments, as for example, housing schemes in south-eastern St.

- Central Inlier (i.e., Albert Town to South Linstead): data collection and analysis;

Catherine (Portmore), Riverton City in south-western St. Andrews, and the Blockwood Housing Development at Old Harbour Bay. Growing demand for housing is directly related to the rapidly increasing population in the KMA.

Coastal locations are also desirable for many types of industrial development. Among recent industrial activity on the waterfront is the establishment and expansion of the Kingston Free Zone to accommodate new industrial enterprises. New industrial development has also taken place on the Montego Bay waterfront.

While coastal sites are generally vulnerable to hurricanes and related storm surge effects, they also are focal points for tourism development. At times, this development has occurred without adequate planning or risk precautions. For example, tourism-related developments have often involved the filling of coastal wetlands. In recent years new tourism-related development has taken place in the Negril West End without the benefits of coordinated planning. In many North Coast resort areas, such as Ocho Rios and Montego Bay, coastal swamps have been filled in an attempt to facilitate tourism development, resulting in significant impacts on natural values in the area. One of the most glaring examples is the disfiguration of the famous Phosphorescent Lagoon (near Falmouth) by an aborted resort scheme.

Use of coastal areas for agricultural purposes is now common. In the past, however, many coastal wetland areas were drained to facilitate sugar cane production (Hudson, 1983). Although not currently used as such, many coastal locations are suitable for crop production, including coconut, and paddy rice cultivation (which is now confined to a few riverine floodplains.)

Peat mining is another potential use of vulnerable coastal areas. Peat is currently being mined in the Negril Morass. Peat mining feasibility studies have been carried out in the Black River Swamps.

Riverine Floodplains. The major development pressure on riverine floodplains is to meet housing needs. In Kingston, for example, extensive informal housing developments (squatter communities) have occurred in flood prone areas such as the Hope River Valley, including Hope Tavern and parts of August Town, and along major gullies such as the Sandy Gully and McGregor Gully. ODP has identified the Hope Tavern area as a priority site for mitigation

planning to minimize loss of lives and property during high magnitude flows.

A number of old gully systems (such as the Sandy Gully) which carry storm water run-off, were constructed at a time when potential run-off was less than at present. Potential run-off in the KMA has been substantially increased over the past thirty years, raising questions as to the capability of Sandy Gully to accommodate high magnitude flows. The vulnerability of sites in close proximity to these conduits has thus become greater.

ODP has also identified other riverine floodplain sites outside the KMA which have come under sufficient development pressure to warrant the formulation of special mitigation plans. These include the Chalky River, the Bull Bay River and in St. James, the North and South Gully, Flankers, Catherine Hall and the Creek.

Agricultural land-use has also increased the vulnerability of many riverine sites, on which the major commercial agricultural activities of Jamaica are focused. In many instances, the use of riverine sites for agricultural purposes has not proceeded with consideration of potential ecological and socio-economic impacts.

Wetlands. Historically, many of Jamaica's wetlands have been drained and filled to create land for agricultural use as well as urban development. As several coastal towns developed in the 1600's, they turned to reclamation of wetlands to enlarge their sites and gain deep-water frontage. Kingston, which was founded after the 1692 earthquake which largely destroyed Port Royal, soon began to expand into the harbour and its fringing mangrove swamps. The same expansion process has continued to this day. Similarly, Montego Bay has steadily enlarged its area by wetland reclamation. The Creek, which over two centuries ago occupied much of the site of present downtown Montego Bay, is now all but completely filled, while Strand Street, which probably did border the strand or shore when the town was first established, now lies well inland.

Over the years numerous swamp reclamation schemes in various parts of the island have been proposed. Originally many of these schemes were intended for control of malaria. After World War II, and especially after the country achieved independence in 1962, wetland reclamation was undertaken mainly to provide additional areas of developable land, as well as areas for waste disposal, and for the creation of deepwater frontage.

Since the 1960's several major reclamation projects have been undertaken and some are currently being implemented:

- o In the early 1960's a team of Dutch experts undertook a comprehensive study of the Black River morasses and made proposals for a reclamation scheme to convert the swamps into rich agricultural land. Some 3600 hectares at Elim in the Black River Upper Morass are currently being developed for agriculture by the Jamaican Government with the aid of the Inter-American Development Bank. Earth drains and pumps have converted much of this area into productive arable land.
- o At Meylersfield in the Cabarita Swamps, about 800 hectares have been developed with the assistance of the Netherlands Government, largely for the cultivation of rice. A smaller Dutch assisted scheme, at Hague on the lower Martha Brae River, proved less successful, however, and has been suspended indefinitely.
- o Kingston Harbour, scene of some of Jamaica's earliest reclamation schemes, has been the site of many of the country's major post-war urban reclamations. The configuration, profile and ecology of the 18 square kilometre harbour has been altered by landfill projects and much of the shoreline is now artificial.
- o On the enclosing spit of the Palisadoes where reclamation of land from the sea began in the seventeenth century, the twentieth century influence can be seen in the Norman Manley International Airport which is built on man-made land, with the runway forming an artificial promontory projecting two kilometres into the harbour. An earlier runway, now abandoned, forms a smaller peninsula on reclaimed land nearby.
- o Across the water at Rockfort, where over two centuries ago a fortress was built beside the harbour, a strip of reclaimed land now separates the old building from the sea. Elsewhere along the harbour, waste from the Rockfort Cement Works along with debris and wrecked cars have been dumped, forming a narrow but widening strip of level land at the foot of Long Mountain.
- o At the western end of the harbour is Portmore, a large residential suburb linked to Kingston by a causeway and bridge. Portmore has been developed on land that was formed by draining and filling coastal swamps. Portmore has been the subject of controversy

over proposals to continue developing this lowlying tract of poorly consolidated alluvium as a residential area. The area appears to be at particular risk from natural hazards, especially earthquake and hurricane danger.

- o The Kingston Waterfront complex, with its modern blocks of offices, shopping mall, apartments, hotel and landscaped Ocean Boulevard, was one of the first projects undertaken by the Urban Development Corporation (UDC).

Precautions against natural hazards have been taken in the comprehensive redevelopment of the Kingston Waterfront. This most recent effort began in the late 1960's and involved further expansion of the reclaimed land on which the downtown harbour-front area was originally built. As in most modern port developments, extensive dredge and fill operations were necessary for the successful realization of this project, which was followed by additional reclamation to accommodate a container transshipment facility.

- o The UDC has undertaken many other development schemes around Jamaica, most of them involving some reclamations of swamps or coastal shallows. These include: the Ocho Rios resort development, which required the reclamation of 16 hectares and the creation of an artificial beach; Oracabessa, which involved the reclamation of 8 hectares of land originally intended for a port and marina; and St. Ann's Bay, where a reclaimed waterfront strip is now occupied by a bypass road carrying traffic around the town.
- o UDC's Montego Bay Waterfront project involved the reclamation of 20 hectares from the sea and the creation of three artificial beaches. In addition to roads for improvement of traffic flow, the new land is intended for resort, commercial, entertainment and cultural purposes. Level, easily developed land is at a premium in this resort city which is largely hemmed in by hilly and swampy terrain.
- o The Montego Bay Freeport is a 140-hectare private development on land reclaimed by dredge and fill from coastal shallows and mangrove swamp. This is the site of the Fort of Montego Bay which was formerly on the waterfront now transformed by the U.D.C. In addition, there has been some tourist, commercial, industrial and residential development, but much of the reclaimed land, although pleasantly landscaped, is yet to be developed.



## RECOMMENDATIONS

### Mapping of Riverine Flood-prone Areas

Although data related to flooding is more readily available than data for other hazards, detailed flood mapping is lacking. There is need for a comprehensive, island-wide flood-mapping programme as a precursor to the formulation of plans related to flood plain management.

### Mapping of Coastal Flood-prone Areas

Although the GSD, in collaboration with ODP and other agencies, has identified general areas subject to coastal flooding, available data is rudimentary. Even in the few areas where there has been some assessment of potential storm surge effects (e.g., Kingston Harbour), there has been a general lack of consensus among researching agencies regarding the extent of risk and vulnerability. This unresolved conflict has been a deterrent to comprehensive mitigation planning for these areas.

### Generation and Documentation of Data on Seismic Risk

Expansion of activities on generation, documentation and dissemination of technical data on seismic risk is needed.

### Landslip Mapping

Priority should be given to the completion of site specific landslip mapping being undertaken by the GSD.

### Agency Coordination

A methodology needs to be formulated that would ensure efficient interaction among disaster related agencies, as well as other agencies concerned with environmental problems of the country.



Plate 48 - Flood Damage in Trelawny; banana trees destroyed.



Plate 49 - Flood Damage in Trelawny; trees uprooted.

## KEY TO FIGURE 6 - SOILS MAP OF JAMAICA

**P PLAINS** (elevation in general less than 60 m; relief intensity less than 5 m; slope gradients in general less than 5 %)**PR SOILS FORMED ON RECENT ALLUVIUM**

**PR1** Well drained, deep, yellowish brown to strong brown stratified soils with a loamy or clayey texture; generally high in silt; in places with a humic surface layer or calcareous.  
(*Eutric Cambisols, Dystric Cambisols and Haplic Phaeozems*)

**PR2** Well drained, deep, brown and strong brown clayey soils with a humic surface layer; calcareous; in places with a morly substratum.  
(*Calcic Phaeozems*)

**PO SOILS FORMED ON OLD ALLUVIUM**

**PO1** Moderately well drained, deep, yellowish brown and reddish brown cracking clay soils; in places with secondary lime.  
(*Chromic Vertisols and Pellic Vertisols*)

**PO2** Imperfectly drained, deep, yellowish brown to strong brown, mottled, cracking clay soils.  
(*Chromic Vertisols*)

**PO3** Moderately well drained, deep, reddish brown to brown cracking clay soils, in places slightly gravelly, and deep, red and brown, distinctly mottled, clayey soils with a 10 to 40 cm thick loamy surface layer.  
(*Chromic Vertisols and Orthic Luvisols*)

**B INTERIOR BASINS** (elevation in general about 150 m; relief intensity less than 10 m; slope gradients in general 5 to 16 %)**BO SOILS FORMED ON OLD ALLUVIUM WITH HILLWASH ADMIXTURES**

**BO1** Moderately well drained, deep yellowish brown and red cracking clay soils with common iron and manganese concretions.  
(*Chromic Vertisols*)

**BO2** Moderately well drained, deep yellowish brown to strong brown mottled, cracking clay soils; in places with secondary lime.  
(*Chromic Vertisols*)

**H HILLS AND FOOTHILLS** (elevation in general 60 to 800 m, relief intensity up to 200 m; slope gradients in general 16 to 50 %)**HS SOILS FORMED ON CALCAREOUS SHALES**

**HS1** Moderately well drained and well drained, predominantly moderately deep, brown to yellowish brown clayey soils; in places cracking or gravelly.  
(*Eutric Cambisols and Vertic Cambisols*)

**HS2** Well drained, predominantly shallow, yellowish brown and olive yellow loamy soils; often with gravelly layers.  
(*Eutric Regosols and Eutric Cambisols*)

**H33** Well drained, moderately deep and deep, brown to reddish brown clayey soils; in places with a 10 to 30 cm thick loamy surface layer; often high in gravel.  
(*Orthic Luvisols and Eutric Cambisols*)

**HX SOILS FORMED ON NON-CALCAREOUS SHALES, CONGLOMERATES AND TUFFS**

**HX1** Well drained, predominantly shallow, brown and reddish brown, loamy and clayey soils high in gravel.  
(*Dystric Regosols and Dystric Cambisols*)

**HX2** Well drained, predominantly moderately deep reddish brown clayey soils, locally with a thin loamy surface layer, and imperfectly drained, deep, yellowish brown clayey soils, in places gravelly.  
(*Dystric Cambisols, Orthic Luvisols and Chromic Vertisols*)

**HL SOILS FORMED ON LIMESTONE**

**HL1** Well drained, predominantly shallow, brown to dark yellowish brown loamy and clayey soils with a humic surface layer; stony; in places with many rock outcrops.  
(*Rendzinas and Eutric Cambisols*)

**HL2** Imperfectly drained, moderately deep, yellowish brown cracking clay soils and soils similar to those of unit HL1.  
(*Eutric Cambisols and Chromic Vertisols*)

**HL3** Imperfectly drained, moderately deep, olive to yellowish brown cracking clay soils and soils similar to those of unit HL1.  
(*Ferriozems, Eutric Cambisols and Chromic Vertisols*)

**HL4** Somewhat excessively drained, predominantly shallow, strong brown to reddish brown loamy and clayey soils; stony; in places with many rock outcrops.  
(*Ferric Cambisols*)

**HL5** Moderately well drained, moderately deep, yellowish brown cracking clay soils and soils similar to those of unit HL4.  
(*Ferric Cambisols and Chromic Vertisols*)

**HL6** Well drained, moderately deep, red to yellowish red clayey soils with a 10 to 30 cm thick loamy, and in places humic, surface layer and low similar to those of unit HL4.  
(*Ferric Cambisols, Hemic Acrisols and Ferric Acrisols*)

**HL7** Well drained, deep and strongly weathered, brown to strong brown loamy soils and soils similar to those of unit HL4.  
(*Ferric Cambisols and Orthic Ferrisols*)

**HL8** Well drained, moderately deep and deep, strongly weathered red to dark red clayey soils and soils similar to those of unit HL4.  
(*Ferric Cambisols and Ferric Ferrisols*)

**HG SOILS FORMED ON GRANODIORITE**

**HG1** Well drained, shallow and moderately deep, dark yellowish brown to yellowish brown loamy soils; in places gravelly.  
(*Dystric Cambisols and Dystric Regosols*)

**M MOUNTAINS** (elevation in general over 800 m; relief intensity over 300 m; slope gradients in general over 50 %; in places steeply dissected)**MS SOILS FORMED ON CALCAREOUS SHALES**

**MS1** Well drained, predominantly shallow, yellowish brown and pale brown, loamy soils; high in gravel.  
(*Eutric Regosols and Eutric Cambisols*)

**MS2** Well drained, predominantly moderately deep, brown to reddish brown clayey soils with a thin loamy surface layer and soils similar to those of unit MS1.  
(*Eutric Cambisols, Eutric Regosols and Orthic Luvisols*)

**MX SOILS FORMED ON NON-CALCAREOUS SHALES, CONGLOMERATES AND TUFFS**

**MX1** Well drained, shallow and moderately deep, brown to reddish brown loamy and clayey soils; in places very gravelly or stony.  
(*Dystric Regosols and Dystric Cambisols*)

★

**T TIDAL FLATS AND SWAMPS** (regularly flooded; slope gradients less than 1 %)**TR SOILS FORMED ON RECENT ALLUVIUM**

**TR1** Very poorly drained, unopened stratified soils of various colours and textures; highly saline and sodic; often with sulfidic materials.  
(*Thionic Fluvisols and Eutric Fluvisols*)

**TR2** Poorly drained, greenish gray and olive brown clayey soils with common mottles; in places underlying partly decomposed organic materials; in places with sulfidic materials.  
(*Eutric Fluvisols, Thionic Fluvisols and Eutric Histosols*)

**TP SOILS FORMED ON PEAT**

**TP1** Very poorly drained, partly decomposed organic materials, lacking sulfidic materials.  
(*Eutric Histosols*)

**KEY TO LEPTH CLASSES**

SHALLOW ..... less than 50 cm  
MODERATELY DEEP ..... 50 to 100 cm  
DEEP ..... over 100 cm

Stony or bouldery phases

**MAPPING UNIT BOUNDARY**

physiography  
parent material or rock  
soil properties

**MAPPING UNIT SYMBOL**

physiography  
POI—soil properties  
parent material or rock

□ (2:500) ..... boundary to the nearest metre (Approximate location)

# APPENDICES

**APPENDIX A: INTERAGENCY ADVISORY COMMITTEE MEMBERS**

Miss Joy Alexander	-	Town Planning Department
Ms. Jossette Charlton	-	Ministry of Local Government
Mr. Calvin Colterell	-	Department of Forestry, Ministry of Agriculture
Ms. Vivienne Hyatt	-	Ministry of Tourism
Mrs. Cathrine Levy	-	Gosse Bird Club
Mrs. Audrey Downer	-	Gosse Bird Club
Mr. Karl Aiken	-	Zoology Department, University of the West Indies
Mameta Robertson	-	Metropolitan Parks and Market
Mr. Y. K. Saxena	-	College of Arts, Science and Technology/UNDP
Mrs. Ellie Irons	-	Environmental Control, Ministry of Health
Ms. Cora Ramsay	-	Bureau of Health Education, Ministry of Health
Mr. Guy Symes	-	Forest Industry Development Company
Dr. Adhamar C. Mollinado	-	Environmental Control Division, Ministry of Health
Lt. Errol Taylor	-	Jamaica Defence Force, Coast Guard
Lt. Cdr. Mike Rodriguez	-	Jamaica Defence Force, Coast Guard
Dr. Ted Aldridge	-	Environmental Control Division, Ministry of Health
Ms. Majorie Brown	-	Ministry of Public Utilities
Mr. Gray Rose	-	Petroleum Corporation of Jamaica
Miss Cheryl Dixon	-	Planning Institute of Jamaica
Mr. Keith Ford	-	Planning Institute of Jamaica
Miss Thelma Kerr	-	Hope Zoo, Ministry of Agriculture
Mrs. Y. L. Martin	-	Ministry of Mining, Energy and Tourism
Mr. Herbert J. Wallen	-	Jamaica Public Service Co. Ltd.
Ms. Paulette Taylor	-	Petrojam Limited
Mr. Glen Simmonds	-	Jamaica Bauxite Institute
Mr. Neville Brown	-	Ministry of Public Utilities (Marine Division)
Mr. Basil Fernandez	-	Underground Water Authority
Mr. Milton Vassel	-	Social Development Commission
Mr. Carey Robinson	-	Jamaica National Heritage Trust
Ms. Pam O'Gorman	-	Institute of Jamaica
Ms. Hermine McKenzie	-	Department of Sociology and Social Work, University of the West Indies
Mr. G. Pencle	-	Ministry of Agriculture
Dr. Frank Ross	-	Director of Aquaculture, AGRO 21 Corporation Ltd.
Mr. Roy Moo-Young	-	Fisheries Division, Ministry of Agriculture
Ms. Avril Shirley	-	Petroleum Corporation of Jamaica
Mr. Manley Haye	-	Jamaica Public Service Co. Ltd.
Mr. Winston Wakefield	-	DEEM Consultant Limited
Ms. Yvonne Laidlaw	-	Ministry of Agriculture

## APPENDIX B: BIBLIOGRAPHY

### **PART I: CONTEXT**

Braatz, Susan. Draft Environmental Profile of Jamaica. U.S.AID, Office of Forestry, Environment, and Natural Resources and U.S. Man and the Biosphere Program. 1981.

Kaplan, L, et. al. Area Handbook for Jamaica. The American University. 1976.

Planning Institute of Jamaica. Quarterly Economic Report. (Various issues 1985-1986).

Town Planning Department. Jamaica Ministry of Finance & Planning. The Natural Atlas of Jamaica. 1971.

### **PART III: SECTOR ANALYSES**

#### **Human Resources and Culture**

Brathwaite, Edward. The Development of Creole Society in Jamaica 1770-1820. Oxford. Clarendon Press. 1971.

Brodber, Erna. "A Study of Yards in the City of Kingston." Working Paper No. 9, Institute of Social and Economic Research. Mona, Jamaica. 1975.

Carnegie, Charles V. "The Human Strategy: If you Lose the Dog Grab the Cat." Natural History 92 (10). 1983.

Comitas, Lambros. "Occupational Multiplicity in Rural Jamaica." In, L. Comitas and D. Lowenthal, eds., Work and Family Life: West Indian Perspectives. Garden City, N.Y. 1983.

Davies, Omar. "Housing: The Basis for a National Policy in Jamaica." Occasional Paper No. 3, Department of Economics, UWL Jamaica. 1984.

Frucht, Richard. "Caribbean Social Type: Neither 'Peasant' nor 'Proletarian'." Social and Economic Studies 16: 295-300. 1967.

Higman, B.W. Slave Population and Economy in Jamaica 1807-1834. Cambridge: Cambridge University Press. 1976.

Mintz, Sidney. Caribbean Transformations. Chicago: Aldine. 1974.

National Planning Agency. "Emigration to North America from Jamaica 1970-1980." 1982.

Nettleford, Rex. Caribbean Cultural Identity: The Case of Jamaica. Kingston, Institute of Jamaica. 1978.

"Population and Jamaica's Future: A Statement of National Population Policy." (Author unknown.) Jamaica. 1982.

Price, Richard. "Caribbean Fishing and Fishermen: A Historical Sketch." American Anthropologist 68:1368-83. 1966.

Smith, M.G. The Plural Society in the British West Indies. University of California Press, Berkeley. 1965.

Statistical Institute of Jamaica. "Demographic Statistics." 1984.

Statistical Institute of Jamaica. The Labour Force. (Various issues.)

United Nations. Demographic Yearbook. 1983.

National Planning Agency. Urban Growth and Management Study. Jamaica. 1978.

World Bank. World Tables. Baltimore, The Johns Hopkins University Press, 1980.

#### **Environmental Education**

Glasgow, Joyce. Correspondence re: Environmental Education in Jamaica. School of Education, U.W.L, Mona, July, 1984.

\_\_\_\_\_. Preliminary Directory of Some Environmental Education Activities in Jamaica. Faculty of Education, U.W.L, Mona. June, 1985.

Estimates of Expenditure for the Year Ending 31st March, 1985; as presented to the Jamaica House of Representatives on 10 May, 1984.

Mass Communications and Society: Course Overview MC100/500. Carimac. 1985/86.

Miller, Beverly A. "Environmental Health Training and Research Capabilities Within the Commonwealth Caribbean." A Report to UNEP's Regional Office for Latin America and the Caribbean. Jan. 1985.

NRCD. "An Environmental Education Network for Jamaica." Report on the Introductory Meeting of October 19, 1983. NRCD Files, unpublished.

PIOJ. Economic and Social Survey. Jamaica, 1984.

Regulations and Syllabus: Faculty of Natural Sciences, U.W.L. Academic Year 1985-86.

"Syllabuses with Environmental Emphasis in the Caribbean." A Paper prepared for the Conference on Science and Technology Education and Future Human Needs. Bangalore, August 1985.

UNEP (ROLAC). "Suggestions for Organizing the Environmental Training Network at the National Level: Environmental Training Network for Latin America and the Caribbean."

UNESCO. "Environmental Education in the Light of the Tbilisi Conference." 1980.

### Coastal Resources

Aiken, K. "The Forgotten Fishery -- The Artisanal Fishery in the Lower or Great Morass, Saint Elizabeth". Natural History Notes, New Issues. Vol. 9: 9-17, 1984.

Aiken, K. "Technical Aspects of Jamaican Artisanal Fishery." IICA Report, Annex L. 1984.

Allman, L. "Ocho Rios Development. The Extent of UDC's Involvement." UDC Seminar, July 14-18, 1985.

Barnes, E.S. "Sewage Pollution from Tourist Hotels in Jamaica." Pollution Bulletin. March 4: 103-106. 1973.

Bjork, S. "Summary Environmental Feasibility Study of Peat Mining in Jamaica." Prepared for the Petroleum Corporation of Jamaica. 1983.

Carrol, P. Rio Cobre: A Pollution Case Study. MSc., U.W.L., 1978.

Coke, L., Bertrand, R. and Batchelor, S. "Macrophyte Vegetation of the Negril and Black River Morasses." P.C.J., Jamaica, 1982.

Environmental Consultant Services. "Oil Pollution in Portland Bight." A Report for the Ministry of Mining and Natural Resources. Government of Jamaica, 1974.

Ewbank Engineering Consultants Limited. "Pre-feasibility Study Report on the Production and Utilization of Peat at Negril and Black River Morasses." Report submitted to the Jamaica Government. 1979.

Fairbairn, P.W. and Haynes, A.M. "Jamaica Survey of the West Indian Manatee (Frechechus manatus), Dolphin (Families Cheloniidae and Dermochelyidae) and Booby Tern (Family Tardidae)." FAO, Fisheries Report No. 278, Supplement, pp.289-90, 1982.

Geological Survey Department. Geological Map of Jamaica (1:250,000). 1970.

Henry, B. "The Environmental Impact of Tourism in Jamaica." Sunday Gleaner. June 2, 1985.

Hudson, B.J. "Coastal Land Reclamation in Jamaica. A Conservation Problem." Conservation In Jamaica. Ed. B. Hudson. pp. 15-22, 1983.

Japanese International Cooperation Agency. "The Agriculture Development Project on the Black River Lower Morass Feasibility Report," Volume II. Report for the Ministry of Agriculture, GOJ. February, 1985.

Jupp, B. "The Seagrasses of Jamaica". Jamaica Journal. 16(4): 23-25. 1983.

NRCD. Wetlands Inventory. 1982.

NRCD. "The Conservation and Ecology of Sterna fuscata and Anous stolidus in Jamaica." Report by A. Haynes. 1982.

NRCD and Traverse Group Inc. "Environmental Feasibility Study of the Jamaica Peat Resources Utilization Project." 3 Vols. Final Report to the Ministry of Mining and Energy, Jamaica. 1982.

**NRCD Files:**

L1/56-Sea View Gardens  
L14/74-Half Moon Bay, Fishermen, Saint Catherine.  
2/1/10-Complaints Re: Pollution Problems.  
5/1/18-Canoe Valley  
7/2/3-Removal of Sand, etc. from Beaches.  
7/2/4-Coastal Erosion  
7/2/6-Beaches Pollution  
7/4/1-Fisheries Division, Ministry of Agriculture  
13/2/1-Water Pollution Special Investigations  
13/2/6-Oil Pollution  
13/2/7-Harbour Pollution File  
13/3/3-Kingston Harbour Monitoring Programme  
14/2/1-Wetlands Special Investigations Great Salt Pond and Long Pond  
14/2/2-Wetlands Reclamation of Hague and Meyersfield  
15/4/3-Oyster Bay Study  
15/6/1-Ocho Rios Marine Park  
15/6/2-Montego Bay Marine Park

Nordan International A/S. "A Preparatory Field Report for an Oil Pollution Contingency Plan." For the Government of Jamaica. 1982.

ODA/UWI. Fisheries Ecology Research Project, 1969 - 1973. "The Biology, Ecology and Bionomics of Caribbean Reef Fish."

Petroleum Corporation of Jamaica. Pamphlet on Peat Resources in Jamaica. 1985.

Port Authority of Jamaica. Port Statistics. 1985.

Reeson, P. "The Jamaican Peat Project Resource Use and Environmental Management." Proceedings. Seminar on Man Versus the Environment. June 5, 1984. pp. 10-1 - 10-14.

Rural Physical Planning Unit, Ministry of Agriculture, CRIES Project, Michigan State University, US Dept. of Agriculture Soil Conservation Service. Jamaica Resource Assessment Project. Land-Use Maps. 1982.

Thorhaugh, A. "Seagrass Restoration in the Caribbean Nearshore Areas." Final Report, U.S.AID. 1984.

Town Planning Department. National Physical Plan, 1978 - 1998. 1979.

Urban Development Corporation. "Catherine Hall, Montego Bay. An Urban Expansion and Housing Project." 1974.

\_\_\_\_\_. "Hellshire." The Hellshire Bay Development Company Booklet. 1981.

\_\_\_\_\_. "Making Development Happen." Information Booklet. 1983.

Wade, B.A. "Coastal Pollution in Jamaica with Special Reference to Kingston Harbour." Jamaica Journal. 6(2): 14 - 19. 1972.

\_\_\_\_\_. "The Pollution Ecology of Kingston Harbour, Jamaica". Scientific Report of the UWI/ODM Kingston Harbour Research Project, 1972 - 1975 Vol. 1. 1976.

Wallace Evans and Partners . "Ocho Rios Pollution Control Study." Final Report to the National Water Commission, GOJ. 1976.

**Water Resources**

CEDSL. "Small Scale Hydropower Study." Unpublished Report of the Ministry of Mining. 1983.

CRIES. "Jamaica Resource Assessment." Ministry of Agriculture and USAID. 1982.

Hall, A.B. and Logan, L.B. "A National Water Plan for Jamaica." A first stage report for the Jamaica National Investment Company, Limited. 1984.

Jamaica Meteorological Division. "Climate of Jamaica."

JICA. "The Agricultural Development Project on the Black River Lower Morass." Unpublished report of the Ministry of Agriculture. 1984.

Stanley Associates Engineering Ltd. and Joint Consultants. "Jamaica Rural Water Supply Study." Report of National Water Commission. 1980.

UWA. "Analysis of June 12, 1979, Flood Rains in Western Jamaica." Prepared by Lloyd Donaldson and Michael White. 1979.

\_\_\_\_\_. "Water Resources and Demand Inventories." Draft Reports (No. 1 and 2) of National Water Resources Development Master Plan Project being developed by UNDP, DIC and UWA. 1985.

## Wildlife

Bacon et. al. Proceedings. Western Atlantic Turtle Symposium. 17- 22 July, 1983.

Fairbairn, P.W. "Proposal for study of the relationship between crocodiles and fish, Luana Point Wetland." 1978.

\_\_\_\_\_. "The cattle egret in Jamaica. A proposal for co-operative research." 1978.

\_\_\_\_\_. "The mandate of the Ecology Branch. 1980."

\_\_\_\_\_. "Jamaica Wildlife." 1981.

\_\_\_\_\_. "Conservation of Jamaica's Avifauna." 1982.

\_\_\_\_\_. "Parrot Conservation in Jamaica." 1982.

\_\_\_\_\_. "Regulations governing the Exploitation of Jamaican Wild Plants and Animals with particular reference to exports." 1982.

Fairbairn, & M. Plotkin. "Endangered species of Jamaica." Undated.

Gordon, R & C Cotterell, E. Ross, A. Haynes, M. Allen. "A proposal to establish a National Park at Portland Bridge and Ridge." 1983.

Haynes, A. "An outline of the services requested from Honorary Game Wardens." 1982.

Hudson, B. (ed). Conservation in Jamaica. Symposium.

Jones R.S. & C. Cotterell. Recreation, Wildlife and Nature Conservation. 1980.

Miller, B. "Environmental Abuse: The Jamaican Experience." 1984.

Mittermeier, R.A. "Jamaica Endangered Species." Oryx 11:258-262. 1972.

NRCD. Proposed amendment to the Wildlife Protection Act. 1981.

NRCD. "Enhancing the Jamaican Environment." 1981.

Oliver, W. "The Coney and the Yellow Snake: The distribution and status of the Jamaica Hutia

Geocapromys brownii and the Jamaica Bon Epicrates subflavies." 1982.

\_\_\_\_\_. Proposals for creation of wildlife reserve at White Rock, Worthy Park. Letter. 1982.

Proctor, G.R. "Conservation of Jamaican Plants." Institute of Jamaica. Partial List of Endangered Species. Pre-1980.

Seubert, J.L. Report on Bird Hazard at Sangster International Airport. 1975.

Thorsell, J.W. "Towards a National Park System for Jamaica." Report prepared for NRCD, Ministry of Mining. 1981.

Vincent, J. Red Data Book. Vol. 2. ICUN. Switzerland. 1967.

Woodley, J.D. "A History of Jamaican Fauna". Jamaica Journal. 2(3). 1968.

## National Parks and Protected Areas

Bullard, E.F. "Forestry Development and Watershed Management in the Uplands Regions: Parks and Recreation in Jamaica." FAO Report. 1972.

Carlozzi, et.al. "National Parks and Recreation Plan Report." UNDP Physical Development Planning Project. 1969.

CCA. "The Preservation and Development of the Environment." 1977.

Cotterell, C., et.al. "A proposal to establish a National Park at the Portland Bight and Ridge." Unpublished. NRCD, Kingston, Jamaica. 1983.

Cotterell, C. "A proposal for the development of the Palisadoes/Port Royal National Park." NRCD, Kingston, Jamaica. 1980.

\_\_\_\_\_. "The proposed development of the Cockpit Country." Unpublished. NRCD, Kingston, Jamaica. 1979.

\_\_\_\_\_. "Proposed National Parks and Other Protected Areas in Jamaica." Presentation at the International Seminar on National Parks and Equivalent Reserves. Unpublished. NRCD, Jamaica. 1977.

CNPPA. "Categories, Objectives and Criteria for Protected Areas." In McNeeley, J.A. and



K.R. (eds.). National Parks Conservation and Development. Smithsonian Institute Press. Washington, D.C. 1984.

Douglas, E. "Proposed Development Canoe Valley." Town Planning Department. Unpublished. NRCD, Kingston, Jamaica. 1974.

Douglas, K.S.T. "National Parks Policy." Unpublished. NRCD, Kingston, Jamaica. 1982.

Forster, R.R. Planning for Man and Nature in National Parks. IUCN. 1973.

Garrick, L. "The current status of the Black River Morass, St. Elizabeth Parish, Jamaica, Threatened Wetland." Monitor International Report. 1983.

Garrick, L. "The Black River Lower Morass; threatened wetland in Jamaica." Gryx. 20:13, pp. 155-160. 1986.

Haynes, A.M. "A Survey of Training Needs for the NRCD." Presentation to CAST on World Environmental Week. 1985.

Haynes, A.M. "Development of a Black River National Park." Unpublished. NRCD. Kingston, Jamaica. 1984.

Haynes, A.M. "Luana Point - Font Hill Wild Life Reserve Proposal." Unpublished. 1983.

IUCN. "1982 United Nations List of National Parks and Protected Areas." UNEP/UNESCO Publication. 1981.

IUCN. Proceedings. 18th Working Session of IUCN CNPPA: Conserving the Natural Heritage of Latin America and the Caribbean. IUCN Publications. 1981.

IUCN. "Proposed Criteria for Selecting Wetlands of International Importance." Ramsar Convention. UNEP/UNESCO Publications. 1980.

IUCN. International Conference on Marine Parks and Reserves, Papers and Proceedings. UNEP/UNESCO Publication. 1976.

Island Resources Foundation. "Economic Impact Analysis for the Virgin Island National Park." USDI, National Park Service. UNEP/UNESCO Publications. 1981.

Scott, K. National Parks in Jamaica. CAST Thesis. 1986.

Town Planning Department. National Physical Plan 1970-1990. Kingston, Jamaica. 1970.

## **Fisheries Resources**

Aiken, K.A. "Conch fishing on the north Jamaican coast." Ministry of Agriculture, Fisheries Division Report. 1979.

\_\_\_\_\_. "Further investigations of the Jamaica spiny lobster fishery." National Reports and Selected Papers presented at the Third Session of the Working Party on Assessment of Marine Fishery Resources, Kingston, 17-21 May, 1982. FAO Fisheries Report, No. 278, Suppl: 177-191. 1983.

\_\_\_\_\_. "Identification of a Project for the Development of the Artisanal Fisheries Sub-Sector." Vol. II. Technical Annex 1. Inter-American Institute for Co-operation on Agriculture, IICA/OAS. 1984.

Aiken, K.A. and Haughton, M. "Status of the Jamaica reef fishery and proposals for its management." A paper presented at the 38th Annual Gulf and Caribbean Fisheries Institute. Martinique, November, 1985.

Bodurtha, R.M. "Fish production in Jamaican coastal waters." Zoology Department, UWL. 1975.

Chuck, L.M. "Sample survey of the fishing Industry in Jamaica." Division of Economics and Statistics, MOA. Kingston. 1963.

Statistical Institute of Jamaica. External Trade, 1984. Kingston.

Environmental Consultant Services, Ltd. "Oil Pollution in Portland Bight." A Report for the Ministry of Natural Resources, GOJ. 1974.

FAO/IDB. "Report of the Jamaica Fisheries Development Project." Vol. I. Annexes 1-4. Rept. 7/78. DDC, JAM. 7. 1979.

Fisheries Division. "The status of fisheries development in Jamaica." 1982.

Goodbody, L.M. "The Biology of Kingston Harbour." J.Sci. Res. Council. Jamaica, 1:10. 1970.

Goodbody, L.M., Munro, J., Reeson, P. & Watson, D. "The biology of Dawkins Pond, Saint Catherine." Report to the Scientific Research Council of Jamaica. 1969.

- Goodbody, L.M., Eubanks, J., Williams, D. & Barrow, P. "The biology of Plumb Point Lagoon." Report to the Scientific Research Council of Jamaica. 1970.
- Iversen, E.S. and Munro, J.L. "Preliminary shrimp surveys on the south coast of Jamaica". Carib. J. Sci. 9:3-4.
- Johnson, W.B. "Coastal Zone Management: Kingston Region." United Nations Centre for Human Settlements. UNDP/JAM/82/010. Tech. Report No. 9. 1985.
- Munro, J.L. "Prospects for a small-scale trawling industry in Jamaica". Information. Bul. Sci. Res. Council, Jamaica. Vol. 8 (II-IV): 91-96. 1968.
- Munro, J.L. "The biology, ecology, exploitation and management of Caribbean reef fishes. Part VI. Summary of biological and ecological data pertaining to Caribbean reef fishes." Zoo. Dept., UWI. No.3. 1974.
- Munro, J.L. and Thompson, R. "The biology, ecology, exploitation and management of Caribbean reef fishes. Part II. The Jamaica fishing industry, the area investigated, and the objectives and methodology of the ODA/UWI Fisheries Ecology Research Project". Zoo. Dept., UWI. No. 3. 1973.
- NRCD. Status Report. Organic waste Pollution Research Project. Aquatic Resources Division, Water Quality Branch. 1980.
- NRCD. "Inventory of coastal wetlands of Jamaica." Unpublished report, Wetland Branch, Aquatic Resources Division, Natural Resources Conservation Division, MOA. 1982.
- Nicholson, W. and Hartsuiker, L. "The state of the fishery resources of the Pedro Bank and the south Jamaica shelf." Selected Papers presented at the Third Working Party on Assessment of Marine Fishery Resources, Kingston, May, 1982. FAO. Fish. Rep. 2789. Suppl: 215-254. 1982.
- Popma, T.J., Ross, F.E., Nerrie, B.L. and Bowman, J.R. "The development of commercial farming of Tilapia in Jamaica, 1979-1983." Research and Development Series, No. 31. International Center for Aquaculture, Alabama Agricultural Station, Auburn University, Alabama. AID/LA-C-1166. 18 pp. 1984.
- Reeson, P. An ecological survey of a Jamaican coastal lagoon. M.Sc. Thesis, Department of Zoology, University of the West Indies. Jamaica. 1971.
- Sahney, A.K. "Sample survey of the fishing industry in Jamaica, 1981." Data Bank and Evaluation Division, MOA, Kingston. 1982.
- Smith, C.L. and Tyler, J.C. "Space resource sharing in a coral reef fish". HELGOL. WISS. MEERES., 24:246-275. 1972.
- USSR-Jamaica Fishery Research Project Report. 1980. Ministry of Fisheries of the USSR (ATLANTNIRO), Kallingrad.
- Vidaeus, L. "An inventory of the Jamaica fishing industry." FAO/UNDP Caribbean Fishery Development Project. SF/CAR/REG/180/M9. 1970.
- Wade, B.A. "Marine pollution problems in Jamaica." Mar. Poll. Bull. 2:29-30. 1971.
- Wade, B.A. "The Pollution Ecology of Kingston Harbour, Jamaica." Scientific Report of the UWI-ODM Kingston Harbour Research Project 1972-1975. Zool. Dept. UWI, Mona, No. 5, Vols. 1-3. 1976.
- Forestry**
- Allan, T.G. "Draft Terminal Project Report." (JAM/82/006). 1984.
- Department of Forestry and Soil Conservation, Research and Development Unit. Annual Report. 1984-85.
- Department of Statistics. Statistical Year Book. Jamaica, 1981.
- Forest Department. Five Year Development Plan. 1984.
- Gane, Michael. "Private Forestry in Jamaica - Synopsis of New Schemes and Proposed Outline Implementation Project." 1984.
- IBRD. Annual Report. Washington D.C. 1978.
- Jones, Roy S. "Status of Forest Resources in Jamaica." 1986.

Symes, G.D. "The Forest of Jamaica." Jamaica Journal. Vol. 5 N4. 1971.

\_\_\_\_\_. "Economics of Forestry". 1986.

Town Planning Department. National Physical Plan 1978/98. 1978.

UNDP/FAO. K.M. Gray and G.A. Symes. "Forest Inventory of Jamaica." Part 4, Final Report, Jamaica. 1971.

UNDP/FAO. Based on work of B.F. Gibson. "Forestry Development and Watershed Management in the Upland Regions. Development Prospects in Wood Production and Watershed Management in Jamaica." Jamaica. 1973.

UNDP/FAO. K.M. Gray and E. Billeschou. "Forestry Development and Watershed Management in the Upland Regions." Jamaica Forestry Development Plan. FO:SF/JAM 505, Kingston. 1973.

UNDP/FAO. T.C. Sheng and T. Michaelson. "Forestry Development and Watershed Management in the Upland Regions, Jamaica; Run-off and Soil Loss Studies in Yellow Yams." FO:SF/JAM 505 Project Working Document, Kingston. 1973c.

UNDP/FAO. T.C. Sheng. "Forestry Development and Watershed Management in the Upland Regions, Jamaica. Watershed Management and Soil Conservation Activities in Jamaica." An Evaluation Report. FO:SF/JAM 5, Technical Report 9, Kingston. 1973d.

UNDP/FAO. W.L. Powell. "Forestry Development and Watershed Management in the Upland Regions. Hillside Agriculture in Demonstration Watersheds in Jamaica." JAM/505. Project Technical Report 11. 1974c.

UNDP/FAO. T.C. Sheng. "Forestry Development and Watershed Management in the Upland Regions." FO:DP/JAM/67/505. Technical Report 12. Kingston. 1975.

UNDP/FAO. "Forestry Development and Watershed Management in the Upland Regions, Jamaica. Project for the Rehabilitation and Development of the Pindars River and Two Meetings Watershed." FO:DP/JAM/67/505 Tech. 13/1. Rome. 1977.

USAID. "Jamaica Forestry Development." Capital Assistance Paper. Proposal and recommendations for the review of the Development Loan Committee. Washington D.C. USAID. 1973.

### **Tourism and Recreation**

Ministry of Tourism. Travel Statistics. Jamaica Museums Division, Institute of Jamaica. Annual Report. 1984-85.

Planning Institute of Jamaica. Economic and Social Survey. Jamaica. 1985.

### **Minerals and Mining**

ADELATEC. "Health and Recreational Spa, Milk River Bath, Jamaica." Preliminary Report. Prepared for the Urban Development Corporation. 1970.

Ahmad, R. "Opal in Jamaica" Geological Society of Jamaica Newsletter. Vol. 6, No. 1. p. 23. 1985.

Blackwood, M. "A Study of the Saline Water in the Negril Great Morass." PCJ Report. 1984.

Brown, K.D. "Current Programmes to Monitor and Control Environmental Problems in the Essex Valley Area of Saint Elizabeth." Proceedings. Symposium on Environmental Studies in Jamaica. Chemistry Department, UWI, Mona. May 25-26, 1979.

Carby, B. The Geology and Geochemistry of the Hope Lead Zinc Deposit, Jamaica. PhD Thesis, UWI, Mona. 1985.

Cooke, D.L., Bailey, B.V. "Marble at Mount Hibernia, Jamaica." Caribbean Geological Conference Proceedings. pp. 123-126. 1960.

Davis, C.E. "The Bauxite Industry: Strategies for Survival." Journal of the Geological Society of Jamaica. Vol.6, No.1, pps 16-36. May, 1983.

Douglas, C. "JBI Opens Alumina Pilot Plant. A Project for Technical Development". Daily Gleaner. p. 19. 29/6/85.

- Fenton, A. "The Mineral Resources of Jamaica." Geological Survey Division, Bulletin No. 8. 1981.
- Hill, V.G., McFarlane and N. Morgan N.D. "Mineral Resources and National Development III". Minerals and the Transfer of Technology. 1978.
- Hudson, B. "Wetland Reclamation in Jamaica." Caribbean Geography. Vol.1, No.2, pp 75-88. 1983.
- JBL "The New Bauxite Levy Agreements: What do they Mean?" JBI News brief. 1981.
- McDonald, F. "Geology, Mineral Resources and Planning for Development." A talk presented at the SRC Conference Room, Geologic Survey Division, Ministry of Mining and Natural Resources. 1979.
- Ministry of Mining and Natural Resources. "Jamaica's Mineral Endowment." 1977.
- Ministry of Mining and Natural Resources. Annual Report. 1978.
- Mitchell, S. The Rio Cobre Drainage Basin. Unpublished BA Thesis, UWI, Mona. 1985.
- NRCD. Traverse Group Inc. Final Report. "Environmental Feasibility Study of the Jamaica Peat Resource Utilization Project." Vol. 1, Executive Summary and Technical Report. 1981.
- Oliver R. A Preliminary Radiogeological Study of Jamaica. M. Phil Thesis, UWI, Mona. 1985.
- PIOJ. Social and Economic Survey, 1982. 1983.
- Porter, A. and Jackson, E. Rocks and Minerals. 1982.
- Robinson, E. "Peat as Fuel." Jamaica Journal. Vol. 44, pp. 46-51. 1980.
- Rodrigues, K. "Petroleum Source Rock Potential in Jamaica." Oil and Gas Journal. pp. 115-119. Jan. 1983a.
- \_\_\_\_\_. "Source Rock and Reservoir Properties of Clastic Sediments in Jamaica in Relation to Petroleum Prospects". J. Geological Society of Jamaica. Vol. 22, pp. 32-49. 1983b.
- Taffe, C. "Socio-Economic Impact of the Peat Project upon Negril and its Environs." PCJ Report. 1984.
- Town Planning Department. Atlas of Jamaica. 1971.
- White, M. "Underground Water Resources of Jamaica". J. Geological Society of Jamaica. Vol. 18, pps 54-66. 1979.
- Wright, R. Energy Exploration: Prospects in Jamaica. Seminar of Heads of Geological Services. Kingston, Jamaica. Oct. 1981.
- Zan, V.A. "Recent Geological work on Mining Development in Jamaica." Transactions. The 2nd Geological Conference, Mayaguez, Puerto Rico, 4-9th January. 1959.
- \_\_\_\_\_. "Geology and Mineral Deposits of Jamaica." Handbook of Jamaica. 1960.
- \_\_\_\_\_. "Development of our Mineral Resources". No date.
- \_\_\_\_\_. and Bailey, B.V. Marble "Deposits of Mount Hibernia and Adjacent Areas in North Western Saint Thomas". Geonotes, Vol. 14, pts. 1 and 2, pps 8-11. 1961.

### **Agricultural Resources**

- AGRO 21 (1985). Agro 21 Update. Vol. 3. June, 1985.
- AIJCFA. The All-Island Jamaica Cane Farmers Association. 43rd Annual Report. 1984.
- Anderson, Marcel A. Efficacy and Persistence of Several Insecticides in Different Types of Jamaican Soils and their Effects on Soil Fauna. Ph.D. Thesis. University of the West Indies, Mona, Jamaica. 1986.
- Anderson, M. and Mansingh, A. "Persistence of Insecticidal Residues in Different types of Jamaican Soils and their Effects on Soil Fauna". Proceedings. The Symposium on Environmental Studies in Jamaica. Chemistry Dept., UWI, Mona. May 25-26, 1979.

Black, Clinton. A Short History of Jamaica: Introduction and Development. 1957.

Blustain, H.S. "Customary Land Tenure in Rural Jamaica: Implications for Development". In Strategies for Organization of Small-Farm Agriculture In Jamaica. pp. 47-65. 1981.

CARDL. Annual Report, 1984. Jamaica Unit . 1985.

Coconut Industry Board. 42nd Annual Report, 1983. 1984.

Cunningham, C.G. Water Resources Seminar on the Role and Importance of Watershed Protection of Water Availability. "Supply Implications to the Year 2000." 1983.

Douglas, J.E. "Small Watershed Experimental Proposal Mount Airy Region Northern St. Andrew. UNDP/FAO Working Paper. 1983.

Dunkley, E. Small Farming in Frankfield, Clarendon, Jamaica. Unpublished B.A. Thesis, UWI, Mona. 1985.

FAO. "Second Expert Consultation on Environmental Criteria for Registration of Pesticides." FAO Plant Protection and Production Paper. No. 28. 1981.

FAO. Sheng, T.C. and Stenned, H.R., eds. "Forestry Development and Watershed Management in the Upland Regions of Jamaica." UNDP. 1975.

Furtick, W.R. "The Future For Pesticides." In Metcalf, R.L. and McKelvey Jr., J.J., eds. Wiley. pp.223,229. 1973.

Gooding, E.G.B. "Pest and Pesticide Management in the Caribbean." Vol. III. 1981. Proceedings of Seminar and Workshop. Nov. 3-7, 1980. Trinidad, W.I.

IICA and CARDL Seminar on cropping systems. JSA Auditorium, Jamaica. Dec. 4, 1980.

JAS. "Annual Report - The Farmer". Journal of the Jamaica Agricultural Society. Vol. 87 No. 14, pp 337-380. 1984.

JLA. Annual Report of the Jamaica Livestock Association. 1984.

Laws of Jamaica. "The Need for Coordination and the Geographer in Watershed Management in Jamaica." A paper presented at the NCGE Convention, 23-28 October, Ocho Rios, Jamaica.

Mansingh, A. "Management of Pests and Pesticides in Tropical Islands: Trends and Needs." UNESCO Symposium on Risk Assessment in the Eastern Caribbean. St. Lucia. Oct., 1985.

Michigan State University, US Department of Agriculture, Soil Conservation Service, Ohio State University. Jamaica Resource Assessment, CRIES Project. Prepared for the Jamaica Ministry of Agriculture. 1982.

Ministry of Agriculture, Data Bank and Evaluation Division. Livestock and Feed Statistics . 1975-1985.

Ministry of Agriculture. Five Year Food and Agricultural Policy and Production Plan, 1983/84-1987/88. Kingston, Jamaica. 1984.

Miyata, T., Mansingh, S., and Tomizawac, C. "Pesticide Residue in Jamaican Environment." West Indies Med. J. In press, 1987.

NRC D. National Watersheds Management. April, 1983.

PIOJ. AGRO 21. "Making Agriculture Jamaica's Business Master Plan." April, 1983.

\_\_\_\_\_. Social and Economic Survey Jamaica, 1983. 1984.

Richardson J. A Method of Assessing the Influence of a Pinus caribaea forest on stream flow and sedimentation, Mount Airy, Jamaica. Unpublished M. Phil Thesis. UWI, Mona. 1979.

Richardson J. "The Influence of Forest Covering or Aspects of Erosion and Stream Flow at Mount Airy, Eastern Jamaica." Journal of the Geological Society of Jamaica. Vol. 1, pp 35-39. 1980.

Sheng, T.C. "Some Watershed Management Problems of Taiwan and Jamaica." Seminar on Development and the Use of Jamaica's Water Resources, Oracabessa. September, 1968.

Singh, N.C. Physico-chemical Studies on Selected Pesticides. Ph.D. Thesis. University of the West Indies, Mona, Jamaica. 1985.

SIOJ. Statistical Yearbook of Jamaica, 1981. 1983a.

\_\_\_\_\_. Census of Agriculture 1978-1979. Preliminary Report Agri-census 1978. 1983b.

\_\_\_\_\_. The Labour Force, 1982. 1983c.

Stone, C. "A Sociological Survey of Tenant Farmers on Project Landlease." 1974.

Town Planning Department. Atlas of Jamaica. 1971.

White, M. "Saline Intrusion of the Karstic Limestone Aquifer in the Lower Rio Cobre Basin Jamaica." Journal of the Geological Society of Jamaica. Vol. 19, pp 25-34. 1980.

### **Urban and Rural Infrastructure**

Charles, P. "Ministry Paper No. 13." Ministry of Public Utilities and Transport. April 30, 1985.

Cox, O. Jamaica Public Service Company Limited Annual Report, 1983. 1984.

National Planning Agency. "Urban Growth and Management Study." 1978.

Oswald, W.J. "Wastewater Management Techniques for Kingston Sewerage." Kingston Water Commission. 1978.

PIOJ. Social and Economic Survey Jamaica 1983. 1984.

PIOJ. Social and Economic Survey Jamaica 1984. 1985.

Reid Crowther and Partners Limited. "Kingston, St. Andrew and St. Catherine Waste Water Management Programme Engineering Study." Jamaica. World Bank/Water Commission Study. 1980.

\_\_\_\_\_. "Report on Preliminary Engineering. Kingston and St. Andrew Jamaica Sewerage

programme." Wastewater Reclamation and Agricultural Re-use Project (Flow West Project). 1983.

SIOJ. Statistical Yearbook of Jamaica, 1981. 1983.

SIOJ. Population Census, 1982.

SWFCO. "Blue Mountain Multi-Purpose Project Pre-Investment Study Main Project." Vol. 2, Ministry of Mining and Natural Resources. 1980.

Toyloy, N. "Yallahs Pipeline Project - On the Last Lap." Sunday Gleaner 21/7/85.

TPD. A National Physical Plan for Jamaica, 1970-1990.

TPD. The National Physical Plan, Jamaica 1978-1998. 1978.

TPD. Kingston Metropolitan Regional Plan. 1978a.

Wade, B. "The Pollution Ecology of Kingston Harbour." Jamaica Scientific Report of the UWI/ODM Kingston Harbour Research Project 1972-1975, Volume 1, Research Report from the Zoology Department. UWI, Mona. No. 5. 1976.

Wallace Evans and Partners and Environmental Resources Limited. "Study on Solid Waste Management in the Kingston Metropolitan Region." NPA. 1979.

### **Environmental Hazards**

Field, R.M. and Associates. "Natural Hazards Mitigation: A Recommended Strategy for Jamaica." Report prepared for the Office of Disaster Preparedness. 1984.

Gaby, L.D. Earthquake Resistant Structures in Jamaica. 1975.

Geological Survey Division. Preliminary Map of High Risk Areas and Preliminary Map of Landslip Areas.

Hudson, B. "Wetland Reclamation in Jamaica". Caribbean Geography. November, 1983.

McDonald, F. "Comments on the Geology of Jamaica with Special Reference to the Evaluation of Seismic Risk."

\_\_\_\_\_. "Establishing the Risk and Priority for Mitigation Under Disaster Conditions for Kingston Jamaica. Department of Geography, University of Hawaii. 1981.

Periera, J. "Earthquake Risk in Jamaica: History and Probability."

Shepherd, J.B. "A Study of Earthquake Risk in Jamaica and its Influence on Physical Development Planning." Town Planning Department. 1971.

Shepherd, J.B. and Aspinall, W.P. "Seismicity and Seismic Intensities in Jamaica West Indies: A Problem of Risk Assessment." 1981.

Shepherd, J.B. and Aspinall, W.P. "Modeling Earthquake Response on the Liguanea - St. Catherine Plains." Seismic Research Unit. 1977.

Shepherd, J.B. and Tusnovsky, J. "Micro-zoning of Earthquake Effects in Kingston." S.R.U. 1976.

Spence, B. "Perception of Natural Hazards in the Kingston Waterfront and Portmore Area." Geography Department, U.W.I. 1982.

\_\_\_\_\_. "Perception of Flood Hazards on the Floodprone Areas of Westmoreland." Geography Department, U.W.I. 1982.

Town Planning Department. National Physical Plan. 1978-1998.

Water Resources Division. "Hydrological appraisal of damage in Western Jamaica caused by the June 12, 1979 flood rains." Ministry of Local Government. 1978.