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Environmental Profile

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**COUNTRY  
ENVIRONMENTAL  
PROFILE**

Prepared Under the Aegis Of:

**THE CARIBBEAN CONSERVATION ASSOCIATION**  
St. Michael, Barbados

On Behalf Of:

**THE GOVERNMENT OF THE COMMONWEALTH OF DOMINICA**  
Forestry and Wildlife Division  
Ministry of Agriculture and the Environment

With the Technical Support Of:

**THE ISLAND RESOURCES FOUNDATION**  
St. Thomas, U.S. Virgin Islands

And

**THE DOMINICA YES COMMITTEE**  
(Years of Environment and Shelter, 1989-1990)

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**THE U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT**  
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Bridgetown, Barbados

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## FOREWORD

One of the most serious threats to sustainable economic growth in the Caribbean is the increasing degradation of the region's natural ecosystems and a concurrent deterioration in the quality of life for Caribbean people. The task of reversing this unfortunate trend requires better knowledge and understanding of the region's unique environmental problems and the development of appropriate technologies and public policies to lessen and even prevent negative impacts on our fragile resource base.

In an attempt to provide such a framework, the Caribbean Conservation Association, with funding provided by the United States Agency for International Development and with the technical assistance of the Island Resources Foundation, has produced a series of Country Environmental Profiles for six Eastern Caribbean countries -- Antigua and Barbuda, Dominica, Grenada, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines.

Even though these documents do not claim to be encyclopedic in their treatment of individual sectors and issues, each Profile represents the most current and comprehensive information base assembled to date on environmental and conservation issues that affect, and are affected by, the development process in the Profile countries.

Each document addresses key environmental problems, constraints, and policy directions as these were identified and fleshed out by a team of researchers and writers, in collaboration with a local coordinating committee. Each Profile also identifies and examines a variety of opportunities and planning tools which may prove useful in meeting environment/development goals in the future. All of this information should play a significant role in informing and influencing ecologically-sound development planning in the region, and should provide a basis for improved decision-making -- both immediate as well as long-term. This may best be accomplished by using the data to define priorities (in view of related benefits and costs), to pursue in-depth analysis of issues, and to undertake necessary follow-on activities in such a way that they are mutually reinforcing. In short, action emanating from the recommendations contained in the Profile might best be undertaken within a comprehensive environmental management framework, rather than from a piecemeal, project-oriented perspective.

The Caribbean Conservation Association is very pleased to be able to make this contribution to development planning in the region.

Calvin A. Howell  
Executive Director  
Caribbean Conservation Association

*(April 1991)*

## ACKNOWLEDGEMENTS

Overall project management for the Dominica Country Environmental Profile Project was provided by the Caribbean Conservation Association (CCA) under the direction of Acting Executive Director Mr. Calvin Howell. Technical guidance in preparation of the Profile was the responsibility of the Island Resources Foundation (IRF). Dr. Edward L. Towle, President of the Foundation, is the Team Leader for the Profile Project in the Eastern Caribbean; Ms. Judith A. Towle, IRF Vice President, is the Editor of the CEP Report Series; and Mr. Avrum J. Shriar served as Coordinator for the Dominica CEP.

Dominica Government liaison for the CEP effort was the Division of Forestry and Wildlife of the Ministry of Agriculture, Lands, Fisheries, Trade, Industry and Tourism. Additionally, the Core Committee for the Government's YES (Years of Environment and Shelter) program was designated as the CEP National Committee with overall responsibilities for in-country coordination, review and support activities. The YES Committee is comprised of representatives from both the public and private sectors. Professional counterpart assistance to the CEP project team was provided in Dominica by Mrs. Roma Douglas, who with competence and resourcefulness supported the technical team and became a key member of the project's working group.

Special recognition is due to Mr. Felix Gregoire, who wore two hats for the CEP project -- as head of the Forestry and Wildlife Division and as chairman of the YES Committee, a dual assignment he executed with considerable skill and good cheer. Appreciation is also expressed to the technical and support staff of the Forestry and Wildlife Division and to the Executive members and support staff of the Dominica Conservation Association. The technical review of the Profile provided by Dr. Peter G.H. Evans of Oxford University was extremely helpful.

Staff at the U.S. Agency for International Development, Caribbean Regional Development Office in Barbados facilitated implementation of the Dominica Profile Project, in particular, Mission Environmental Officer Rebecca Niec, whose support has been appreciated throughout this effort by both CCA and IRF.

Many persons in Dominica gave willingly of their time and expertise in providing interviews and information for the CEP writing team and in the report review process (these contributions are discussed in more detail in the Introduction section to the Profile). The list of names which follows (in alphabetical order) is by no means an inclusive one, but we wish to take this opportunity to thank those whose input was particularly useful in writing the Profile report: Isaac Baptiste (Physical Planning Division), Claudia Bellot (Agriculture), Deo Bhagowtee (Legal Affairs), R. Bruney (DOMLEC), Anthony Burnette-Biscombe (Communications/Works), Adolphus Christian (Forestry), Michael Didier (DBMC), Eisenhower Douglas (EDU), Marie-Jose Edwards (National Development Corporation/Tourism), John Fabien (Health), S. Govindaraj (UNDP/DOMLEC), F. Adler Hamlet (DOMLEC), Errol Harris (Agriculture), R.C.M. Harris (Law Review Office), Arlington James (Forestry), Edward Lambert (Dominica Agro Industries, Ltd.), Randall LaRonde (Small Lumber Producers Group), Nigel Lawrence (Fisheries), Jon Mann (CICP), C. "Bud" Meckling (CIDA/DOWASCO), Jean-Rene Noiseux (CIDA/DOWASCO), Greg Robin (CARDI), Phillippe Ross (CICP), Christopher Sorhaindo (DOWASCO), Sylvester Vital (Communications/Works), Allan White (FAO/Forestry), David Williams (Forestry), and Jeff Williams (Forestry). Many other organizations, agencies, and individuals in Dominica gave valuable assistance during the course of the project. To each we extend our gratitude, along with the hope that the Environmental Profile will assist the country in defining and achieving its goals for sustainable development in the decade ahead.

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*(June 1990)*

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Typical luxuriant rain forest habitat in Dominica, featuring a mature, heavily buttressed Chataignier (*Sloanea* spp.), usually found in association with Carapite (*Amanoa caribaea*), which has moderate buttresses, and with Gommier (*Dacryodes excelsa*).

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**ACRONYMS USED IN  
THE DOMINICA COUNTRY ENVIRONMENTAL PROFILE**

<b>AGM</b>	Annual General Meeting
<b>AIDB</b>	Agricultural, Industrial, and Development Bank
<b>BDD</b>	British Development Division
<b>CANARI</b>	Caribbean Natural Resources Institute (formerly ECNAMP)
<b>CARDI</b>	Caribbean Agricultural Research and Development Institute
<b>CARICOM</b>	Caribbean Community
<b>CCA</b>	Caribbean Conservation Association
<b>CCCE</b>	Calle Centrale Commerciale (France)
<b>CDB</b>	Caribbean Development Bank
<b>CEHI</b>	Caribbean Environmental Health Institute
<b>CEP</b>	Country Environmental Profile
<b>CFTC</b>	Commonwealth Fund for Technical Cooperation
<b>CICP</b>	Consortium for International Crop Protection
<b>CIDA</b>	Canadian International Development Agency
<b>CIDE</b>	Center for International Development and Environment
<b>CITES</b>	Convention on International Trade of Endangered Species of Wild Flora and Fauna
<b>CNF</b>	Canadian Nature Federation
<b>CTO</b>	Caribbean Tourism Organization (formerly Caribbean Tourism Research and Development Center)
<b>CTO</b>	Chief Technical Officer
<b>CZM</b>	Coastal Zone Management
<b>DAI</b>	Dominica AgroIndustries Limited
<b>DBGA</b>	Dominica Banana Growers Association
<b>DBMC</b>	Dominica Banana Marketing Corporation
<b>DCO</b>	Development Control Officer
<b>DCP</b>	Dominica Coconut Products
<b>DEXIA</b>	Dominica Export Import Agency
<b>DCA</b>	Dominica Conservation Association
<b>DOMLEC</b>	Dominica Electric Company
<b>DOWASCO</b>	Dominica Water and Sewerage Company
<b>DTL</b>	Dominica Timbers Limited
<b>EARTHSAT</b>	Earth Satellite Corporation
<b>ECLAC</b>	Economic Commission for Latin America and the Caribbean (United Nations)
<b>ECNAMP</b>	Eastern Caribbean Natural Area Management Program (renamed 1989 as Caribbean Natural Resources Institute, CANARI)
<b>EDU</b>	Economic Development Unit
<b>EEC</b>	European Economic Community
<b>EEZ</b>	Exclusive Economic Zone
<b>EDF</b>	European Development Fund
<b>EHO</b>	Environmental Health Officer
<b>EIA</b>	Environmental Impact Assessment
<b>EIS</b>	Environmental Impact Statement
<b>FAD</b>	Fish Aggregating Device
<b>FAO</b>	Food and Agriculture Organization of the United Nations
<b>FDD</b>	Fisheries Development Division
<b>GATE</b>	German Appropriate Technology Exchange
<b>GDP</b>	Gross Domestic Product

GOCD	Government of the Commonwealth of Dominica
GTZ	German Agency for Technical Co-operation (Deutsches Gessellschaft fur Technische Zusammenarbeit)
HIAMP	High Impact Agricultural Marketing and Production (USAID)
ICBP	International Council for Bird Preservation
ICOD	International Center for Ocean Development (Canada)
IDA	International Development Association (World Bank)
IFAD	International Fund for Agricultural Development
IICA	Inter-American Institute for Cooperation on Agriculture
ILO	International Labor Organization
LPG	Liquid Propane Gas
IRF	Island Resources Foundation
IUCN	International Union for the Conservation of Nature and Natural Resources
LAC	Latin America and the Caribbean
MOA	Ministry of Agriculture
NET	Northeastern Timber Cooperative Limited
NCC	National Culture Council
NDC	National Development Corporation
NGO	Non-Government Organization
OAS	Organization of American States
ODA	Overseas Development Administration (UK)
OECS	Organization of Eastern Caribbean States
OECS-NRMP	Organization of Eastern Caribbean States-Natural Resources Management Project
PAHO	Pan American Health Organization
PHC	Primary Health Care
PPD	Physical Planning Division
RAMSAR	Convention on Wetlands of International Importance Especially as Waterfowl Habitat
REMS	Regional Environmental Management Specialist (USAID)
SPAT	Small Projects Assistance Team
TFR	Total Fertility Rate
UK	United Kingdom
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
US	United States
USAID	U.S. Agency for International Development
USAID/RDO/C	U.S. Agency for International Development/ Regional Development Office/Caribbean
UWI	University of the West Indies
WHO	World Health Organization
WIAEC	West Indies Agro-Economic Conference
WINBAN	Windward Islands Banana Growers Association
WWF	World Wildlife Fund
YES	Years of Environment and Shelter

## Abbreviations Used In The Country Environmental Profile

ac	acre	kW	kilowatt
BOD	biochemical oxygen demand	kWh	kilowatt-hour
BTU	British Thermal Unit	l/s	liter per second
cm	centimeter	lb	pound
COD	chemical oxygen demand	m	meter
EC\$	Eastern Caribbean Dollar	MGD	million gallons per day
ft	foot	mi	mile
g	gram	ML	millions of liters
gpd	gallons per day	ml	milliliter
GWh	gigawatt hour	mm	millimeter
ha	hectare	MW	megawatt
in	inch	TOE	Tonnes of Oil
kg	kilogram	US\$	American Dollar
km	kilometer		(US\$1.00 = EC\$2.67)
kn	knot		
kV	kilovolt		

## Conversion Coefficients Between Imperial Measures and Weights And The Metric System

	<u>Imperial</u>	<u>Metric System</u>
LENGTH	1 inch	2.540 centimetres
	0.39370 inch	1 centimetre
	1 yard	0.91440 metre
	1.094 yards	1 metre
	1 mile	1.609 kilometres
	0.6214 mile	1 kilometre
	1 fathom (6 feet)	1.829 metres
AREA	1 square foot	0.093 square metre
	10.6 square feet	1 square metre
	1 acre	0.405 hectare
	2.471 acres	1 hectare
	1 square mile	2.59 square kilometres
	0.386 square mile	1 square kilometre
VOLUME	1 pint	0.568 litre
	1.76 pints	1 litre
	1 gallon	4.546 litres
	0.220 gallon	1 litre
	1 cubic foot	0.028 cubic metre
	35.31 cubic feet	1 cubic metre
	WEIGHT	1 pound
2.205 pounds		1 kilogram
1 long ton		1016 kilograms
1 short ton		907.185 kilograms
0.9842 long ton		1 tonne (1,000 kilograms)
1.102322 short ton		1 tonne (1,000 kilograms)
TEMPERATURE		Conversion F to C: subtract 32 and divide by 1.8

## INTRODUCTION

Preparation of Country Environmental Profiles (CEPs) has proven to be an effective means to help ensure that environmental issues are addressed in the development process. Since 1979, the U.S. Agency for International Development (USAID) has supported Environmental Profiles in USAID-assisted countries. Those completed to date have provided:

(1) a description of each country's natural resource base, including a review of the extent and economic importance of natural resources and changes in the quality or productivity of those resources;

(2) a review of the institutions, legislation, policies and programs for environmental planning, economic development and natural resource management;

(3) identification of the major issues, conflicts or problems in natural resource management and opportunities for effective responses.

Profiles have highlighted gaps in the existing information base, suggested new guidelines for the design and funding of development programs, pinpointed weaknesses in regulatory or planning mechanisms, and illustrated the need for changes in policies. Most importantly, the process of carrying out a profile project has in many cases helped establish new working relationships and even consensus among government and non-government bodies concerned with environmental issues and has also served to strengthen local institutions and improved their capacity for incorporating environmental information into development planning.

### PROFILES FOR THE EASTERN CARIBBEAN

Country Environmental Profiles have been prepared for several countries in the Wider Caribbean Region, including Panama, Belize, the Dominican Republic, Haiti, and Jamaica. The potential utility of CEPs in the Eastern Caribbean sub-region (essentially the OECS

countries) has been a subject of discussion since the early 1980's. The need for the profiling process to begin in those countries was reaffirmed during a seminar on Industry, Environment and Development sponsored by the Caribbean Conservation Association (CCA) and the University of the West Indies in August 1986.

Shortly thereafter, USAID entered into a Co-operative Agreement with CCA for preparation of a series of CEPs for the Eastern Caribbean. It was decided to begin the profile process in the country of St. Lucia as a pilot project, to be followed by profiles for Grenada, Antigua-Barbuda, Dominica, St. Kitts-Nevis, and St. Vincent and the Grenadines.

Early in 1987, CCA and the Island Resources Foundation (IRF), of St. Thomas, U.S. Virgin Islands, entered into an agreement whereby it was determined that IRF would provide technical assistance and support to CCA in the execution of the profile project in the Eastern Caribbean. The Executive Director of the Caribbean Conservation Association is the CEP Project Director, while the President of the Island Resources Foundation serves as CEP Project Manager/Team Leader.

### THE DOMINICA COUNTRY ENVIRONMENTAL PROFILE

Early in 1990 a Memorandum of Understanding was signed by CCA and the Government of the Commonwealth of Dominica (GOCD) for the purpose of executing a Country Environmental Profile, with the Forestry and Wildlife Division of the Ministry of Agriculture serving as the designated counterpart agency for the Government. At the same time, the Committee for the Government's on-going program called YES (for Years of Environment and Shelter, 1989-1990) was designated by CCA and GOCD as the local implementing and coordinating organization for the CEP project, and the members of the YES Core Committee served as members of the CEP National Committee for Dominica. In effect, implementation of the Country Environment Profile Project was accepted by the YES Committee as one of its primary objectives for

1990 (for additional information on YES, see Chapter 11 of the Profile).

The Profile effort in Dominica has received considerable support from the country's Prime Minister, The Honourable Eugenia Charles, who early on met with the project director, Mr. Calvin Howell of the Caribbean Conservation Association, and with the leader of the project's technical team, Dr. Edward Towle of the Island Resources Foundation, to discuss program goals. In Dominica, coordination of CEP activities has also been facilitated by the Prime Minister's designation of the Forestry and Wildlife Division as the lead Government agency, for that unit of Government is ably headed by Mr. Felix Gregoire, who also serves as chairman of the YES Committee. Professional counterpart support for the IRF technical team was provided by Mrs. Roma Douglas, who assisted with interviews, research, and writing tasks.

The CEP National Committee (i.e., the YES Core Committee) was called on to support the project in a variety of ways, most importantly in helping to identify critical environmental issues, obtaining reference materials, and coordinating and assisting with the in-country review of materials prepared by the CEP technical team. A broad spectrum of individuals, selected locally by the YES Committee, participated in the review of the Profile, on a chapter-by-chapter basis.

The draft Profile Report was prepared during a five month period, February - June, 1990, with draft chapters circulated to in-country reviewers for comments and input as each was readied by the CEP technical team. The full CEP document, in "draft final" format, was completed in July and disseminated for final review both in Dominica and to other reviewers in the Caribbean region.

#### **ORGANIZATION OF THE DOMINICA CEP REPORT**

As determined by the Dominica CEP National Committee and the IRF technical writing team, the Dominica Country Environmental Profile

has been organized in twelve primary sections. Each sector-specific chapter provides the reader with an overview summary of the sector, reviews key environmental problems and issues within the sector, and concludes with recommendations specific to that sector.

SECTION ONE provides background information on the general environmental setting of the country and also briefly reviews historical, economic and demographic features.

SECTION TWO begins a review of the country's resource base, including a discussion of primary environmental issues within each key resource sector. SECTION TWO focuses on Forests and Wildlife, SECTION THREE on Agriculture. SECTION FOUR reviews the country's Freshwater Resources, while SECTION FIVE specifically deals with Coastal and Marine Resources.

The Profile moves away from an examination of the physical environment to consider Energy issues in SECTION SIX and Industry and Tourism issues in SECTION SEVEN. Pollution and Public Health is the subject of SECTION EIGHT.

The topic of land use and physical planning is examined in SECTION NINE, while SECTION TEN focuses specifically on the management of historical and cultural resources.

The subject of SECTION ELEVEN is the institutional framework for environmental management in Dominica, including an overview of key agencies and organizations with resource management and development responsibilities. The final chapter, SECTION TWELVE, provides a summary and synthesis of critical environmental issues, conclusions, and recommendations.

A comprehensive bibliography of source materials dealing with natural resource development and environmental management is found at the end of the Profile. Most references cited deal specifically with Dominica or with the Eastern Caribbean sub-region. It is the most thorough assemblage of such reference material on Dominica to be published to date.



Looking north to the Cabrits, seen in the distance, across Prince Rupert's Bay.



The Layou River, Dominica's largest river.

## SECTION 1 INTRODUCTION AND BACKGROUND

### 1.1 COUNTRY OVERVIEW

The most northerly and largest of the Eastern Caribbean's Windward Islands (Figure (1.1(1))), the country of Dominica has, with justification, been heralded as the region's premier nature island. With its very rugged terrain, perennial streams, rivers and waterfalls, and its great diversity of flora and fauna, Dominica's mostly unspoiled landscape is considered by island aficionados to be among the most dramatically beautiful and pristine in the world. The country's undisturbed vegetation is more extensive than on any other island in the Lesser Antilles, a chain of Caribbean islands which descends in a graceful arc from the Virgin Islands in the north to Trinidad in the south. Its forests have been extolled as undoubtedly the finest in the Caribbean, even comparing favorably with those of Central and South America.

In promotional literature designed to lure visitors and tourists, Dominica is described as an island of rainbows, a place where mists rise gently from lush green valleys and fall softly over blue green peaks, where trees sprout orchids, and where rivers framed by banks of giant ferns rush and tumble to the sea. Along mountain slopes, fields of broad-leaved bananas contrast with cocoa and citrus trees, and cattle graze in the feathery shade of coconut palms. The island's uniqueness can be explained in varying ways -- it is home to the region's surviving Carib Indians (who gave the Caribbean its name and who still reside on the island's windward coast); it is also the site of a fascinating boiling lake and within its borders is located one of the most diverse and luxuriant rain forests in the Americas.

Dominica's rugged and mountainous landscape contributes greatly to its dramatic beauty, in part because the topography has made it difficult to clear the lush vegetation. However, this and other physiographic features have also hampered development efforts, particularly those which were instigated within a colonial or neo-colonial framework or were based on imported strategies often ill-

sued to Dominica's mountainous, humid, tropical and insular environment. Like virtually all Caribbean islands, Dominica found few opportunities in the past to pursue an indigenous program of development, while external influences still heavily dominate growth and development patterns. At the same time, more recent development strategies have placed ever-increasing pressures on natural and cultural resources. While largely beneficial, development has also had a variety of adverse, undesirable and often unintended impacts on the environment, which will be discussed in more detail in this Environmental Profile. The risk for future generations of Dominicans lies in under-valuing the country's remarkable, common resource base and, by doing so, inadvertently allowing it to deteriorate and devolve into a diminished habitat for Dominicans in the future.

### 1.2 THE BIOPHYSICAL ENVIRONMENT

#### 1.2.1 Topography

Dominica is characterized by very rugged and steep terrain. The cone of Morne Diablotin dominates the topography of the northern half of the island, along with Morne Au Diable on the northern peninsula, while a chain of mountains, including Morne Trois Pitons, Morne Micotrin, Morne Anglais, and Morne Plat Pays, extends through the south of the island (see Figures 1.2(1) and 1.2(2)). The peaks of all of these mountains are less than seven km from the sea, an indication of the island's high relief which, in turn, has had and will continue to have an important orographic influence on climate, on land use and on the general physical development of the island.

Flatter areas are restricted primarily to river valleys, the coastal areas of the north-east, and an area in the center of the island

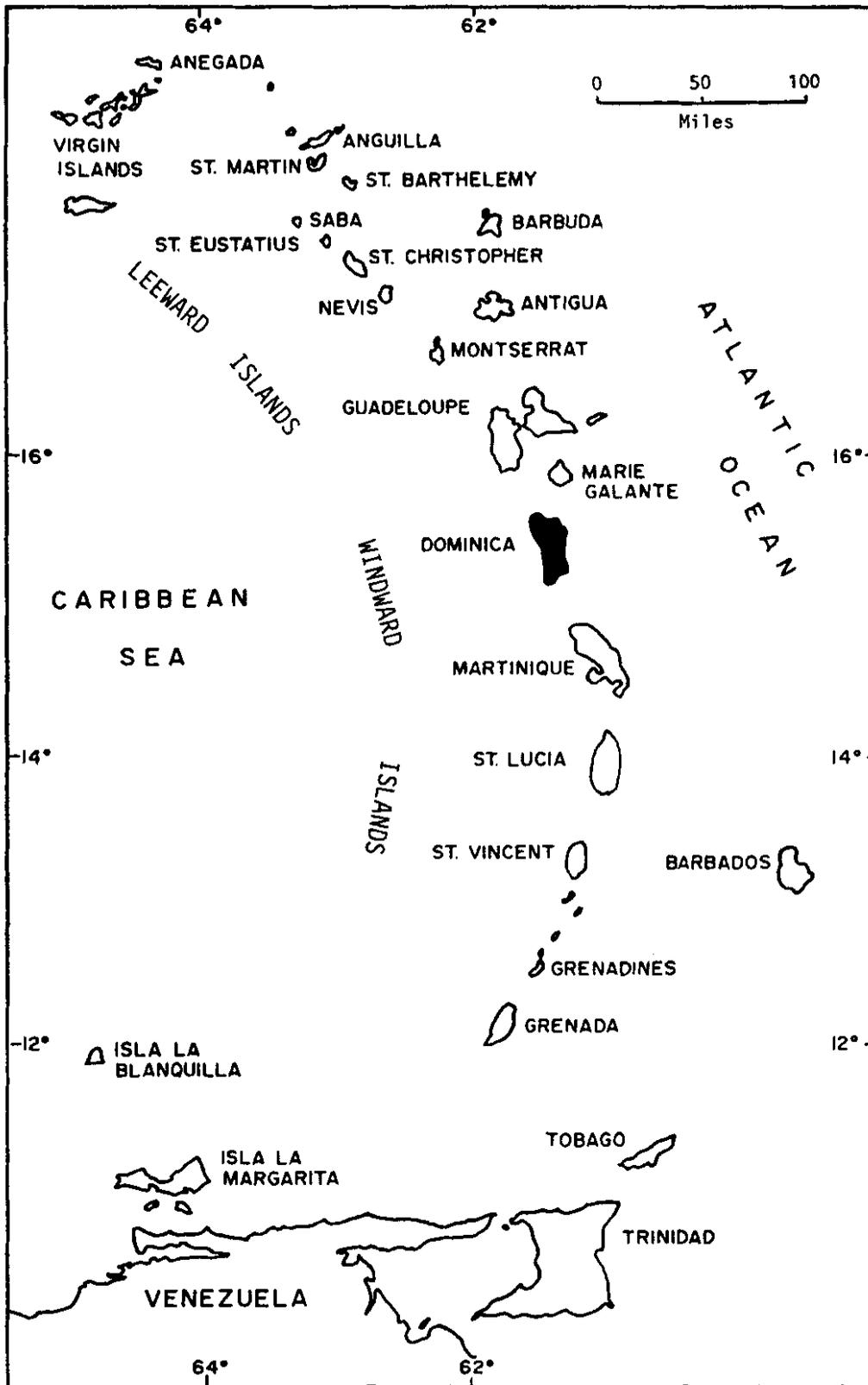


Figure 1.1(1). General map of the Eastern Caribbean, showing the location of Dominica.

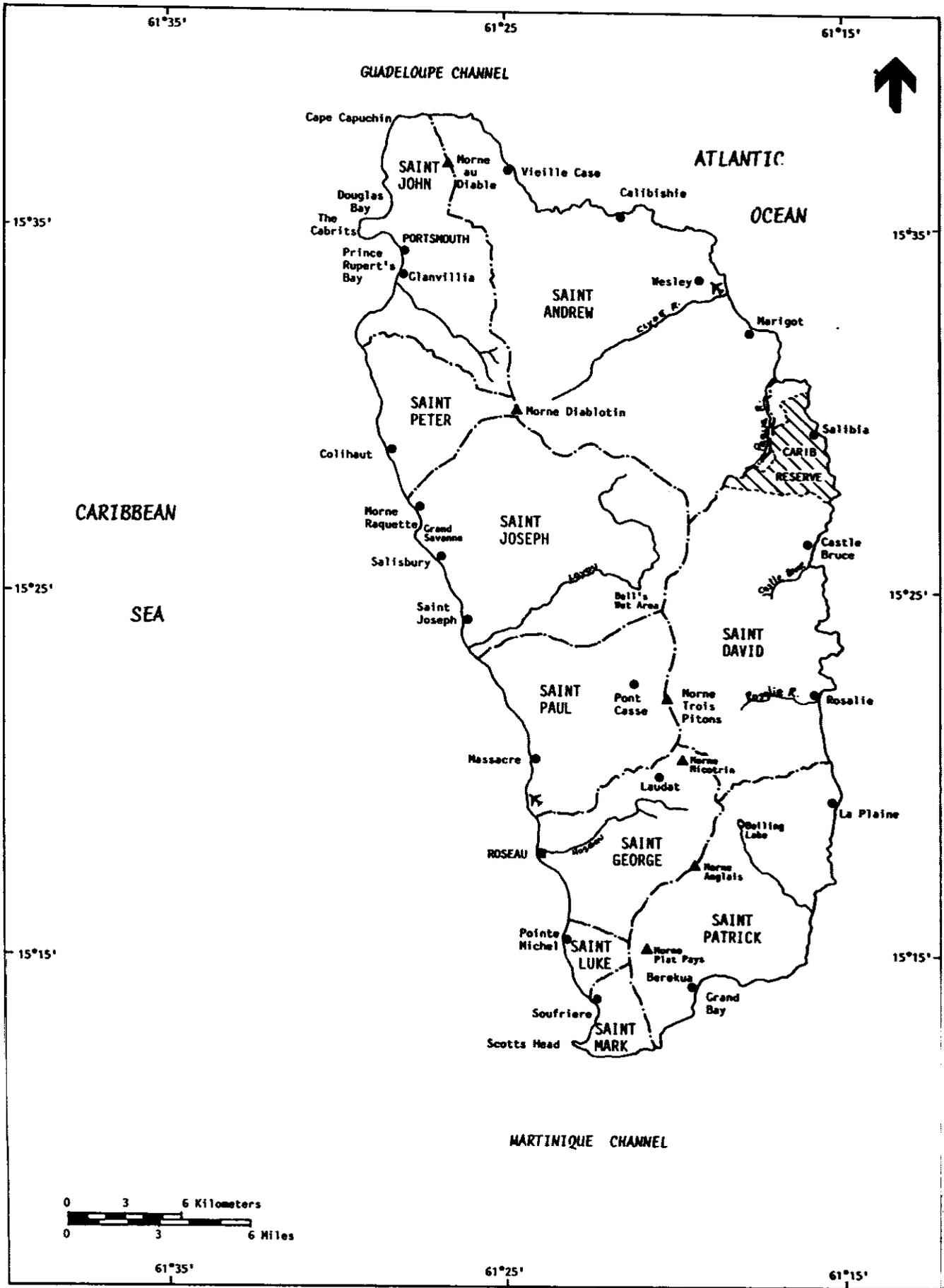


Figure 1.2(1). General location map for the island of Dominica.

known as Bell's Wet Area. The main river valleys are also found in the center of the island. These include the Roseau and Layou Valleys on the leeward side of the island and, on the windward side, the Clyde, Pagua, Castle Bruce, and Rosalie River Valleys.

Most flat or moderately sloped land occurs near the coasts, and thus most urban and agricultural development has occurred in these areas. Some 90 percent of the population lives along the coast, primarily (70 percent) on the leeward side. The latter offers more protection from the wind and other climatic extremes as well as providing relatively calm seas suited to fishing and navigation. The country's two main centers, the city of Roseau (the capital) and the town of Portsmouth, and all port facilities are located along the leeward coast.

The rugged topography manifests a major constraint to the development of human settlements and agriculture. As described further in Section 9 on Physical Planning and Landscape, most existing communities have no room for expansion except through hillside residential development or density increases in already built up areas. Portsmouth is the only major settlement with a substantial amount of reasonably flat land available for expansion (GOCD, 1985).

### 1.2.2 Geology

Dominica's geology is similar to that of other volcanic islands in the Lesser Antillean Archipelago. The islands are the summits of a submerged mountain range which forms the eastern boundary of what is known as the Caribbean Tectonic Plate. Tectonic plates are mobile; they behave like rafts of solid crust floating atop less dense, relatively fluid materials in the earth's underlying mantle. Movement of the plates is believed to result from the presence of convection currents in the mantle.

The Caribbean Plate is bounded to the north and east by the North American

Plate, to the south by the South American Plate, and to the west and southwest by the Cocos Plate (Figure 1.2(3)). The North American Plate is moving westward relative to the Caribbean Plate, while the Cocos Plate is moving in a northeast direction. Little relative displacement is presently occurring between the Caribbean Plate and the South American Plate.

The North American and Cocos Plates are "subducting" below the Caribbean Plate, down into the mantle where they proceed to melt (Figure 1.2(3)). This melted material forms magma which is extruded to the earth's surface as lava by volcanoes. The island of Dominica and the rest of the Antillean Archipelago were formed by such lavas forced through the volcanoes that formed alongside the subduction zone of the North American and Caribbean Plates.

The entire island archipelago is geologically young, having begun to form probably less than 50 million years ago, during the Miocene period of the Cenozoic era. Dominica has since undergone numerous and considerable changes in elevation but is now relatively stable. Evidence of previous submergence can be seen on the face of Morne Bruce above the city of Roseau and elsewhere to the south, as an association of aqueous and igneous rock formations.

The volcanic rocks are mainly andesites with subordinate dacites and basalts. The discovery in the Roseau Basin of welded tufts reveals that Morne Macaque (Micotrin) has had a long history of activity that may not yet have completely subsided. Volcanism is active at present in the Sulphur Springs region and the area of the Boiling Lake and Valley of Desolation. On January 4, 1980, a minor eruption occurred. The most recent lava flow took place in the Grande Savanne area (GOCD, 1985).

Ongoing seismic activity on the island has been recorded since 1953 and has revealed that a number of earthquakes may be volcanically related, associated with shallow processes taking place beneath Dominican volcanoes.

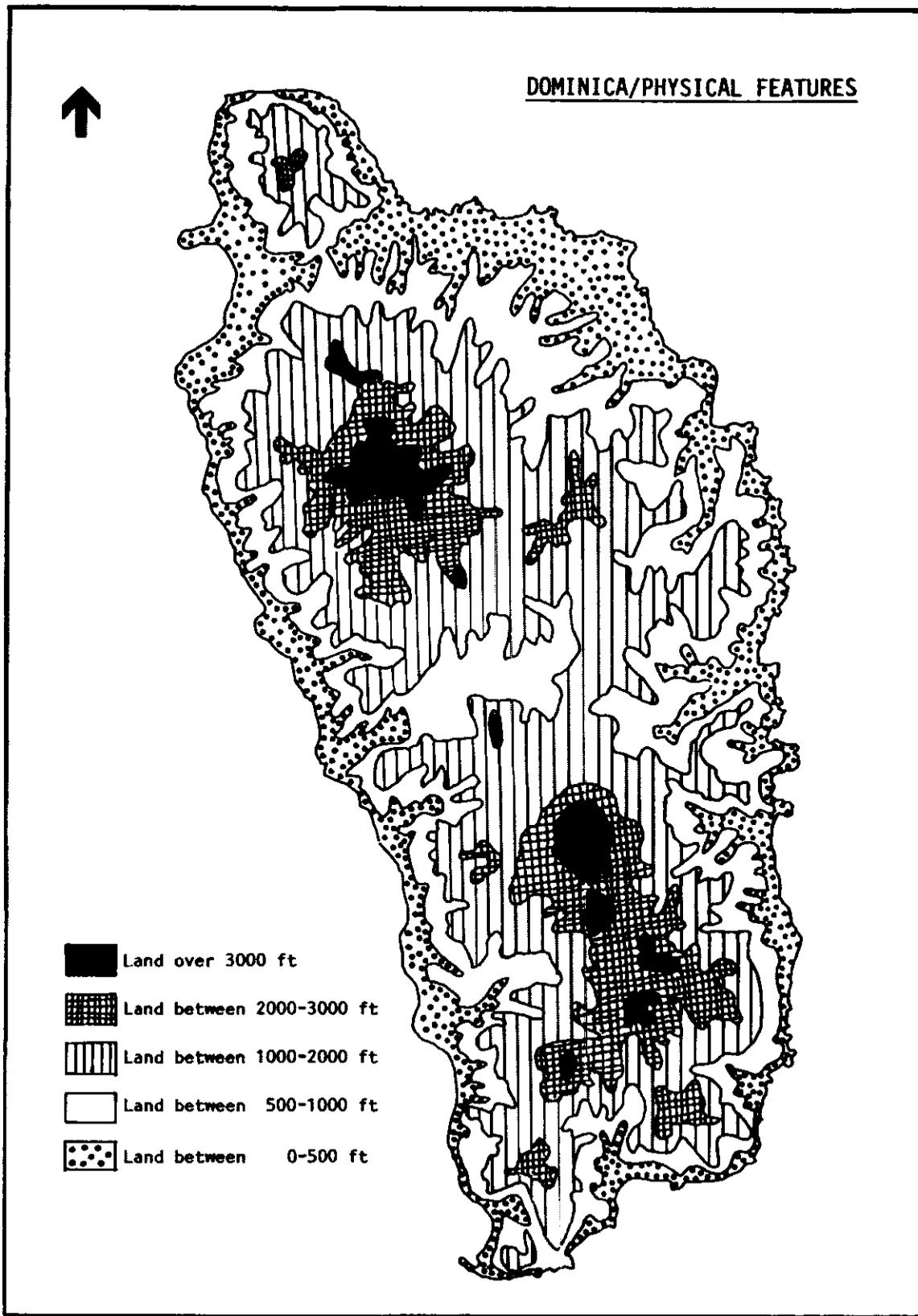


Figure 1.2(2). Physical features of the island of Dominica (source: Shankland Cox and Associates, 1971).

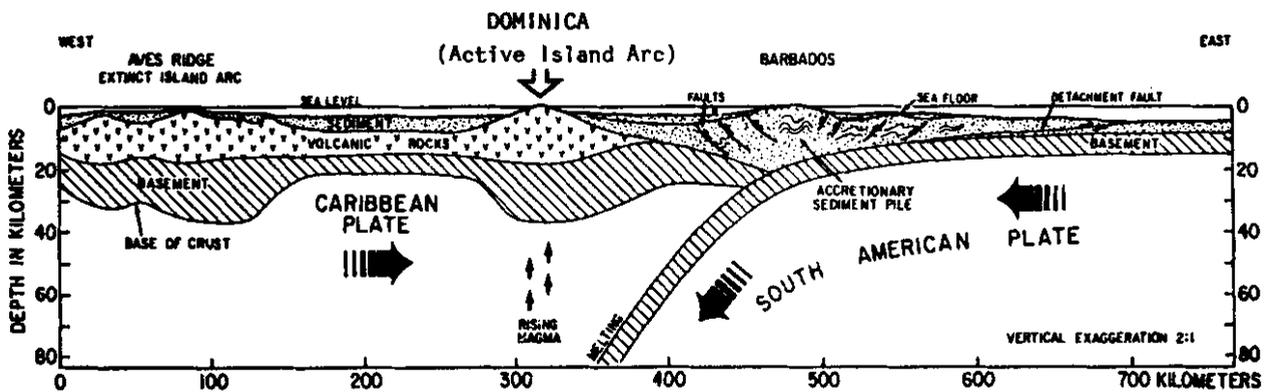
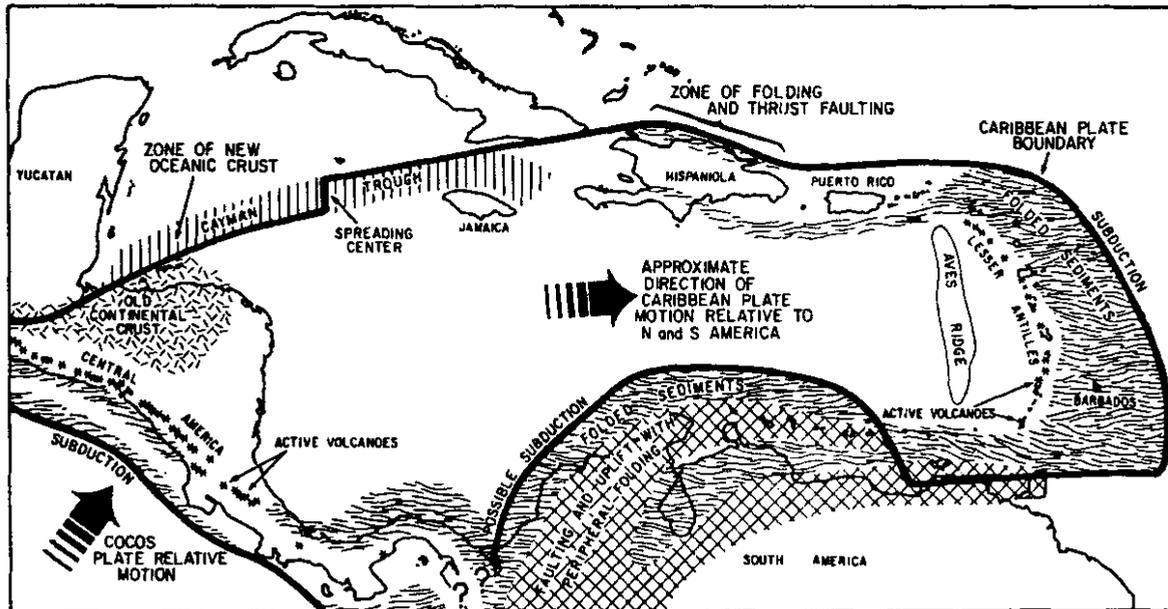


Figure 1.2(3). Above: Geological features of the active boundary zone of the Caribbean Plate (source: Dillon, *et al.*, 1987).

Below: The eastern margin of the Caribbean Plate at the location of Barbados and Dominica. Cross section showing the Caribbean Plate being underthrust by the South American Plate. Figure adapted from Dillon, *et al.*, 1987.

### 1.2.3 Climate

Dominica's climate is classified as humid tropical marine, characterized by little seasonal or diurnal variation and strong and steady trade winds. These winds blow in a westward direction between the Atlantic-Azores subtropical high pressure zone and the intertropical convergence zone. They contact the island from the northeast throughout most of the year, but a southeasterly pattern develops during the summer when the sun's declination to the equator shifts northward and, in turn, alters their positions.

Wind speeds are generally moderate, averaging 6.4 km (4 miles) per hour at sea level and about 14.4 km (9 miles) at an elevation of 1,450 feet above sea level (at the Brantridge Meteorological Station).

The island's rugged topography contributes strongly to micro-climatic variability within very short distances as depicted in Figure 1.2(4), and serves to "capture" a great deal

of the moisture contained within the air masses that enter the region from the Atlantic ocean.

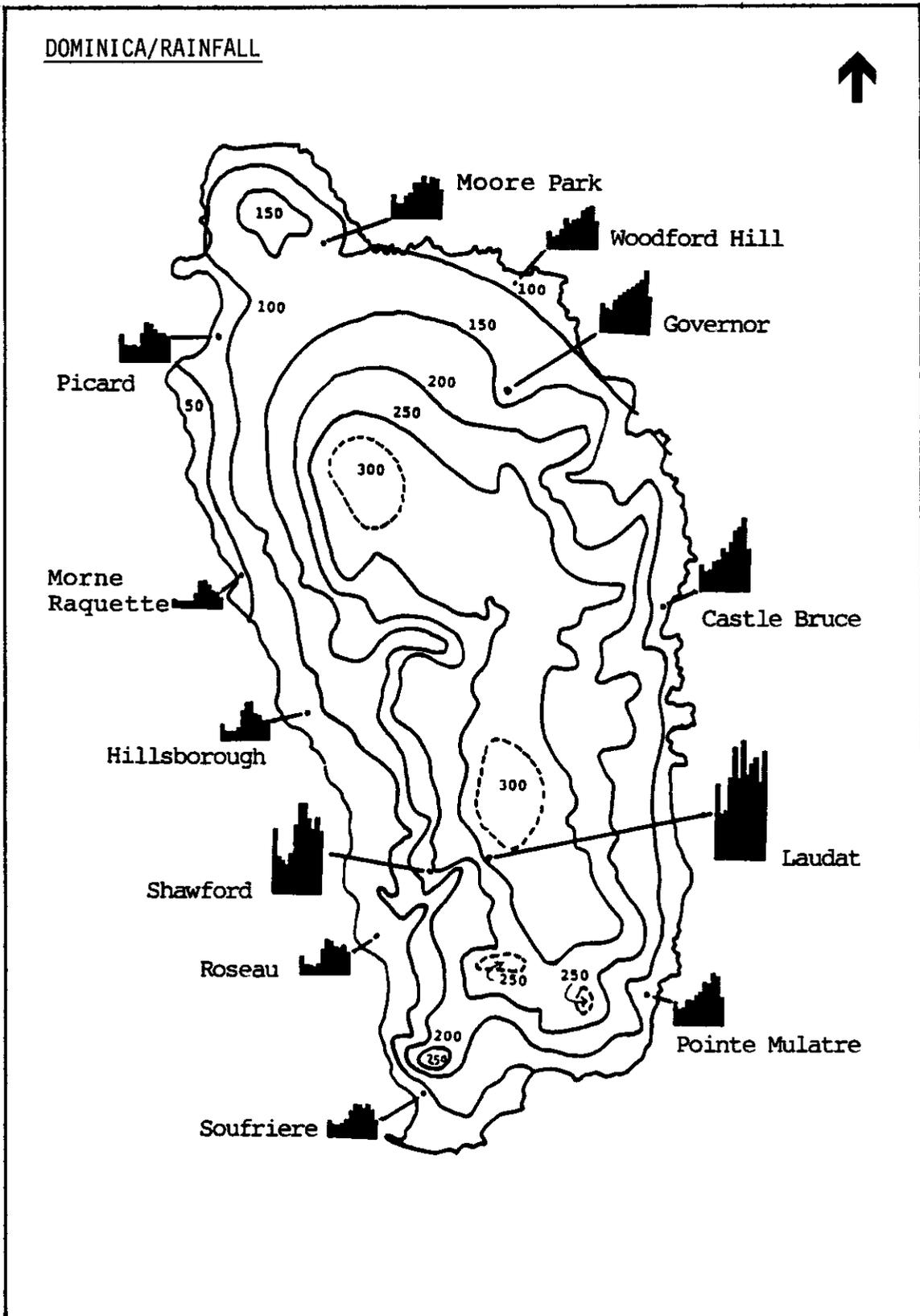
The island is among the wettest in the Caribbean, a factor which gives rise to its lush vegetation. Rainfall increases from the leeward side eastward toward the central parts of the island where it reaches over 10,000 mm (almost 400 inches) annually. On the leeward (or western) side of the island, in the shelter of the steep mountains, rainfall drops off substantially, to as little as 1,200 mm (less than 50 inches) per year (e.g. in the areas of Batalie and Picard). Statistically, there is a dry (or drier) season between February and June and a wetter period from July to December, but in some parts of the island (e.g., on the east coast and in the interior), and in some years, this distinction is much less pronounced. Rainfall is generally heavy but of short duration. In 1942, for example, some nine inches were recorded within a single 24-hour period, and in 1972 five inches fell within six hours (GOCD, 1985).

Table 1.2(1). Temperature data for Dominica at two locations (degrees Fahrenheit).

STATION ELEV. FEET	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
<b>Melville Hall* 230</b>												
Maximum	83	83	84	86	86	87	88	88	89	88	87	86
Minimum	64	64	66	67	70	71	72	72	71	70	69	67
Average	75.9	76.4	76.8	77.5	79.0	80.8	81.1	80.4	79.2	79.6	78.8	77.3
<b>Wet Area Exp. Station** 1,000</b>												
Maximum	77	78	78	79	81	81	82	82	83	82	81	79
Minimum	67	66	66	66	68	70	70	71	71	71	69	66
Average	72.0	71.7	72.0	72.1	74.4	75.6	76.1	76.3	77.1	76.4	75.1	72.5

\* Years of Record: 5; \*\* Years of Record: 4

Source: Atkins Land and Water Management, 1983.



**Figure 1.2(4).** Rainfall data for Dominica: (1) recorded as average monthly rainfall for specific sites and (2) shown at various elevations (e.g., numbers record inches of rain) (source: adapted from Lang, 1967, as reprinted in Shankland Cox and Associates, 1971).

In a pattern opposite that of rainfall, temperature decreases with altitude. Average values range from 27 degrees Celsius on the coast to approximately 21 degrees at the highest elevations. There is little seasonal fluctuation, generally less than two degrees Celsius (Lang, 1967; Fehr, 1989). Temperature data for two locations (at low and high elevations) are presented in Table 1.2(1); the difference in temperature can be seen although the average minimum temperatures between the two stations are not greatly different.

Relative humidity is high on the island, usually in the region of 95 percent and seldom falling below 85 percent in the interior. On the leeward coast, which is less humid throughout the year than the windward, relative humidity ranges between 58 and 86 percent. At night, relative humidity levels

rise, particularly in the interior where temperature drops off markedly.

#### 1.2.4 Soils

The soils of Dominica have been studied and described in detail by Lang (1967). Edaphic conditions have been greatly influenced by the island's volcanic origins. Soils of a given type are in most cases a product of the extent to which a given volcanic parent material has weathered. Lang (1967) mapped 75 soil types in Dominica which can be divided into five main groups as shown in Table 1.2(2). The distribution of soil types is shown in Figure 1.2(5).

Table 1.2(2). The five primary soil groups for Dominica as identified by Lang (1967), with percentage distribution (see also Figure 1.2(5)).

SOIL TYPE	PERCENTAGE
Shallow soils over volcanic material	32 percent
Deep, strongly weathered allophanic and kaolinitic clay soils with good physical properties	51 percent
Deep, weakly weathered sandy soils from volcanic pyroclastics	6 percent
Montmorillonitic clay soils, usually shallow and with a silica pan (Shoal Soils)	9 percent
Alluvial soils	1 percent
Other soils	1 percent

Source: Atkins Land and Water Management, 1983.

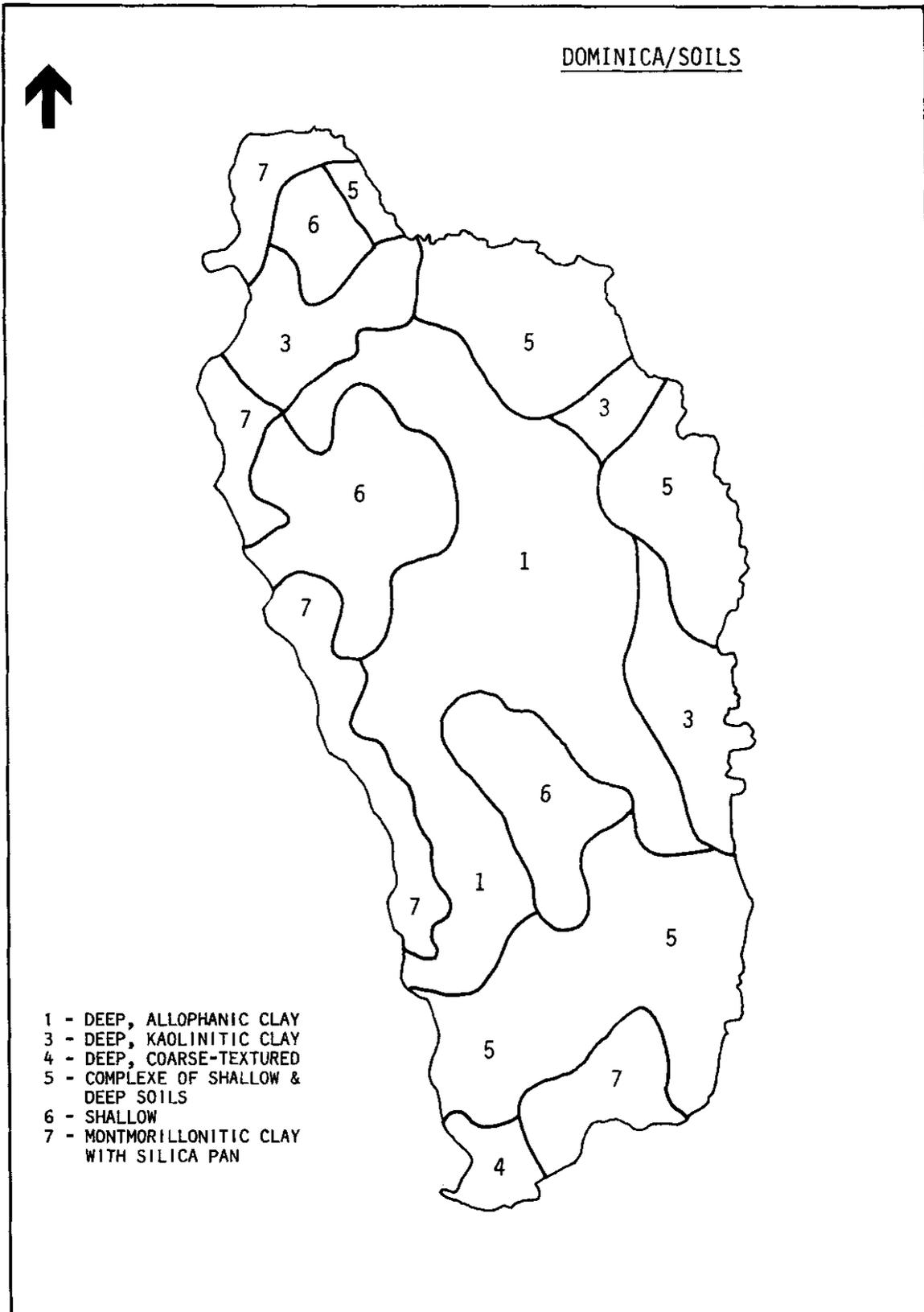


Figure 1.2(5). Distribution of soil types in Dominica (source: Atkins Land and Water Management, 1983).

## TERMS USED IN SOIL CLASSIFICATION

Various terms are frequently encountered in descriptions of Dominica's soils.

*Texture* refers to the relative amounts of different-sized soil particles (i.e., sand, silt and clay) present. Clay soils have a predominance of very fine particles (> 40 percent), sand soils have a predominance of sand-sized particles (> 80 percent) and loam soils are in between. These classes can be subdivided further to cover intermediate soil compositions, e.g., sandy loams or clay loams. Sandy soils are sometimes called "light" and clay soils are called "heavy" – these terms refer not to weight but to the ease of working the soil.

*Shoal* is a term used to describe a special type of soil found in the relatively dry areas of all volcanic islands. Actually "shoal" is a kind of parent rock which is made up of cemented volcanic lava material; the cementation process is thought to have taken place under water during a period of submergence. Shoal clay soils are fine-textured, dark brown to grey, and have a poor physical structure. In the dry season they shrink and develop large cracks; in the wet season they become very plastic and sticky.

*Alluvial soils* are derived from river-transported sediments; *colluvial soils* are derived from materials brought down from neighboring hillsides by gravity.

*Latosols* are a very broad grouping that includes most of the red, yellow and brown soils of the Caribbean region. These are generally mature soils of moist or wet areas with free or only slightly impeded drainage. They vary from slightly acid to acid in reaction and are usually leached of bases.

*Lithosols* are very shallow, rocky soils found in steep, hilly areas with stony, rocky or shaly parent materials.

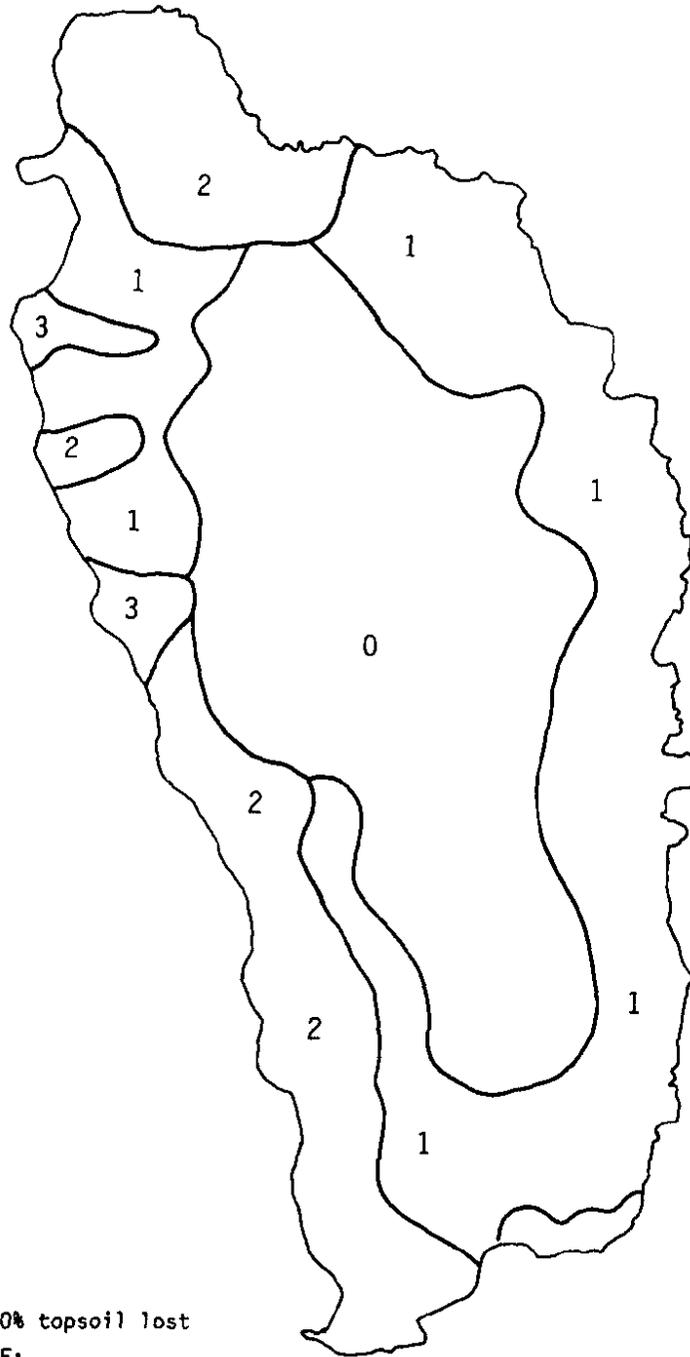
During the soil survey Lang (1967) made a subjective assessment of soil loss from each of the soil mapping units. This information was simplified by a British consulting team (Atkins Land and Water Mngmt., 1983) and is presented in Figure 1.2(6). Soil loss from the forested central part of the island is slight; elsewhere it is slight or moderate, although it is worse on the leeward side of the island on the montmorillonitic clay soils (Atkins Land and Water Mngmt., 1983). Approximately 53,000 ha or 70 percent of the island's total land base of 70,000 ha is unsuitable for agriculture as a result primarily of erosion risks, waterlogging, or poor soil quality (GOCD, 1985).

The soils of Dominica are, in general, readily erodible since they tend to be uncon-

solidated and friable; where cementation of the subsoil occurs it is only incipient and the cemented layers readily decompose when exposed at the surface. The risk of erosion depends on many factors, including: the type and properties of the soil; the intensity, duration and amount of rainfall; the slope of the land; the extent and nature of the vegetation; and the agricultural or silvicultural practices used.

On steep slopes denuded of their tree cover by clearing, the soil surface is directly exposed to the erosive force of rain, and soil erosion is greatly accelerated. Alterations in the pathways and rates of water flow due to clearing of vegetation can cause changes in the timing of peak flows and greater flood discharges downstream. Erosion transports soil

DOMINICA/SOIL LOSS



- 0 - NIL
- 1 - SLIGHT;  
up to 50% topsoil lost
- 2 - MODERATE;  
more than 50% topsoil lost
- 3 - SEVERE;  
all topsoil lost

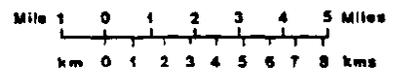


Figure 1.2(6). Soil loss in Dominica (source: Atkins Land and Water Management, 1983).

downslope and causes the loss of plant nutrients from the uplands. When topsoil is lost, the formation of replacement soils is an extremely slow process; it may take hundreds of years just to form one inch of top soil.

When trees are clear-cut, there is a permanent loss of nutrients from the soil if the felled vegetation is removed as in logging and an even greater loss if the slash is burned. If the area is replanted in crops or timber plantation, plant diversity is sharply reduced. If herbicides are used to keep planted areas free from weeds, the soil is then much more exposed than it would be under natural conditions, and erosion is thereby increased.

### 1.2.5 Vegetation

Dominica's undisturbed forests have been identified as the most extensive in the Lesser Antilles, while its rain forest is considered the finest in the Caribbean (see, for example, ICBP, 1990; Evans, 1986b and 1989). The vegetation, which comprises over one thousand species of flowering plants with about sixty woody plant and tree species per hectare, supports, among other wildlife, over 50 species of resident birds, including two endemic parrots (ICBP, 1990).

The following is a brief description of each vegetation zone on the island, drawing in part on a report prepared by Earth Satellite Corporation (EARTHSAT), 1986, which was based on OAS's vegetation map of the island (prepared at 1:50,000 scale). The descriptions have been modified by Evans, 1986b, and P. Evans, pers. comm., 1990. Information on the spatial extent of each zone is found in Section 2.1.

**Mature Rain Forest.** Vegetation type occurring toward the interior of the island, generally not below 1,000 feet and having few periods without precipitation -- customarily only a few weeks between April and June. The canopy is dominated by *Dacryodes excelsa*, *Sloanea* spp., and *Amanoa caribaea*. Undercanopy species include *Licania ternatensis* and *Tapura antillana* and numerous epiphytes and lianas.

**Montane Thicket and Elfin Woodland.** Vegetation type occurring at high elevations, approximately 3,500 feet. The tree stratum is severely reduced at these elevations as a result of wind exposure. Characteristic species are *Richeria grandis*, *Byrsonima martinicensis* and *Podocarpus coriaceus*, with *Heliconia bihai*, the tree ferns *Cyathea imrayana* and *Hemitelia* spp., and razor grass *Scleria latifolia* forming the understory. Montane Thicket includes Elfin Woodland which occurs at higher elevations, where exposure to wind is high, and is characterized by *Chusia venosa* and *Lobelia cirsiifolia*.

**Littoral Woodland.** Community occurring along the eastern and northeastern coast line. The tree canopy is subjected to nearly constant onshore winds yielding asymmetrical tree crown development shaped by pressure from sea breezes. The species of this community, which are salt spray tolerant, are characterized by *Coccoloba uvifera*, *Chrysobalanus icaco*, *Terminalia cattapa* and *Tabebuia pallida*. *Calophyllum antillanum* is conspicuous.

**Scrub Woodland.** Vegetation type occurring at lower elevations on the west coast. Community is dominated by a shrub layer and represents the most xeric conditions on the island. Characteristic species are *Lonchocarpus pentaphyllus*, *Pisonia fragrans*, *Haematoxylon campechianum*, *Myrsia atrifolia*, *Chrysophyllum argenteum*, and *Erythroxylum ovatum*.

**Grassland and Savanna Sub-types.** These are restricted in area and most likely the result of anthropogenic influences. Grand Savanne exemplifies the most extensive area of the savanna sub-type, characterized by *Sporobolus indicus*, *Andropogon condensatus*, and the grass *Citrinella*.

**Secondary Rain Forest.** Areas previously occupied by mature rain forest that have experienced disturbance, primarily logging and shifting agriculture. Characterized by *Miconia* species (*Miconia mirabilis* in particular), *Cecropia schreberiana*, and, in the smaller gaps, *Simaruba amara*. Canopy cli-

max forest trees such as *Sloanea* exist but are not dominant.

**Semi-Evergreen Forest.** Really a transition vegetation zone with species characteristic of dry and rain forest. In many Lesser Antillean islands, it occupies a moderate area. In Dominica (because of its steep slopes leading quickly into high rainfall areas), it is very narrow in extent, with indistinct boundaries; therefore, it is not useful to classify this as a separate vegetation type.

**Fumarole Vegetation.** Plant community restricted to areas of geothermal activity, primarily Valley of Desolation and parts of Morne au Diable. Characteristic species are various melastomes, particularly *Tibouchina ornata*. There are also some endemics which are prominent, notably *Pitcairnia micotrinensis*.

**Swamp and Wetlands.** Restricted to an area immediately east of the Cabrits Peninsula in the northwest of the island, an area experiencing a seasonal supply of fresh water. Characteristic species are *Pterocarpus officinalis* (which also occurs in narrow strips along stream banks, particularly between Blenheim and Calibishie), *Laguncularia racemosa* and *Avicennia germinans*. In the larger swamps such as Cabrits and Glanvillea, the semi-aquatic vegetation is dominated by the fern *Acrostichum aureum* and various sedges, particularly *Cyperus* spp., *Eleocharis mutata* and *E. interstincta*.

The classic description of the vegetation of the Windward and Leeward Islands, including Dominica, was provided by J.S. Beard, a member of the Colonial Forest Service in Trinidad and Tobago who carried out a forest resource assessment in 1942. When he started his decade of work in the Lesser Antilles, Beard found that the systems of vegetation classification then in use lacked any real ecological basis. He therefore proposed a new classification of vegetation which led to publication of his classic monograph, *The Natural Vegetation of the Windward and Leeward Islands*, in 1949. This is still widely used as a basic reference over forty years later.

Beard characterized existing vegetation during the 1940's as primarily resulting from human use of the land during historic times, although he identified large areas of primary forest in Dominica still in a relatively unmodified natural state. He provided a small-scale sketch map (Figure 1.2(7)) showing the major areas of natural vegetation at the time of his survey, and, like the monograph of which it is a part, it remains a useful reference point for researchers and resource planners.

### 1.2.6 Natural Hazards

The Caribbean -- one of the most disaster-prone areas of the world -- is exposed to hurricanes and their associated storm surges and wave action, earthquakes and earthquake-generated ocean waves (tsunamis), volcanic eruptions, landslides and rockslides, flooding and droughts. Natural hazards, as the term is used here, include all these occasional short-term natural phenomena which have the potential for negative impacts on the physical, economic and social environment of an area. The islands of the Eastern Caribbean are particularly vulnerable to natural hazards because of their small size and their dependence on foreign revenues earned from agriculture and tourism. Dominica has suffered a number of such occurrences and is well acquainted with the effects of all types of natural disasters.

The primary natural hazards affecting the island are hurricanes and other storms and their related impacts, landslides, and coastal erosion. Financial constraints make it almost impossible to ensure that all infrastructure is designed and built to withstand hurricanes, while the rugged terrain makes it particularly difficult and expensive, perhaps even impossible, to ensure that road building, for example, does not lead to landslides. Similarly, a shortage of flat land has resulted in considerable development in areas immediately adjacent to the shoreline and thus in a vulnerable position relative to coastal hazards. Recurring incidents of coastal road damage, for example, can be seen to the north and

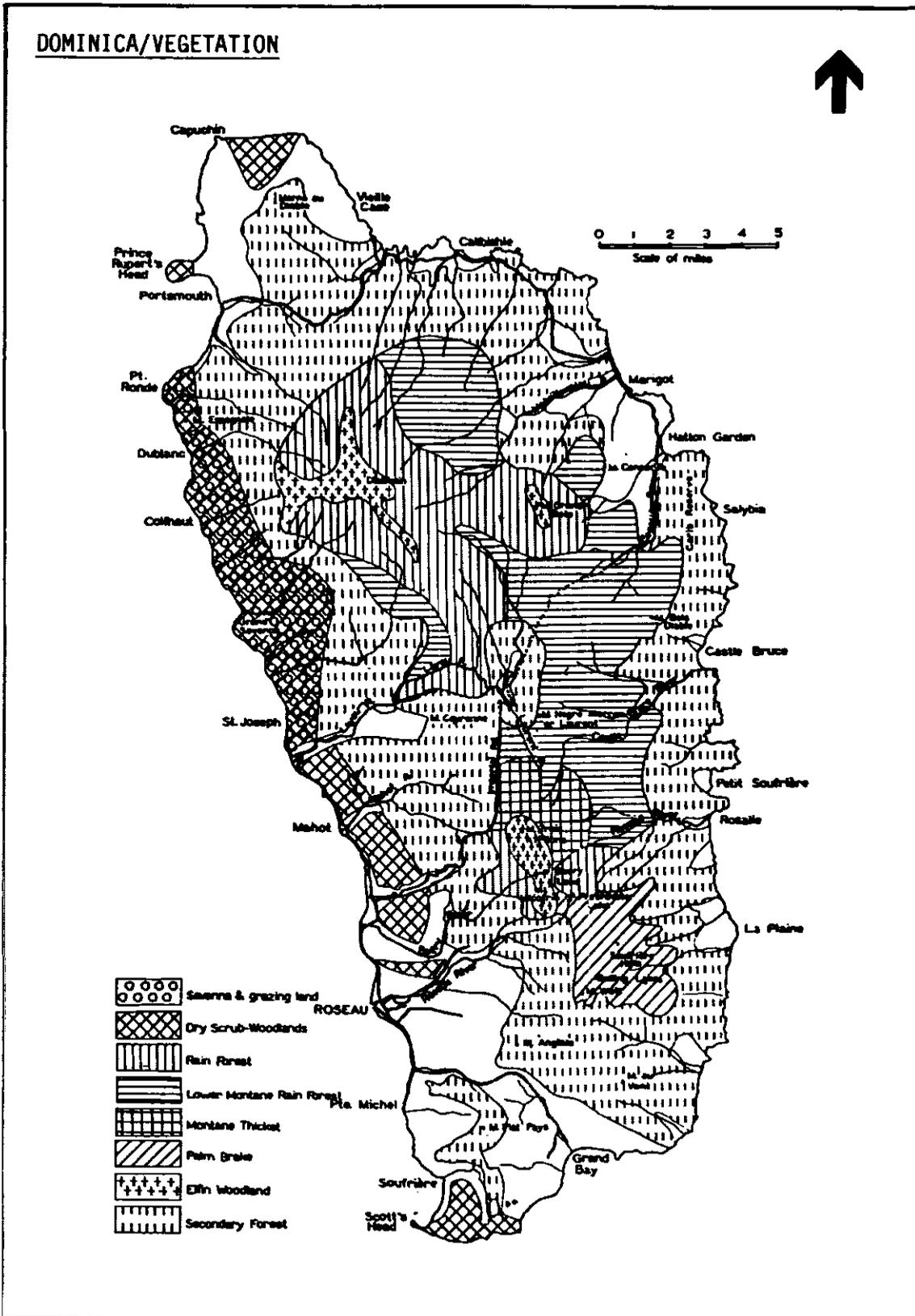


Figure 1.2(7). Natural vegetation in Dominica, circa mid-1940's (source: Beard, 1949).

south of Roseau, in the directions of Canefield and Pointe Michel, respectively.

Hurricanes of varying intensity occur in Dominica on average every 15 years. The first recorded hurricane hit the island in 1780, but the most destructive hurricane, called David, did not occur until almost two hundred years later in the summer of 1979 (see sidebar, page 17). Only twice previously had such destructive storms struck the island. In the 1806 hurricane, 131 people died primarily as a result of the Roseau River shifting its course and flooding the capital; and in the "Great Hurricane" of September 10, 1834, over 200 lives were lost (Honychurch, 1984).

Although high winds are the most distinctive feature of hurricanes, usually the most damaging winds affect a very small radius (as small as 20 miles) of the entire storm system. On the other hand, torrential rains can be experienced from one edge to the other of a 300 mile diameter storm, and ten inch rains from well-developed tropical storms are not unusual. Therefore, unless a storm has very strong winds and the center passes directly over an island, much of the damage will be from the direct and indirect effects of flooding. In order of decreasing impact, the major causes of damage from most hurricanes can be ranked as follows: flooding from rainfall, coastal flooding and damage from storm waves, landslides, and -- lastly -- winds.

Floods may cause property damage, severe erosion and even the loss of life during natural events such as rainstorms and hurricanes. Floods can be the result of downslope rainwater run-off, especially over paved or deforested areas, and/or seawater driven inland by above-normal tides and surges. Storm surges caused by reduced atmospheric pressure during hurricanes can be augmented by wind-driven waves, swells, and spray.

The extent of the problem associated with inland flooding in a particular area is dependent on the amount of rainfall, the slope of the land, the porosity of the soils, and the size and shape of the river basin through which the water will eventually flow. Damages from inland flooding include: water

damage to normally dry property; physical damages from the force of the waters and associated mud, silts and rocks; biochemical and physiological damage due to the introduction of large volumes of freshwater to the nearshore marine ecosystems; and destruction of sea life from overloading with silt and nutrients washed from the land.

The most common landslide type in Dominica is debris flows, but the country also experiences rockfalls, rockslides, and debris slides. The volcanic origin of the island has led to a steep topography and a lithology which are conducive to landslide occurrence, particularly in the presence of abundant moisture and rainfall. Some two percent of the island's land area is disturbed by existing landslides. Losses attributable to landslides include structural damage, crop destruction, and loss of human life. An average of EC\$316,000 per year is spent on clearing and repairing roads affected by landslides. Agricultural losses appear to amount to thousands of dollars per year, but this is difficult to assess. Twenty-five Dominicans were killed in landslides between 1924 and 1986 (DeGraff, 1987). A particularly destructive landslide event occurred during the hurricane season of 1977 when days of torrential rain loosened the rocky hillside above the southern village of Bagatelle, sweeping tons of soil and debris through a section of the village, smashing and covering houses and killing eight villagers (Honychurch, 1984).

Generally, landslides are localized events and depend on the type of soil, the angle of repose and the steepness of the slope at the site. Landslides occur when the forces of gravity exceed the strength of the forces holding soil material together, resulting in a mass of soil being pulled downward. A secondary effect of flooding on steep slopes covered with clay-rich soils is the increased tendency for landslides to occur. Water in soils contributes to increased landslide risk because the weight of the water is an added stress on the soil mass that is also being lubricated by the water molecules.

Although no volcano-related disasters have occurred in Dominica, at least in historic

## THE IMPACT AND AFTERMATH OF HURRICANE DAVID \*

At first expected to hit Barbados, the hurricane named David shot across the southern section of Dominica on August 29, 1979. There was little local radio warning and no operational systems for disaster preparedness. With swirling 150 mile-an-hour winds, David pounded Dominica for approximately six hours. Thirty-seven people were killed and an estimated 5,000 injured. Over three-quarters of the population was left homeless, with many temporarily sleeping under rough cover in the open or huddled into the homes of more fortunate friends for weeks and months after the storm.

The Dominican economy was almost totally destroyed resulting in substantial social and economic dislocation. Roads and bridges were blocked and swept away. The hurricane destroyed most of the island's electricity transmission system and severely damaged its communication network. All eight telephone exchanges were damaged along with the Cable and Wireless building, telephone poles and transmission lines. Agricultural crops were devastated, but many (e.g., bananas) would have been severely damaged even by much more moderate wind speeds. In the southern half of the island, where damage was heaviest, some 50 percent of the trees were damaged in forested areas. Researchers estimated that it will take over fifty years for the climax forest to re-establish itself. The commander of a Royal Navy frigate arriving the day after the storm likened the island to a bombed-out battlefield.

The plight of Dominicans received immediate attention from regional and international agencies, and relief aid was quick in arriving. Unfortunately, little pre-planning for dealing with disaster relief had been executed by the newly-independent country pre-David and, given a lack of adequate control for distribution of relief supplies post-David, measures adopted following the storm were mostly *ad hoc* and short-term. They were designed to minimize the immediate plight of those affected and often became politicalized in anticipation of a pending general election. At present, there is a National Emergency Planning Organization, chaired by the Honorable Prime Minister, which is credited with better preparing the nation for Hurricane Hugo in 1989. But, as in most Eastern Caribbean countries, additional steps need to be taken to better facilitate long-term, inter-agency planning and coordination policies to mitigate the consequences of catastrophic natural disasters in the future.

\* Information taken from Honychurch (1984); GOCD, 1985; Lugo, *et al.*, 1983; and Watty, 1984.

times, the capital city of Roseau is virtually "looking into the gun barrel of a set of active and dangerous volcanoes," according to Dr. John Shephard, the Director of UWI's Seismic Unit. He notes that at least four live volcanoes are present and that Dominica is "perhaps the most complicated volcanic island in the whole of the eastern Caribbean" (*Caribbean Disaster News*, June 1988).

As pointed out by Watty (1984), naturally occurring phenomena only become natural disasters when man is placed in the way of such phenomena without sufficient regard

to the probable effects of such a relationship. In the Dominican context, however, it is extremely difficult to avoid placing people "in the way" of such risks due to the physical characteristics of the island, its location in the hurricane belt, and its limited economic capacity to deal both with natural hazard preparedness and with the aftermath of natural disaster events.

In light of these factors which limit Dominica's ability to optimally manage natural hazard risks, perhaps the most feasible strategy would be, first, to minimize the need

for additional facilities and infrastructure which require development in high-risk areas and, second, to ensure that preparedness plans for managing the effects of natural disasters are well developed, particularly at the local community level.

Relative to the first recommendation, the upgrading of existing arteries that have proven to be reasonably stable would minimize the overall need for new roads in more high-risk areas. Additionally, improved land use planning could guide future development into areas which are best suited for particular kinds and densities of land use.

Concerning disaster preparedness efforts, Watty (1984) notes that much remains to be done to strengthen institutional structures, improve facilities, train personnel, and define inter-agency relationships in order to significantly improve natural hazard planning in Dominica. Such steps must be established at the village as well as national level, along with implementing procedures for storm warning mechanisms, shut-down techniques, the designation of refuge centers, the creation of emergency food and medical stations, and the observation of community drills. Additionally, school curricula should cover disaster prevention and avoidance, and greater public participation is required in disaster-related planning and decision-making (Watty, 1984). In light of these recommendations and the country's vulnerability relative to natural disasters, it is unfortunate that no funds were set aside in the GOCD Fiscal Year 1989/90 (Budget) Estimates for these purposes, although approximately EC\$28,000 had been allocated the prior fiscal year.

### 1.2.7 Climatic Change

Geological and other studies of the earth reveal that climatic change has been the norm throughout its history. Since the middle of the last century, the planet has generally been undergoing a warming trend, but the present warming pattern is believed to be due in part to the anthropogenic (i.e., human-induced) buildup in the atmosphere of carbon dioxide and other so-called "greenhouse

gases." Since the industrial revolution of the 1800's, the carbon dioxide content of the atmosphere has increased by almost 25 percent and, in the past 30 years, by nine percent (Gable, Gentile, and Aubrey, 1989).

It is unlikely that future temperature changes resulting from these phenomena will be uniformly distributed over the globe; for example, during the warmest decade on record, the 1980's, some of the most pronounced warming occurred in the lower latitudes, which includes the wider Caribbean region (Gable, Gentile and Aubrey, 1989). Changes in meteorological and oceanographic conditions (e.g., storm and precipitation patterns, sea-level rises, circulation patterns) will coincide with this warming.

Unfortunately, Dominica and most other Caribbean islands will be faced with these changes despite the fact that their contribution to the alleged causes of such change (e.g., industrial activity) has been minor, except perhaps through deforestation.

A fairly detailed examination of the effects on the Caribbean of global environmental change and related sea level rise is provided by Gable, Gentile, and Aubrey (1989). These investigators note that within the wider Caribbean relative sea levels have risen at an estimated rate of 2.5 mm/year. Meteorological changes already are apparent with the occurrence of more severe storms and hurricanes. The rising sea levels, in conjunction with the meteorological changes, generate potential for increased coastal erosion and the loss of mangroves and other wetlands, as well as other habitats such as coral reefs. These effects in turn might have a significant impact on future land use and development practices and on general economic well-being, in large part through the curtailment of tourism (e.g., resulting from beach degradation or destruction).

Reliable and abundant regional data (e.g., tide-gauge data) useful in forecasting these impacts more specifically are generally absent in the region. Even with such data, forecasting in relation to the impacts of global warming is fraught with many difficult problems. It is generally agreed, however, that sea

levels in the region will continue to rise and that the frequency and intensity of tropical storms and hurricanes will increase. Thus, there is a need to develop local and regional policies and programs which will minimize the impact of these climatic changes and, in general, a need to address the many issues that will be raised in the process. Some of these issues are discussed in a report prepared as part of the work program of the Economic Commission for Latin America and the Caribbean/Caribbean Development and Cooperation Committee (ECLAC, 1989).

In the face of uncertainty about the magnitude of warming trends and their effects on sea level, most experts recommend that governments should adopt a flexible, adaptive strategy for coping with the expected effects of climate changes. This is easiest to implement in planning for the construction or renovation of infrastructure such as roads, buildings, and coastal facilities.

In the case of older infrastructure (which would have to be replaced in any event), the best and cheapest response may be to do nothing and accept the loss of the structures, provided that they can be rebuilt in an alternative location. Where existing, economically vital infrastructure is threatened and no alternative location exists, such as certain sections of the coastal road and some coastal villages, an immediate defensive response would be justified provided it is cost-effective and environmentally sound.

In other cases, especially where infrastructure has not yet been built, measures to adapt to the warming trend should be taken only if such steps have good prospects of yielding benefits even without a climate change. If the predicted climate changes do occur, then the measures taken, of course, will yield a much greater benefit.

A rigorously-enforced coastal setback policy would be a good example of the latter type of response because it also offers protection from storm surges and tsunamis, maintains the aesthetic qualities of the coastline, and precludes monopolization of what should be a public resource by private interests. Other opportunities for this type of

multiple-benefit measure exist in the areas of coastal zone management, energy conservation and alternative energy sources, water resource conservation, natural hazard disaster planning and building code revisions.

### 1.3 SOCIO-ECONOMIC CONTEXT

#### 1.3.1 Historical Overview

#### AFTER GOD, THE EARTH: A HISTORY SHAPED BY THE LAND.

*"After God, the Earth,"* the unembellished motto of the Commonwealth of Dominica, conveys with simplicity the intrinsic, underlying spirit of the country – the deeply religious values of its people, the agricultural, rural foundation of its society, and the dominating influence of natural features on its development (Van de Velde, 1986a).

This country, which pays homage to both God and earth in its national crest, is the most northerly, the largest, the most tropical, the most mountainous (and therefore the wettest) of the Antillean island chain that separates the Atlantic Ocean from the southern Caribbean Sea. Situated anomalously between the French overseas departments of Guadeloupe to the north and Martinique to the south, much of the island's history has been dominated equally by topography, landscape and location.

The French influence on Dominica is not inconsiderable. English is the official language of the country, but a form of *patois* ("Kweyol") is also spoken by most of the population. The country abounds with French place-names and family-names. Indeed, English domination for 200 years has not erased most of these names, perhaps because, as suggested by local historian Lennox Honychurch (1984, 1988), Dominicans felt more comfortable with the French words which described natural features (e.g., La Grande Baye, Petit Savanne), in contrast to English place-names

### DOMINICA: "VITAL STATISTICS"

The country of Dominica is the most northerly and largest of the Windward Islands in the Eastern Caribbean. It lies between the French islands of Guadeloupe to the north and Martinique to the south.

<b>Location</b>	Latitude: 15 degrees 20 minutes North Longitude: 61 degrees 22 minutes West
<b>Area</b>	751 sq km (289.5 sq mi) - approximately 50 km (30 miles) long, 22 km (14 miles) wide
<b>Population</b>	Last census (1981): 73,795 Estimated by GOCD (1988): 81,335 Largely concentrated around the capital of Roseau in the south and Portsmouth in the north, both on the leeward coast
<b>Language</b>	English; a local French Patois is also spoken
<b>Economy</b>	Predominantly agricultural; a growing tourism sector, largely nature tourism-oriented; small but lively manufacturing sector
<b>Primary Crops</b>	Bananas are the major crop, exported mostly to the UK; citrus crops (oranges, grapefruit and limes) also important; coconut crop consumed primarily for production of soap and cooking oil; other agricultural efforts: coffee and cocoa crops, pilot aquaculture projects, and cultivation of ornamental flowers for export.
<b>Tourism</b>	Tourism geared to nature holidays with facilities for hiking, diving, fishing and river bathing. Earnings from tourism becoming a more visible part of GDP, notwithstanding the lack of direct international air links.
<b>Ports</b>	Two minor ports (Roseau and Portsmouth); Roseau maintains a deep water harbor at Woodbridge Bay north of the capital; Prince Rupert's Bay at Portsmouth provides a smaller harbor which is less deep but more sheltered than Roseau.
<b>Airports</b>	Main airport is at Melville Hall on the windward coast, some 40 miles from the capital; a secondary, smaller airport is located at Canefield, three miles from Roseau.
<b>Roads</b>	750 km (467 miles) of roadway, of which 500 km (312 miles) are paved
<b>Rainfall</b>	Interior: 250-300 inches/year; coastal lowlands: 50-70 inches/year; over 80 percent of the island has 2,500 mm (100 inches) or more of rainfall a year
<b>Physical Features</b>	High volcanic peaks rising in the south (Morne Trois Pitons) to 1,424 m (4,670 feet) and in the north (Morne Diablotin) to 1,730 m (4,747 feet); deep forests, lakes, waterfalls and numerous rivers; little flat land apart from the Portsmouth area which has two swamps.

which favored personalities or military victories. In any event, the influence of English colonists was confined to small areas of the island in contrast to French settlers.

The influence of topography and landscape is even more dominant in understanding the island's development. Steep, tree-covered mountainsides afforded protection against invading forces in centuries past -- as well as shelter and refuge for the region's surviving Amerindian population and for runaway slaves in the eighteenth century. Those same landscape features, however, represented and continue to represent formidable constraints to development, whether because of the shortage of flat arable land, the difficulty of road communications, or the inaccessibility of exploitable resources. (Some have noted that the present level of development of the various Windward Islands seems to be reflected, in inverse proportion, by the ruggedness of their terrain, with St. Lucia, the most developed, having the most flat land and Dominica, the least developed, having the least amount of flat land [Trench, 1982]). More recently, Dominicans have promoted and marketed their natural features in building a small resource-based tourism industry, luring travelers and visitors with the country's many attractions as "The Nature Island."

Nature's place (some might say God's place) in the life of Dominicans was most dramatically demonstrated when, during a short 12 month period from August 1979 to August 1980, the island was lashed by three hurricanes, the most devastating of which left three-quarters of the population homeless and almost completely destroyed the existing Dominican economy. These natural occurrences, coming one year after independence, were followed by a period of political upheaval and internal crises which for a moment captured not only local but regional and worldwide headlines -- and compelled the young nation, during its earliest years as an independent country, to face unprecedented disasters of both natural and man-made derivation.

## EARLY HISTORY

Christopher Columbus sighted Dominica on a Sunday in November of 1493 and hence called it Dominica after the day of the week. Although the Admiral and his fleet approached the island, they could find no safe anchorage along the island's jagged windward coast, and the party moved on to Marie Galante and Guadeloupe to the north without landing. A member of the party did record, however, that "Dominica is remarkable for [its] beauty ... and must be seen to be believed" (Honychurch, 1984).

At the time, Dominica, like other islands in the West Indies, was occupied by Carib Indians who had earlier displaced the more peaceful Arawak Indians by killing off the males and enslaving and interbreeding with the women. The Caribs, who called the island Waitukubuli, proved determined defenders of their territory and successfully resisted European colonization for some time, using the country's formidable terrain as one form of protection against would-be invaders. In fact, at the Treaty of Aix-la-Chapelle in 1748 both Britain and France declared that the islands of Dominica and St. Vincent were "neutral", existing for the sole benefit of their Carib populations.

Dominica's status as a neutral territory did not last long, however, and was soon violated first by French settlers and then by the British, who obtained possession by the Treaty of Versailles in 1763, after driving the Caribs from the more hospitable Caribbean coast to the mountains and more exposed, more rugged Atlantic coastal environment.

Portsmouth in the north of the island on the leeward coast was intended by the British to be the capital, given its better harbor surrounded by flat land facing Prince Ruperts Bay. It never became the capital, however, for early settlers perceived the site, which had been set out near a large swamp, to be unhealthy, and eventually Portsmouth was replaced by Roseau as the choice for the seat of government -- despite the latter's inferiority as a harbor and anchorage. Portsmouth saw little further development and survived primarily as a fishing village and center for the

construction of inter-island boats. In the mid-nineteenth century, the town was used by American whalers as a depot and later became a market center for villages at the northern end of the colony. By the time island commerce and government were firmly concentrated at Roseau, a polarization had also been created, i.e., north versus south, Roseau versus Portsmouth, an attitude which continues to the present (Honychurch, 1983 and 1984).

Since its earliest colonial days Dominica has been an exporter, supplying first coffee and sugar for European households, later limes for the British Navy, and more recently bananas and citrus fruits for world markets. The French planters first introduced coffee cultivation to the island, and their estates became the most flourishing. Sugar cane was only introduced after the British took control of the island, which meant that sugar cultivation came to Dominica later than other islands of the West Indies. Cocoa production, as well as lime production, gained prominence as export crops at the end of the nineteenth century, following a decline in the sugar industry. Coffee continued to be exported, but most estates were gradually turned over to cocoa and limes.

Like other plantation-based colonial societies, Dominica was initially dependent on the importation of inexpensive African labor to sustain its development, creating a socio-economic system which did not end until 1834 when the former slaves were granted their freedom. During the years of slave labor, runaway slaves, known as Maroons, often used the luxuriantly forested, mountainous terrain of the island's interior for concealment from authorities seeking out escapees. Runaways were also given refuge by the Caribs, who survived in Dominica on a remote 200 acre site on the Atlantic coast. This began a process of interbreeding and intermarriage which continues to the present time.

### **THE CARIBS OF DOMINICA**

Dominica is unique in the region as the primary homeland of the last survivors of the once-powerful Carib Indians (a much

smaller population can be found in St. Vincent). The Carib Reserve (now called the Carib Territory), perched on a mountainside on the northeast shoulder of Dominica (see Figure 1.2(1)), is the only such reservation in the region and was officially established in 1903 when the 232 acres over which the Caribs then had jurisdiction were increased to 3,700 acres. At that time, the British Government recognized the authority of the Carib chief, but official title to Carib lands was not granted until 1978 with passage of the Carib Reserve Act, whereby the newly-independent Dominican Government vested land title for the reserve in the Carib Council.

From its inception, the Carib Reserve maintained a system of communal land tenure which had existed since pre-Columbian times; it is probably the only substantial remnant of communal land in the region today. While much of the Carib culture has not survived the 500 years since the first European occupation (e.g., the Carib language, religion and most of its rituals have been lost), the last 15 years have witnessed a growing ethnic consciousness among Dominica's Caribs. The relationship between the Caribs and Government has been strained in recent years, particularly over proposals to change the Carib's communal land tenure system to one based on private property, an approach which some feel would render the Caribs landless within a short period of time (Gregoire and Kanem, 1989).

### **CONSTITUTIONAL HISTORY**

In 1898, Crown Colony rule was introduced in Dominica, thus eliminating the locally elected House of Assembly and placing government control for the next 70 years in London. Movement for constitutional reform gained momentum twenty-five years later when, in 1924, a new constitution restored semi-representation, under a limited franchise. During this period, Dominica emerged as a regional leader for constitutional change; in 1932 the Dominica Federation Conference put forward strong demands for full representative government. As a result of these agitations, a new constitution was granted in 1936 which, while increasing the number of elected representatives in the Legislative

Council, still did not remove the Crown Colony system. At the end of the 1930's Dominica was separated from the Leeward Island grouping, where the island had been placed since 1871, and became a colony within the Windward group. In 1951, universal adult suffrage was introduced, and provisions for an elected majority in the Legislature were approved, with the ministerial form of government proclaimed just five years later in 1956. Finally, in 1967, Dominica became a State in Association with Great Britain, with complete internal self-government.

Full independence was achieved on November 3, 1978, the 485th anniversary of the sighting of Dominica by Christopher Columbus. Under its new constitution, the executive authority of the State is vested in a President, not the British Monarch as is the case in neighboring, former British colonies in the Eastern Caribbean. Furthermore, to avoid confusion over the similarity of names with the Spanish-speaking Dominican Republic, the new country assumed the formal nomenclature of The Commonwealth of Dominica (Honychurch, 1984).

#### RECENT EVENTS

Dominica was the second of the Windward Islands to achieve independence, an event which was followed shortly by both natural disasters and political strife of extraordinary dimensions. The Government which brought the country to independence quickly ran into problems in 1979, with a major scandal breaking out over a proposed scheme to lease a fifth of the island to an American businessman, the land to be taken from small farmers to set up a free port which would have constituted a virtual mini-state within a state. Although plans for the free port were dropped, attempts by the Government to curtail the press and trade unions were followed by a period of heated civil disobedience that ended only with the resignation of the Government.

An even more devastating blow befell the island in August of 1979 when Hurricane David, one of the most destructive storms to ever strike the region, passed over Dominica,

followed shortly thereafter by Frederick and then Allen the following year. While the country was struggling to recover from these natural catastrophes, an invasion plot to topple the Government was revealed in 1981. White racist mercenaries from Canada and the United States had been involved in a bizarre plan to invade the island, overthrow the Government with the support of disgruntled members of the disbanded Dominica defense force, and restore the ex-Prime Minister to power. The invasion plot was halted before it could be successfully executed, bringing to an end the more unsettling events of the 1979-1981 period.

#### DOMINICAN ROOTS

Colonial domination, with its plantation-based social and economic systems, never took hold in Dominica in quite the way it did on other islands of the Eastern Caribbean. The terrain and a climate influenced by heavy rains made effective colonization by the British more difficult; in fact, when the British took control of the colony in the late eighteenth century, their jurisdiction was limited to Roseau, the capital, and Portsmouth in the north. Elsewhere were rival French timbermen and farmers who lived with African Maroons and Caribs in mountain villages. Under these conditions, it is not difficult to understand why Dominica was the last island of the region to be colonized (CARICOM, 1984).

A strong tradition of peasant farming took hold early and spared the island much of the political and labor strife which characterized more developed Caribbean islands in the twentieth century. The terrain made large-scale, plantation-style agriculture more difficult, and the islanders therefore have long tended to live as small farmers in villages near their land. The village link is important in Dominica, reflected in the fact that, except for those long established in Roseau, there are few families in urban areas who cannot trace their immediate connections to a village (Honychurch, 1988; Trench, 1982). The significance of the village in the development of Dominican social and cultural patterns is underscored by the relative newness of modern

transportation links; before 1956 and the completion of the Transinsular Road, the principal link between Portsmouth and Roseau was by boat, and prior to 1958 and completion of an airstrip at Melville Hall, air transport was limited to sea planes whose landing was often prevented by inclement weather.

The country's cultural roots are varied, steeped in the lifestyle influences of the Caribs, the Africans and the colonizers (more the French than the English). It is a society richly imbued with colorful contributions from a multicultural past, from the base of Amerindian craft and botanical lore through African social elements and eighteenth century French patterns to more modern western influences (Honychurch, 1988). As one local historian wrote, Dominica is an island of natural splendor upon which man has been a passing visitor in many forms: the Carib warrior, the European settler, the Africans. The French influence is everywhere in the dominant Afro-Creole culture and the local patois, while the British left their primary mark on the island's system of government (Honychurch, 1984).

Yet, above all, are the values of a deeply religious and overwhelmingly agrarian

society. In the end, the islanders of Dominica look to God for their spiritual sustenance and to the resources of the land for material support. In the original Creole, "*Après Bondie, c'est la Ter*" -- *After God, The Earth*.

### 1.3.2 Demographics and Population Trends

[The following discussion on demographic features in Dominica has been derived from Bouvier (1984) except where otherwise indicated.]

In 1844 the first census following emancipation enumerated over 22,000 people in Dominica. The period between 1844 and 1871, the year of the next census, is believed to have been characterized by extremely high crude birth and death rates and thus by minimal natural increase.

Between 1871 and 1921 six censuses were conducted (see Table 1.3(1)) which revealed another period of low growth, an average of 0.7 percent. Mortality probably declined somewhat during this period while fertility remained high, a pattern that was common throughout the developing world at the turn of the century. Natural increases were

Table 1.3(1). The population of Dominica, 1844 - 1990.

Year	Number	Year	Number
1844 (1)	22,200	1931 (2)	39,500
1871 (1)	27,178	1946 (1)	47,630
1881 (1)	28,211	1960 (1)	59,920
1891 (1)	26,841	1970 (1)	69,549
1901 (1)	28,894	1981 (1)	73,795
1911 (1)	33,863	1988 (2)	81,335
1921 (1)	37,059	1990 (2)	85,000

1 Census figures

2 Estimated figures

Source: All figures from Bouvier (1984), except 1988 (GOCD, 1985) and 1990 (Population Reference Bureau, 1990).

thus undoubtedly higher than ever before, but were offset by emigration which also increased during this period, probably to Panama where the canal was under construction and to the larger islands of the Caribbean.

It is estimated that in the early twentieth century crude birth rates averaged 45 per 1,000 population, while death rates hovered around 30 per 1,000. If correct, net migration would have stood at about 7 per 1,000.

Between 1921 and 1946, the population grew by almost 10,600 persons, with a net emigration of 5,637 persons. The level of natural increase was 1.5 percent annually during this 25-year period, but due to high emigration, the island population actually grew much more slowly, at around one percent annually. The entire first half of this century was characterized by substantial declines in both fertility and mortality, but also by increased net emigration.

The early post-World War Two period featured a significant increase in the population growth rate, to 1.6 percent. Between 1946 and 1960 the number of people on the island jumped from 47,630 to 59,920. This was caused by a dramatic rise in the rate of natural increase, from 1.5 to 3.2 percent, and by a rare (for a developing country) drop in the mortality rate relative to the birth rate. Dominican women averaged five or six children during this period. Net emigration over the 14 years totaled 6,190, but because of the very high natural increases, total population was affected less than previously.

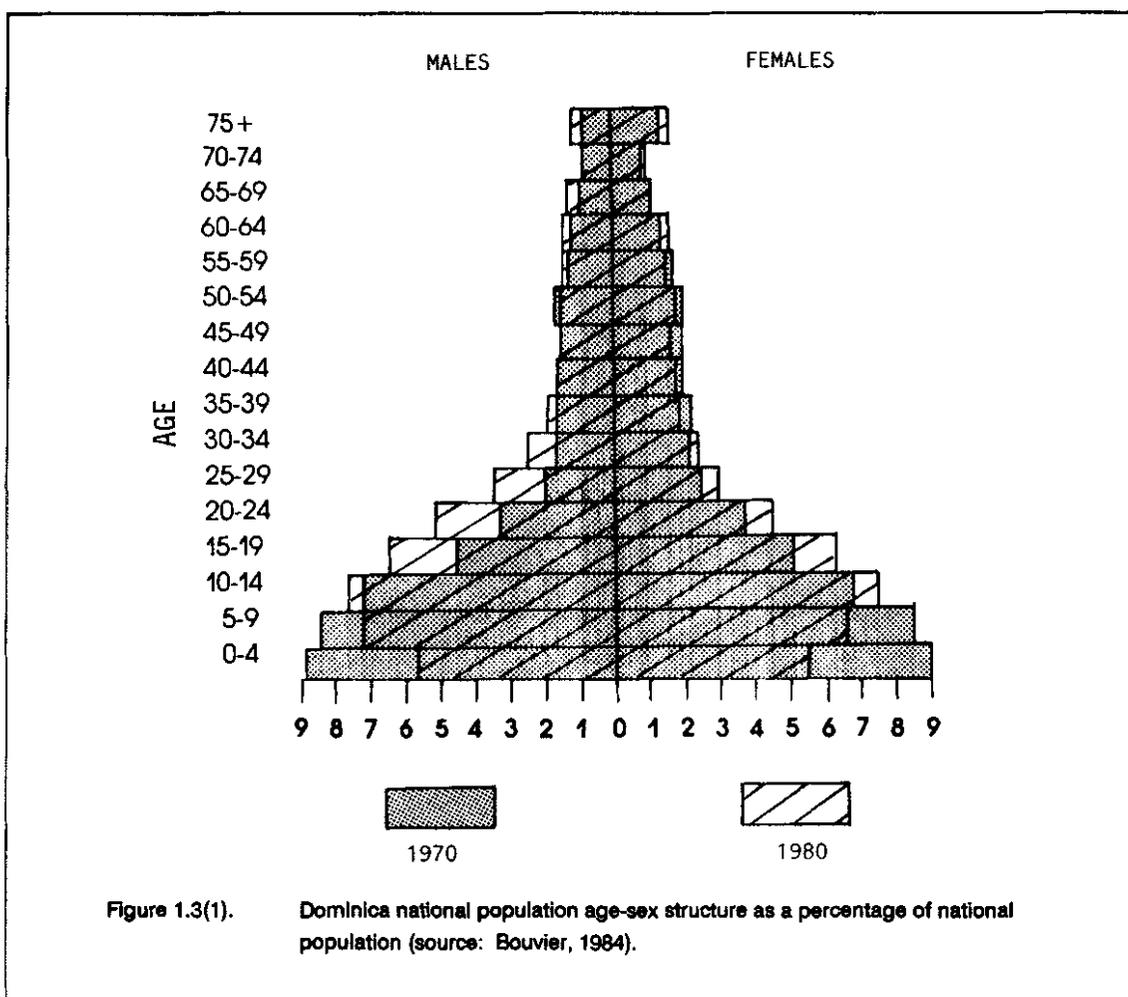
In the 1960's, the rate of natural increase grew even more substantially, and only because of massive emigration did annual growth remain at 1.5 percent. Since 1946 most emigrants from Dominica have gone to Martinique, Guadeloupe, Canada, the United Kingdom and the United States. Migration to the British Isles almost stopped completely with passage of the 1962 Commonwealth Immigration Act, which served to make the United States and Canada more attractive to migrants. The importance of emigration to Dominica's demographic character, particularly during the post-war period, is such that

in the absence of it the island's population reportedly "would have easily surpassed the 100,000 mark by 1970" (Bouvier, 1984). The actual population in 1970 was 69,549, following slower growth rates of 0.5 percent in the 1970's. These slower growth rates resulted from a drop in fertility as acceptance of family planning among Dominican couples increased during the decade. In 1979, it is interesting to note, Hurricane David compelled hundreds of Dominican women to move to Guadeloupe where many of them gave birth, thus lowering Dominica's fertility rate.

The 1970's also witnessed a further drop in mortality rates (to 6 per 1,000 population by 1980). In fact, the nation's mortality levels are among the lowest in the Third World, but in part this is due to the young age composition of the overall population. Infant mortality has fallen sharply from 119.6 per 1,000 births in the 1950's to 27.0 in 1977. Emigration remained high in the 1970's, particularly among women. In fact, some 4,000 Dominicans entered the United States alone during the decade.

The composition of Dominica's population (see Figure 1.3(1)) has changed significantly due to fertility declines and persistent emigration patterns. Between 1970 and 1980 the median age rose from 15.4 to 18.5. While this is still a young population, the three year increase is substantial. In 1970 half of all Dominicans were under 15 while 5.9 percent were 65 or older. The dependency ratio (i.e., the number of "dependent" persons -- those under 15 or 65 and over -- per 100 persons in the population age 15 to 65) was 122. In 1980 this ratio fell to 89, with 40 percent of the population under 15 and 7.2 percent 65 years of age or older. A dependency ratio of 89 is still relatively high and reflects the high level of emigration among those of "non-dependent" age status.

The last census was taken in 1981 and reported a total population of 73,795. Population figures for years since then can only be estimated. The island's total 1988 population (at year-end) has been estimated at 81,335 (GOCD, 1988b). If this estimate is accurate, the growth rate since 1981 has been about 1.5 percent annually, substantially higher than the



rate which prevailed during the previous decade.

To study Dominica's future demographic character, a series of projections were outlined by Bouvier (1984) based on various postulates regarding fertility and migration. The following scenarios were considered (see Table 1.3(2) and Figure 1.3(2) for projected population size under the four hypotheses):

- Scenario A: current (i.e., 1984) fertility (3.4) and current (i.e., 1984) net emigration (800 per year);
- Scenario B: declining fertility (2.6) and declining net emigration (to 400 per year);
- Scenario C: replacement level fertility (2.1) and net migration of zero.

- Scenario D: current fertility (3.4) and declining net emigration (to 400 per year).

In Bouvier's report, Scenario A is viewed as an encouraging one, but given its dependency on continued high rates of net emigration, it is predicated on external factors (e.g., immigration policies in receiving countries) over which Dominica has no control, and the country could witness increases in return migration generated in part by restrictions in other countries.

Scenario D reflects the outcome if immigration restrictions were imposed, i.e., current fertility and half the emigration. This outcome would be problematic as a population of almost 150,000 would be reached by 2030 whereas a level of 100,000 to 110,000 was considered by Bouvier to be "quite reasonable."

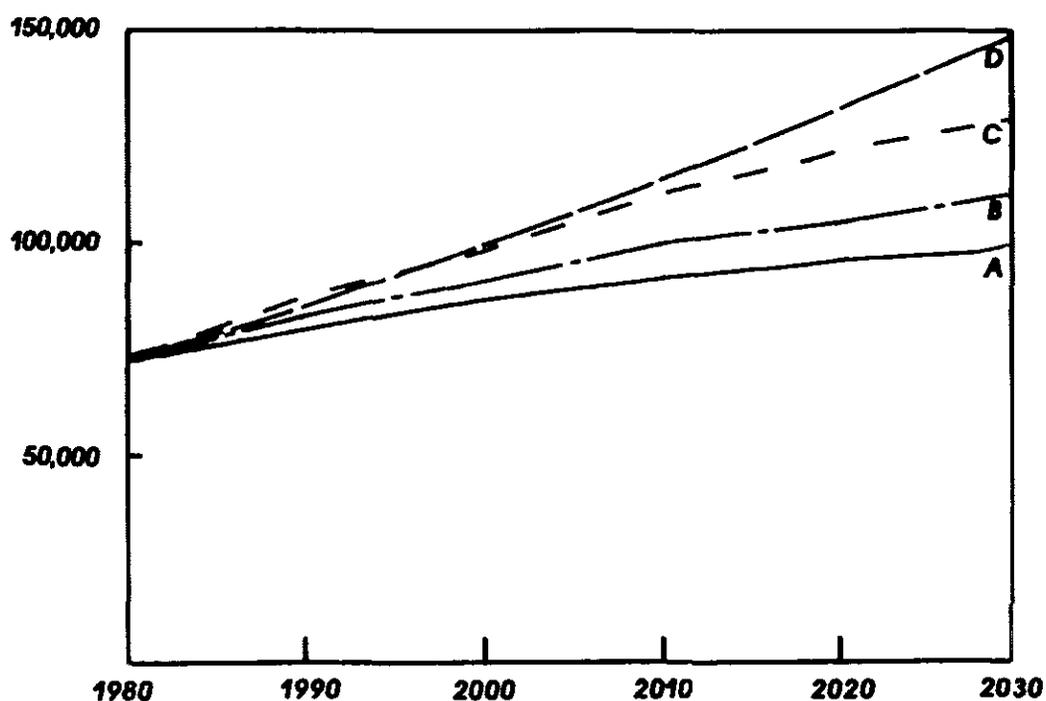
Table 1.3(2). Dominica population projections, 1980-2030, under four growth scenarios.

Scenario	1980	1990	2000	2010	2020	2030
A	72,311	78,899	86,387	91,165	94,485	96,767
B	72,311	82,521	91,710	100,129	104,792	110,980
C	72,311	86,682	98,431	110,794	121,242	128,789
D	72,311	83,880	98,937	114,032	131,143	149,622

- A: TFR of 3.4, net emigration of 800  
 B: TFR of 2.6, net emigration of 400  
 C: TFR of 2.1, net migration of zero  
 D: TFR of 3.4, net migration of 400  
 TFR = Total Fertility Rate (average number of live births per woman)

Source: Bouvier, 1984.

Population



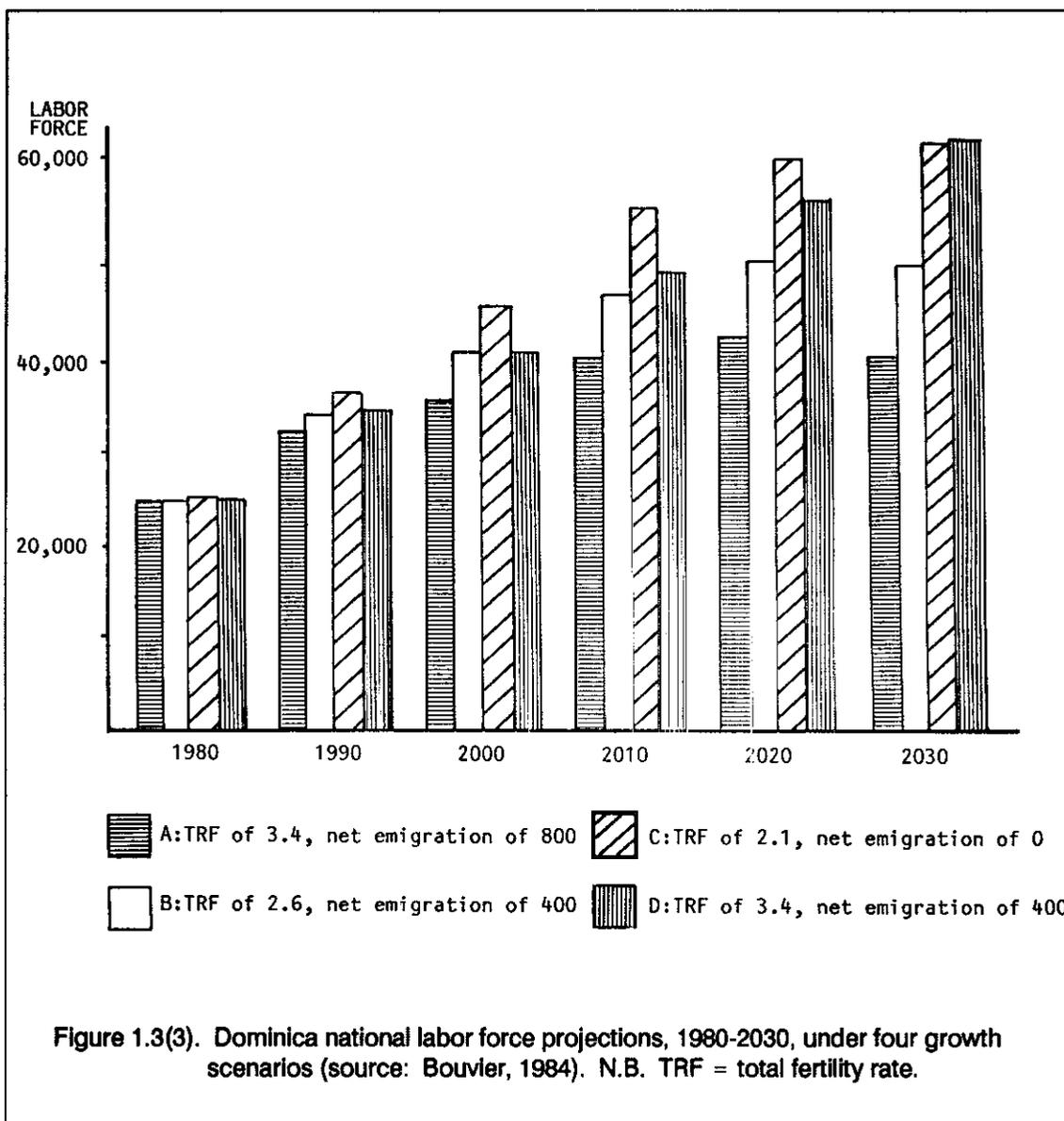
- A: TFR of 3.4, net emigration of 800  
 B: TFR of 2.6, net emigration of 400  
 C: TFR of 2.1, net migration of zero  
 D: TFR of 3.4, net emigration of 400

Figure 1.3(2). Dominica population projections, 1980-2030, under four growth scenarios (source: Bouvier, 1984). N.B. TFR = total fertility rate.

Scenarios B and C reflect possibilities falling between the two extremes. Scenario C assumes a fertility rate of 2.1, the level which would replace the population over the long run in the absence of migration. However, it takes an average of 60-70 years after first reaching replacement level fertility for a country to obtain zero population growth without migration.

Bouvier concluded that the country was in a favorable demographic situation, but such conclusions about the demographically "healthy" status of Dominica were tentative at best -- and remain valid *only* if fertility does

not rise and net emigration does not fall, thus assuring Dominica of a slow rate of growth into the twenty-first century. However, if emigration decreases, substantial declines in fertility will be necessary to ensure the achievement of a stable population with manageable growth rates. Furthermore, a large number of additions to the labor force will soon be a problem (as the youthful population ages); the large size of the elderly population (within 30-40 years) also has implications for social policy planners. (See Figure 1.3(3) for various labor force projections to the year 2030 under Bouvier's hypothetical scenarios.)



More current statistics from the Population Reference Bureau (1990), which sponsored Bouvier's 1984 work, show a population of 85,000 by mid-1990, while Bouvier's "best case" scenario projected the population would not reach that level until the year 2000 (i.e., 86,387; see Table 1.3(2)). The Population Reference Bureau's 1990 statistics estimate a population of 101,000 by the turn of the century and 134,000 two decades later, a pattern more closely approximating Bouvier's "worst case" scenario (Table 1.3(2)). Although the Population Reference Bureau's 1990 demographic estimates do not provide complete information on how these projections were arrived at, they are somewhat disturbing in the

case of Dominica and point to the need for GOCD policymakers to be aware of the built-in momentum implicit in even slight shifts in fertility and/or migration behavior.

With respect to spatial distribution of the national population it is evident from the figures in Table 1.3(3) that Dominicans are concentrated primarily along the west coast, especially its southern portion (Figure 1.2(1) provides the location of the parishes referred to in the table). As discussed in more detail in Chapter 9 of the Profile, most residential and other construction continues to focus in this sector of the country.

Table 1.3(3). Non-institutional population of Dominica classified by Parish, rural and urban districts: 1981 census. For location of parishes, see Figure 1.2(1).

PARISH	MALES	FEMALES	TOTAL	DISTRICT	MALES	FEMALES	TOTAL
St. George	9,826	10,675	20,501	Urban	4,970	5,513	10,483
St. John	2,744	2,668	5,412	Sub Urban	4,070	4,543	8,613
St. Peter	803	798	1,601	Semi Urban	12,267	12,213	24,480
St. Joseph	3,355	3,251	6,606	Rural	15,447	14,772	30,219
St. Paul	3,120	3,266	6,386				
St. Luke	712	791	1,503				
St. Mark	935	966	1,921				
St. Andrew	6,519	6,229	12,748				
St. Patrick	4,902	4,878	9,780				
St. David	3,862	3,475	7,337				
<b>TOTALS</b>	<b>36,778</b>	<b>37,017</b>	<b>73,795</b>		<b>36,754</b>	<b>37,041</b>	<b>73,795</b>

Source: GOCD, 1988b. N.B. The total number of males and the total number of females as enumerated by parish and by district are not consistent, although the total population figures by parish and by district are consistent.

### 1.3.3 National Economy and Development Trends

#### OVERVIEW

The economy of Dominica is similar to its sister OECS states, where the primary characteristics are openness and dependency on outside influences. The country's economy is still small; however, despite its size, it has shown steady growth over the past decade, as measured by the increase in Gross Domestic Product illustrated for the decade 1978 through 1987 by Figure 1.3(4).

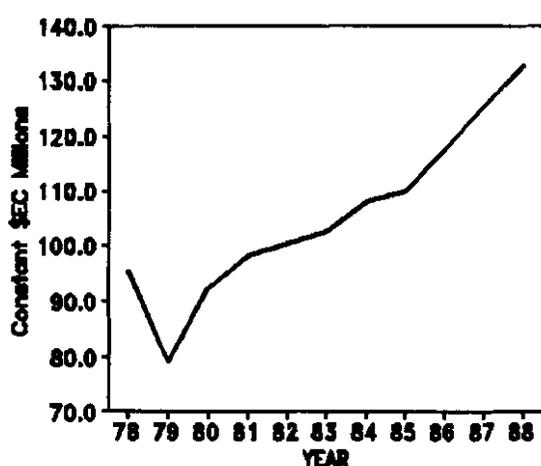


Figure 1.3(4). Growth of gross domestic product, 1978 through 1987 in constant 1977 EC\$ (GOCD, 1988b).

This figure, as most others in this section, shows a remarkable drop in production (i.e., GDP) in 1979 -- representing the devastating effects of events during the final year of that decade, one marked by civil unrest, political turmoil and devastating natural disaster. In spite of the widespread destruction wrought by Hurricanes David and Frederick in 1979 (followed by Allen in 1980), the economy in general, and agricultural production specifically, recovered rapidly. But the events of the late seventies and early eighties, which saw such a sharp down-turn in the economy, are a clear demonstration of the fragility of Eastern Caribbean economies in general. In Dominica, in particular, the economy is still primarily dependent on agricultural produc-

tion -- which, in turn, remains just as vulnerable to the vicissitudes of natural phenomena today as it was in 1979.

In the Eastern Caribbean context, the economy of Dominica is "pre-modern" (McElroy and deAlbuquerque, 1989), that is, the process of diversifying the economy away from a monocrop base and of rapid urbanization and suburbanization has only just begun in Dominica, which is still a predominantly agricultural country, with a relatively low rate of net population growth, a small tourism sector, and no other "modernizing" sector, such as insurance or banking. The pre-modern designation, however, is potentially a very positive factor for Dominica because it means that many of the crucial choices about future development paths have *not* already been foreclosed, as they have been in the U.S. Virgin Islands, for example.

Other characteristics of the Dominican economy include:

- a dominant agricultural sector with export markets in European, North American and Caribbean countries;
- expensive energy systems given small scale, high capital costs for hydro-power, high costs for diesel fuel, and the need to maintain, at present, both power systems;
- high costs for transportation on and off the island;
- growth of foreign-held debt which is high in relation to other OECS states;
- abundant natural resources which represent potential growth sectors, e.g., forest products and nature-based tourism;
- a small manufacturing/industrial sector, although Government development plans include an emphasis on expanding light manufacturing

industries concentrating principally on agro-processing.

Finally, although cash incomes are relatively low in the country, they have been advancing steadily over the last decade, as shown in Figure 1.3(5). Although population growth rates during this period appear higher than the previous decade (see Section 1.3.2), they are still relatively modest, averaging a little over one percent per year for the 1980's. This factor has contributed to substantial per capita income growth as illustrated in Figure 1.3(5). In fact, average per capita income has advanced more quickly than the overall economy, especially in recent years (see Figures 1.3(4) and 1.3(5)). It should also be noted that the use of constant (1977) dollars in Figure 1.3(5) considerably understates the current per capita figure, which was about EC\$3,400 in 1988.

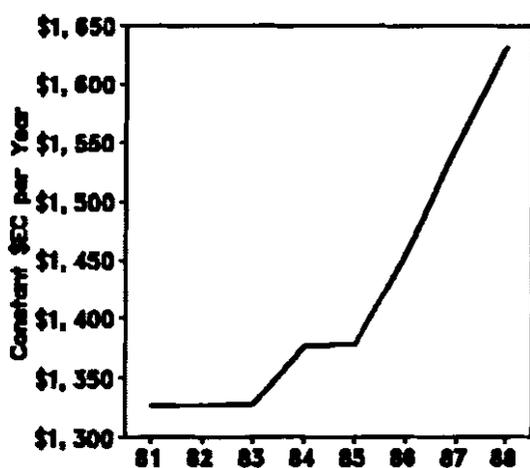


Figure 1.3(5). Growth in per capita income in Dominica, 1981 - 1988, based on 1981 census count and using constant 1977 EC\$ (source: GOCD, 1988b).

## THE DOMINANCE OF AGRICULTURE

Figure 1.3(6) provides an overview of growth in the major sectors of the Dominican economy as recorded by GOCD in the decade

from 1978 to 1988 (GOCD, 1988b). Table 1.3(4) summarizes similar data for the five year period 1984-1988. These data clearly show that the foremost sector of the economy, and the most dynamic over the past decade, has been agriculture.

Bananas are still the dominant crop, but there have been strong attempts recently at crop diversification. Citrus is important with oranges and grapefruit grown primarily on estates, packed by the Citrus Growers Association, and exported to the UK and US. Grapefruit is also canned and exported. Limes are grown principally in the southwest of the island, and the bulk of the crop is converted into lime juice and lime oil. Most of the country's coconut crop is used in the production of soap and cooking oil, and special attention has been given to this crop in recent years through a Coconut Rehabilitation Project. Other efforts in agriculture include the development of coffee and cocoa crops, pilot projects in aquaculture, the introduction of exotic vegetables and rice, expansion of the acreage used for cultivation of ornamental flowers for export, and the distillation of essential oils (patchouli) for export (Taylor, 1989).

The continuing dominance of Dominica's agricultural sector is at variance with the experience of many other Eastern Caribbean islands where agriculture has been assuming a smaller role in recent years -- with the exception of the "green gold" phenomenon which has encouraged accelerated banana production throughout the Windward Islands in response to the special protection afforded this crop in UK markets, at least until 1992. The results of recent attempts at greater agricultural diversification in Dominica can be seen in Figure 1.3(7), where the percent of agricultural production for both bananas and root crops in 1987 is shown as just over 30 percent for each; during the period 1978 to 1987 the percent of agricultural production for bananas rose from 27 percent to 31 percent while the percentage for ground provisions stayed constant at 34 percent. In 1987, the production of the most popular root crops -- dasheen, tannia, yams and sweet potato -- was about EC\$30.5 million (production value), nearly equal to the production value of total banana production at EC\$30.9 million (GOCD, 1988b). While root crop production has always been an important high-volume, domestic food source,

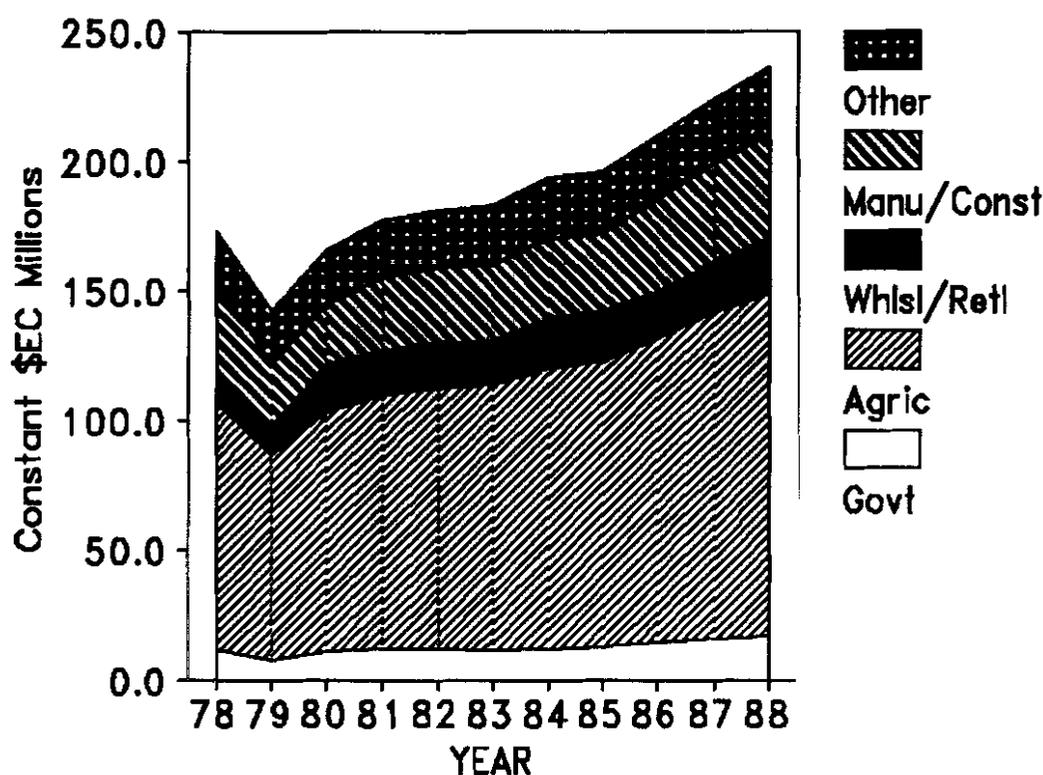


Figure 1.3(6). Gross domestic product by major sector, 1978 - 1987 (source: GOCD, 1988b).

more recently a portion of domestically-produced ground provisions has found its way into the export markets, primarily to near-by islands in the Caribbean. Production figures over the last decade indicate production of most root crops doubled during the period 1978-1988 (GOCD, 1988b), and some of this added production is contributing to the export earnings of the state. Proportionately, however, export earnings for root crops remains small; for example, while 29,305 tons of bananas were exported in 1983 with a value of US\$11.2 million, in that year Dominica exported only 863 tons of vegetables, which included root crops, valued at US\$600,000 (World Bank, 1985).

It is obvious that, despite diversification, bananas remain the big export earner. Income from banana exports accounted for more than one-half of the increase in Dominican exports in 1988, rising by 17 percent to just under EC\$100 million. This growth was derived almost entirely from an increase in the volume of fruit exported.

Soap products, the second largest contributor to export earnings, realized EC\$24.3 million in 1988, an increase of 18.8 percent or EC\$4 million over 1987 receipts. The average unit price for these products declined during the year, but a 19 percent growth in volume compensated for the reduction. Other domestic exports in 1988 yielded EC\$22.3 million, an increase of

Table 1.3(4). Sectoral distribution of GDP at current factor cost, 1984-1988.

	1984	1985	1986	1987	1988
<b>GDP (EC\$ Million)</b>	<b>202.7</b>	<b>223.3</b>	<b>253.3</b>	<b>281.8</b>	<b>309.2</b>
Agriculture	56.8	62.4	76.6	82.6	95.4
Mining/Quarrying	1.5	1.5	1.4	1.8	2.1
Manufacturing	12.4	14.4	16.9	18.3	19.6
Utilities	5.9	6.2	6.7	7.4	8.1
Construction	17.17	15.0	11.8	14.4	16.8
Transport and Communications	26.5	29.3	34.4	41.8	45.3
Wholesale/Retail	14.7	21.1	25.8	30.2	32.3
Hotels/Restaurants	2.2	2.6	3.1	3.8	4.8
Banking/Insurance	16.7	28.3	19.8	22.1	23.8
Government Services	47.1	50.1	54.4	57.6	59.5
Other Services	1.8	2.3	2.5	1.8	1.5
<b>GDP (%)</b>					
Agriculture	28.0	27.9	30.3	29.3	30.9
Mining/Quarrying	0.7	0.7	0.5	0.6	0.7
Manufacturing	6.1	6.4	6.7	6.5	6.4
Utilities	2.9	2.8	2.6	2.6	2.6
Construction	8.5	6.7	4.7	5.1	5.4
Transport/Commun.	13.1	13.1	13.6	14.8	14.6
Wholesale/Retail	7.2	9.4	10.2	10.7	10.4
Hotels/Restaurants	1.1	1.2	1.2	1.4	1.5
Banking/Insurance	8.2	8.2	7.8	7.8	7.7
Government Services	23.2	22.4	21.5	20.5	19.2
Other Services	0.9	1.0	1.0	0.7	0.5

N.B. 1988 = Estimated Figures  
Source: CDB, 1988.

46.7 percent (EC\$7 million) over the 1987 figure. The main contributors to this increase were exports of plantain and citrus fruit from the agricultural sector and garments, gloves, paints, and varnishes from the manufacturing sector (Eastern Caribbean Central Bank, 1989).

Dominican exports to CARICOM countries yielded EC\$29.8 million in 1988, EC\$4.5 million more than the previous year but accounting for a smaller proportion of total exports. As Figure 1.3(8) depicts, the last decade has seen an expansion of Dominican exports to other Caribbean countries, including its CARICOM partners, with Jamaica becoming

a major importer of Dominican exports in the region.

## DIVERSIFICATION

Dominica still faces the difficult issue of how to further diversify its economy. Yet within the last two to four years, the country has taken a variety of steps in the direction of broad diversification within both agriculture and other sectors. Some of these steps are summarized below. (N.B. The reader is cautioned that some of these efforts, while enhancing diversification, do have associated environmental costs which are discussed elsewhere in this Profile.)

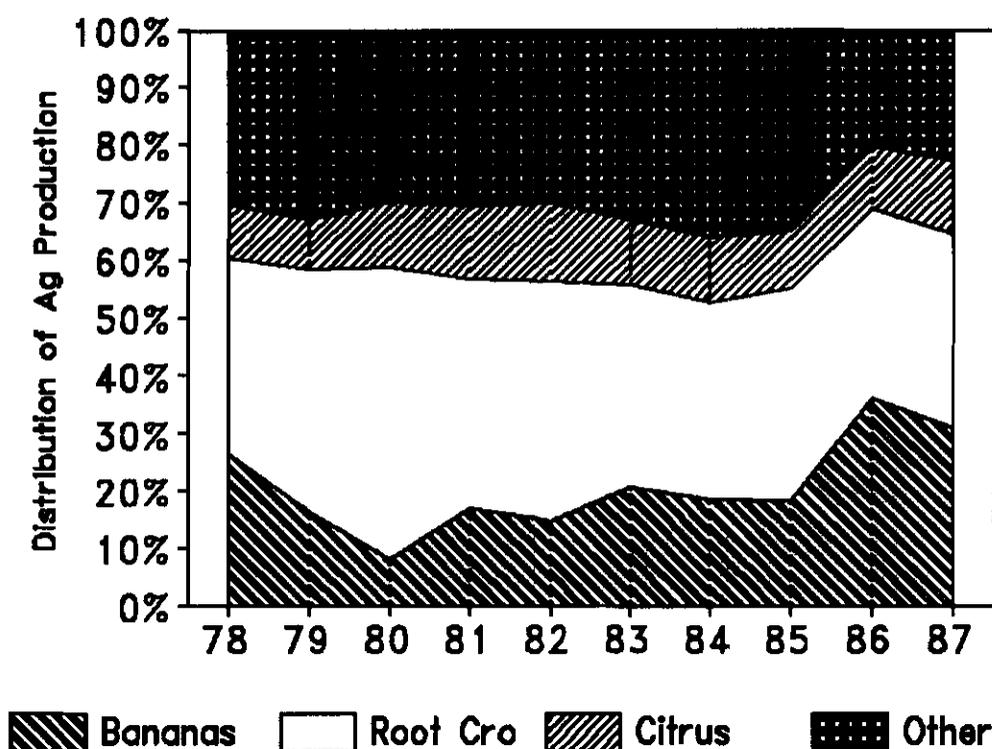


Figure 1.3(7). Dominican crop production, 1978 - 1987 (source: GOCD, 1988b).

(1) In 1989, Government announced proposals for new port facilities at Portsmouth and Roseau at a cost of EC\$24 million. Plans call for building a 300 foot cruise ship berth at Cabrits north of Portsmouth; additionally, the existing port at Woodbridge Bay north of Roseau will be extended by 300 feet, (also for cruise ship use), and a new container park for containerized cargo to accommodate increased volumes of import and export goods is also being built at the Roseau facility.

(2) A marina is planned for the Indian River area adjacent to Portsmouth. This would be the island's first small boat harbor suitable for attracting yacht traffic which has traditionally by-passed Dominica because of its lack of an adequate harbor and marina facilities.

(3) An unusual feature of the Cabrits cruise ship dock is a US\$600,000 five mile fresh water pipeline which will link the Picard River with Portsmouth and provide cruise ships with 200,000 gallons of water within five hours. Water is projected to cost US\$8.00 per 1,000 gallons.

(4) In late 1989 the Minister of Agriculture announced a major program of agricultural diversification to include the growing and processing of passion fruit, soursop, mangoes, avocados, and hot peppers. Additionally, he noted that the 200 acres of coffee then in production would be expanded by another 200 acres by 1992.

(5) Current hydro projects, which for the first time provide for the use of impounded

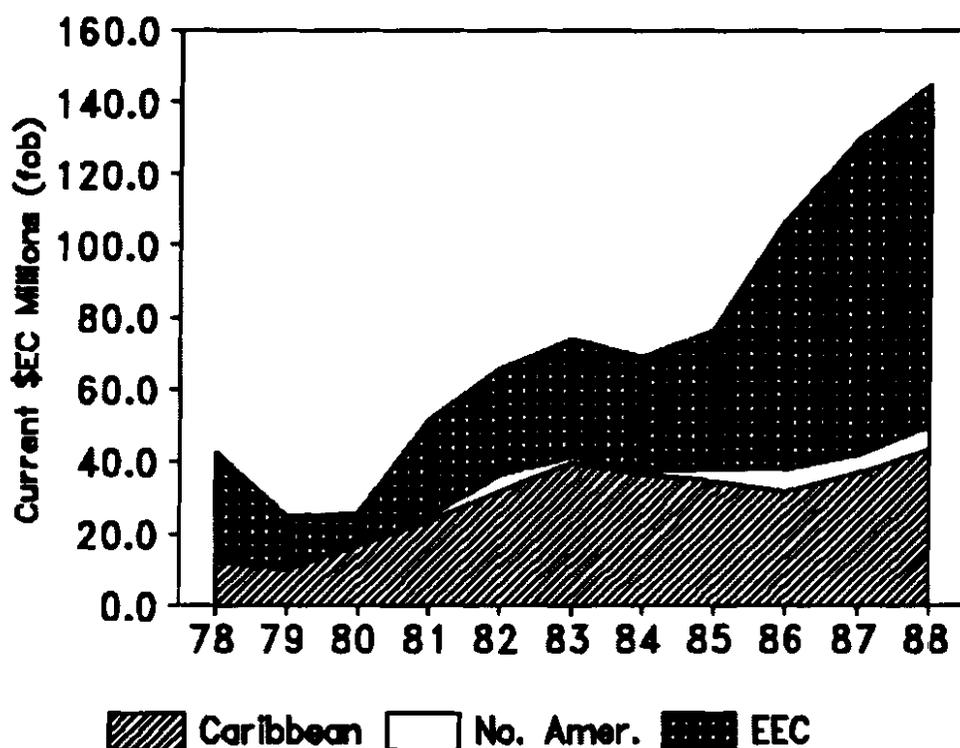


Figure 1.3(8). Dominican export markets, 1978 - 1988 (source: GOCD, 1988b).

water, will assure that the island's electric power supply will soon (i.e., projected for 1992) be just under two-thirds water-supplied, substantially decreasing the current need for importing diesel oil for power systems.

(6) In January of 1990 Dominica AgroIndustries Ltd., the island's only citrus processing plant, successfully marketed its entire output of grapefruit juice concentrate to an American firm. This is linked to a major program to double the acreage and increase the productivity of grapefruit orchards in the country.

(7) During 1989 Dominica Coconut Products increased its prior year sales by 16.5 percent to a new record of EC\$29.7 million. This is due in part to implementation of new li-

censing arrangements with major U.S. soap and cosmetic firms.

(8) Although the size of Dominica's tourism sector remains small, there are indications that it is definitely growing. Between 1984 and 1988, total hotel arrivals rose 43 percent from 22,207 to 31,784 (CTO, 1989). Between 1984 and 1987, the number of cruise ship visitors rose over 250 percent from 3,216 to 12,080. Plans call for expansion of hotel rooms from 1989 levels (approximately 400 rooms) to 575 by 1992, a 44 percent increase (CTO, 1990).

(9) Formal studies are underway for a new jet airport at Woodford Hill in the north-eastern part of the state, which would give Dominica for the first time direct international links for jet aircraft, thereby enhancing the

marketability of the country as a tourist attraction.

### TRADE AND FOREIGN DEBT

Even under the relatively improved commodity conditions enjoyed in recent years, Dominica's economy is unable to produce a surplus, or even a balance, in visible trade. Figure 1.3(9) illustrates the long-term persistence of the negative trade balances which have affected the country.

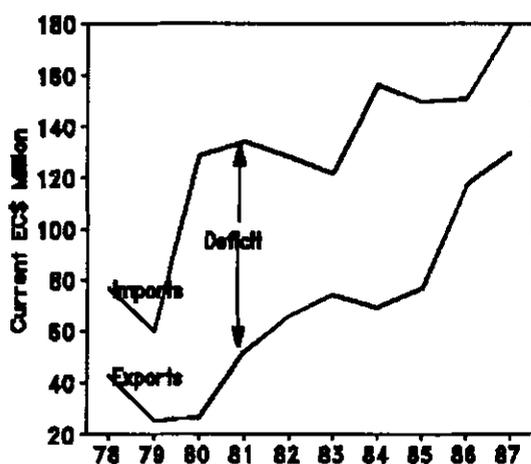


Figure 1.3(9). Dominica balance of trade, 1978 - 1987 (GOCD, 1988b).

More important than the absolute amount of the trade deficit, however, is the deficit in relation to the overall productive capacity of the economy. As Figure 1.3(10) illustrates, after a catastrophic period in the early 1980's, the balance of trade to GDP ratio has improved considerably, averaging around 30 percent or 40 percent for the last four years for which data are available. The extremely high deficit to GDP ratios of the early 1980's reflect the combined effects of low productive capacity because of hurricane damages and the need for massive new investments to replace housing and basic infrastructure following the hurricanes of the 1979-80 period.

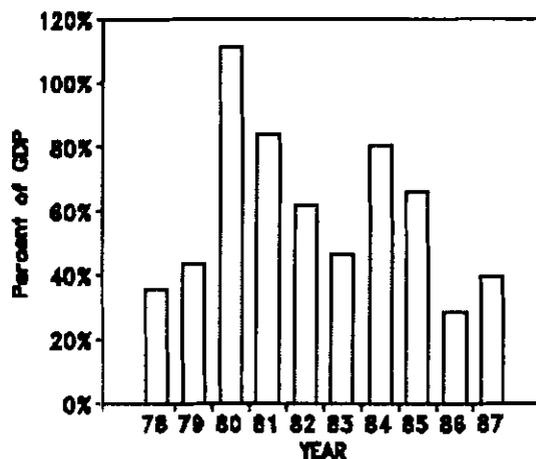


Figure 1.3(10). Dominica trade deficit as a percent of GDP, 1978 - 1987 (GOCD, 1988b).

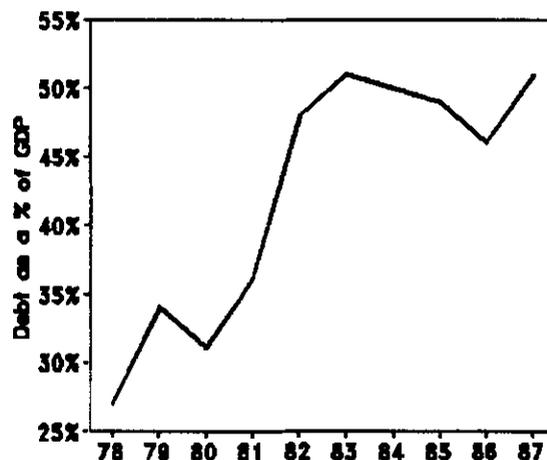


Figure 1.3(11). Total debt to GDP in Dominica, 1978 - 1987 (source: McElroy and deAlbuquerque, 1990).

In spite of the resiliency of the Dominican economy, the ratio of total debt outstanding to GNP is still increasing (see Figure 1.3(11)). Among the OECS states (in 1985, the latest year for which comparative data are uniformly available), only Grenada has a higher debt to GNP ratio. Among Third World countries, a debt to GNP ratio of 50 percent is not necessarily disastrous, but, as McElroy and deAlbuquerque (1990) point out, conditions among the smaller countries of the Eastern Caribbean seem to lead to payment difficulties at relatively low debt lev-

els. Basically, the authors suggest that the extreme openness of their economies, plus poor or inelastic revenue collection mechanisms, make OECS states much more prone to defaulting on foreign debt than has been assumed in the past.

The implications of these trends in Dominica is that future economic policy must devote considerable attention to reducing the rate of growth of foreign-held debt and in-

creasing the foreign exchange earnings (i.e., the efficiency) of investments. This will undoubtedly result in increased pressure for higher returns from export agriculture, more tourism development and more exports from small industry development, particularly after the current program of air and shipping facilities improvements is completed. All three options tend to increase risks to the environment.

### THE "GREENING" OF ECONOMICS

In the area of environmental management, the role of economics traditionally has been diagnostic, scene-setting, and related to the identification of dollars to pay for expensive infrastructure programs. Most of the prescriptive elements of environmental policies are usually dealt with within natural resource sectors such as agriculture or forestry. But that's now changing. As the *Economist* magazine (5 May, 1990) noted, *Environment policies that take no heed of economics will backfire; but so will economic policies that ignore the environment.* This statement is just as valid for the islands of the Eastern Caribbean as it is elsewhere in the world.

Progressive environmental policies are most likely to achieve their goals in a cost-effective manner if they use economic mechanisms such as taxes and control of pricing for non-market goods (e.g., in Dominica: water, electricity and other utilities). Regulations and direct subsidies are demonstrably less effective than economic tools which control prices to consumers.

It is important for governments to eliminate subsidies for the exploitation of scarce natural resources. Although this is easy to say, it sometimes clashes strongly with fundamental political issues, such as government-financed housing schemes where a subsidy is used to support the conversion of prime agricultural land into housing tracts. Another traditional subsidy with usually negative environmental consequences is the construction of farm-to-market roads. In contrast, however, taxes on scarce natural resources and energy can serve the dual goals of revenue generation while ensuring that the prices of such goods more fully reflect the full costs to society.

There are many opportunities for GOCD to explore the elimination of environmentally-harmful "subsidies" or the adoption of creative fiscal disincentives to protect the environment. For example:

- Are timber tax and depletion policies designed to encourage wise cultivation and harvesting of exotic varieties and sustainable silviculture practices for utility grades of lumber?
- Do agricultural support programs encourage and/or enforce environmentally sound farming and soil conservation practices?
- Are water exports being subsidized?
- Are sand exports being subsidized because the Government is not reimbursed for the loss of a non-renewable (or very-slow-to-renew) resource?

It is important for Dominica and other Eastern Caribbean governments to explore more ways for economics and the environment to work together creatively.



Rain forest landscapes in Dominica, such as the one depicted, offer new prospects for attracting the attention of eco-tourists who find inspiration and enjoyment in visiting and experiencing new and complex ecosystems.

## SECTION 2 FORESTS AND WILDLIFE

Over two-thirds of the land surface of Dominica is covered by forests. Indeed, in the Eastern Caribbean, the words "rain forest" are almost synonymous with the name Dominica. One observer, writing some sixty years ago, exclaimed upon seeing the island: "I had not believed that anything could be so green" (Waugh, 1949). Forests dominate the island's landscape; they have been a key geographic determinant in shaping its history and development and continue to inspire images of true tropical splendor. Dominica's forests modify its weather and seriously limit agricultural opportunity; at the same time, the country's lush forested areas provide a home for exotic tropical flora and fauna and are critical to retaining the island's light tropical soils on steep mountainous hillsides.

There is a general consensus that the forests of Dominica are the finest in the Caribbean. They cover between 60-75 percent of the island and contain a rich assemblage of plant and animal species. Over 1,000 species of flowering plants are represented, with up to sixty tree species per hectare. Over fifty species of resident birds have been recorded, including two endemic parrots, both of which are endangered.

Since the time of the first French settlements at the beginning of the eighteenth century, the island has been favored for its forest resources (Honychurch, 1984). Exploitation continued into the twentieth century until, by 1971, an article in *American Forests* warned that these forests, the only large expanse of undisturbed flora remaining in the Lesser Antilles, were "doomed," about to fall victim to the latest commercial venture to win rights to cut them down (Weber, 1971). That venture, spearheaded by a Canadian firm called Dom-Can Timbers Ltd., had, in 1967, been granted a 21-year logging agreement by the Government of Dominica. However, in 1971, the same year that the warning in *American Forests* appeared, the company failed as a result of the high costs associated with timber extraction and other operations in the island's difficult topographic and climatic environment (Prins, 1987). Other assessments

held the firm itself accountable, claiming the operation was "under-capitalized" and "mismanaged" (May, 1981). Yet another attempt at large-scale forestry on Dominica's rugged terrain began operation six years later in 1977, but this too had failed by the end of the decade.

The collapse of previous attempts at large-scale timber harvesting has not eliminated risks to Dominica's magnificent ecosystems from multinational corporations looking for new offshore sites. As outlined below, at present these include two relatively large timber operations which receive a variety of subsidies from international organizations.

### 2.1 FORESTS

#### 2.1.1 Overview

#### THE FOREST RESOURCE BASE

Dominica contains some 52,000 ha of natural forest, woodland and bush. Steep topography, high relief, and considerable microclimatic variability have a strong influence on the distribution of vegetation types. Littoral woodlands occur within the immediate coastal zone of the windswept east side of the island. Scrub and savanna vegetation are found along the leeward coast which comprises the driest part of the country. Mature forest, montane thicket, and elfin woodlands occur only in the high rainfall interior, while rain forests, both mature and secondary, are found in well-drained areas of intermediate elevation and moderate rainfall. Freshwater swamps and mangroves are rare. The former occur mainly along stream outlets in the northeast and northwest, while small stands of mangrove are present along the northwest and northeast coasts. In addition, fumarole vegetation can be found in selected areas, primarily in the Valley of Desolation just south of the Boiling Lake in the south central part of the island.

A more detailed description of the island's vegetation zones is provided in EARTHSAT (1986), which is based on an OAS classification. Table 2.1(1) contains 1984 data on the spatial extent of each vegetation zone and is drawn from OAS figures.

Several words of caution are warranted regarding the figures in Table 2.1(1). First, they differ significantly from those obtained from an earlier map compiled by Shanks and Putney (1979). In some cases, the difference is too substantial to reflect actual changes in land use or vegetative cover. For example, the OAS map indicates a total area of secondary rain forest of 9,090 ha (as presented in Table 2.1(1)), while the Shanks and Putney (1979) map, obviously produced from earlier aerial photographs, reveals a much larger total area of over 20,000 ha (Prins, 1987).

One researcher (Dr. P. Evans, Oxford University-based Director of the Dominica Multiple Land Use Project) urges

additional caution in using the OAS map and figures. Some areas on the map are attributed to the wrong vegetation type; boundaries are in some cases incorrect; and some vegetation categories are not appropriate. For example, differentiation between mature and secondary rain forest is not well defined (there is an element of secondary growth throughout the rain forest areas); also, "montane rain forest" may prove difficult to distinguish in some locations from "mature rain forest". Similarly, "semi-evergreen forest" is a category that could be omitted. It is a transitional zone containing species characteristic of rain forest and dry forest, but the boundaries of the zone and its areal extent appear to have been drawn arbitrarily.

The photography on which the OAS maps was based is far from perfect, as admitted by EARTHSAT (1986). However, a new air photo project for the Windward and Leeward islands has recently been initiated by CIDA. A related project by UNDP will utilize the CIDA photography to develop a

Table 2.1(1). Spatial extent of Dominica vegetation zones.

VEGETATION TYPE	1984 AREA (ha)	% OF TOTAL LAND AREA *
Mature Rain Forest	24,490	31.0
Montane Rain Forest	3,640	4.6
Montane Thicket	800	1.0
Elfin Woodland	170	0.3
Littoral Woodland	140	0.2
Scrub Woodland	6,240	7.9
Secondary Rain Forest	9,090	11.5
Semi-evergreen Forest	7,170	9.1
Swamp	30	0.1
<b>TOTAL</b>	<b>51,770</b>	<b>65.7%</b>

\* Total land area of Dominica = 79,000 hectares.

Source: McKenzie, 1987b, cited in Prins, 1987.

computer-based agricultural land information system. This will initially focus on Barbados but will offer training for personnel from other Windward and Leeward Islands to enable application of the technology elsewhere, including Dominica.

Between 1986 and 1987 an inventory of Dominica's major commercial forests was conducted by the Division of Forestry and Wildlife with assistance from FAO (DeMilde, 1987). A review of the inventory results indicated that Dominican forests were relatively rich in timber and uniform in composition, and had a large total utilization volume (FAO, 1989). Timber richness was found to be 200 cubic meters/ha on an estimated 12,500 ha and 600 cubic meters/ha on an estimated 3,500 ha. In terms of composition, three species -- gommier (*Dacryodes excelsa*), carapite (*Amanoa caribaea*), and bois cote

(*Tapura latifolia*) -- made up 50 percent of all trees enumerated (Table 2.1(2)). Ten species comprised over 90 percent of the total volume. This uniformity is viewed as advantageous for timber extraction and utilization and for forest management. Estimated total utilization volume (all species) was 4.9 million cubic meters, enough to "cover the needs of the existing (small) timber industries and of those which are expected to be established in the near future" (FAO, 1989).

As part of a current FAO/UNDP Project, entitled Implementation of Forest Management in Dominica, the volume available for maintenance of a sustained yield from Government-owned land without depletion of the resource is being examined to determine long-term management objectives. For this exercise, only currently marketable species have been considered to avoid overcutting and

Table 2.1(2). Species composition, all forest strata\*, 1987 FAO forest inventory of Dominica.

SPECIES	PERCENTAGE	
Gommier ( <i>Dacryodes excelsa</i> )	22.3	
Carapite ( <i>Amanoa caribaea</i> )	13.9	
Bois cote ( <i>Tapura latifolia</i> )	<u>13.8</u>	50.0
Chataignier ( <i>Sloanea</i> spp.)	12.2	
Mahot cochon ( <i>Sterculia caribaea</i> )	9.9	
Bois diable ( <i>Licania ternatensis</i> )	<u>7.2</u>	79.2
Bois riviere ( <i>Chimarris oymosa</i> )	3.8	
Mauricli ( <i>Byrsonima martinicensis</i> )	2.7	
Balat ( <i>Pouteria pallida</i> )	1.4	
Zorange blanc ( <i>Swarzlia caribea</i> )	1.3	
Others and Unknown	<u>8.2</u>	100.0

\* Trees with a diameter equal to or exceeding 30 cm d.b.h. (diameter breast height).

Source: DeMilde, 1987, cited in Prins, 1987.

downgrading of the remaining resource. Whereas DeMilde (1987) derived an estimate of available growing stock within the assessment area amounting to 4.9 million cubic meters, adjustment for marketable species reduces this figure to 3.7 million cubic meters (pers. commun., A. White, 1990). Of this, approximately three million cubic meters are located on Government lands, as estimated by DeMilde. This figure is likely to be reduced further as the management planning process proceeds and the actual extent of Government-controlled land which can be utilized without constraint is identified.

This revised resource figure and that of the inventory are both significantly less than the figure derived by Brown (1962) in his survey, which indicated a total resource on the order of seven million cubic meters over an area of 29,000 hectares. This included private land and land subsequently allocated to National Park use and therefore unavailable for utilization. It also included areas damaged by Hurricane David in 1979, which further contributed to the reduction in available resource.

The major factor which emerges from the continuing decline in estimates of available volume is the need for the early introduction of management practices for the remaining resource in order to ensure that this decline does not continue.

## PRODUCTION

The island's primary producers together generate about 75 percent of the raw material for furniture makers, carpentry shops, building contractors, and a manufacturer of prefabricated housing (Prins, 1987). The producers include two relatively mechanized companies, Dominica Timbers Limited (DTL) and Northeastern Timber Co-operative Ltd. (NET), as well as 114 small-scale "pitsawyers" (Zamore, 1988), almost all of whom now use chainsaws and portable "Alaskan mills" rather than pitsaws (a decade ago, in 1979, some 80 percent of the small sawyers used pitsaws [GOCD, 1988a]).

The annual output of the small sawyers is estimated at 1-2 million board-feet, while that of DTL and NET is 2.8 million board-feet and 1.2 million board-feet, respectively (GOCD, 1988a). Prins (1987) claims, however, that the small sawyers actually produce up to 65 percent of all domestic primary production, a great deal more than would be implied by the above figures.

DTL is the island's main supplier of kiln-dried lumber. Since 1982, when it was established, the company has had only two profitable years, this record reportedly due to mismanagement and to the difficult environmental conditions which have also led, in part, to the failure of larger scale harvesting schemes. The operation lacks a proper road network and thus must contend with excessively long skidding distances. This leads to low productivity and heavy wear-and-tear on the firm's only skidder (Prins, 1987), not to mention considerable disturbance of the state-owned forest land on which the firm presently operates (see Section 2.1.2).

NET has benefited the rural communities of northeastern Dominica by providing inexpensive lumber, low cost prefabricated homes, agricultural feeder roads, wood-based fuels, employment and training. The company nevertheless is plagued by equipment inadequacies and financial difficulties, the latter largely due to high extraction costs and to social obligations stemming from its association with the Catholic Mission in Dominica (Prins, 1987). The environmental effects of NET's operations are outlined in Section 2.1.2. The company operates primarily on private land and unallocated state land, but it has also cut within a 20 ac area of the Northern Forest Reserve.

Small sawyers may generate up to 65 percent of all production. They can work in areas that are inaccessible to mechanized operators and with minimal damage to the resource because they essentially bring their sawmills into the forest rather than drag out huge logs. However, in some locations they may be contributing to the clearing of important windbreak areas on private lands as sawyers have reportedly approached farmers with requests to fell trees within the wind-

breaks (pers. commun., P. Evans, Dominica Multiple Land Use Proj., 1990). Traditionally, the small sawyers have yielded a low quality product in terms of dimensional consistency, surfacing, and a lack of seasoning or finishing (Prins, 1987). However, an ongoing CANARI-supported (formerly ECNAMP) project, with funding from WWF-US, Rockefeller Brothers Fund, and Weyerhaeuser Corporation, is aimed at improving product quality and marketing through a Small Lumber Producers Group. According to the Group's Manager (pers. commun., R. LaRonde, 1990), membership is currently limited to about 35, but more cannot be accommodated until a larger facility is developed for finishing, drying, storing, and marketing lumber. A site for such a facility will soon be leased from Government on the west coast, but an estimated US\$90,000 is needed and is being sought to set up and equip the facility (see also Section 10.4 of the Profile).

According to Butler (1982), production of wood-based fuels (firewood and charcoal) consumes an estimated 10,000 tons (15,000 cubic meters) of timber per year, but others provide a figure of 32,000 tons just for charcoal production (Bellman, *et al.*, 1987). Butler's survey found there were a total of 210 charcoal producers on the island, most of whom employ the traditional, but marginally efficient earth pit (kiln) method of production (see also Section 6 of the Profile).

## FOREST RESERVES AND PARKS

Dominica has two Forest Reserves -- the Northern, at 8,800 ha (21,745 ac), and the Central, at 410 ha (1,013 ac) in size (see Figure 2.1(1)). Under the Forests Ordinance of 1958, restrictions or prohibitions were placed on activities within the reserves, e.g., forest product extraction, land clearing, and hunting. Wood harvesting has primarily been stopped in the forest reserves although NET recently received a concession for harvesting an eight ha (20 ac) area on the east side of the Northern Reserve (pers. commun., D. Williams, Forest Officer, 1990). In the late 1960's and early 1970's, Dom-Can harvested in the Cen-

tral Reserve at D'leau Gommier in an area of approximately 60 ha (Bell, 1976) that was partly reforested in 1982 as part of an ILO/Forestry Division Reforestation Program. This effort sought primarily to address the ravages caused by Hurricane David in 1979 (pers. commun., A. Christian, Forest Officer, 1990).

On all state lands a minimum girth limit ranging from three to six feet is required for harvesting; in the case of the NET concession area, reforestation was also required. NET has replanted about half of the area in which it harvested in the Northern Reserve, and a recent inspection shows survival has been relatively good in the 10 acre area replanted, even though little care was given. DTL has not replanted at all in the unreserved, state land areas (Morne Plaisance) where it continues to harvest.

NET has planted exotic species (mostly mahogany) from stock provided by Forestry. The choice of mahogany was based on the difficulty of germinating and raising gommier (*Dacryodes excelsa*) seedlings outside of natural habitat, the growth rate of mahogany, which is faster than gommier, and the wide use of mahogany in surrounding islands, making it a high value species. Most reforestation programs to date in Dominica have incorporated the use of exotic species. Miller, *et al.* (1988) claim that although reforestation is "well meaning", the use of exotics is inappropriate for the forest type (see also Section 2.1.2 below). Instead they recommend a cutting prescription and a management system aimed at natural regeneration of indigenous species.

The Morne Trois Pitons National Park, Dominica's first, was established in 1975 and contains an additional 6,872 ha (16,980 ac) of legally protected forest in the south central part of the island. Some 380 ha (940 ac) of the Park formerly comprised the Archbold Preserve, an extensive area of rain forest. These lands were donated to Dominica by the American owner of Springfield Plantations, Mr. John Archbold, after first being held from 1974 to 1982 by a US-based NGO, The Nature Conservancy.

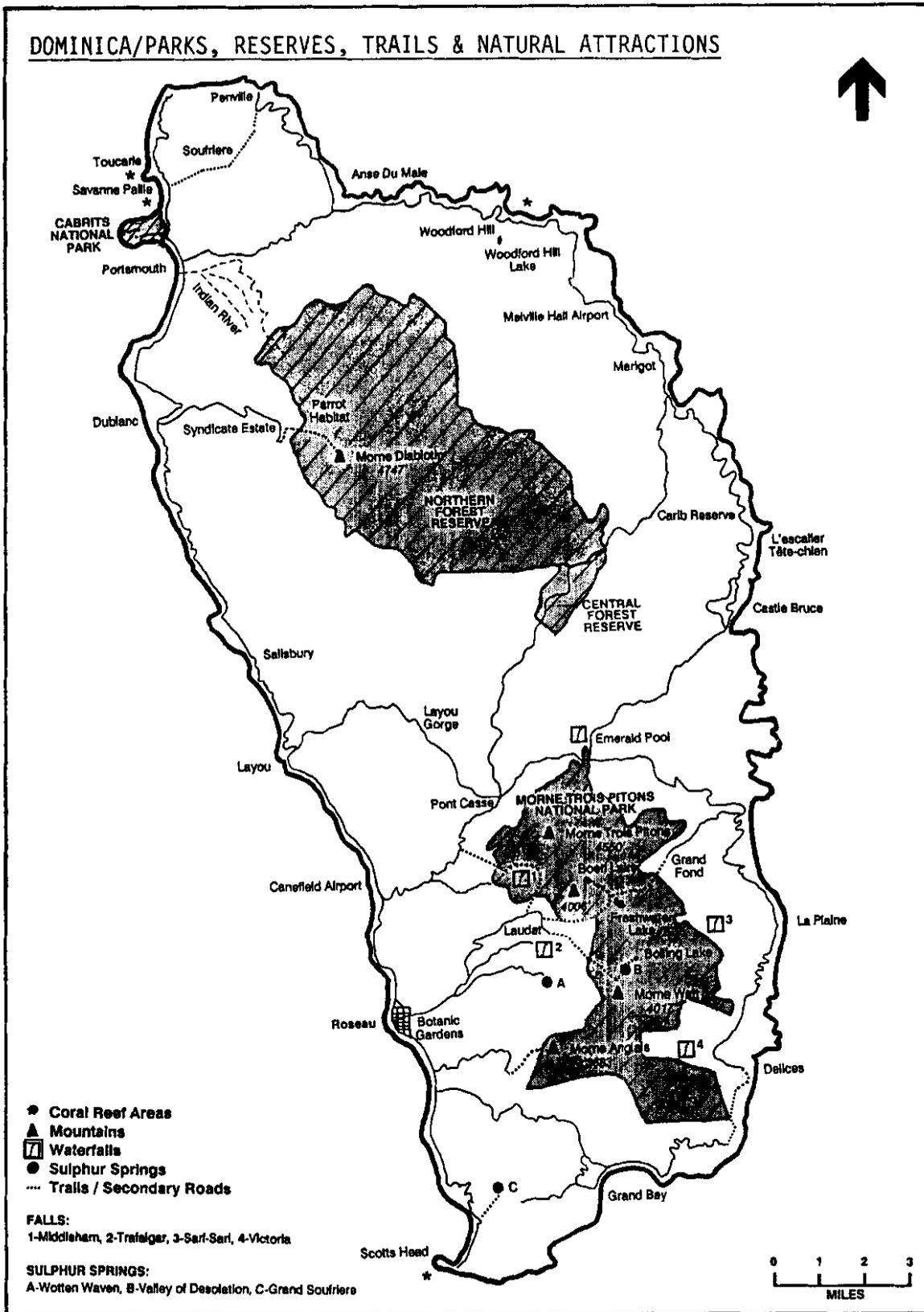


Figure 2.1(1). The parks, reserves, trails and natural attractions of Dominica (source: Division of Forestry and Wildlife, GOCD).

Morne Trois Pitons National Park is rich in natural resources and phenomena. It encompasses some of the outstanding physical features of the island, including: five major mountains (Morne Trois Pitons, Morne Macaque, Morne Nicholls, Morne Watt, and Morne Anglais), Boeri and Fresh Water Lakes, the Boiling Lake and a unique thermal area, at least two waterfalls, and large tracts of undisturbed rain forest and tropical montane forest vegetation (Christian, 1989) (see also Figure 2.1(1)). No logging *per se* is permitted in National Parks.

According to Miller, *et al.* (1988), the Park forms the largest stand of protected, undisturbed forest in the Caribbean, but this assertion is not correct. The Northern Forest Reserve is in fact the largest such area, and the protection afforded it is similar to that for the National Park. At least one researcher maintains that the Northern Forest Reserve has a higher biodiversity than the Park and contains richer and better forests (pers. commun., P. Evans, Dominica Multiple Land Use Proj., 1990). Furthermore, as discussed in more detail in Section 2.1.2, the National Park is the site of ongoing and intensifying human disturbances.

A ten year management plan was recently drafted for the Morne Trois Pitons National Park by Scheele (1989a) under the sponsorship of the OAS. It includes a zoning plan which identifies Special Use Zones, Intensive Use Zones, Extensive Use Zones, Environmental Study Zones, Research Zones, and a Wildland Management Zone which covers all remaining areas of the Park that require no human interference. Details on each of these designations and on program planning priorities are outlined in Scheele (1989a).

The reader is also referred to Wright (1985) for an excellent account of the development of Dominica's parks legislation and of Morne Trois Pitons, the country's first national park. Dominica has a second, much smaller, national park, the Cabrits National Park, which was legally established in 1986. This park includes the ruins of an extensive British fortification nestled in dry woodlands adjacent to a wetland area. It is located on the northwest coast of the country, and the

reader is referred to Sections 10 and 5 of the Profile for additional information on this National Park.

The island's present, legally defined forest reserves and national parks together incorporate 20 percent of the country's forest base. A proposal for a third national park was recently prepared by the Forestry Division with support from ICBP and the RARE Center for Tropical Bird Conservation (ICBP, 1990). The proposed park would encompass the forested area along the western slopes of Morne Diablotin, the island's highest peak, and would consist of 2,497 ha (6,171 ac) of the very rich Northern Forest Reserve (roughly 28 percent of its total area), as well as 82.5 ha (204 ac) of land at Dyer Estate which has been proposed (but not yet legally established) as a parrot reserve (see Butler, 1989; ICBP, 1990). The estimated total cost of all park development requirements (e.g., boundaries, visitor center, parrot viewing platform, trail work, roads, interpretation) for the proposed park is EC\$2.16 million (ICBP, 1990).

### 2.1.2 Problems and Issues

The recent inventory of Dominica's major forested areas pointed to a "slow, but definite, degradation" of the resource (FAO, 1989). The most important species from an economic standpoint, gommier (*Dacryodes excelsa*), was said to be on the decline. Some of the larger trees were found to be hollow or rotten and thus would provide a lower timber output. Additionally, it was stated that gommier was not regenerating well and was being replaced by a variety of other species in early stages of regeneration. Reportedly, good quality gommier trees were being harvested in areas not leased for such purposes, with subsequent implications for the forest's long-term production potential and economic exploitability (FAO, 1989).

## DEFORESTATION

Figure 2.1(2) provides an illustration of the extent to which the island has been deforested over the years, particularly since 1945. Deforestation is considered one of the "most crucial" issues confronting Dominica according to a recent document prepared by a Government-sponsored environmental awareness committee (YES, 1990a). Agricultural expansion and timber harvesting is causing rapid removal of vegetation on both private and public lands. Forested state land is being sold, largely as a means to relieve agricultural land hunger, but this commonly has been done haphazardly and with inadequate controls to protect against soil erosion and other forms of land degradation. In many areas, especially on steep slopes, lands being cleared for agriculture are unsuitable for such uses, particularly in the absence of specialized controls to protect against soil erosion (see also Section 3.2 of the Profile).

State lands affected by illegal encroachment and intensive cultivation include lands in the Brandy area (OAS Vegetation Map, 1984), an area which is now being allocated to settlers, and the area along the south boundary of the Morne Trois Pitons National Park (Shanks and Putney, 1979), e.g. near Petit Savane.

Prins (1987) estimates, on the basis of preliminary interpretations of the 1984 OAS vegetation map, that 1,980 ha (4,891 ac) and 70 ha (173 ac), respectively, have been encroached upon in Morne Trois Pitons National Park and in the Forest Reserves. Several officials of the Forestry Division (pers. comm., A. Christian and A. James, 1990), contest this estimate in relation to the Park. For example, one Forest Officer estimates that only about 20 ha (50 ac) of park land are being squatted upon and primarily by cultivators from the Village of Petit Savane, which was established in the area long before park boundaries were drawn. It is likely that Prins (1987) mistakenly reversed his figures when he wrote them into his report; i.e. he may have meant to write that there are about 1,980 ha of encroachment in reserve areas, but only about 70 ha in the Park, a situation which is

closer to the figures cited by Forestry Division personnel.

In any event, interpretation of the OAS map by Prins (1987) reveals that the area under cultivation on the island is already greater than that projected by Government for the year 2001 in its National Structural Plan (GOCD, 1985) -- 26,390 ha vs. 23,700 ha. Construction of agricultural feeder roads, a major effort of the present Government, and the current high price for bananas are accelerating the deforestation process, frequently in areas that should be kept under natural forest to protect steeply-sloping lands against erosion.

The conversion to agriculture is also generating localized shortages of fuelwood, charcoal, poles, posts, and other utility timbers, e.g. along the west coast (Prins, 1987), while many felled trees are left unused. In fact, even prime timbers, in substantial quantities, are left to rot under recently planted banana trees. This wastage seems to stem from a lack of effective coordination between farmers and the wood products industry, even though the latter is struggling with raw material costs.

It is believed by some observers that timber-growing stocks on privately-owned lands will be depleted in the near future, and thus the reserve areas will be increasingly relied upon by the forest industry (Prins, 1987). This is one of the primary reasons why a management plan for the efficient, yet sustainable use of the forest is so critical at this time. The intensification of agricultural land use, in conjunction with a greater focus on agroforestry and plantation forestry, will also be critical to relieve pressure on remaining areas of natural, undisturbed forest.

## INDUSTRIAL FORESTRY

Both of the relatively large-scale or "industrial forestry" operations presently functional on the island -- Dominica Timbers Ltd. (DTL) and Northeastern Timber Cooperative Ltd. (NET) -- appear unable to sustain profitable ventures. An evaluation by Kehr

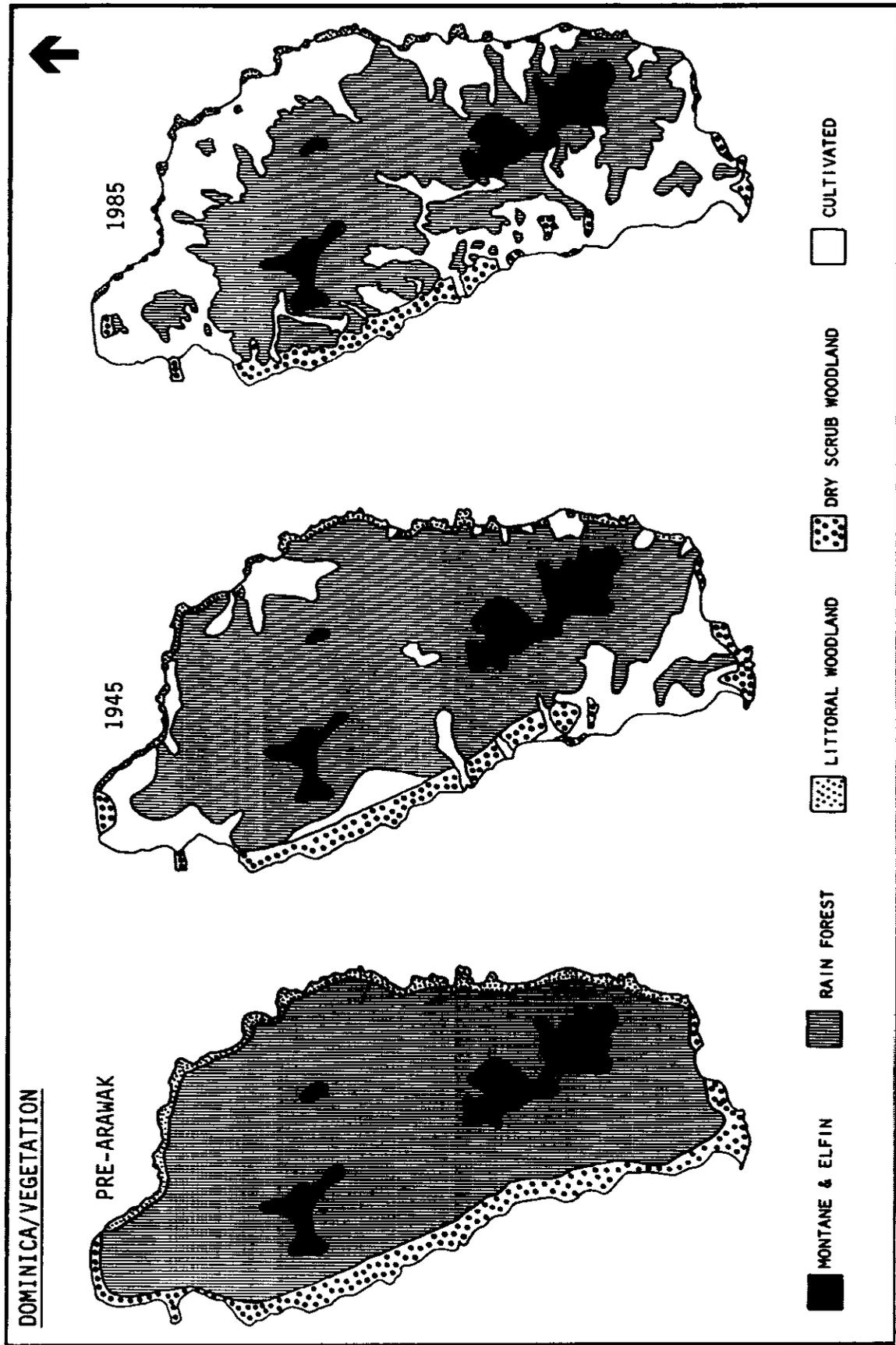


Figure 2.1(2). The vegetation of Dominica (source: Evans, 1986b).

## CROWN LAND SALES

According to Lausche (1986a), it is Government policy to transfer to private ownership all crown (i.e., state) land that is not reserved in national park or forest reserve status or (under the Crown Lands Ordinance) not located within five chains (330 ft) of a stream at its headwaters. The Director of Forestry and Wildlife (pers. commun., F. Gregoire, 1990) indicates that this is not in fact a stated policy, but, in any case, a substantial amount of state-owned land has been sold off since independence in 1978.

Unfortunately, much of this land has been sold without effective consultation with the Forestry Division or with other agencies in a position to contribute to decision-making about optimum land use. Lands have been redistributed on slopes too steep or infertile for cultivation, in locations with great park and tourism potential (like Soufriere Estate), and even in domestic water catchment areas immediately along river banks. There also have been instances in which the Forestry Division has actively initiated action against suspected offenders, unaware that the latter had legally purchased their land from Government (Prins, 1987).

There is no formal or required mechanism by which Forestry staff communicate on an ongoing basis with other ministries on matters of land use planning and development (Lausche, 1986a). Decisions relating to these concerns have therefore often been neither well coordinated nor reflective of an integrated approach to resource planning and management -- exceptions are the development of Melville Hall, Geneva, Castle Bruce and Soufriere Estates (pers. commun., F. Gregoire, 1990). However, since the mid-1980's, an increasing effort reportedly has been made by the Division of Forestry and Wildlife and the Division of Lands and Surveys to improve this situation by better coordination of agricultural land allocation decisions, better subdivision designs, use of community studies for planning purposes, and similar measures. An example of this improved approach can be found in the Gommier Ellick area where a community-wide problem of land hunger previously existed (pers. commun., A. Christian, Forest Officer, 1990).

(1987), an FAO consultant, led him to conclude that both urgently require capital investment -- for survival and rehabilitation in the case of DTL and for diversification and expansion in the case of NET. He cautioned, however, that since their wood supply is insecure because of "government's indecision regarding logging agreements and concessions on Crown Land," a logging concession of approximately 700 ha should be a prerequisite to any capital investment.

Even with such concessions, as well as additional capital investment, there is no guarantee these firms will be transformed into self-sustaining operations. Both producers have been operating for about ten years. They already have received substantial financial and technical assistance and have had access to

some of the best logging opportunities in the country (Prins, 1987). Putney (1989) claims that both companies probably would have failed if not for the subsidies they receive.

Such analyses have primarily focused on narrow, micro-economic parameters. The *additional* environmental costs of the two operations have not yet been fully accounted for. It is quite likely that if these environmental costs, now externalized and borne by the community, were internalized as a cost of production, the companies' economic position would show an even more substantial loss.

Logging practices of both firms have been questioned by various consultants. DTL uses a skidder over long distances because its road network is insufficient. This creates wide

and lengthy furrows (i.e., skidder tracks) with great propensity for gully erosion. Some skidder trails have been cut through excessively steep terrain, only to be abandoned after minimal use. A land management and logging plan was prepared by Sage (1983) for DTL activities in the Morne Plaisance Estate. There is no evidence, however, that the firm utilized the plan.

NET also generates substantial environmental costs through its operations which include clear felling on steep slopes and log extraction with a D6 Caterpillar. Even where selective cutting is being practiced by both firms, there often is considerable damage to remaining trees and to saplings, seedlings and other ground cover.

#### **REPLANTING AND NATURAL REGENERATION**

Reforestation programs conducted to date in Dominica have relied heavily upon exotic tree species. As noted elsewhere in this chapter, some observers believe that replanting with exotics is undesirable, given the forest type which prevails in Dominica. However, such observations may not have taken into account the fact that some reforestation with exotics occurred as an attempt to rehabilitate damaged areas following Hurricane David in 1979. At the time, it was critical to provide needed coverage for the soil, and only exotic seedlings were readily available (pers. commun, F. Gregoire, Director of Forestry and Wildlife, 1990).

Nevertheless, in harvested areas, it may now (ten years after David) be more appropriate for the Forestry Division to establish a cutting prescription which would ensure proper site preparation and the availability of quality seed trees for the natural regeneration of desirable species (e.g. gommier) -- as has been suggested by Miller, *et al.* (1988). Several representatives of the Forestry Division counter that gommier and other high quality native timber species simply grow too slowly, by comparison, and thus are unsuitable for maintaining a viable timber industry.

Clearly this is an issue of considerable importance that will be addressed, in part, through the present GOCD/FAO-assisted program to formulate a forest management plan. It is likely that plantations of exotic species (e.g., high value furniture species) will have some role in relieving pressure on the primary forest in the reserves. Furthermore, there appears to be some potential for supporting marketable native species given that the French are collecting white cedar in Dominica for use on the adjacent islands of Martinique and Guadeloupe.

Some foresters argue that if harvesting practices were conducted more sensitively, then natural regeneration would keep pace and thereby eliminate the high cost of artificial regeneration (which requires the removal of "climber" vines from the young trees, an expensive operation). Research conducted by Bell (1976) suggests that this is in fact the case. At present, some of these issues are being addressed through the Dominica Multiple Land Use Project which includes, among other studies, the monitoring of permanent vegetation plots for regeneration, seedling survival, and the like.

#### **RESOURCE MANAGEMENT INITIATIVES IN THE LONGER TERM**

Approximately 20 percent of Dominica's forest lands consist of legally defined forest reserve or national park. As noted by McHenry and Gane (1988), this constitutes an inadequate basis for resource management purposes, e.g., for the protection of watersheds or wildlife habitat.

Most of the lands within present water catchments are privately owned. But even the limited areas within catchments that are state-owned have not been declared forest reserves, while private catchment areas, which could be better managed as legally-declared "protected forests", have not (with a single exception) been so designated (see also Section 4 of the Profile). The country's water authority, DOWASCO, plans to upgrade the water system and, at the same time, avoid compensation and/or land acquisition expense by es-

establishing new water intakes higher up into state-owned lands wherever possible. Prins (1987) claims that even if DOWASCO's proposed scheme for a multi-village consolidated water system is successful, some 40 percent of the watershed areas will still not fall within park or reserve boundaries. The present day figure is closer to 60 percent (pers. commun., A. Christian, Forest Officer, 1990), which should be a cause of some concern for resource managers charged with maintaining water quality.

A similar lack of legal protection prevails for sites of cultural, scientific, or historic importance (see also Section 10). But until these areas and sites have a more secure protected status, forests, as well as wildlife, water and other resources, will remain at risk. Deferred decisions and postponed action will inevitably result in some ecological system loss, as well as increased land acquisition costs and reduced water production in the not too distant future.

#### **NON-CONFORMING USES OF NATIONAL PARK RESOURCES**

Several existing and proposed activities within the Morne Trois Pitons National Park clearly are incompatible with the area's stated wildland and tourism objectives. The first of these are the agricultural practices of squatters in the Park, whose actions -- although illegal -- are tolerated because of the country's need for agricultural land.

Other non-conforming activities in the Park are nonetheless legal under ministerial authority provided in enabling legislation (i.e., National Parks and Protected Areas Act of 1975). For example, many would consider ongoing hydropower development in the Park (which includes transformation of the Freshwater Lake -- one of the Park's main attractions -- into a reservoir to expand generating capacity) to be a non-conforming use of the resource. (See also Section 6 of the Profile.)

One of the objectives for the Morne Trois Pitons National Park as stated in the Forestry Division's Management Plan for the

site is to gradually eliminate or control damaging or incompatible uses (Scheele, 1989a). With respect to the cultivators, reportedly a healthy and cooperative working relationship has been developed between them and the Forestry Division (pers. commun., F. Gregoire, Director of Forestry and Wildlife, 1990), thus, presumably, limiting the damaging effects of their activities. However, with regard to the Hydroelectric Expansion Project, the Division had little control over or input to decisions made by other GOCD agencies in the Project's planning and design stages, even though such decisions would impact on the Park. As discussed in detail in Section 6, the sustainability and economic benefits of the hydro project, particularly after all costs -- both external and internal -- are considered, remain unknown. Certainly the scale and nature of such projects, and their cumulative impacts within the context of a small island such as Dominica, have implications for the country's emerging tourist image as "the nature island" destination of the Caribbean.

Several other developments are under consideration which could threaten the environment around the Morne Trois Pitons National Park and present difficult challenges for Park staff. These include a road access across the southern portion of the Park (i.e., transforming the Grand Fond track into a road), geothermal energy development, and shortening the hiking distance to Boiling Lake by building a road from Morne Prosper to a point closer to the Lake. The Director of Forestry and Wildlife (pers. commun., F. Gregoire, 1990) is probably correct when he argues that the road is defensible given that the hike to the lake is presently long and strenuous and that only about 1.6 km (1 mile) of the road would fall within Park boundaries.

#### **2.1.3 Policy Recommendations**

##### **MORE EFFICIENT, APPROPRIATE AND INTENSIVE LAND USE**

Perhaps the most fundamental problem facing the managers of Dominica's forests

is the rapidly expanding pressure on this resource as a source of timber, fuelwood and charcoal and as an area increasingly utilized for crop cultivation. Much of this pressure on the resource could be reduced, however, inasmuch as most of the country's requirements for forest resources or for land now under natural forest could be met (1) in areas that already have been cleared or otherwise disturbed and (2) through more efficient utilization of the resource base.

Given this general observation, the following specific policies are recommended.

(1) Steps need to be taken by GOCD to ensure the protection of those areas which are appropriate *only* for wildlife conservation, watershed protection, recreation, nature tourism and biological diversity. Examples include lands too steep for sustainable cultivation, commercial forestry or other human activities; areas of montane and elfin forest (due to soil type, poor quality or stunted timber, or inaccessibility); and other areas which are unique by virtue of their scenic, floral or faunal characteristics or their overall contribution to the natural heritage of the country.

The specific recommendations of Shanks and Putney (1979) for the allocation of state lands and some privately-owned lands to protected area status should be reviewed and updated by Forest and Park Service staff. This action has been suggested by numerous investigators since the Forest and Park System Plan, contained in the Shanks and Putney report, was first formulated. Although many of the parcels targeted in 1979 (both those that have long been private and those more recently "privatized") have already been cleared for cultivation or other purposes, substantial amounts of land remain undisturbed which could be considered for allocation along the lines of the Shanks and Putney recommendations. Priorities need to be established which assess high risk as opposed to less threatened areas.

As already noted in this chapter, since the mid-1980's the program of state land sales to private farmers has been improved through a coordinated approach by the

Forestry Division and the Lands and Surveys Division. The question which now needs to be addressed is whether there in fact remains any state land which is suitable for cultivation on a sustainable, long-term basis. In 1979, Shanks and Putney suggested that of 10,526 ha of unallocated Government land (see Table 3.2(5)), only 530 ha were suitable for release to private ownership. Presumably, all or most of this land has already been privatized in the interim eleven year period.

It is possible that Shanks and Putney (1979) underestimated the extent of state land that is suitable for agriculture, but if in fact no more land of this classification remains, or only very little, it will be necessary for future programs of land reform to focus primarily, or solely, on privately-owned estates that are under-utilized. There may be some remaining state land with potential for sustainable land use, but only if conditions which promote environmentally-sound agricultural practices are imposed on such use.

(2) Recommendations for land use control for specific zones *within* the forest reserve are now being developed by GOCD with the assistance of FAO. A Forest Management Plan will be prepared which gives balanced consideration to land capability restrictions and to the socio-economic as well as conservation choices confronting the nation. GOCD should adopt a Forest Management Plan after appropriate vetting of the document now in preparation and should be prepared to take steps to ensure its enforcement once it has been put in place.

(3) Given that a full "zoning" program for agricultural land is likely to be prohibitively expensive (see also Section 3.3), a limited program should be considered with the objective of identifying "Protected Forest" zones in which special management practices are required, e.g., agroforestry, contour planting, tree cropping, and terracing. Concurrent with such a policy is the need for public sector commitment to enforcing land use restrictions on private lands. Given the dismal history of such controls within the country's largest water catchment area (also its only Protected Forest), the prospects are not encouraging (see also Section 4).

## PRECEPTS ON SOCIAL FORESTRY \*

The term *social forestry* has been used to distinguish a new approach to the management of trees, which is different from the technically and commercially directed development that previously prevailed in the field. Commercial forestry deals with trees on a large scale, in monocrop operations, and without involvement of the people who live in and around the forests. Conventional approaches often appear to regard people as enemies rather than as partners in forest management and include no more local institutional development than assigning a few technicians and many forest guards.

Social forestry recognizes the need for associating local people closely with any forest management effort. In social forestry, trees are managed in association with other plants and animals, often in small or fragmented areas. Multiple uses not necessarily for market sales are emphasized, and management is done largely by the people living nearby and primarily for their benefit.

Users of forest resources are an ambiguous group even when the resources themselves are readily identifiable and delimitable. Not only do persons in the immediate area utilize the resources, but outsiders may use them as well. Therefore, voluntary user groups cannot be relied upon as a management institution. More authoritative institutions, such as local governments, are usually required to regulate outside as well as local resource use and to mobilize people's time and funds for improving the resource base.

Successful forestry management depends on the cooperation of the poorer strata in rural areas as well as the richer ones. Although local governments are often dominated by the more substantial elements of the community, they are more likely than central government agencies to produce a consensus on a resource management regime that is broadly perceived as fair and binding.

With appropriate technical guidance, locally elected bodies at the village level can provide effective institutional support for small social forestry schemes. However, simply assigning certain responsibilities to local government within administratively conceived and implemented social forestry programs is not the answer. Since the benefits from planting and protecting trees are relatively long-term, before local people will commit their time and effort to forest management, they will usually require unambiguous control over use rights and benefits.

The local government should therefore be given clear responsibility for the resources, and all or most of the immediate benefits from improved management should accrue to the community. If by doing this forests are preserved, soil erosion reduced, and the water cycle protected, there are obvious gains at the national level as well.

\* Source: Uphoff, 1986.

(4) More efficient land use practices need to be encouraged, for example, through extension efforts and land reform programs, as one means to minimize pressure on remaining natural areas. As discussed in

Section 3, many farmers could increase yields, and thus their incomes, through employment of more efficient cultivation techniques on lands already cleared. An expanded commitment to farmer education and exten-

sion is required, particularly if land use regulations for protected forests, or other protected "zones," were implemented and enforced.

(5) Substantial amounts of timber are wasted as a result of land clearing for agriculture and for timber harvesting as currently carried out by the island's mechanical logging operations (DTL and NET). Recommendations for the logging operations are discussed in the following sub-section; with respect to timber waste as a result of land clearing, a primary problem appears to be lack of coordination between those clearing the land and those who could utilize the felled trees, e.g., for lumber products, fuelwood, or charcoal. The Forestry Division and/or the Small Lumber Producers Group should take a lead in improving information exchange within this network of resource users (e.g., sawyers, charcoal producers, and farmers).

(6) More emphasis should be placed on promoting agroforestry and plantation forestry on private land. A study of agroforestry in the Marigot/Melville Hall area (Fehr, 1989) revealed that agroforestry was seldom practiced and its potential benefits rarely exploited to their full extent. A similar situation undoubtedly exists in many other parts of the country and could be improved by expansion of cooperative programs between the Divisions of Forestry and Agriculture, both housed within the Ministry of Agriculture (see also sidebar on Social Forestry).

At present, there is virtually no plantation forestry being practiced on private land despite the probable economic benefits of doing so in many areas (e.g., the west coast). An incentive program for plantation forestry on private land was developed by the Forestry Division, but approval for the program has not been sought (Prins, 1987).

#### **IMPROVEMENT OF FOREST HARVESTING PRACTICES**

As discussed elsewhere in this chapter, it is important that the operations of the country's two relatively large-scale and mech-

anized timber harvesters be better controlled. The Forest Management Plan, currently in formulation, will outline cutting and management prescriptions designed for sustainable forestry on forest reserves and unallocated state lands. Such regulations should be adopted by Government, and if, when implemented, they are not followed by commercial logging firms, such ventures should be terminated. In the interim, given that GOCD owns some 50 percent of the shares of Dominica Timbers Limited (DTL), one approach to improving harvesting and other forest management practices would be establishment of an independent board to monitor and regulate the operations of the country's industrial loggers (at present, DTL and NET).

On private lands, the provisions in existing legislation regulating the establishment of Protected Forests and control of land use practices in such areas, including timber harvesting, should be more widely employed by GOCD (see also recommendation number three in the preceding sub-section).

Finally, any forest management policy for Dominica should provide assistance for improving the output, efficiency and economic contribution of the country's small sawyers. They may account for as much as 65 percent of production (Prins, 1987); the logging systems they employ are generally more appropriate and sustainable than those of the "industrial" loggers; and, at least within the context of the Small Lumber Producers Group, the small sawyers have attempted to integrate forest resource conservation techniques with broader economic objectives. It is possible that equal or even greater economic as well as social benefits could be derived through a forestry policy which placed more emphasis on small-scale logging operations.

#### **COMMITMENT ON PARK OBJECTIVES**

In Morne Trois Pitons National Park, Dominica's only large and terrestrial national park site, competing demands for use of the resource base have intensified in recent years, e.g., for hydropower development, geothermal power development, power transmission, road

development, and, in some locations, cultivation. Such demands are often in direct conflict with the more traditional objectives of park land use, namely, conservation of wildlife, enhancement of biodiversity, and passive "wilderness" recreation.

At present, no policy directive or consensus appears to have been developed on what is an appropriate balance between these competing interests. The larger issue of defining the kind of park system desired by the majority of Dominicans has not been addressed at the policy-making levels of Government. For example, should additional large-scale energy projects or other major developments be permitted within park boundaries? If such activities are approved, should environmental impact studies be required as a condition of approval, as well as the submission of a plan for environmental impact mitigation measures? Alternatively, should such activities be prohibited in order to maintain national parks in an environmentally pristine condition?

In light of the not-so-gradual chipping away at park resources that has occurred in recent years and the variety of projects currently under consideration, such an attempt to arrive at a consensus on *prioritizing* park objectives is particularly important. There is no indication that the recently formulated Park Management Plan for the Morne Trois Pitons National Park, which covers the years 1990-2000 (Scheele, 1989a), included an opportunity for public or community input, particularly on the subject of defining long-term park objectives. In any event, the objectives described for the plan are those of the Division of Forestry and Wildlife, which, in turn, advises Government on policy. They do not necessarily reflect any clear consensual commitment on the part of GOCD on priority objectives for park development in Dominica or on the ultimate direction for future development of the Morne Trois Pitons National Park, in particular.

## 2.2 WILDLIFE

### 2.2.1 Overview

Dominica is host to the most diverse assemblage of wildlife remaining in the smaller Eastern Caribbean islands, with birds and bats particularly well represented. Although no one document covers all the major invertebrate and vertebrate groups, there is a substantial body of literature which resulted in part from the Bredin-Archbold biological surveys conducted in the 1960's (e.g., Chace and Hobbs, 1969; Jones and Schwartz, 1967; Schwartz and Jones, 1967), plus several more recent reviews (Evans, 1986a, 1988, 1989; Faaborg and Arendt, 1985; Swank and Julien, 1975). For this section of the Profile, common usage has been employed, and the term "wildlife" includes vertebrates and terrestrial and aquatic decapod crustaceans -- the larger, more familiar animals in the island's ecosystems. A brief discussion of each group follows, stressing diversity within the group, species currently recognized as unique to Dominica, and human utilization.

### DECAPOD CRUSTACEANS

The decapod fauna of Dominica includes eleven species of freshwater shrimp and twenty species of freshwater or terrestrial to semi-terrestrial crabs (Swank and Julien, 1975). There are no species endemic to Dominica, and most are widely distributed in the Caribbean (Chace and Hobbs, 1969). Except for one crab, the larvae of these animals require some salinity to complete development (varying from estuarine conditions to full-strength seawater).

Some of the most remarkable West Indian biological phenomena are a result of the seasonal mass migrations of several land crab species, from dispersed, inland populations to dense aggregations at the shore where they release their larvae *en masse*. For these species, in particular, recruitment of larvae (and therefore genetic exchange) from other islands is likely, so Dominican populations are probably not genetically distinct. If catastrophic destruction of shrimp or crab populations in Dominica occurred, those species with

abundant marine larvae would likely recover most rapidly. For species whose link to the sea is weaker or broken -- i.e., larval development is completed in fresh or low-salinity water -- local adaptation is possible but recovery from extirpation would be slower.

The twenty crab species are ecologically diverse but most occur in coastal habitats. Six are typically found in or near the wave-splash zone on marine shores, three occur in reduced-salinity waters of partially blocked river mouths, and six more occupy low-elevation swamps and mud flats. Two occur in wet areas further into the interior, including stream margins and seepage sites, and three occur away from surface water, but avoid desiccation by taking refuge under stones or in damp soil (Chace and Hobbs, 1969). Three of the larger crabs are commonly sought as food: the freshwater crab ("Ciriques"), *Guinotia dentata*, the white crab ("Corbo"), *Cardisoma guanhumi*, and the black crab, *Gecarcinus ruficola* (Zamore, n.d.).

Shrimp are common in Dominican streams, distributed from cascading mountain reaches to slowly flowing river mouths. Several of the larger species are used as food; three species -- *Atya innocous*, *A. scabra*, and *Macrobrachium carcinus* -- are preferred (Zamore, n.d.).

## FISH

The freshwater fish fauna of the Lesser Antilles is not well studied, but apparently includes no species which occur exclusively in freshwater (Bauchot, 1959). All the known families -- Poeciliidae, Anguillidae, Gobiidae, Eleotridae, Mugilidae, Gerridae, Centropomidae, and Carangidae -- can move between fresh and salt water, and some spawn at sea. Although the CEP team could identify no published species list for Dominica, a recent collection made by a team from the University of Bielefeld is housed at the Forestry Division in Roseau. Freshwater fish, particularly the mountain mullet (*Agonostomus*

*monticola*), are a traditional food resource (Brown, 1945).

## AMPHIBIANS

All Antillean amphibians are frogs, and two Lesser Antillean endemics -- a small tree frog, *Eleutherodactylus martinicensis*, and the large "mountain chicken" or "crapaud," *Leptodactylus fallax* -- occur on Dominica. The tree frog is widespread and abundant in moist habitats (Bullock and Evans, 1990). Populations of the crapaud support a seasonally restricted, partly commercial harvest for food. In its natural range, the crapaud now appears confined to Dominica and Montserrat as some combination of over-harvesting, mongoose predation and habitat modification is likely to be responsible for eliminating it in Guadeloupe, St. Kitts and St. Lucia in historic time. The main populations remain on Dominica (Rainey, *et al.*, 1987).

## REPTILES

The reptile fauna is more diverse -- consisting of nine or ten lizards (*Sphaerodactylus microlepis* has been recorded although only on the basis of one specimen collected over 25 years ago), five snakes and one tortoise (Bullock and Evans, 1990; Rainey, *et al.*, 1987). Included is *Gymnophthalmus* sp., a small lizard (previously unrecorded) which was observed but not collected in February 1986 (Rainey, *et al.*, 1987) and has not been observed since (probably an introduction). Of the nine or ten lizard species, two are endemic. Four of the snakes are recognized as Lesser Antillean endemics. The iguana, *Iguana delicatissima*, is a Lesser Antillean endemic, limited to a few islands and much reduced in numbers on all of them. The tortoise (*Geochelone carbonaria*), presumed to be an aboriginal introduction on several islands in the region (Corke, 1990), has been observed in the wild in Dominica (pers. commun., P. Evans, Dominica Multiple Land Use Proj., 1990).

Table 2.2(1). Terrestrial reptiles and amphibians recorded in Dominica.

**REPTILES**

**Testudines (Turtles)**

*Geochelone carbonaria* Introduced by man

**Sauria (Lizards)**

*Sphaerodactylus vincenti* Native and endemic of West Indies

*Sphaerodactylus microlepis* Native and endemic of West Indies

*Sphaerodactylus fantasticus* Native and endemic of West Indies

*Thecadactylus rapicauda* Native but also native in Trinidad/  
Tobago and/or the South/Central  
American mainland

*Hemidactylus mabouia* Introduced by man

*Iguana delicatissima* Native and endemic of West Indies

*Anolis oculatus* Dominican endemic

*Mabuya mabouya* Native but also native in Trinidad/  
Tobago and/or the South/Central  
American mainland

*Ameiva fuscata* Dominican endemic

*Gymnophthalmus pleei* Native and endemic of West Indies  
Probably introduced by man

**Serpentes (Snakes)**

*Typhlops dominicana* Lesser Antillean endemic

*Boa constrictor* Lesser Antillean endemic

*Aisophis antillensis* Lesser Antillean endemic

*Liophis juliae* Lesser Antillean endemic

*Clelia clelia* Native but also native in Trinidad/  
Tobago and/or the South/Central  
American mainland

**AMPHIBIA (Frogs)**

*Eleutherodactylus martinicensis* Native and endemic of West Indies

*Leptodactylus fallax* Lesser Antillean endemic

Source: Bullock and Evans, 1990; Rainey, et al., 1987.

**BIRDS**

Dominica's bird fauna is the most diverse in the Lesser Antilles, and there are several recent studies of habitat, distribution and conservation status (Evans, 1986a, 1989; Faaborg and Arendt, 1985; Swank and Julien, 1975). Evans (pers. commun., 1990) presently reports 166 species, many of which are migratory. Fifty-nine species breed on the island. The best known are the two endemic

parrots, the imperial ("Sisserou"), *Amazona imperialis*, and the red-necked ("Jacquot"), *Amazona arausiaca*. Based on field work between 1982 and 1987, Evans (1988) estimated that the total populations for these endangered species reached levels as low as about 60 imperials and 200 red-necks. However, both have shown signs of recovery; estimates for 1990 stand at about 80 imperials and 300-400 red-necks, but the analysis is not yet complete (pers. commun., P. Evans, 1990;

see also Butler, 1989). Figures 2.2(1) and 2.2(2) illustrate the decline in the distribution of the two parrots since 1950.

Other species of limited distribution (Dominica and other Antillean islands) are the endangered black-capped petrel (*Pterodroma hasitata*), once thought extinct on Dominica but recently captured offshore and observed flying inland at dusk (Evans, 1986a, 1989), the blue-headed hummingbird (*Cyanophaea bicolor*), the plumbeous warbler (*Dendroica plumbea*), the scaly-breasted thrasher (*Margarops fuscus*), the trembler (*Cinclocerthia ruficauda*), and the forest thrush (*Cichlherminia herminieri*). As on other Eastern Caribbean islands, there is a hunting season (from the beginning of September to the end of February) for pigeons, doves and a number of other birds.

## MAMMALS

There are twelve species of native mammals on Dominica, all bats, the highest diversity in the Lesser Antilles (Baker and Genoways, 1978; Evans, 1986a; Rainey, *et al.*, 1987) (see Table 2.2(2)). One of these, *Eptesicus fuscus*, was discovered in 1982 (Hill and Evans, 1985). With the exception of the agouti, the wild terrestrial mammals (six species, also including opossum, ship and Norway rats, house mouse, and pig) were introduced in historic time. The agouti is generally considered to be an introduction by Amerindians in early historic times. The opossum, agouti, and pig are all hunted for food. The bats include one endemic species, *Myotis dominicensis*, and three genera endemic to the Antilles, *Monophyllus*, *Ardops*, and *Brachyphylla*. Nectar- and fruit-eating bats pollinate and disperse the seeds of a significant number of tropical trees and shrubs, including several economically important crops.

Table 2.2(2). Bats recorded from Dominica (1986).

SPECIES	REFERENCE	ZOOGEOGRAPHICAL STATUS
<i>Noctilio leporinus</i>	1,2	Caribbean and mainland So./Central America
<i>Pteronotus davyi</i>	1,2	Lesser Antilles and mainland So. America
<i>Monophyllus plethodon</i>	1,2	Antillean endemic (now confined to Lesser Antilles)
<i>Sturnira Illium</i>	1,3	Lesser Antilles and mainland So. America
<i>Artibeus jamaicensis</i>	1,3	Caribbean and mainland So./Central America
<i>Ardops nichollsi</i>	1,3	Lesser Antillean endemic
<i>Brachyphylla cavernarum</i>	1,3	Antillean endemic
<i>Natalus stramineus</i>	1,3	Caribbean and mainland So./Central America
<i>Myotis dominicensis</i>	1,3	Dominican endemic
<i>Eptesicus fuscus</i>	2,3	Caribbean and mainland America
<i>Tadarida brasiliensis</i>	1,3	Caribbean and mainland America
<i>Molossus molossus</i>	1,3	Caribbean and mainland So. Central America

**Sources:**

1 = Baker and Genoways, 1978

2 = Hill and Evans, 1985

3 = Evans, 1985

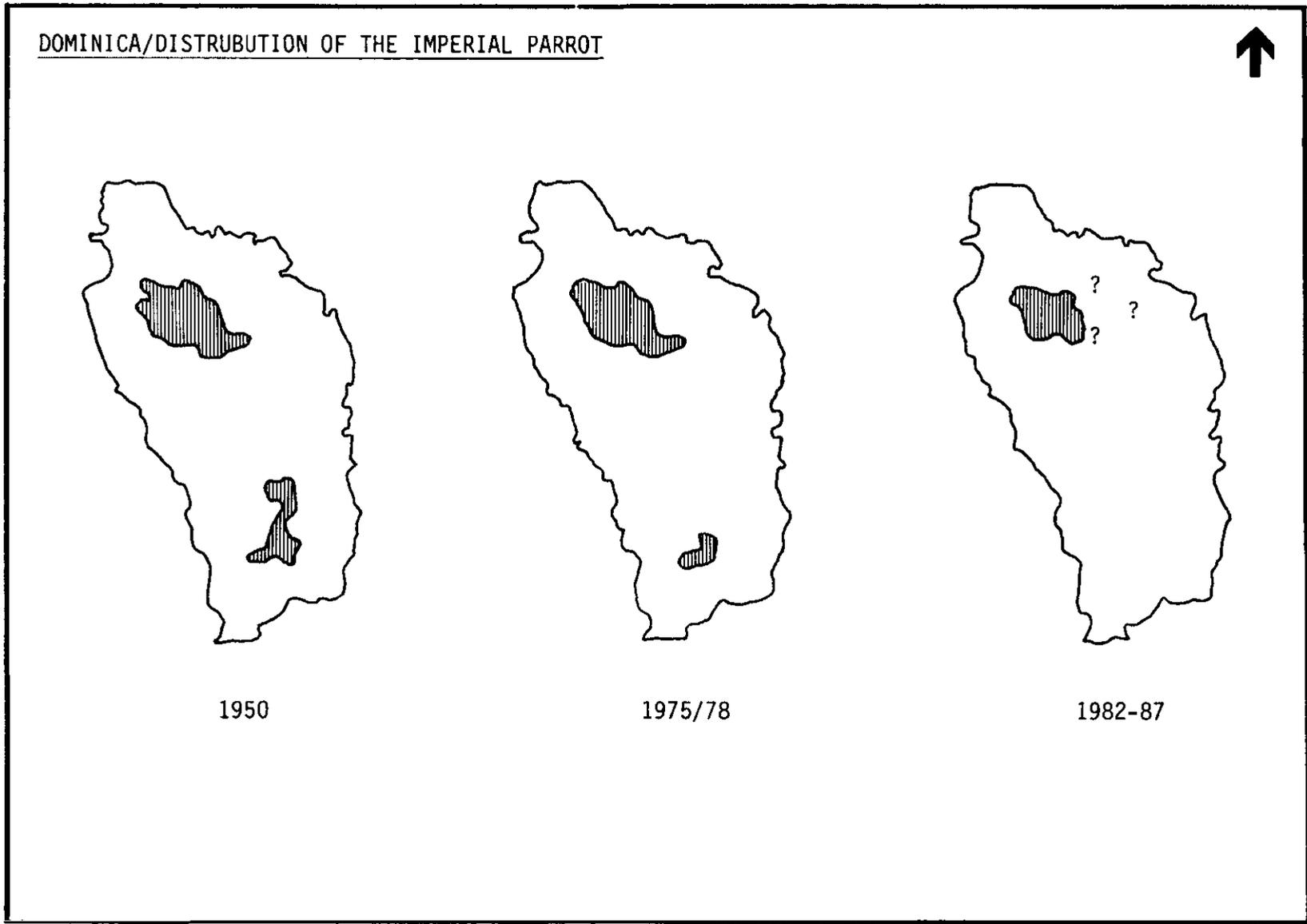


Figure 2.2(1). Distribution of the imperial parrot ("Sisserou"), *Amazona imperialis* (source: Evans, 1988).

## WILDLIFE MANAGEMENT AND INSTITUTIONS

The Division of Forestry and Wildlife is responsible for wildlife management and protection in the country (see also Section 11). A key responsibility is enforcement of the Forestry and Wildlife Act and its provisions for a closed hunting season, which extends from March 1 through August 31 of each year.

In light of their endangered status, the conservation of the country's two endemic parrot species is one of the Division's priority concerns. A parrot lookout has been erected in the Syndicate Estate area, and some attempts have been made to acquire private lands, comprising prime parrot habitat, for protection of the species. With support from the International Council for Bird Preservation (ICBP) and the RARE Center for Tropical Bird Preservation, approximately 200 ac in the Dominica Fruit Syndicate/Dyer Estate area have been acquired for a parrot reserve. This particular program, known locally as Project Sisserou, was finalized in August 1989 (pers. commun., F. Gregoire, Director, Forestry and Wildlife Division, 1990), although it is recognized by Forestry officials that continued efforts aimed at parrot protection and wildlife education must be strengthened (Christian, A., 1989).

The legislation which pertains most directly to wildlife management is the Forestry and Wildlife Act of 1976, as amended (see also Section 11). It focuses on the protection of wild fauna and on management of forests and forest reserves for the protection of wildlife. Maximum penalties for violation of the Act presently stand at EC\$5,000 and three years imprisonment for offenses related to parrots and EC\$400 and/or three months in jail for violations pertaining to other species. The Act also authorizes the creation of wildlife reserves.

Dominica has not yet become party to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Since it came into force in 1975, CITES has maintained a global system of import and export controls to ensure that international trade does not threaten the world's

wild plants and animals. It should be noted that a nation's membership in CITES does not limit domestic use of CITES-listed species. For species which play a significant role in *local* subsistence and commercial markets, a CITES member country is obligated only to ensure that products from such species do not enter *international* trade. Although it offers imperfect protection to endangered species, the treaty does contribute to the goal of bringing wildlife exploitation down to levels that wild populations may be able to sustain. Of the OECS countries, only St. Lucia and St. Vincent and the Grenadines have joined CITES; in view of the endangered status of its two endemic parrots, Dominica should be a member of CITES, and preliminary arrangements should be given necessary follow-up.

### 2.2.2 Problems and Issues

#### HABITAT REDUCTION AND ALTERATION

Wildlife habitat reduction, closely associated with deforestation issues, has resulted primarily from the expansion of agriculture (especially banana cultivation) into forest lands (see Section 2.1.2 above).

At present, information about home range requirements and minimum viable population sizes for rain forest species is limited. Nevertheless, it seems likely that gazetted forest reserves and parks, *if maintained largely as native forest*, include sufficient area to prevent the extinction of smaller species. Other species, however, may require larger areas for survival. A recent research report (Rainey, *et al.*, 1987) noted that in light of their reduced numbers, low productive potential, and probable large range requirements, it is difficult to be sanguine about the survival potential of the large endangered parrots, particularly the imperial parrot, *if* reduction of native forest area continues.

However, Dominica's remaining forest reserves are not presently managed to

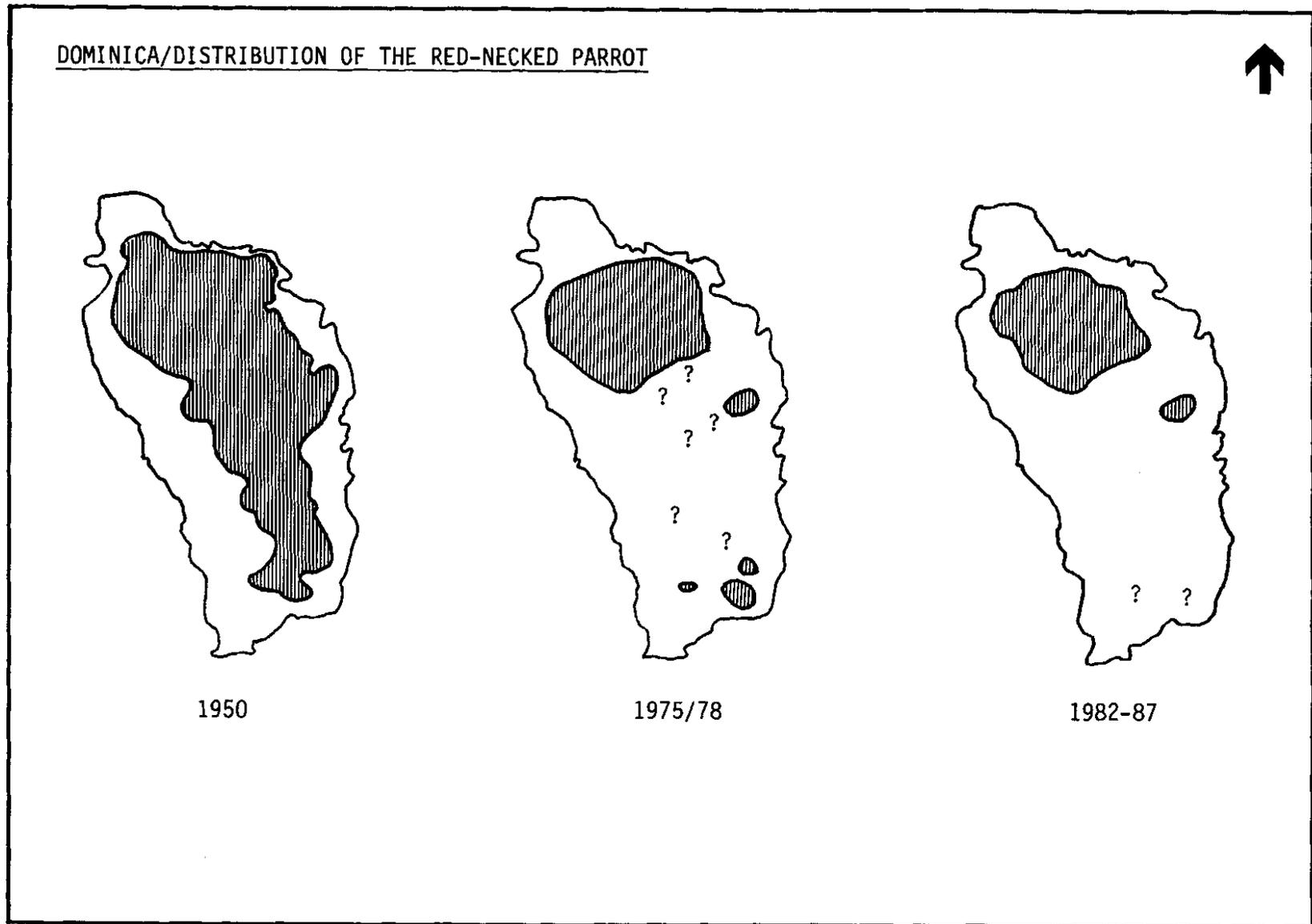


Figure 2.2(2). Distribution of the red-necked parrot ("Jacquot"), *Amazona arausiaca* (source: Evans, 1988).

## THE DOMINICA MULTIPLE LAND USE PROJECT

A healthy ecosystem is comprised of a variety of sustainable plant and animal communities. Since 1982, a long-term research effort, the Dominica Multiple Land Use Project, has been seeking to identify information which will help Dominica maintain such diversity and richness by specifically studying the effects on flora and fauna of different forms of land and resource use. Under the direction of Dr. Peter G.H. Evans, an Oxford University-based population geneticist with a particular interest in conservation biology, the project has conducted some of the most intensive field research on the island in recent years. The fact that this research is being undertaken over a relatively long period increases its value to the country.

In each natural habitat selected as a study site, the project has determined the diversity of species, their densities, and the species composition for birds, mammals, reptiles, butterflies, and woody plants. The same data were then collected from adjacent areas that have been modified through logging, agriculture, or by natural disturbance (e.g., hurricanes). Some of the study's main conclusions as of 1989 include (Evans, 1989):

- The intercropping of banana and citrus is compatible with conserving native animals if certain rules are observed. Conservation interests are best served if the two crops are grown together at not too high densities and in relatively long, narrow plantations. This creates a high ratio of edge to center and thereby benefits a wider array of animal species. Additionally, the great majority of native species of mammals and forest birds could be conserved through the maintenance of forested corridors of at least 10 m width between plantations. A few species, however, namely those that occur at low densities (e.g., the two parrots and the forest thrush), do require large areas of intact forest for survival.

- Coconuts, coffee, and cocoa can also be grown without great harm to wildlife as long as these tree crops are in mixed plantings with other species such as mango, citrus, and pawpaw and have undisturbed forest tracts nearby. Root crops and shrubs such as guava and bay leaf support little wildlife; thus, they are best cultivated beneath or alongside trees.

- Only a few species favor tree crops such as banana, citrus, and coconut when cultivated by themselves. However, in seasonally dry areas an accumulation of leaf litter in plantations (particularly coconut) will support a reasonable biomass of reptiles and a variety of butterfly species. Plantations with fruit crops attract bats which cause some damage, but this can be reduced by mixing the stands with non-food plants.

preserve only native plant species; exotics have been and are being planted, while stands of native species, notably gommier, may be degrading, at least in some locations (see Section 2.1.2 above). Even-aged plantations of exotic timber trees typically are almost free of native wildlife; even mixed tree crops constitute better habitat. For smaller endemic rain forest species, the island's existing forest reserves or parks likely assure species survival, so long as substantial tracts of native forest are retained. But to the extent that native forest within the reserves is replaced by exotic

trees, this projection becomes more tenuous. On the basis of current reforestation patterns, some of the smaller faunal species, in addition to the parrots, are under threat.

Rain forest areas are not the only important natural habitat requiring protection. Coastal woodlands and swamp are now represented by only isolated patches. The more important of the island's wetlands (e.g., Cabrits Swamp, Indian River Flats, Canefield Pool, and North Coast Swamps) form feeding grounds for numerous species of migrating

birds including waders, egrets, herons, waterfowl, and North American passerines. The coastal woodlands are the most important habitat for reptiles. They also support most of the island's 53 butterflies and many birds and bats (Evans, 1989).

The ongoing investigations of the Dominica Multiple Land Use Project will help determine habitat requirements for various species, both on agricultural lands and for various kinds of natural areas. For example, the project's ecological studies have revealed that mixed plantations of bananas and citrus as widely practiced in the country are probably the best form of land use for animal and plant communities as long as there are corridors of forest between plantations and a sufficiently large area of forest to preserve particular species (Evans, 1986b).

A significant expansion of cultivation and/or environmentally-harmful forestry practices within a given watershed also have an adverse effect on stream habitat through soil erosion, stream bed scour, sedimentation, and increases in water flow variability. Low flow periods will be lower and peaks higher. Increased peak discharges will carry more sediment, and stream beds will be more heavily scoured. Increased amounts of fine sediment released from eroding slopes may fill the interstices among pebbles, cobbles, and boulders and create a habitat less favorable to animals which rely on these spaces as a primary refuge under difficult conditions.

During periods of low flow, as in the dry season when aquatic animals may concentrate in small pond areas, removing the forest canopy and exposing pools to sunlight can significantly warm the water and reduce available oxygen. Sunlight and additional nutrients (from soil erosion and fertilizer) also enhance algal growth, which can deplete oxygen at night in small pools with low-flow rates. Decomposing organic matter in the water also consumes oxygen. Reductions in available oxygen can either stress or kill sensitive organisms and contribute to changing the species composition of aquatic communities. These concerns, however, do not apply in those parts of Dominica where elevated dissolved oxygen levels are maintained as a con-

sequence of the freely-flowing, rapid movement of water in streams.

## AGROCHEMICAL POLLUTION

Qualitative and quantitative observations in and around banana cultivations reveal no marked population declines in common terrestrial vertebrates (birds, bats and one amphibian) that might be attributable to pesticide contamination (see Rainey, *et al.*, 1987). However, isolated instances of bird mortality associated with agrochemicals applied during planting have been reported. Furadan, a nematocide used in bananas, has caused many bird kills in the U.S. and may present a similar risk in Dominica.

Water pollutants, including pesticides, have caused fish kills in local streams and rivers, but information is available on only isolated events. While there is cause for concern, if only from a human water quality perspective, the scale of the problem is unclear. Native shrimp spanning a range of ages are present in small streams running through banana cultivations. Since these species are thought to be fairly sensitive to several of the pesticides used, their presence suggests contamination, at least in these upland areas, is episodic rather than continuous.

Fish kills also provide a warning that expansion of aquaculture may be restricted by pesticides in run-off. More closely monitored and controlled agricultural practices (e.g., maintenance of buffer strips of native vegetation along stream courses) would benefit aquaculture, water quality for human use, and native fauna.

## ILLEGAL HUNTING AND LIVE CAPTURE OF WILDLIFE

Despite legal protection and a maximum penalty of EC\$5,000 and three years imprisonment, the hunting and capture of parrots continues to pose a threat due to problems associated with enforcement. However, only one to three birds per year are estimated to be hunted or captured (Johnson, 1988).

Two native reptiles, the mountain chicken, or crapaud, and the edible iguana are under pressure as preferred food sources. Iguana hunting has been illegal since 1976 but is still practiced, while crapaud hunting is restricted to the open season. Neither species is threatened with extinction, but the iguana is uncommon and vulnerable (Evans, 1989).

### 2.2.3 Policy Recommendations

#### HABITAT REDUCTION AND ALTERATION

Habitat reduction and alteration are the direct result of problems associated with agricultural expansion and deforestation, issues which are discussed in some detail elsewhere in the Profile. Specific recommendations pertaining to these issues are provided in Sections 2.1.3 and 3.3.

On the basis of studies for the Dominica Multiple Land Use Project, Evans (1989) recommends that specific areas of importance to wildlife should be protected as native forest habitat including the slopes of Morne Diablotin -- both reserved and non-reserved sections -- and various wetland and coastal woodland areas (some wetlands might be designated as protected areas under the RAMSAR convention). Similar recommendations have been made in proposals for the establishment of a national park at Morne Diablotin (ICBP, 1990), and GOCD is encouraged to explore the feasibility of these recommendations, or some subset which includes the most critical areas for the preservation of wildlife and biodiversity.

Additional research (e.g., distribution and habitat studies) needs to be undertaken for wildlife, with priority given to those that are endemic, locally or internationally endangered or threatened, migratory species, or those species that are legally hunted. Population monitoring should be undertaken for critical species.

Consideration should be given to the planting of tree species that are particularly

important to wildlife in selectively harvested areas (pers. commun., A. Christian, Forest Officer, 1990). The findings of the Dominica Multiple Land Use Project should be communicated to extension agents, farmers, and land use planners in order to emphasize the importance of wildlife and biodiversity objectives.

#### CHEMICAL POLLUTION

In addition to recommendations regarding integrated pest management as found in Section 3 of the Profile, it is increasingly important that the Forestry and Wildlife Division develop a capacity to monitor wildlife pollutant impacts. The United States Environmental Protection Agency forms for recording fish kills could be adapted for similar purposes on Dominica and distributed to appropriate GOCD personnel. Since the public media (particularly radio) have disseminated information about fish kills in the past, similar cooperation could be sought and coordinated with official Government record-keeping efforts. Descriptive information, even if unconfirmed by site visits, would provide a perspective on the frequency and distribution of events.

#### HUNTING AND TRAPPING

According to the Forest Officer responsible for wildlife protection in the Forestry Division, the problem of illegal hunting and live capture requires further increases in penalties (pers. commun., A. Christian, 1990). Only for parrots have penalties been sufficiently raised.

Several Division staff feel that additional manpower, particularly for weekend and night-time patrols, as well as equipment (e.g., radios) would help improve enforcement capability. They also suggest that efforts be made to organize the country's hunters into a formal association. In fact, a meeting with this objective in mind was held in May of 1990. Such an organization could assist in efforts to monitor illegal hunting and could thereby contribute to enforcement efforts.

Additionally, this group of resource users could provide useful information on breeding and other behavioral patterns required for better wildlife management. At present, for example, only one open season exists for all hunted species, and there is no limit on the number of animals that can be taken during this period. In some cases this season corresponds with a particular animal's breeding period. The Director of Forestry and Wildlife (pers. commun., F. Gregoire, 1990) has pointed out that little is known about the carrying capacity of certain species for hunting; but more data, as well as greater

enforcement capability, are required before different hunting seasons, bag limits, and other management systems could be practically established and subsequently enforced. A hunters association might provide assistance to Forestry personnel in all of these efforts.

Finally, a proposal for Dominica to join CITES has been supported by the Forestry Division since 1980, an initiative also endorsed more recently by several consultants and researchers (Butler, 1989; Johnson, 1988; Evans, 1988, 1989, 1990; and Lausche, 1986).

## SECTION 3 AGRICULTURE

### 3.1 OVERVIEW

Dominica, more than most other countries in the Eastern Caribbean, depends heavily upon agriculture. In 1978, it accounted for 42 percent of the total gross domestic product (GDP), forming the single most important sector of Dominica's economy. This percentage declined immediately after the hurricanes David and Allen in 1979 and 1980, which destroyed crops and badly damaged houses, factories, roads and natural vegetation. By mid-decade agriculture had recovered from its temporary decline and accounted for 30 percent of GDP and 55 percent of export earnings, and occupied 60 percent of the labor force. Agriculture's contribution to GDP has remained stable at about 30 percent in more recent years, 29.3 percent in 1987 (GOCD, 1988b) and 30.9 percent in 1988 (CDB, 1988).

The history of Dominica's agriculture has been very much one of reliance upon single crops. The first was coffee, grown by the French followed by English settlers during the late seventeenth and early eighteenth centuries. Sugar increased in prominence toward the end of the eighteenth century and through the nineteenth century whenever coffee suffered disease outbreaks. However, with the decline of cheap labor after the abolition of slavery near the end of the nineteenth century -- upon which sugar estates were then dependent -- agricultural production shifted to cocoa followed by limes. By 1920, Dominica was the world's largest producer of limes, but disease combined with changing market forces caused a slump in the industry. There followed a period of stagnation for agriculture which lasted until about 1960, despite a short-lived boom in vanilla growing during the Second World War when supplies to the UK from the Far East were cut off. Over this period, bananas were increasingly grown and were exported to Great Britain as early as the 1930's. During the mid-1950's, a contractual arrangement with Geest Industries guaranteed purchase of bananas on a fixed price basis, and the modern era of banana growing began.

Many of the environmental problems that Dominica faces today are related to this historic emphasis on one or two crops. Dominica's natural vegetation is disappearing at an accelerating rate as land-hungry farmers clear forests for agriculture, at present primarily for bananas. Yet much of this land is quite unsuitable for such uses, while at the same time there are large areas of cultivatable land elsewhere that are under-utilized. One result has been increasing pressures on wildlife, particularly species which require large areas of primary forest to survive such as the nation's two endemic parrots. Farming on steep slopes and the clearance of trees adjacent to watercourses or which form wind-breaks have also increased soil erosion and nutrient loss through run-off during heavy rains. Although many of these problems might be addressed through improved soil conservation education programs for small farmers, many are also the result of socio-economic factors beyond the control of individual farmers. An economic review of the agricultural sector is therefore pertinent to any discussion of the environmental problems facing Dominica.

#### 3.1.1 Primary Crops

As also discussed in Section 1.3.3, attempts are being made by Government to diversify the Dominican agricultural sector (see Table 3.1(1)). The following discussion focuses on the principal crops currently cultivated in Dominica.

#### BANANAS

The dominant agricultural crop in Dominica is bananas, accounting for 70 percent of total exports and 40 percent of the total acreage under cultivation (see Figures 3.1(1) - 3.1(3)). In 1988 bananas accounted for just under EC\$100 million in export

Table 3.1(1). Dominica agricultural production, 1987.

Crop	Tonnage	% Total	Value EC\$'000	% Total
Banana	67,725	49.31	30,897	30.84
Root crops	29,597	21.55	33,637	32.82
Citrus	25,105	18.28	12,779	12.76
Vegetables	4,507	3.28	10,058	10.04
Mango	3,821	2.78	5,234	5.22
Coconut	2,820	2.05	1,975	1.97
Plantain	2,122	1.55	841	0.84
Cocoa	474	0.35	1,292	1.29
Coffee	434	0.32	1,456	1.45
Avocado	263	0.19	229	0.23
Ginger	203	0.15	418	0.42
Breadfruit	191	0.14	157	0.16
Cut flowers	44	0.03	197	0.20
Bay leaf	30	0.02	820	0.82
Spices	16	0.01	179	0.20

Source: GOCD, 1988b.

earnings, far ahead of the second export earner (soap products) with just over EC\$24 million in export income (see Section 1.3.3).

About 12,000 of the 22,000 people employed in the agricultural sector grow bananas. Banana growing has been popular with farmers for three main reasons: (1) the assurance of a steady income since banana plants bear fruit year round; (2) existence of a guaranteed market to the United Kingdom through Geest Industries, which visits the Windward Islands every week to collect for shipment all bananas of an acceptable standard; and (3) assistance provided to the growers by the Dominica Banana Marketing Corporation, e.g., provision of fertilizers and pesticides, coordination of packaging, and negotiation of banana marketing agreements.

During the 1970's, Dominican GDP declined due to a general worldwide economic recession and high energy prices. This decline particularly occurred within the agricultural

and manufacturing sectors, with a steady fall in the production of export crops such as bananas. However, the 1980's has seen a recovery in the banana industry due to a combination of factors:

- improved banana prices helped by better arrangements provided by the Dominica Banana Marketing Corporation;
- more favorable exchange rates;
- and improved production and quality of bananas resulting from better husbandry and packaging.

Despite these improvements, the banana industry is not without its problems. There have been uncertainties regarding the loss of preferential market arrangements with the UK after the Unitary European Market

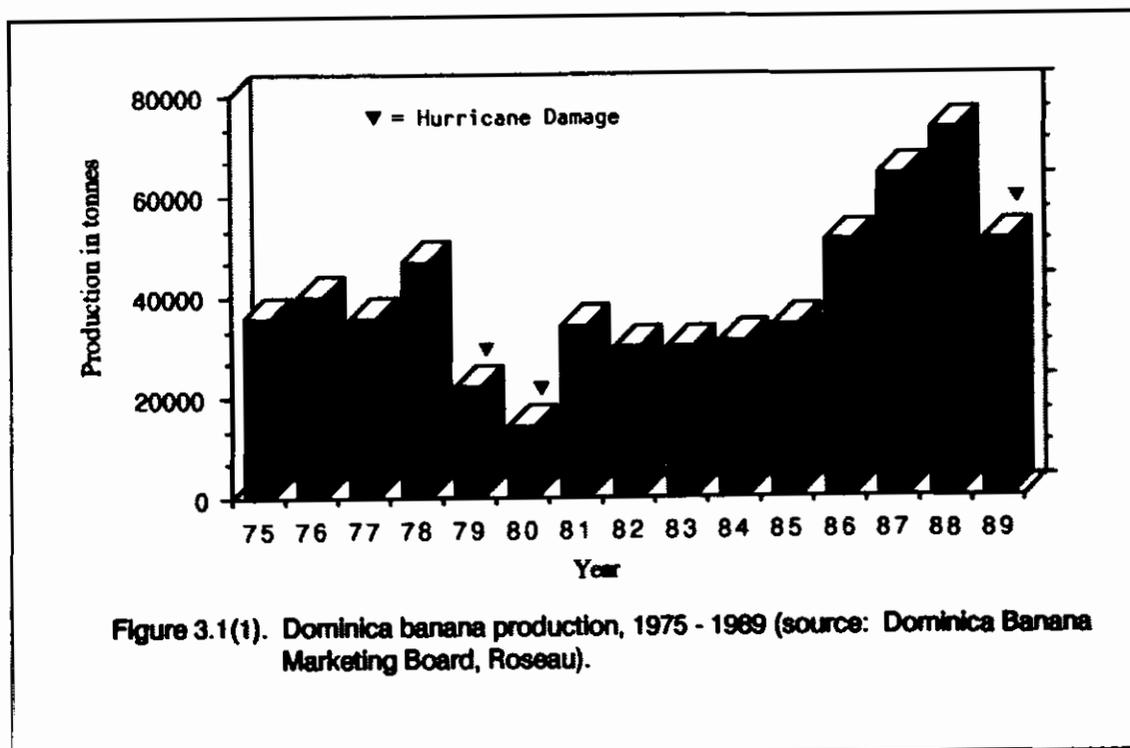


Figure 3.1(1). Dominica banana production, 1975 - 1989 (source: Dominica Banana Marketing Board, Roseau).

comes into being in 1992. Although assurances have been made that some protection will be offered (in 1989 the Windward Islands had a 52 percent market share), this is likely to depend upon whether the countries can produce fruit of a more stable high quality. Fruit of variable quality has been a continued problem for Dominica, and production fell in 1989 by 10 percent, resulting in Dominica dropping to third place, below St. Lucia and St. Vincent, with a 20 percent share (DBMC, 1990a). In September 1989, Hurricane Hugo devastated the banana industry, resulting in a 76 percent loss of production for the month. The damages sustained were as high as 100 percent in some areas, particularly in the north, northeast and eastern districts. The hurricane reduced annual production by 30 percent compared with 1988 (DBMC, 1990a).

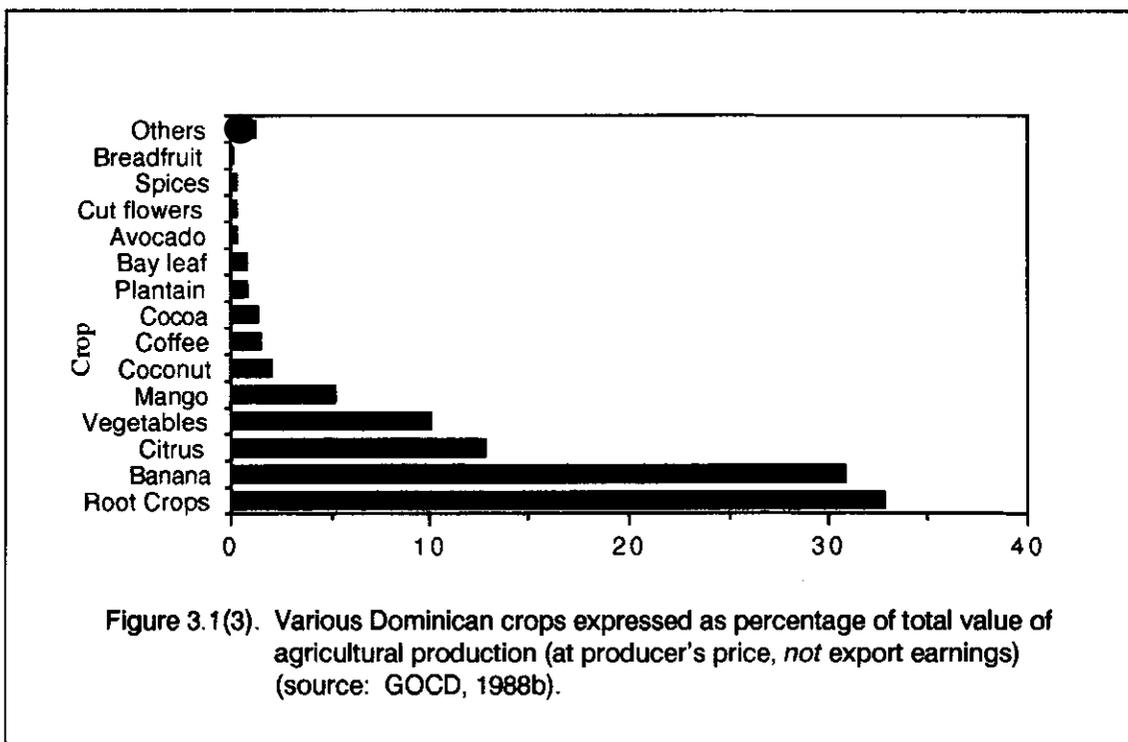
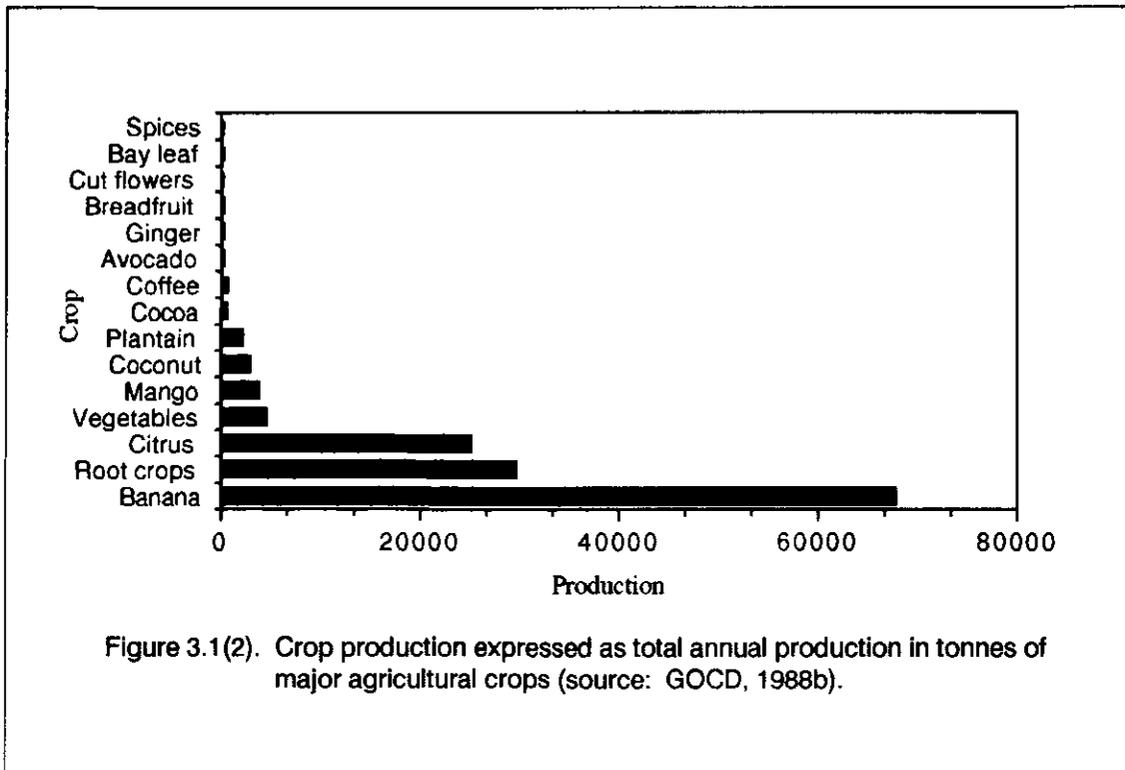
### COCONUTS

Coconuts and derived products such as soaps, edible oils and coconut meal are an important agricultural crop. Although comprising only two percent of the total agricultural output, together with their products, coconuts account for about 19 per cent by value

of total domestic exports (GOCD, 1988b). In 1982, before bananas assumed their recent importance, coconut products accounted for 44 percent of domestic exports (Mendelsohn, 1983; Evans, 1986b). Today coconut products, primarily soap, are still the second largest contributor to export earnings. At present, Dominica Coconut Products Ltd., in accordance with the CARICOM Oils and Fats Agreement, ensures the purchase of quantities of coconuts from the grower at a guaranteed price.

### CITRUS FRUIT AND OTHER TREE CROPS

Grapefruits, limes and oranges are important in domestic production, accounting for a combined 18 percent by weight and 13 percent by value of agricultural output (see Figures 1.3(2) and 1.3(3)). The cultivation of grapefruits and oranges has increased since World War Two, although production has more recently come into competition with fruit grown by South Africa and Israel. Dominica was once the largest lime producer in the world, but in the first half of the present century it was struck by disease and never re-



covered, its place being taken by synthetic juices. Since 1984, the European Development Fund has sponsored a rehabilitation program in an attempt to increase the amount of land planted with limes. Other high quality tree crops selected include other citrus such as oranges and tangerines, mangoes, and avocados. Although these account for less than ten percent of the total value of agricultural output (GOCD, 1988b), they are becoming of increasing importance as export crops, both within and outside the region.

## COFFEE

Coffee was introduced to Dominica by French settlers in the eighteenth century and was grown on a large scale until toward the end of the nineteenth century. Since then it has declined steadily, particularly on the large estates, due to a combination of bad agricultural practices, low prices and the coffee leaf miner pest (Honychurch, 1984). In the early 1950's and again in the mid-1970's, production increased temporarily as a result of generally high world-market prices. However, production fell drastically after the hurricanes of 1979-80, and until very recently virtually all coffee consumed locally was imported from the United Kingdom (see also Figures 1.3(2) and 1.3(3)). A two-phase coffee development project has been funded by BDD (phase two now in operation), with four hundred acres of land scheduled for coffee production. As a result, Bello Products has started to sell local coffee, and this could help meet the existing demand.

## COCOA

Cocoa production became important at the end of the nineteenth century. Although higher yield varieties of cocoa have been planted since the Second World War, the low price obtained for cocoa kept development down, and the poor processing of the crop kept prices low. Production increased in the 1960's and again in the 1970's, but also suffered from the hurricanes of 1979-80. A few reasonably large stands (averaging 70 acres) of cocoa are grown on private estates, and numerous smaller holders produce cocoa.

In total, about 400 acres of land are devoted to the crop, but recently USAID's HIAMP program has provided support for 150 acres of land with the aim of producing 1,000 pounds of cocoa per acre and another 150 acres to yield 1,200 pounds per acre (USAID, 1986). Plans call for cooperatives and grower associations to later take over the management of this crop. Dominica last exported cocoa in any significant amount in 1983. However, in 1990, the Chicago-based firm, World's Finest Chocolate, Inc., proposed a guaranteed price of US\$1.25 more than the current world-market price (i.e., 64 cents [US\$] per pound) and gave a commitment to buy all cocoa produced in Dominica. Cocoa from the Caribbean (in comparison with that of Africa and Brazil) is said to be of better quality and has a natural flavor that is an asset in the production of high quality chocolates.

Intercropping cocoa with banana plants is seen as a useful way to provide temporary shade -- needed by cocoa crops -- while permanent shade tree plantings develop. Cocoa provides a basis for permanent tree crop-based agriculture utilizing more steeply sloping lands which otherwise would suffer problems of soil erosion and water loss with traditional root crop agriculture. Bananas must be removed after four years if farmers are to avoid a constant struggle against etiolated cocoa trees (i.e., trees whose leaves have lost their chlorophyll and become pale through lack of sunlight) (USAID, 1986).

## ROOT CROPS AND VEGETABLES

Root crops and vegetables, although not exported extra-regionally to any extent, are very important for domestic consumption and export within the region (see Figures 1.3(2) and 1.3(3)). Root crops provide an increasing contribution to GDP and to exports (see Section 1.3.3). Dasheen is the most important root crop; it is grown by 80 percent of Dominican farmers and accounts for a little over ten percent of total agricultural production. Other root crops grown on a large scale include tannia, sweet potato, cassava (for processing into farine) and toloma (for processing into baby foods). Vegetables are also popular with farmers, grown either for

domestic consumption or for export to other islands in the region via the huckster trade. Crops grown are cucumbers, tomatoes, cabbages, carrots, peppers, aubergines and pigeon peas, while in the Carib territory, farmers often grow soy beans which are not presently exported.

## LIVESTOCK

Livestock forms only one to two percent of GDP. Although cattle, sheep, goats, pigs and chickens are all reared on the island, increasing quantities of meat are imported. In 1982, meat and meat products accounted for 4.3 percent of total imports, and butter, milk and cheese 3.5 percent. Forty-six percent of farms own poultry, and yet 30 percent of imported meat is chicken, mainly because of its low price (Mendelsohn, 1983; Evans, 1986b). There are no local hatcheries so chicks are imported as is feed. On the other hand, the country is self-sufficient in eggs.

Sheep may be one area of livestock production that could be developed since they require lower capital outlays than cattle and can subsist on relatively poor grazing without the need for costly supplement feeds. However, at present, sheep breeding in Dominica is characterized as a subsistence activity with a high mortality rate, minimal growth, poor herd reproduction, and inadequate husbandry practices. In this context, the Inter-American Institute for Cooperation on Agriculture (IICA) has been supporting small-scale sheep production in collaboration with the Ministry of Agriculture and CARDI. Eight farms have been monitored weekly to assess feeding regimes, flock size, health factors and breeding performance in terms of overall profit-generating potential. Emphasis has been placed on developing crop/livestock compatible systems, and farmers have been encouraged to adopt new recommendations. It is projected that self-sufficiency in sheep production could be achieved by 1992.

## OTHER VENTURES

*Aloe vera* is a recent specialty crop which has been grown since 1984 at Petit

Coulibri Estate, near Soufriere, for export to the United States. One hundred acres are now under cultivation on the Estate, and plants are provided to about fifty farmers elsewhere on the island.

USAID, through its HIAMP program, provided a grant for the establishment of carambola (star fruit) nurseries. Additionally, research and development on cardamon production in Dominica has shown that it can be grown successfully and has commercial potential in export markets to the Middle East, trans-shipping through the United Kingdom and using the services of Central American spice brokers (USAID, 1986).

In recent years there has been an increasingly important market in ornamental plants and cut flowers, particularly anthuriums and ginger lilies. These are exported mainly within the region via the huckster trade, but some are also sent to the United States and the United Kingdom. The Forestry Division has been investigating the possibility of growing orchids on a commercial basis and has established an experimental orchid nursery in the Botanical Gardens. There is probably scope to expand this occupation further, involving other showy ornamentals as well as orchids whose growth is favored by a combination of tropical climate and high rainfall which Dominica, in particular, can offer.

### 3.1.2 Agro-processing and Marketing

Several products are now being made from agricultural tree crops which can then be sold abroad. Bello produces a variety of fruit juices as well as hot pepper sauce and coffee for export around the Caribbean, and recently Dominica Agro Industries (DAI) on Bath Estate has begun receiving grapefruit from local farmers for processing. In January 1990, DAI successfully marketed its entire output of grapefruit juice concentrate to an American firm. The Government has also provided grant aid through DEXIA (Dominica Export Import Agency) to Dominica Agro Industries for lime processing and for direct payment to growers for the sale of limes.

The regional market is of considerable and growing importance to Dominica for fresh produce. By 1984, intra-regional trade accounted for 86 percent of the country's non-banana fresh produce exports (USAID, 1986). The most significant crops are grapefruit, oranges, plantain and dasheen, although there are plans to develop other fruit crops such as passionfruit. At present, Guadeloupe is the single most important regional market for such produce, followed by Antigua and Trinidad.

As part of the Ministry of Agriculture's Tropical Fruit and Spices Project, there are plans to establish 100 acres of passionfruit throughout the island for export within the Caribbean region. USAID's HIAMP project has approximately 200 acres already established in passionfruit. Under this project, farmers who qualify are given free plants, wire, and other inputs as required. All fruits produced under the project will be purchased by Corona Development, a local processing company.

By regional standards, Dominica's coconut production -- 2,820 tonnes in 1987 (GOCD, 1988b) -- is also significant. These are processed locally by Dominica Coconut Products Ltd. at the Belfast Estate and largely exported as soap products to Jamaica (HIAMP, 1986). Soap products contributed EC\$25.25 million to export earnings in 1988, second in value only to bananas (GOCD, 1988b).

## **3.2 PROBLEMS AND ISSUES**

### **3.2.1 The Banana Industry**

With banana plantations accounting for approximately 5,061 hectares (12,500 acres) under cultivation (pers. commun., M. Didier, DBMC, 1990), the environmental and economic implications of current land use practices center in large measure on the banana industry. The country's significant dependency on one particular crop -- in this

case, bananas -- puts it in an economically vulnerable position should a natural catastrophe befall the crop or market forces suddenly change. Bananas are easily blown down by high winds and are therefore particularly exposed to hurricane and other storm damage. Furthermore, by 1992 Dominica will have to be more competitive in the production of high quality fruit if the industry is to survive changes in the protected UK export market.

Agriculture in Dominica has traditionally been characterized by "boom and bust" patterns of development, with emphasis upon a single crop until a natural disaster, disease, or a change in the export market have compelled farmers to switch to another crop. At present the major crop is bananas, but there are justifiable fears that over-reliance on this crop exposes the country's economy to great risk. With 1992 approaching and the likelihood of a more competitive European market for Eastern Caribbean countries such as Dominica, the need both to streamline the banana industry, with improvements in quality and yields, and to further diversify into other agricultural products is becoming more important.

The bulk of banana production is carried out by a small number of growers. In 1989, less than 15 percent of all growers produced about fifty percent of the total banana crop (DBMC, 1989). Although some of these are large landowners, there is also great variation in production levels for small farmers with similar-sized plantations (pers. commun., G. Stedman, Financial Controller, DBMC, 1990). This is caused by a variety of factors, the most important being the percentage of time spent working the farm, distance of farm from home, availability and quality of access, soil fertility and topographic situation, and planting and management practices. Many farmers are converting unsuitable land into agricultural land, particularly on steep slopes where run-off of water and nutrients is high, and are planting bananas too close together (or, alternatively, letting the bananas produce second shoots alongside the original plants) so that plants compete with one another for nutrients.

## THE ENVIRONMENTAL IMPACTS OF BANANA CULTIVATION

Despite its dominant role in the overall economic development of Dominica, banana cultivation comes with an environmental price tag which should not be overlooked.

In the first place, most of the "marginal" agricultural areas now supporting banana production have steep slopes which, if cropped at all, should be planted only with tree crops to ensure against soil erosion. The banana, however, is an herbaceous perennial species which, unlike a true tree crop, has a very shallow rooting system and no tap root. Therefore, while the plant's large leaves afford protection against rainfall damage where cropping patterns are dense, erosion can be significant as the roots do little to stabilize the soil.

This is less of a problem where ground provisions or other crops are interplanted with bananas, for example, on many small family farms. But in many instances, steep slopes are the focus of commercial banana growers seeking short-term profits with little regard for long-range impacts.

The ongoing destruction of forest cover, which has coincided with expansion of more profitable banana cultivation onto forested lands, is slowly altering the island's hydrological regime. Without forest cover to slow the downslope overland run-off of water, less water is infiltrating the ground, more water is running off, and less is stored within the natural water system or aquifer. One result of this is a lowered base flow in streams during dry periods, a development which is reducing water flow from some catchments and producing high sedimentation rates from accelerated erosion in unprotected upland areas.

Single crop farming, as in the case of bananas, exhausts the natural nutrients in the soil; these are only marginally replaced by using artificial fertilizers because in wetter climates like Dominica's much of the fertilizer input is lost through leaching. Monocrop agriculture also is vulnerable to pest infestation and requires more pesticide use to control disease. This may have detrimental effects upon other wildlife, while single crops tend to lead to reduced biodiversity and increased dominance by a few species.

The importance of this "green gold" crop to Dominica's economy has often disguised the fact that the natural and physical environment to support banana production is becoming increasingly marginal – a situation in no small measure resulting from the very impacts which banana cultivation has created.

Bananas are particularly susceptible to wind damage. Every year between July and October, a proportion of the potential banana crop is lost through damage by high winds. During September 1989, despite the fact that Hurricane Hugo passed over only a small portion of Dominica causing little damage to forest trees, bananas were destroyed over a large part of the island, resulting in a substantial loss of production (76 percent) for that month (DBMC, 1989).

In the northwest of the island, the practice of leaving corridors of forest between bananas plantations to act as windbreaks has in times past served not only to give banana plants some protection but also to enrich the soil with nutrients provided by the deeper-rooting systems of the neighboring forest trees. In recent years, however, with more land being turned into banana plantations, farmers have tended to cut into the windbreaks so that forest corridors, which once

were 10-20 meters broad, are now often no more than five meters wide or even reduced to scattered isolated trees. This not only has a detrimental effect upon banana yields, it also has wider environmental implications, i.e., reduction of biodiversity, of particular animals important for pollination, seed dispersal and regulation of insect pests (Evans, 1986b, 1989).

One reason for intensified deforestation by shifting cultivation has been the easier access afforded to once remote areas by the construction of feeder roads. New roads have been built, and many existing tracks surfaced. While such roads have had an indirect environmental impact by enhancing access to lands often unsuitable for agriculture, they have improved the proportion of acceptable fruit reaching exporters since reduced levels of fruit are bruised and transport to boxing plants is easier. The boxing of fruit has also reduced fruit damage. In 1988, a container cardboard plant (ABC Containers) was established at Gimmit to supply cardboard boxes for the banana industry and other local needs. Many farmers have now built small huts to house these boxes on site for ease of collection.

### 3.2.2 Crop Diversification

Dominica's recognition of the risks associated with over-dependence on a monocrop agricultural base has led to the country's experimentation with a variety of crops. Diversification has been predicated on a number of factors, the more important being:

- (1) Emphasis upon a single crop leaves the country's agricultural sector vulnerable to natural disasters; bananas are at particular risk from hurricane and other storm damage which may not have as severe an impact on other crops.
- (2) Monocrops usually develop serious pest and disease problems.

- (3) Demand on the international market for certain types of fruits and vegetables can vary so that a product commanding a high price one season may lose its value the next; this is particularly true when eating habits change often for dietary reasons.

However, there are also problems associated with developing a broad-based agricultural system. The first relates to economies of scale. There is only a limited amount of land (or, at least, suitable land) available for agriculture. Secondly, the practice of intercropping two or more crops makes it more difficult to apply pesticides or fertilizers specific to a particular crop. To some extent this will be counterbalanced by the increased chance of infection within monocrops. Finally, despite the advantages of intercropping, management of a small farm may be complicated by the presence of a variety of crops, particularly if the requirements of one crop conflict with those of another.

Despite these disadvantages, crop diversification is generally considered to be a positive move (Demas, 1987), and at present approximately 5,000 acres, over different parts of the island, are under exotic fruit cultivation, mainly citrus, passionfruit, soursop, mangoes, sugar apples and avocados for export to international markets, particularly Europe. The total acreage for coconuts stands at just over 16,800, as of the end of 1989 (pers. commun., D. Francis, Agriculture Statistics Division, 1990). Tables 3.2(1), 3.2(2) and 3.2(3) provide a review of crop characteristics.

Crop diversification has one additional benefit in that it may promote species diversity of native wildlife. Studies carried out by the Oxford University/ICBP Multiple Land Use Project in Dominica have highlighted how single crop plantations increase the dominance of bird communities by particular species (bananaquits, bullfinches, and hummingbirds) at the expense of other species (for example, parrots, thrushes and thrashers) (Evans, 1986a, 1986b, 1989).

Table 3.2(1). Present and proposed fruit crop production in Dominica.

Crop Type	Area (acres)		Production (tons/annum)	
	1985	1995	1985	1995
Grapefruit	2,065	2,159	5,198	9,020
Oranges	1,217	1,417	580	2,800
Limes	1,235	1,305	1,220	3,175
Other citrus	50	80	75	200
Mango	598	712	600	1,740
Avocado	238	288	163	640

Source: BBD/Tropical Development and Reserach Institute, 1986.

Table 3.2(2). Environmental profiles for different crops.

Crop Type	Chemical Usage	Erosion Control	Wind Sensitivity	Wildlife Habitat Value
Banana	High	Poor	High	Moderate
Coconut	Low	Poor	Moderate	Moderate
Citrus	Low	Moderate	Low	Good
Avocado	Low	Moderate	Low	Good
Guava	Low	Moderate	Low	Poor
Cocoa	Moderate	Good	Low	Moderate
Coffee	Moderate	Moderate	Moderate	Moderate
Bay leaf	Low	Good	Low	Poor
Aloe	High	Poor	Low	Moderate-Poor
Root Crops	Low	Moderate	Low	Very Poor

Source: Oxford University/ICBP Dominica Multiple Land Use Project (unpublished data).

Table 3.2(3). Agricultural profiles for particular tree crops.

Crop Type	Season	Main Cultivars	Age (yrs)	Condition	Yield (tons/acre)	Retail Price (cents/lb)
Banana	All year	Robusta	NA	2-5	6.00	30-40
Grapefruit	Aug-Mar	Marsh Ruby	1-25	2-5	2.52	11-25
Oranges	Aug-Feb	W. Navel Valencia	1-30	2-4	0.48	30-55
Limes	Apr-July (Nov-Dec)	W.I.	1-50	3-5	0.99	50-80
Tangerine Mandarin	July-Dec		1-20	2-4	1.50	50-80
Mango (grafted)	Apr-Sept	Julie	1-40	2-4	1.00	55-85
Avocado	June-Dec	Various	1-5	2-3	0.68	50-65
Guava	All year	Local pink	1-20	3-5	?	20-50

Notes: Condition of trees estimated on a scale of 1 (very well managed) to 5 (abandoned orchards).

An estimated 75-85% of total yield may be suitable for commercial usage, i.e., local export, processing.

Yield estimate per acre is only approximate since acreages under cultivation for a particular crop do not include intercropping.

Data for bananas is for year 1989; data for all other crops is for year 1985.

NA = Not Applicable.

Sources: BBO/Tropical Development and Research Institute, 1986; Dominica Banana Marketing Corporation, 1990a.

### 3.2.3 Increased Domestic and Regional Agro-production

Dominica has potential for greater agricultural self-sufficiency and increased export of its produce within the region. At the same time, many agricultural products (for example, coffee, cocoa, cheese, butter, beef, pork and chicken) are imported in substantial quantities. In view of the high and increasing costs of imported meat and dairy products as well as animal feed, it would seem to be advantageous to increase local production.

Trade of Dominican agricultural produce within the Eastern Caribbean region has increased during the last decade. This has been carried out to a large extent through a

network of local hucksters -- mainly women who move around nearby islands buying and selling from one to the next. Dominica has been particularly successful at selling fruits (grapefruit, orange, lime, mango and avocado), root crops (dasheen, tannia, and sweet potato), and cut flowers (anthurium and ginger lily).

Various local organizations have been involved in improving trading arrangements. For example, the Dominica Export Import Agency (DEXIA) was set up in 1986 by the Government with responsibility for the development of more export markets, improvement of food self-sufficiency, and domestic market development through the administration of the Roseau market. Coordi-

nation of information exchange between farmer and exporter is another important function of DEXIA. Such information includes updates on prices, market demand, boat schedules, freight rates, and financing arrangements. By improving the marketing of a range of crops, DEXIA aims to provide growers of such produce with more regular incomes, such as that currently enjoyed by banana farmers.

Other areas where development is taking place towards greater local or regional self-sufficiency are livestock production (particularly sheep), the growing of various herbs and spices for flavoring of foods, and floriculture. The Forestry Division has been investigating the possibility of growing orchids on a commercial basis and has established an experimental orchid nursery in the Botanical Garden.

Improved local self-sufficiency in agricultural products as well as expansion of the regional export market for agro-products depend on continued development of a multiple land-use policy, which in turn could have several important ecological benefits for the country. First, it offers an opportunity for appropriately linking land use with land capability -- the latter based on the differing characteristics of a given land area such as climate, soil type, and steepness of slope. A mosaic of habitats promotes biodiversity particularly if plant communities cultivated include herbs, shrubs and trees forming a number of vertical strata. From a wildlife conservation perspective, extensive areas of pasture for livestock or grassland with sugar or cereal crops are not to be recommended, but in a mosaic with patches of forest, biodiversity is encouraged by limited disturbance of the vegetation (Evans, 1986a,b; 1989). This gives rise to an "edge" effect where a relatively high proportion of the habitat is sufficiently open for colonizing species to flourish, bearing flowers and fruits that are important food for a variety of wildlife. Were these plants to dominate, on the other hand, as in herb meadows or scrub, the diversity of animal species that use forest trees would not occur; thus, a balance between the two is the best compromise.

### 3.2.4 Land Ownership and Land Use

In the past, a high proportion of Dominica's land was owned by a few people. In a census carried out in 1961, the wealthier 1.4 percent of farmers occupied 56.4 percent of the land. Sixty-nine percent of all holdings were less than two hectares and accounted for 3,135 hectares, whereas nine percent of holdings were more than 80 hectares and occupied 14,416 hectares (Weir's Agricultural Consulting Serv., 1980). The situation was little improved by 1975 (see Figures 3.2(1) and 3.2(2)).

Since independence in 1978, the large estates have declined in importance and have been either divided and sold or, in some cases, left to lie idle due to absentee landlords and a shortage of cheap labor to work the land (Narendran, 1980). Many of these estates are on the most fertile soils and so remain greatly under-utilized. Elsewhere, demand for land has resulted in Government distribution of crown land to farmers, usually in lots of less than four hectares. Table 3.2(4) summarizes available information on Government distribution of land prior to 1975, and Table 3.2(5) shows the proportion of Government lands (allocated and unallocated) in comparison to privately-held lands in 1978. Since then, feeder road construction following hurricanes David and Allen has opened up new areas and encouraged further sale of Government lands, despite the presence of under-utilized tracts of estate lands with reasonable access (McQuillan, 1984; UNDP, 1986; DeGeorges, 1988).

Through GOCD's Integrated Rural Development Program and other land reform projects, several estates have been divided into small plots and distributed among local tenant farmers, e.g. Carholm in the center of the island; Melville Hall, Castle Bruce and Newfoundland in the east; Geneva, Bagatelle and Petite Savane in the southeast; and Soufriere in the south. Nevertheless, such distribution has not always prevented further encroachment into neighboring forested areas. For example, in the area around Governor Estate west of Melville Hall and Crown and Gregg to the south, farmers are clearing both mature and secondary rain forest (Fehr,

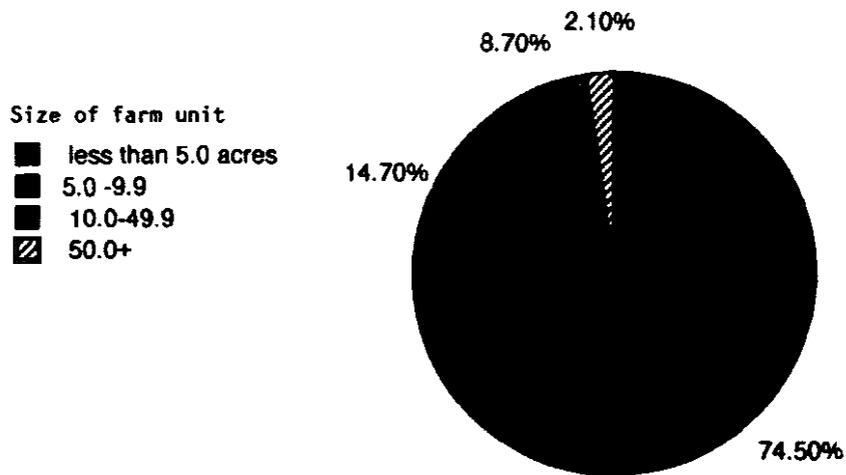
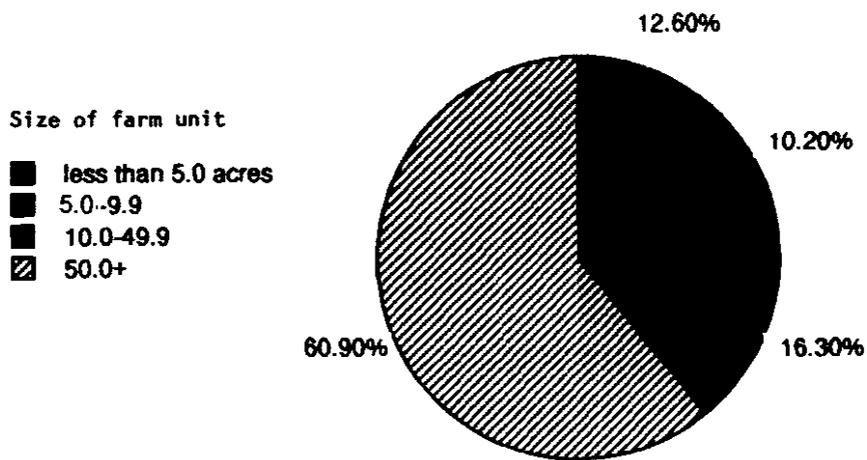


Figure 3.2(1). Distribution of land as percentage of holdings of different sized units as reported in the 1975 Agricultural Census (source: GOCD, 1975).



"Land distribution"

Figure 3.2(2). Distribution of land as percentage of acreage held in different sized units as reported in the 1975 Agricultural Census (source: GOCD, 1975).

Table 3.2(4). Government distribution of land in Dominica, 1950 - 1975.

Lot Size (acres)	1-5	5-10	10-15	15-20	20+
No. of lots	435	949	278	84	63
Acreage	1,522	6,800	3,315	1,431	1,855

Source: Mendelsohn, 1983.

Table 3.2(5). Dominica land ownership, 1978.

	No. of hectares
<b>Allocated Government Lands:</b>	
Morne Trois Pitons National Park	6,349
Central Forest Reserve	410
Northern Forest Reserve	8,814
	<hr/>
Subtotal Total Allocated Government Lands	15,573
Unallocated Government Lands	10,526
	<hr/>
Total Estimated Government Lands	26,099
Total Privately Owned/Claimed Land	52,901
	<hr/>
Total Dominica Land Area	79,000

Source: Shanks and Putney, 1979.

1989; P. Evans, pers. observ.). At the same time, the division of old estates has not necessarily been successful in terms of crop production, for example on the Castle Bruce and Geneva Estates (Weir's Agricultural Consulting Serv. Ltd., 1980).

In a review of land use in Dominica, Shanks and Putney (1979) estimated that only 30 percent of the 79,000 hectares of total land area was suitable for agriculture. Of this, 35 percent was occupied by farmers, but only 24 percent of the total suitable land was under

permanent cultivation, large estates and private small holdings each occupying about half of this land. Since 1978, a sizeable portion of forest has been turned into agricultural land so these figures are now considerably out of date. Unfortunately, a more recent preliminary map on vegetation and land use in Dominica prepared by the Organization of American States (McKenzie, 1987) contains a number of important errors in the drawing of boundaries and misinterpretations in classification of vegetation types. The result is that it

is not comparable with estimates provided by Shanks and Putney (1979).

The Oxford University/ICBP Multiple Land Use Project in Dominica is currently working on a new detailed vegetation map along with its botanical studies on the ground, but this effort is hindered by lack of comprehensive air photo coverage of the island. In Dominica's National Structure Plan (GOCD, 1985), an estimated 19,844 hectares (i.e., 14.3 percent of land area) of "unutilized" land is

Table 3.2(6). Existing and proposed land use areas, Dominica (areas in hectares).

Land Uses	Existing Areas 1978	% of Land Area	Proposed Areas 2001	% of Land Area	Change in Area
Agriculture	22,000	27.8	23,700	30.0	+1,700
Conservation					
-Forest Reserves	9,224	11.7	14,456	18.3	+5,232
-National Park Units	6,475	8.2	16,002	20.3	+9,527
-Water Catchments	2,134	2.7	5,202	6.6	+3,068
Subtotal	17,833	22.6	35,660	45.1	+17,827
Settlements					
-Major	330	.4	550	.7	+220
-Rural	803	1.0	900	1.1	+97
Subtotal	1,133	1.4	1,450	1.8	+317
Unutilized Land					
-Forests and Idle Agricultural Land	31,134	39.4	11,290	14.3	-19,844
-Scrub	2,100	2.7	2,100	2.7	0
-Other	4,800	6.1	4,800	6.1	0
Subtotal	38,034	48.1	18,190	23.0	-19,844
TOTAL	79,000	100.0	79,000	100.0	

Source: National Structure Plan, 1985.

expected to be transferred to more intensive use (mainly conservation but also agriculture and to a small extent settlement) by the year 2001 (Table 3.2(6)). Of this total, 17,827 hectares are proposed for conservation and only 1,700 hectares for agriculture (the remainder for human settlement). However, it should be noted that between 1978 and the present time, a much greater area than this has almost certainly already been converted to agriculture, mainly utilizing unsuitable land.

Despite land distribution and road building efforts, land hunger continues to be a problem along the west coast, in the Upper Layou Valley (Wet Area), the Melville Hall area, and the Carib Territory. Along the west coast, the land around many of the communities is unsuitable for agriculture. Many of the people in the area practice some fishing, but marine resources are probably not sufficient to support entire communities. Three villages facing such problems are Glanvillia, Dublanc and Bioche (Sutphen, 1986). Because of the unavailability of suitable agricultural land in the proximity of their homes, many farmers have acquired land some distance away and travel daily to their plantations. Those farmers working the land on Syndicate Estate, for example, come from the villages of Colihaut, Coulibistri and even Salisbury, involving daily round-trip journeys of up to 30 kilometers.

Land tenure is another concern which encompasses a number of sub-issues, e.g., many private parcels are leased to small farmers who have yet to make rental payments; in other cases land ownership or title is unclear or uncertain, while some small farmers are squatting on land belonging either to the Government or to absentee landlords.

The fragmentation of land into separate small farms or parcels has been encouraged by the traditional division of a single holding among the children of a given family unit. Children are offered portions of land owned or leased by the parent, but these are often some distance from one another. Furthermore, family members (or other growers without secure title) are usually less ready to make improvements and undertake investment projects on their farms. Narendran (1980) recorded, in a sample of 57

parcels, 21 parcels of family land, 21 freehold, 7 annual rent, 5 private lease, and 3 share cropping. There appeared to be no significant difference between the way freehold and family farms were run, but the latter were more prone to disruption due to family disputes. Rented farms had a noticeably different cropping pattern with much stronger emphasis on short-term crops. CARDI survey data quoted in Chemonics (1988) showed the following distribution of land holdings, with the 52 percent category ("other farms," denoting leaseholds or squatting) not only the largest in the Dominica but also the highest reported in the OECS countries surveyed:

Freehold	33%
Rent	15%
Other Farms*	52%

\* leasehold or squatting on public or private land

Table 3.2(7), taken from Chemonics (1988), updates the information found in Figure 3.2(1), but shows approximately the same size distribution of farms as found in the 1975 Agricultural Census, with almost 90 percent of all farms being less than ten acres in size. Even these small sizes obscure the fact that many farms are comprised of two, three or even more micro-parcels (see Table 3.2(8)), the others often some distance from the first. This complicates farming for the small grower, lowers efficiency, and increases commuting; on the other hand, it diversifies production risk (Chemonics, 1988).

Although some cooperation exists between farmers (for example, help with transport), such efforts have never developed very effectively, probably because of the difficulty farmers have in breaking away from the traditional system of family-held land tenure. Even relatives may operate independently of one another. Despite a number of deficiencies of the traditional large estates, they often operated with relative efficiency, benefiting from economies of scale. The latter has been accommodated in part by the development of cooperatives which coordinate such activities as produce packaging and the application of fertilizers, pesticides and herbicides.

Table 3.2(7). Number and size distribution of all farms, Dominica.

NUMBER OF FARMS	DISTRIBUTION			
	< 1 acre	1 - 10 acres	10 - 50 acres	> 50 acres
1,921	26%	63%	9%	2%

Source: Chemonics, 1988, using data from CIDA's Review of Agricultural Diversification in the OECS (1987).

Table 3.2(8). Farm size and fragmentation in Dominica (one to five acre farms).

1-<2	SIZE CLASS (acres)				PARCELS (#)		
	2-<3	3-<4	4-<5	1	2	3	
42%	15%	24%	19%	38%	38%	24%	

Source: CARDI survey taken from Chemonics, 1988.

As noted above, in recent years the Ministry of Agriculture has been addressing the problem of land hunger through land reform programs. For example, 1,200 acres at Castle Bruce have been subdivided, 730 acres at Geneva and 685 at Melville Hall. Social studies on the communities/households have been carried out to better determine their needs, and funds have been provided for investments. These projects have received aid from OAS, IFAD and CDB.

Although land hunger is a widespread, albeit regional problem, ironically the country is also experiencing a shortage of agricultural labor. Many Dominicans, particularly young persons, are increasingly drawn to the capital, Roseau, where they can earn a more secure income with better working conditions.

Some of these could remain within the broader agricultural sector by entering agro-industries, such as the processing of fruit juices and jams, production of plantain chips, etc. However, this does not solve the need for more field labor. To do this, the profession needs to be made more attractive, and systems of land sharing encouraged. The need for greater security of land tenure should also be addressed, e.g., too often farmers have entered into lease arrangements without adequate capital, further encouraging land-hungry farmers to squat on lands they cannot afford to purchase or lease.

### 3.2.5 The Use of Agrochemicals

Although this subject is also discussed in Section 8, some general comments may usefully be made as they pertain to agricultural development.

Agriculture generally and banana growing in particular have become increasingly dependent on "inputs" not only of chemical fertilizers but also large amounts of a broad spectrum of pesticides. Most chemicals are sprayed by small farmers using back pack sprayers. Airplanes spray a combination of oil plus small amounts of fungicide in the control of leaf spot, but this is not island-wide. The DBMC employs a significant number of ground crew teams for leaf spot control (pers. commun., C. James, Ministry of Agriculture, 1990).

The need for agrochemicals could be reduced if monocrops occupied smaller areas and were interspersed with forest corridors and with plots containing other crops. Other recommendations to control the use of agrochemicals include: improved extension services to farmers on alternatives to pesticide control, broader use of field sanitation and quarantine practices, use of crop varieties resistant to insect pests, and employment of crop rotation strategies, in both space and time.

At present, paraquat (mainly sold as gramoxone in the Eastern Caribbean) is the main product used for the control of weeds (Rainey, *et al.*, 1987). Although it is ineffective against many vines and perennial herbs, it is easily the most cost-effective and attractive herbicide for most small farmers. Advantages include its "rain-fastness" and its rapid and visible action. In a survey of weed control on small farms in various countries in the Eastern Caribbean, Hammerton (1985) estimated that about 30 percent of total crop labor was spent on land preparation and another 30 percent on post-planting weed control depending upon the cropping system. Methods rely mainly on hand labor, using cutlasses, hoes, forks and hand pulling of weeds, with either hand spraying or, in some areas, aerial spraying from a plane.

Mocap (ethoprop) is a commonly used pesticide, functioning effectively as a nematicide in the soil and around root systems (Rainey, *et al.*, 1987).

The problem with agrochemicals like gramoxone and mocap is that they have high toxicity and are non-specific. Gramoxone in particular also has a very long persistence. As a consequence, these chemicals are a threat to wildlife (and to humans where they enter drinking water). Mocap, when applied to fields of aloe infected with nematodes, killed numbers of ground doves, hummingbirds and yellow warblers (pers. comm., M. Barnard, Mng., Windward Island Aloe Products, 1990). Although Rainey, *et al.* (1987) were unable to demonstrate direct effects of gramoxone on wildlife populations (since population changes were most influenced by habitat loss), they did express concern about widespread and unregulated use. Since that study, there have been several reports of mortality of freshwater life (crayfish, crabs and freshwater fishes) and of opossums along paths close to recently sprayed banana plantations.

In recent years there have been several moves to try to regularize the application of agrochemicals. For example, organophosphates or chlorinated hydrocarbons are no longer legally used in the agricultural sector. Furthermore, the Pesticides Control Act was amended and updated to provide legal requirements for protective clothing and annual medical checkups for the sprayers, paid for by their employers (pers. comm., E. Harris, Ag. CTO, Div. of Ag., MOA, 1990). Nevertheless, some sprayers continue to be lax in using protective clothing properly, often spraying without face masks, and there is little attention paid to whether bystanders are in the vicinity of spraying. Some farmers increase the dose levels of the chemicals they apply in anticipation of improved effectiveness, while packaging is often inadequate with containers lacking labels and directions.

Chemicals used on bananas are often also applied to other crops. However, the Agriculture Division now has more appropriate chemicals (pyrethroids) available for vegetable farmers which will be repackaged and

sold to them (pers. comm., E. Harris, CTO, Div. of Ag., MOA, 1990).

At present, there is still very little research on the environmental effects of the use of various agrochemicals in Dominica, particularly where they enter watercourses and can impact upon water quality and aquatic life (see also Section 8).

### 3.2.6 Soil and Water Conservation

Approximately 70 percent of the country's land area is classified by the Government as unsuitable for agriculture (see Table 3.2(9)), primarily because of erosion risks, water saturation due to heavy rainfall, or poor soils. These lands have been summarized as follows (GOCD, 1985):

(1) **Land with very high erosion risk** (about 29,000 hectares or 37 percent of the total land area) - lands with steep slopes found mainly in the interior and windward side of the island. They are unsuitable for cultivation because of the steepness of the terrain and high erosion risk. Most such lands are forested and located in the Morne Trois Pitons National Park or in Forest Reserves.

(2) **Land with moderately high erosion risk** (about 16,000 hectares or 20 percent of the total land area) - lands found mainly in the vicinity of the Northern Forest Reserve and the south of the country. Tree crops and silviculture are the most suitable use for this type of land, but there are many parcels under cultivation with root crops and bananas being the principal crops grown.

(3) **Poor agricultural land** (about 11,000 hectares or 13 percent of total land) - lands found mainly on the southern edge of the Central Forest Reserve and northwest of the Morne Trois Pitons National Park. Because of excessive rainfall and generally nutrient poor podsols, the soils in these areas

are waterlogged, and crops cannot grow or grow poorly.

As shown in Table 3.2(9), only about 23,000 hectares or 30 percent of the island's land area are considered suitable for cultivation; these lands are located in river valleys primarily in the northeast and northwest parts of the island. While some of these agricultural lands are under-utilized (as are lands in the Layou and Roseau Valleys and neighboring valleys on the central west and east coasts), some less suitable areas are intensively cultivated. Settlement growth, especially in the northeast, is encroaching on the scarce agriculturally suitable land, while less suitable areas are being increasingly cultivated (GOCD, 1985).

The drive to clear steeper land of forest growth for conversion to agriculture has had important environmental effects, not least of which has been soil erosion and landslides on the steeper slopes (Evans, 1986b; Rainey, *et al.*, 1987; DeGeorges, 1988). Hurricanes David and Allen initiated much erosion around Morne Trois Pitons and neighboring mountains in the Upper Layou and Roseau Valleys (Walsh, 1982; P. Evans, pers. observs.). However, since then, erosion has been exacerbated by the clearance of secondary growth for planting of bananas, root crops and various vegetables. During periods of dry weather, farmers have been burning vegetation to clear land particularly in coastal regions and along the main river valleys. These fires are often uncontrolled and can cause much wider damage, while the effects of this type of clearance can also be seen in landslides adjacent to roads.

In many areas erosion is caused by the planting of inappropriate tree crops such as bananas as well as the utilization of poor cultivation practices with little attention to methods which ensure soil stability. These activities continue at a time when existing agricultural land is under-utilized, and present yields could be greatly improved by better management practices.

A recent report by Atkins Land and Water Management (1983) states that *technically* there is a moderately severe or severe

Table 3.2(9). Dominica land type according to suitability for agriculture.

	AREA (Hectares)	AREA IN NATIONAL PARK OR FOREST RESERVES (Hectares)	PERCENT OF TOTAL LAND AREA
Very high erosion risk	28,957	9,858	37%
Moderate erosion risk	16,098	3,810	20%
Waterlogged	10,734	1,760	13%
Good agricultural land	23,211	145	30%
<b>TOTALS</b>	<b>79,000</b>	<b>15,573</b>	<b>100%</b>

Source: GOCD, 1985, taken from Dominica Forest and Park System Plan, Forestry Division (1982).

erosion risk of 84 percent in Dominica (higher than the figures in GOCD's Forest and Park System Plan, 1982, and cited in Table 3.2(9)). However, the Atkins report also states the risk of accelerated erosion is small because so much of the country is under natural vegetation. The authors find that only 12 percent of the country has moderately severe or severe erosion, with the worst-affected areas in the west at Salisbury and Colihaut and an area between Marigot and Castle Bruce in the east (other studies have identified other areas with severe erosion, e.g., in the upper Layou Valley; see Walsh, 1980). The Atkins study stresses the particular need for good soil conservation techniques in these areas. Such data point to the importance of maintaining vegetative cover in order to keep erosion within manageable proportions.

### 3.3 POLICY RECOMMENDATIONS

#### AGRICULTURAL DIVERSIFICATION

The present Government policy for diversifying to a broader-based agricultural base needs to be encouraged, although in a regulated manner. The following fresh produce has been identified as having strong market potential (modified from USAID, 1986):

- traditional export commodities such as bananas, cocoa and spices (only the first is grown presently in any quantity);
- traditionally grown produce for which there is strong demand from Caribbean emigrants to the United Kingdom and North America, for example, yams and other root crops, breadfruit, etc.;

- fresh produce items focused at non-Caribbean, ethnic market sectors, for example to the Asian and Oriental communities in developed country markets;
- a rapidly expanding market for exotic, tropical fruits and vegetables demanded by indigenous European and North American consumers, for example, carambola, mangosteens, soursop, red bananas;
- tropical and warm temperate fruits that already have wide consumer acceptance in developed countries, e.g., mangoes and avocados;
- off-season (or "winter") vegetables that exploit market "windows" in the winter months, e.g., bell peppers, eggplant (aubergine), and okra;
- tropical cut-flowers and ornamentals, e.g., anthuriums, ginger lilies, bird of paradise, orchids;
- processed products that already are domestically produced, e.g., passionfruit, lime and grapefruit juices, dried sorrel, pepper sauce, bay rum; and
- mariculture products such as prawns, crayfish, and algae.

Agricultural diversification not only protects Dominica economically, it also promotes biodiversity. Monocrops of banana, coconut and grapefruit have animal communities with lower species diversity than those plantations with two or more crops grown alongside one another (Evans, 1986a,b; 1989).

#### **GREATER DOMESTIC SELF-SUFFICIENCY**

At present, a large proportion of the protein consumed by Dominicans comes from

imported produce such as frozen chicken, beef and pork. To help reduce the balance of payments deficit, suitable areas could be used for livestock rearing -- particularly sheep. Damaged bananas and other fruits could be used as feed, supplemented with some imported feeds. There are no local chicken hatcheries so that chicks are imported at a relatively high cost, as is the feed used to supplement their local diet. The establishment of one or two hatcheries could begin to address this problem.

Other sources of protein commonly eaten in rural areas include agouti and wild pig. There may be scope for either farming agouti or the increased stocking of rain forests with agouti. Along the coasts, iguanas and crabs are hunted regularly; the pressure on the former probably accounts in part for their relative scarcity (Evans, 1986b). Both of these have potential to be farmed as does mountain chicken (*leptodactylus fallax*), a large frog which is considered a delicacy and is caught for sale to local restaurants. The utilization of wildlife such as agouti, iguana and mountain chicken through a system of farming could begin to take pressure off the hunting of wildlife in rain forest and coastal woodland areas.

In the past, Dominica grew crops such as cocoa, coffee and sugar in much greater amounts. Now bananas, coconuts and citrus dominate, and the country imports quantities of coffee and sugar. This situation could be redressed by increasing the acreage devoted to those crops, where suitable land exists. Cocoa and coffee can usefully be intercropped with other tree crops such as coconut and citrus. Although sugar plantations offer little for wildlife, cocoa and coffee can support reasonably diverse animal communities, particularly when intercropped with other tree species and with belts of forest nearby (see Table 3.2(2)).

#### **IMPROVED INTRA-REGIONAL TRADE**

Already great progress in expanding intra-regional trading has been made through the Dominica Hucksters Association and or-

ganizations such as DEXIA, with a variety of produce being sold to other islands in the Caribbean. This trade could be enlarged with vigorous marketing in other countries in the region and better inter-island transport facilities.

A big problem that has frequently faced Dominica has been its inability to sustain markets with sufficient quantities of produce once markets have been identified. This has occurred recently with attempts to develop the growing and marketing of passionfruit. A market clearly exists, but insufficient quantities of passionfruit are being produced. Although provided with seedlings, farmers were not planting them until the damage caused to the banana crop by Hurricane Hugo in September 1989 encouraged them to do so. Likewise, the development of root crops is another area where significant gains could be made since hucksters are frequently short of produce to ship to other countries in the region.

In the past, farmers frequently were encouraged to plant a particular crop but then found they were unable to sell such produce because there was no market for it. This has resulted in farmers shifting from one crop to another. Marketing agreements need to be established which protect both the local grower and the off-island importer. The formation of DEXIA and the success of the Dominica Hucksters Association should substantially advance achievement of this goal. In the long run, despite problems associated with market uncertainties, there are economic and environmental advantages to be gained from accelerated growing of a variety of crops in a sustainable manner.

#### **NEED FOR AGRICULTURAL LAND ZONING**

Zoning restrictions for various forms of agricultural land development need to be considered by Government. As stated throughout this section, at the present time many unsuitable areas are being farmed, while more suitable agricultural lands are underutilized. This situation is partly due to the prevalence of traditional patterns of land

ownership and is partially being addressed by the sale of unallocated parcels of Government-owned lands. Nevertheless, encroachment into forested areas by landless farmers continues to be a persistent problem.

If forests become too fragmented, not only will this result in reduced biodiversity, it will also have detrimental effects upon soil fertility, will increase the land's vulnerability to wind damage and pest outbreaks, and will diminish watershed protection efforts. These problems could be addressed by the establishment and expansion of forest corridors (windbreaks) as part of a land zoning program. In many cases, the corridors could serve multiple purposes.

At present, only state lands within forest reserves and national parks enjoy any degree of protection or land use restrictions, and the only protected water catchment on private land (Stewart Hall Water Catchment) has not been well-managed under existing regulations (see also Sections 2 and 11). Although private landowners or tenants are encouraged to protect watersheds and to maintain good husbandry practices (formalized in the Agricultural Small Tenancies Ordinance of 1953), such standards are rarely enforced. Furthermore, where farmers have been prevented from clearing forest adjacent to watercourses, promised compensation has frequently not been paid. Better zoning regulations and enforcement procedures for agricultural lands are therefore required, together with a policy to provide adequate incentives or compensation to farmers to encourage better land use practices.

#### **IMPROVED PUBLIC INFORMATION AND EXTENSION SERVICES**

Farming practices which do not promote environmentally-sound agricultural systems are often the result of inadequate information about good husbandry procedures reaching the small farmer or, if available, such information may be ignored by the farmers. Attempts to tackle this problem in Dominica have involved the development of a regional network of extension officers within the Agriculture Division, a regular column called

"Around The Farms" in the weekly newspaper *The New Chronicle* and regular broadcasts on local radio. However, there is still much that needs to be done to both inform farmers and better persuade them to adopt improved, integrated pest management, crop rotation, and multiple land use practices such as agroforestry. In general, promotion of agroforestry techniques should be a critical component of all extension efforts, while consideration should also be given to reintroducing soil conservation instruction programs for small farmers which were once operational in the country. Such efforts will require extra staff to expand current levels in the extension/education sector of the MOA.

The Dominica Banana Marketing Corporation has recently adopted a new three-tier price structure according to fruit quality intended to provide additional incentives for better growers in the banana industry. This is being carried out by the DBMC through its 1990 Banana Replanting Program which aims to encourage rotational planting, increase yields per acre, and achieve peak production in the summer months when export prices are highest. To participate in the program, a farmer must have at least two acres of bananas in an agriculturally suitable growing area and must be willing to adopt recommended farming practices. Incentives for participating growers include half price for all inputs (pesticides, herbicides, fertilizers) and the opportunity to learn new methods of growing bananas and proper approaches to farm development and management (DBMC, 1990b).

Similar incentives may be appropriate for other fruit crops or land use practices in general. For example, it might be possible to extend incentives for the maintenance of forest corridors between plantations, for restrictions on the use of steeply sloping land for agriculture, or for more rational use of inputs with greater consideration of environmental hazards. These could be monitored and reported on at regular intervals by extension officers, and on the basis of such reports individual levels of grant aid through discounts or loans could be established.

## RESEARCH ACTIVITIES

In Dominica most agriculturally related research is carried out by CARDI or IICA (see, for example, James, 1986), with additional outside studies carried out by visiting scientists (for example, Evans, 1986b, 1989; Rainey, *et al.*, 1987; Genthon, 1985) and university-student expeditions (for example, Fehr, 1989). However, there is clearly a need for greater research efforts to tackle issues such as the environmental effects of agrochemical use, ways to improve fruit productivity for a variety of crops, and development of livestock rearing or new crops. Too often, funds are spent by aid agencies on short-term surveys implemented by visiting consultants who inevitably produce literature reviews of what other people have done. Original research, with input from local experts, is urgently needed in many subject areas within the agricultural sector.

## CONCLUSION

Dominica has great potential for agricultural development without substantial inroads into forest lands which are more suitable for other purposes such as watershed and wildlife protection, nature tourism, or sustainable small-scale forestry. Yields of existing fruit crops could be greatly improved by better cultivation practices, greater utilization of fruit harvests, and attention to improved fruit quality. Dominican banana crop yields remain relatively low. In Central America yields average 25 tonnes per acre per year compared with eight tonnes per acre per year in the Windward Islands. In Dominica, yields average around six tonnes per acre per year, although some farmers obtain significantly greater yields (Didier, 1990). Clearly there is great scope for improvement in productivity levels without recourse to clearing more hillside land.

With 1992 approaching and fears that countries like the Dominican Republic may force down the price of bananas by flooding the market, Dominica needs to streamline its banana industry. Although farmers could continue to grow bananas for consumption by farm families or for sale in local markets, the

industry in general could operate effectively with a smaller proportion of the present labor force. Those remaining within the export industry should be the most efficient and productive farmers. Others could be encouraged to grow a variety of alternative agricultural crops or pursue other activities within the agricultural sector such as livestock rearing or agro-processing.

However, for this to occur, substantial incentives will be required in the form of grants, loans or other stimuli, and guaranteed markets will need to be ensured for produce, at least initially. Organizations like DEXIA could play an important role, with support from Government and external aid agencies.

Some growers may need to be prepared to move outside of agriculture into areas such as tourism and tourist-related industries such as local furniture and craft making. Although tourism at present is a small sector in the economy, there are indications that it may develop significantly in coming years.

Finally, Dominica is unlikely to be able to compete internationally in the export of many of its more traditional crops. However, the country's heavy rainfall and the soil protection and fertility afforded by its extensive forests would promote the growth of valuable specialty crops including exotic fruits, ornamental flowers, and orchids.

## SECTION 4 FRESHWATER RESOURCES

### 4.1 OVERVIEW

Dominica is the recipient of significant amounts of rainfall, as much as 762 cm (300 inches) per year in some areas at high elevations. The country average, on an areal basis, is approximately 445 cm (175 in) (Farnum, 1987). The island also has the highest ratio of forest cover as a proportion of total area in the Caribbean and boasts a total of 365 "rivers" (many of which are really small streams). In the aggregate, these physical attributes have over time assured Dominica an abundant supply of freshwater for domestic consumption, export markets, hydropower and other uses.

Most of the country's major watersheds are concentrated in the central area of the island on both the leeward side (Layou River and Roseau River watersheds) and windward side (Clyde River, Pagua River, Castle Bruce River, and Rosalie River watersheds) (see Figure 4.1(1)). The Layou River watershed on the leeward side is the largest, although most major watersheds are concentrated on the windward side. There are also a number of smaller watersheds, the largest of which are located in the north of the island: Indian River, Blenheim River and Hampstead River (Figure 4.1(1)).

#### DOMESTIC CONSUMPTION

At present, 43 catchment areas are tapped for potable water (pers. commun., C. Sorhaindo, DOWASCO Project Engineer, 1990). At least five of the catchment areas are fed only by springs.

Approximately 83 percent of the population has access to public water supplies, but additional facilities are presently being developed by the state-owned private water company, DOWASCO, through a CIDA-sponsored water sector program. In early 1990, it was estimated by one source that almost EC\$3 million would be spent on capital works and rehabilitation projects in the water

sector. Another EC\$3.75 million was to be invested in the latter part of 1990 on water supply, distribution, and storage projects in the Portsmouth/Glanvillia area (*The New Chronicle*, 9 February, 1990, Roseau, Dominica). These estimates were correct.

Indoor plumbing is quite rare; about 70 percent of the population served relies on community standpipes and public wash houses (Stack, 1988), although DOWASCO hopes to have 50 percent of the country's households connected by the year 2000 (pers. commun., J. Noiseux, DOWASCO Chief Engineer, 1990). In addition to the DOWASCO supply network, there are several very small-scale water systems set up by non-governmental, international development organizations, such as Save the Children. These systems are managed by Village Councils and individual groups.

Actual per capita consumption levels in 1985 averaged 60 gallons per day (GPD) in urban areas, 40 GPD in rural areas, and 100 GPD in hotels (pers. commun., C. Meckling, DOWASCO General Mngr., 1990).

The total area within potable water catchments amounts to over 6,480 ha (16,000 ac) or 8.2 percent of the island's total hectarage. Catchments vary in size from about 5.0 ha (12.5 ac) to over 688 ha (1,700 ac); they feed streams with minimum daily discharges ranging from 0.3 to 1.3 million liters (James, 1985b; pers. commun., C. Meckling, DOWASCO General Mngr., 1990).

The oldest catchment now in use (serving the Portsmouth area) has been tapped since 1903. Twelve others have been utilized since before 1960 (James, 1985b). Because of age, compounded by the effects of Hurricane David in 1979, many of these systems are in a state of decay and will be rehabilitated under the CIDA-funded water program.

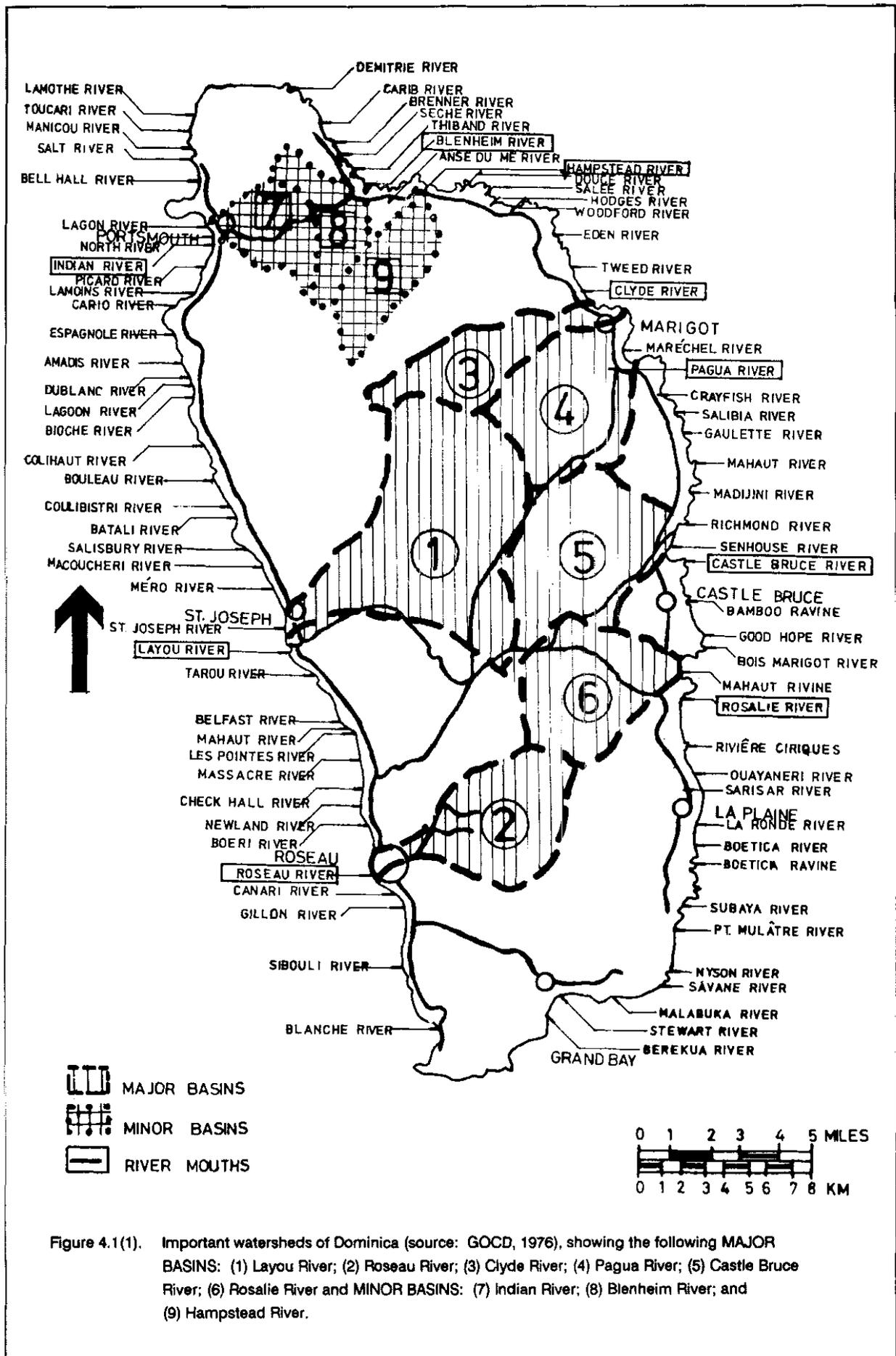


Figure 4.1(1). Important watersheds of Dominica (source: GOCD, 1976), showing the following MAJOR BASINS: (1) Layou River; (2) Roseau River; (3) Clyde River; (4) Pagua River; (5) Castle Bruce River; (6) Rosalie River and MINOR BASINS: (7) Indian River; (8) Blenheim River; and (9) Hampstead River.

The northeastern part of the island is the most poorly serviced (e.g., Atkinson, Bataka, and fringes of other settlements in the area). The region is plagued by both inadequate water supplies and an infrastructure in such poor condition that it is considered unworthy of rehabilitation. A new, consolidated water system has therefore been planned for the area at an expected cost of EC\$10 million (pers. commun., C. Meckling, DOWASCO General Mngr., 1990; *The New Chronicle*, 9 February, 1990, Roseau, Dominica).

Water from all catchment areas is treated only with chlorine, as a means of killing bacteria. As discussed further in Section 4.2, this minimal level of treatment may prove to be insufficient, in part due to the high degree of private ownership of catchment areas coupled with a lack of effective control over land use activities which may affect water quality.

At EC\$2.50 per 4,550 liters (1,000 imperial gallons), the domestic price of water in Dominica is about three times lower than that paid in St. Lucia and probably the lowest price paid in the Caribbean. There seems to be some justification for a price increase which could help offset operational and maintenance costs. Such increases are expected to be recommended by DOWASCO in the near future.

## FRESHWATER EXPORTS

Dominica has been exporting freshwater for at least ten years. Regular shipments go to St. Maarten and occasionally to other Caribbean islands (Antigua, for example, received water exports for a short period in the mid-1980's). Sales have been made on an *ad hoc* basis, on demand, generally one to four times per month, but DOWASCO is currently gearing up to expand water exports. The current purchase price is EC\$5.00 per 4,550 liters (1,000 imp. gal.), twice the amount charged to domestic consumers (pers. commun., C. Meckling, DOWASCO General Mngr., 1990).

The water for bulk sales has traditionally been drawn from the watershed sys-

tem that supplies the greater Roseau area. Prior to Hurricane David in 1979, this system was fed by the Stewart Hall and River Douce catchment areas and, after the hurricane, only by the Stewart Hall catchment (pers. commun., A. James, Forestry and Wildlife Div., 1990). The latter provided insufficient yield to sustain the increase in exports as water shortages within the local supply system commonly occurred following pipeline transfers to the barges. The situation was improved recently by the addition of two new water intakes to the Roseau area system – one at River Douce and the other on a spring at Snug Corner (pers. commun., C. Meckling, DOWASCO General Mngr., 1990). A 4.55 million liter (1 million gallons) water storage reservoir has also been installed, specifically for current sales to water barges. Plans are underway to further increase the export supply with water from the Roseau River, drawn via pipeline from a point below the hydroelectric power stations.

Additionally, to the north adjacent to Portsmouth, a five mile pipeline is under construction to provide cruise ships with freshwater from the Picard River. The project is being undertaken in conjunction with development of a new cruise ship docking facility near the Cabrits National Park and is scheduled for completion in 1991, at a cost of US\$600,000.

Spring water is also bottled for commercial sale, by a firm at the southern end of the island. Reportedly, foreign industrialists recently expressed interest in establishing additional water bottling operations for extra-regional export (*The New Chronicle*, 9 February, 1990, Roseau, Dominica).

## HYDROELECTRIC POWER

As discussed in more detail in Section 6 of the Profile, Dominica's freshwater resources have been targeted for development as a source of hydroelectric power. Until the start of the current Hydroelectric Expansion Project, some 40 percent of all electricity needs were met through generation at the Trafalgar and Padu power stations, both located along the Roseau River. The Trafalgar

Station is presently out of operation during construction for the hydropower project, but following the project's completion, it is projected that approximately 60 percent of the country's electricity needs will be met through hydropower, at least until the mid-1990's (see also Section 6).

#### **ADDITIONAL USES OF WATER RESOURCES**

Other uses of Dominica's streams and waterways by local communities include: fishing (allowed only during the open season, September through February), laundering, bathing, swimming, boating (on the Indian and Layou Rivers), aggregate mining, and for religious baptismal services.

#### **LEGISLATION**

A review of water resources legislation and administration was carried out in 1988 by FAO (Stack, 1988) which concluded that there was an insufficient legal base for ensuring the protection of Dominica's water resources. The study also made note of a variety of problems and limitations associated with extant water legislation at that time.

Among these was the fact that Dominica's water resources were governed by Common Law riparianism, as it had been inherited from the English. Stack (1988) felt that this system was ill-suited to the needs of a developing country and might "result eventually in unsound, haphazard water allocation decisions." In 1989 new legislation was enacted, the Water and Sewerage Act, which established a water rights permit system, as had previously been recommended by Stack (1988), and replaced the former system based on the riparian doctrine. The Act also establishes the Dominica Water and Sewerage Company, Limited (DOWASCO) to manage water and sewage operations in the country. The privately-owned company and the enabling legislation, respectively, have replaced the National Water Services and the Central Water Authority Act of 1986 (see also Section 11).

As noted by the Chief Technical Officer of the Ministry of Communications and Works (pers. commun., A. Burnette-Biscombe, 1990), there is a need for additional regulations regarding the removal of construction material from river banks and beds. The provisions of the Beach Control Ordinance (1966) have not effectively been extended to rivers where the removal of sand, stones, and other aggregate has resulted in stream edge slumping, erosion and flooding in some areas, particularly after heavy storms. Such physical changes can have an adverse effect on water quality and the regularity of downstream flow rates.

## **4.2 PROBLEMS AND ISSUES**

### **WATER LEAKAGE AND WASTAGE**

In 1985 the Government's National Structure Plan reported that of the total amount of water produced by all water catchment systems (8.25 million gallons per day [MGD]), only about 40 percent was actually consumed, due to a high rate of leakage and consumer wastage. Island-wide, the per capita rate of water production was 137 gallons per day, but actual per capita consumption averaged only 60 gallons. GOCD also noted that if leakage could be reduced to approximately 25 percent in various supply areas, present quantities would probably be sufficient to increase supply levels and accommodate population increases for several more years (GOCD, 1985). As outlined in Section 4.3 below, these problems are in the process of being addressed.

### **CONFLICTING LAND USES WITHIN WATER CATCHMENTS**

Virtually all of Dominica's water catchments are comprised primarily of private lands; some are located entirely on privately-owned property (pers. commun., C. Meckling, DOWASCO General Mngr., 1990). Given the lack of effective controls on private land, many land use activities in catchments are inappropriate and potentially put potable water supplies at risk. Additionally, water shortages

and supply disruptions have been reported in some areas (Christian, A., 1988); these might, in some cases, be a result of deforestation and the resultant increase in the overland flow of water rather than its gradual release into streams.

In 1985, only eight of the catchments were free of cultivation and in at least fourteen of them, over 50 percent of the total area was under cultivation. Six or more of the catchments were almost completely (i.e., 90 percent or more) cultivated (James, 1985b). Given the dominance of the agricultural sector in the Dominican economy (see Section 3), it is likely that this problem will continue and become more severe than described in James' 1985 study.

Table 4.2 (1) presents more detailed information about the four key catchment areas, including current land use activities and associated impacts. Together these catchments provide water for about 36,000 people, almost half the island's population.

#### DATA BASE PROBLEMS

Data on stream flows are limited in Dominica, a situation which makes effective planning and management of the nation's freshwater resources more difficult. Some records, although not always continuous, do exist, including:

- one year of daily discharge levels for the Stewart Hall River (June 1956 through May 1957);
- about eight months of flow records for the Roseau River at a site near Trafalgar (August 1956 through March 1957);
- flow data from records kept at the Trafalgar and Padu Power Stations (Farnum, 1987);
- data on the Demitrie, Raymonstone, O'Hara, Riviere Blanche, Riviere Nyson, and Malabuka Rivers, collected between 1983 and 1984 (pers.

commun., A. James, Forestry and Wildlife Div., 1990);

- some data for the Macoucherie and Boeri Rivers for the 1985-1989 period (pers. commun., A. James, Forestry and Wildlife Div., 1990);
- on-going program of data collection for the Layou River since 1984 (pers. commun., A. James, Forestry and Wildlife Div., 1990).

More recent stream flow estimates are available for selected west coast sites (DOWASCO, May 1989 data):

- Picard River (at Portsmouth): 12.5 MGD;
- River Douce (at Roseau): 1.3 MGD;
- Springfield River (St. Joseph to Newtown section): 8.5 MGD;
- Snug Corner (Loubiere and Pointe Michel): 1.3 MGD.

A two-year water resources investigation to collect baseline hydrologic data in three Caribbean countries (Dominica, St. Vincent and St. Lucia) was initiated by the Institute of Tropical Forestry in Puerto Rico in 1983. Three watersheds were selected, one from each island, with continuously-recording gauges established on each to monitor stream flow and rainfall (Diaz, *et al.*, 1985). A comparison of data from the three sites is displayed in Table 4.2(2), and an assessment of rainfall and run-off at Layou River (the watershed chosen in Dominica) is presented in Figure 4.2(1).

Because of data limitations and in order to better assess hydroelectric potential on the east coast, six stream-gauging sites were recommended by the Caribbean Institute for Meteorology and Hydrology (Farnum, 1987) for the following rivers: Demitrie, Raymonstone, O'Hara, Riviere Blanche, Riviere Nyson, and Malabuka. None of these has yet been established, but as outlined

**Table 4.2(1). Principal water catchment areas and their land use activities.**

AREA	SIZE(ha)	INTAKE LOCATION	LAND USE ACTMTIES AND IMPACT
Water Area 1 (Greater Roseau Area)	318	Stewart Hall River	<ul style="list-style-type: none"> <li>- Several main roads</li> <li>- Deforestation</li> <li>- Cultivation ("heavily expanding"): bananas, citrus, root crops, vegetables, pineapple, guava, coffee, flowers</li> <li>- Housing, sheds, development</li> <li>- Pesticide, fertilizer use</li> <li>- Road improvements, improved access</li> </ul>
Grand Bay/ Pichelin Catchment	236	Pichelin River	<ul style="list-style-type: none"> <li>- Limited encroachment due to difficult access and National Park status within much of the area</li> <li>- But some livestock and riverside cultivation of dasheen and watercress</li> </ul>
Marigot Catchment	75	Martipot River (Crebiche)	<ul style="list-style-type: none"> <li>- Extensive cultivation (at least 12 ha): coconuts, citrus, vegetables, coffee, anthuriums, root crops, use of herbicides</li> <li>- Many landslides</li> <li>- Significant soil erosion</li> <li>- Cattle grazing</li> <li>- Human activity (e.g., a garage)</li> </ul>
Portsmouth Catchment	215	South Branch River	<ul style="list-style-type: none"> <li>- Cultivation on steep slopes: vegetables, root crops, bananas</li> <li>- Erosion</li> <li>- Landslides</li> <li>- Cattle</li> <li>- Human settlement</li> <li>- Footpaths</li> <li>- Copra factories (small)</li> </ul>

Source: National Water Services Division (DOWASCO), 1986 Water Catchment Reports.

Table 4.2(2): Comparison of stream discharge for selected rivers in Dominica, St. Vincent, and St. Lucia.

STREAM/ COUNTRY	DRAINAGE AREA (mi <sup>2</sup> )	MEAN MONTHLY DISCHARGE (ft <sup>3</sup> /s)	DISCHARGE PER UNIT AREA (ft <sup>3</sup> /s/mi <sup>2</sup> )
Layou River, Dominica	27.1	290.0	10.70
Buccament River, St. Vincent	7.12	32.0	4.49
Troumassee River, St. Lucia	5.44	20.0	3.68

Source: Diaz, *et al.*, 1985.

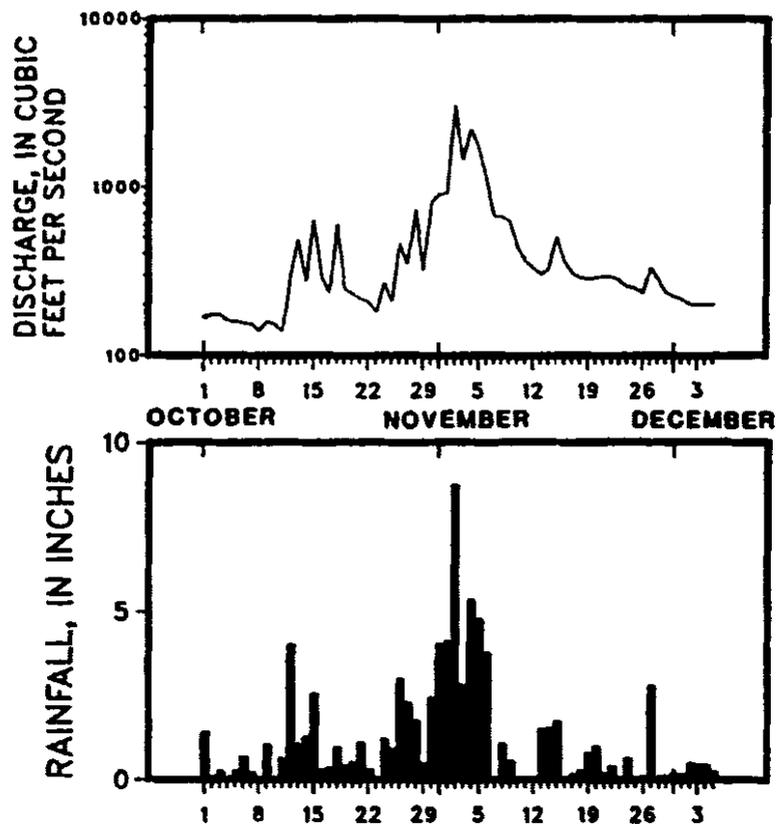


Figure 4.2(1). Run-off/rainfall relationship at the Layou River basin, Dominica, during October and November, 1984 (source: Diaz, *et al.*, 1985).

below a data collection program is now being organized.

The lack of an adequate information base and the need to develop a data management system to provide continuous records over long periods of time have long been recognized in Dominica. Several efforts have been made in the past to establish water data collection programs, but all have had limited success in meeting their objectives (Clark, 1983).

#### 4.3 POLICY RECOMMENDATIONS

##### SUPPLY, LEAKAGE, AND WASTAGE OF FRESHWATER RESOURCES

The main objective of the current phase of the CIDA-sponsored Dominica Water Sector Program is to rehabilitate the country's water supply systems and thereby reduce leakage (other primary objectives are institution building and personnel training). A specific program for leak detection is to begin in late 1990 (pers. commun., J. Noiseaux, DOWASCO Chief Engineer, 1990).

As noted in the National Structure Plan (GOCD, 1985), a metering program also is planned which will reduce wastage. At present, all new water connections are set up with a meter and all existing ones are expected to be metered within 10 years. About one thousand water meters presently exist (pers. commun., C. Meckling, DOWASCO General Mngr., 1990).

By 1995 it is hoped that the overall diffusion rate will be about 95 percent, made possible in part through the installation of new supply systems. The planned projections for potable water delivery for 1995 are as follows:

- Roseau and other urban areas: 60 gallons per capita/day
- Rural areas: 40 gallons per capita/day

- Hotels: 800 gallons per capita/day.

##### MINIMIZING THE THREAT OF CONTAMINATION TO THE WATER SUPPLY

The high level of private land ownership within catchment areas carries with it significant risks of water supply contamination. At present, there are a variety of incompatible activities on these lands, occurring on a fairly widespread and expanding basis. The results of recent studies of agrochemical pollution by the Consortium for International Crop Protection (CICP) suggest that the effects of chemical fertilizers and pesticides are not yet a threat to human health through the water supply (pers. commun., J. Mann and P. Ross, CICP, 1990) (see also Section 8 of the Profile). However, further studies conducted at other times of the year and/or based on other sampling locations may find different, less positive results. In any case, it is difficult to be confident that a contamination problem can be avoided for much longer, given current land use trends.

Authorities responsible for the management and protection of water resources have two basic options for avoiding the eventual degradation of the country's water supply. First, they can move water intakes to other (usually higher) locations that are free, at least for the time being, of human activities which pose a potential threat to the water supply. Alternatively, they can seek to control land use activity in existing domestic water catchment areas. It is the latter option which presently is being pursued by DOWASCO.

As provided for under the 1989 Water and Sewerage Act, the Company recently recommended that *all* of the island's catchment areas be declared "Water Quality Control Areas;" this recommendation has yet to be acted upon by the Ministry of Communication and Works, the agency to which DOWASCO is responsible (pers. commun., C. Meckling, DOWASCO General Mngr., 1990). However, even if this recommendation is accepted and the catchments are in fact declared "Water Quality Control Areas," this is

## THE STEWART HALL WATER CATCHMENT AREA A "Protected Forest"

At present, the Stewart Hall Water Catchment constitutes the country's only Protected Forest zone, as provided for under the 1958 Forests Ordinance. Land use restrictions for the area are established in the Stewart Hall Catchment Rules (1975) and are strengthened by imposition of significant penalties for violations, i.e., a fine up to EC\$10,000 and/or imprisonment for a maximum of one year. The rules prohibit cultivation and other activities which may be detrimental to the water supply. However, as illustrated in Table 4.2(1), a variety of such activities are carried out in the catchment area – without prosecution. In fact, not one violation has been cited since the regulations were enacted. One problem has been the fact that compensation was not provided to the owners of land within the Protected Forest, as was the original intention, and, furthermore, land owners generally have been unable to sell their land, as prospective buyers are aware of the restrictions which (at least on paper) exist (pers. commun., F. Gregoire, Director of Forestry and Wildlife, 1990). Until issues of compensation and enforcement are resolved, there is little incentive for Government to establish other Protected Forests for resource management and protection purposes.

not a guarantee that they will in fact be protected (for example, see sidebar on the Stewart Hall Water Catchment).

Over the longer term, DOWASCO intends to develop multi-village "consolidated water systems" in most parts of the island which would drain catchment areas located partly or largely within the better protected Forest Reserve and/or National Park boundaries. These systems also would enable collected water to be treated in larger, more efficient treatment plants.

With reference to these projected plans, two observations seem appropriate. First, activities that are potentially harmful to potable water supplies can legally occur within Forest Reserves (e.g., logging) as well as National Parks (e.g., hydropower development, intensive recreation). It therefore would be very useful for DOWASCO to identify as early as possible the most promising water resource areas within these zones, for such information will help ensure that future water supply demands and water quality considerations are included in GOCD decision-making for targeted sites.

For example, the detailed forest management plan presently being prepared for all of Dominica's state forests could be improved if more specific information were available about Forest Reserve locations earmarked for water supply exploitation, e.g., the Plan might include more specific recommendations about timber harvesting as well as other prescriptions appropriate for DOWASCO-designated water catchment areas. Unfortunately, location-specific information is presently unavailable regarding DOWASCO's plans for Forest Reserves. Presumably, this stems in part from the lack of available hydrological data, as discussed above.

Secondly, according to Prins (1987), it is estimated that only about 60 percent of the land for consolidated water systems will actually fall within Forest Reserve or National Park boundaries. If this is in fact the case, notwithstanding the lack of location-specific plans for catchment areas, then a large proportion of the island's water catchment areas will continue to fall under private ownership. Inevitably, it will become imperative for restrictions to be introduced and enforced on the use of private lands within all catchment areas or for these lands to be acquired by

Government for protection. In either case, financial or other compensation (e.g., land swaps) will probably be required. Securing the funds or other resources necessary for such compensation should be actively pursued at this time. Over the long term, doing so will most likely prove to be the most cost-effective approach for ensuring a safe and reliable water supply for island residents.

#### **DATA COLLECTION**

As noted earlier in this section, the limited availability of hydrological data has jeopardized effective, long-term planning ef-

forts for the country's water resources, a situation which has not been helped by the lack of a data collection unit within DOWASCO. However, DOWASCO is presently negotiating a contract with the Caribbean Meteorological Institute for the installation of a dozen or so gauges to measure rainfall and stream flow. The project will be funded by CIDA (pers. commun., J. Noiseaux, DOWASCO Chief Engineer, 1990). Additionally, in 1991, DOWASCO intends to expand the data collection system to approximately 50 locations (pers. commun., C. Meckling, DOWASCO General Mngr., 1990).

## SECTION 5 COASTAL AND MARINE RESOURCES

### 5.1 OVERVIEW

#### PHYSICAL FEATURES

Dominica has a 153 km coastline that adjoins a 715 sq km coastal shelf. Most of the western portion of this shelf is less than one km wide but broadens to approximately five km along the east coast in the vicinity of Marigot (Figure 5.1(1)). The coastal plain is similarly narrow except around Portsmouth on the west coast. Currents that sometimes exceed 1 m/sec (2 kn) set westward off the north and south coasts during flood tides. Along the east coast, currents divide in the vicinity of Pointe Giraud and flow north and south around the island (Cambers, 1985). Ebb and flood currents on the west coast set south to southwest and north to northwest, respectively, with a flow generally less than 0.4 m/sec (0.8 kn) (Goodwin, 1985).

Beaches are generally narrow and consist of stones and black volcanic sand. Beaches at Rock-A-Way (south of the Boeri River) and Douglas Bay are particularly popular and, together with those at Prince Rupert Bay and Toucari in the northwest and Woodford Hill Bay and Hampstead on the northeastern coast, are among the most popular bathing sites for visitors. Narrow sand beaches on the east coast are associated with Pagua and St. David Bays. Other major embayments are Soufriere Bay (near Scotts Head), Woodbridge Bay (near Roseau), Grand Bay (southeast coast), and Grand Marigot Bay (east coast). The anchorage in Prince Rupert Bay (at Portsmouth) is the best in Dominica.

#### CRITICAL HABITATS

Seagrass, mangrove, and coral reef habitats are not extensive due to the steep topography and rugged terrain characteristic of Dominica's coast (see Figure 5.1(2)). Goodwin (1985) reports seagrass beds to be relatively extensive in the vicinity of Bioche, Dublanc, and Morne Espagnol and less so off Coulibistri, Colihaut, and the Cabrits. Four small mangrove stands and some larger areas of *Pterocarpus*

swamp forest and marsh occur mainly in the northern part of the island. The most important sites are listed by Johnson (1988) as Cabrits Swamp, Indian River Flats and Lagoon, Cane-field Pool and adjacent meadows, and the north coast swamps. James (1980) provides an in-depth review of some of the wetlands in Dominica.

While true coral reefs are extremely limited or non-existent, there are a number of

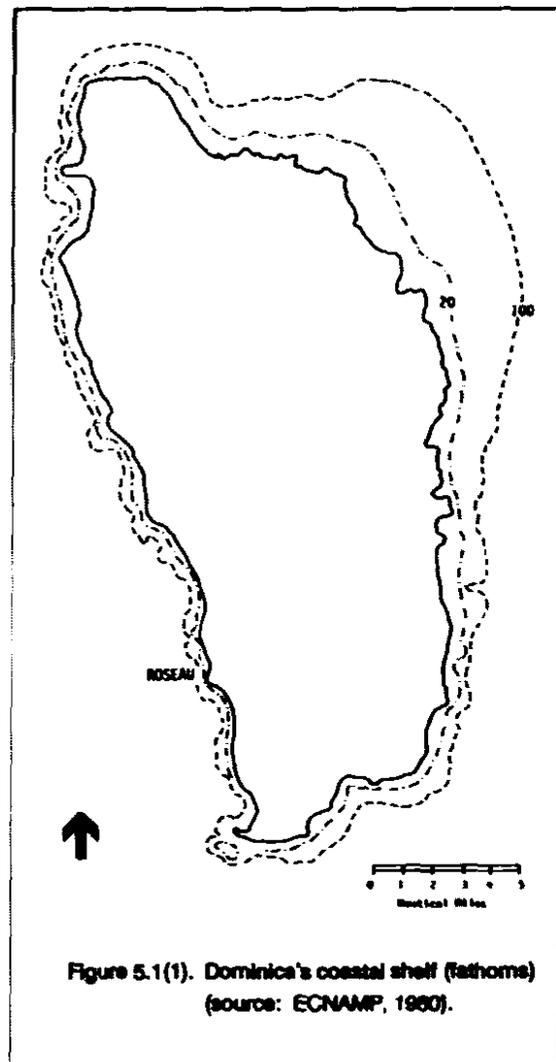


Figure 5.1(1). Dominica's coastal shelf (fathoms) (source: ECNAAMP, 1980).

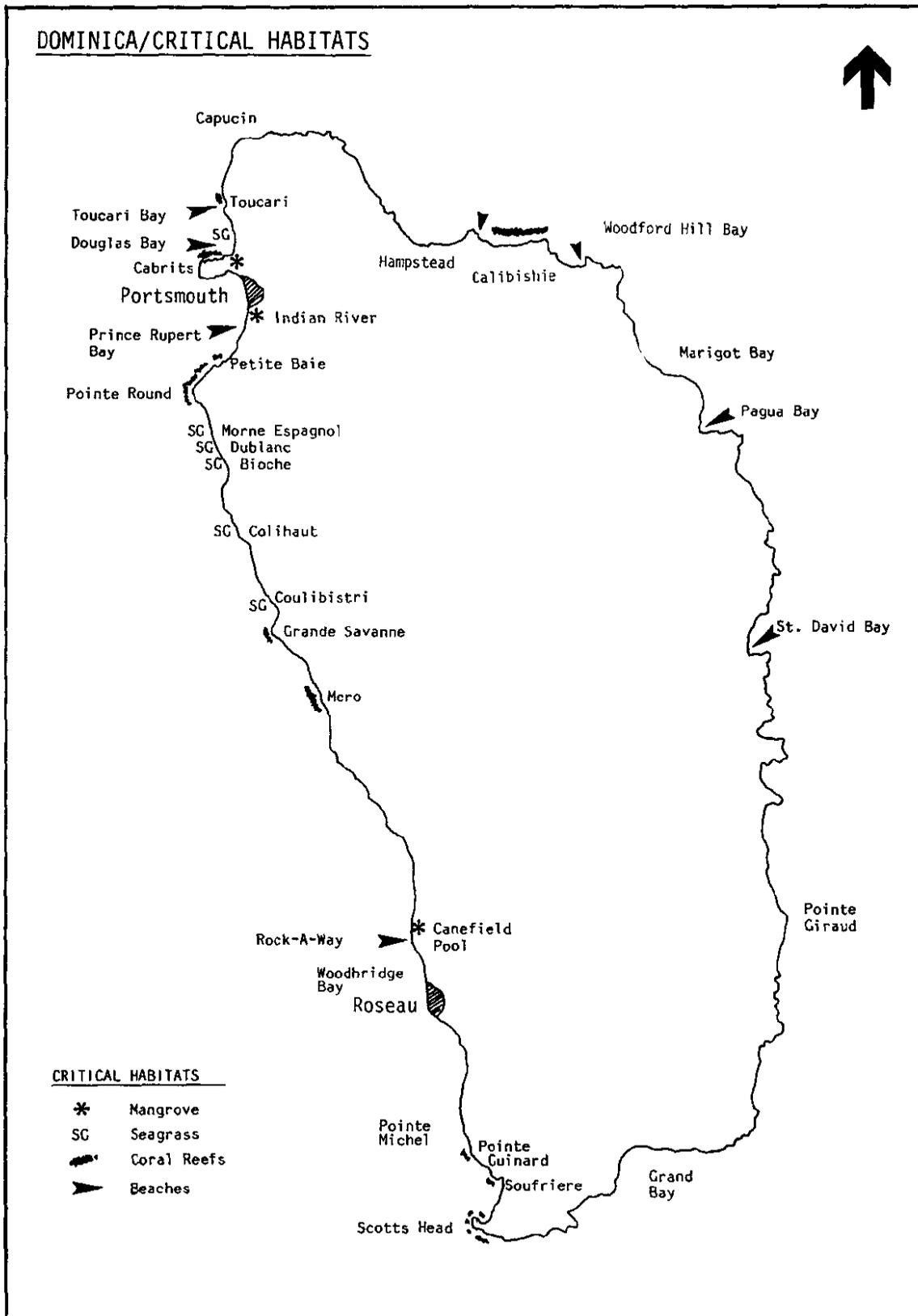


Figure 5.1(2). Coastal and marine habitats of Dominica (source: Goodwin, 1985; Johnson, 1988).

coastal areas in which there is extensive live coral covering rocks and boulders. The most significant sites include Scotts Head, Soufriere, Pointe Guignard, Mero, Grand Savanne, Pointe Round, Portsmouth, the Cabrits, Petite Baie, Toucari, Calibishie, and Pointe Baptiste. Goodwin (1985) identifies the latter two sites as having some of the richest coral assemblages and provides qualitative descriptions of major community components of reefs located on the western coast of Dominica. Summers (1985) surveyed the coral reefs of Scotts Head and provides an annotated species list from three reef communities in this vicinity.

These communities provide habitat for commercially important fish species typical of shallow reefs, as well as spiny lobster and queen conch. The limited extent of these habitats, however, constrains the absolute size of such stocks and their direct economic value. Much more significance has recently been attached to the potential value of underwater habitats to the tourist industry which is targeted for economic development in the country. Good visibility, diverse living veneers covering steep rock walls, caves, and pinnacles combine to make Dominica's west coast one of the most spectacular diving experiences in the Eastern Caribbean. Aside from the value to tourism, these particular habitats are certainly unusual and possibly unique within the Lesser Antilles; consequently, they are an important part of the natural heritage of the region as well as of Dominica.

## MARINE WILDLIFE

Because coastal waters become deep relatively close to shore, they are suited to a variety of pelagic marine vertebrates. Observations over the past eight years have indicated the presence of sperm whale on both windward and leeward coasts (although more frequently off the leeward coast, particularly between the Layou Estuary and Pointe Ronde). These whales are part of a population that ranges through the entire Grenada Basin throughout the year. The inshore portion of this range extends from the Grenadines to Guadeloupe and offshore to an

unknown distance, as the animals follow prevailing currents feeding in the scattering layer. Other cetaceans regularly occurring in the region include spinner and spotted dolphins (*Stenella longirostris*, *Stenella attenuata*, *Stenella clymene*), bottlenose dolphin (*Tursiops truncatus*), short-finned pilot whale (*Globicephala macrohynchus*), and false killer whale (*Pseudorca crassidens*); while Cuvier's whale (*Ziphius cavirostris*), Brydes whale (*Balaenoptera edeni*), and sei whale (*Balaenoptera borealis*) are also recorded. Humpback whales (*Megaptera novaeangliae*) also come into the area during the breeding season between November and March (pers. commun., W. Watkins, Woods Hole Oceanographic Inst. and P. Evans, Dominica Multiple Land Use Proj., 1990).

Twenty-seven species of seabirds have been recorded in Dominican coastal waters. Seven species breed in small numbers (tens to hundreds of pairs) between March and August on relatively inaccessible cliffs and offshore islets, primarily on the east and southeast coasts. These species include the white-tailed tropicbird (*Phaethon lepturus*), brown booby (*Sula leucogaster*), masked booby (*Sula dactylatra*), common tern (*Sterna hirundo*), bridled tern (*Sterna anaethetus*), sooty tern (*Sterna fuscata*), and brown noddy tern (*Anous stolidus*). Magnificent frigatebird (*Fregata magnificens*), laughing gull (*Larus atricilla*), and royal tern (*Sterna maxima*) are common non-breeders. The black-capped petrel, previously thought to be extinct, occurs in small numbers between November and April. Breeding of the latter species has not been established in local habitats (CEP Project Paper by P. Evans, Dominica Multiple Land Use Project, 1990).

Four species of marine turtles are known to breed along the coast of Dominica between May and October. Although no species is common, green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*) and leatherback turtles (*Dermochelys coriacea*) are the main species recorded. Loggerhead (*Caretta caretta*) turtles are rare. The latter species is considered vulnerable; the others are endangered.

## FISHERIES

The fisheries sector has been periodically reviewed in reports prepared by development assistance consultants (Vidaeus, 1971; Lintern, 1978; Michell and Gold, 1983; Anderson and Matthes, 1985; Goodwin, *et al.*, 1985). A recent overview (OECS, 1989) and description of a fisheries data collection system for Dominica (Lawrence, *et al.*, 1988) provide the most recent perspective.

Current annual fish landings are estimated at around 950 metric tons per year, although only half this quantity was landed in 1988 (pers. commun., N. Lawrence, Fisheries Development Division, 1990). Most substantial fish landings are taken from migratory pelagic stocks to the east of the island or in the channels to the north and south. Traditionally, this has been a seasonal fishery based primarily upon trolling from keelboats and canoes, supplemented by drift fishing or surface gill netting. Recent exploratory efforts, however, have established the viability of longlining on a more extensive basis than previously supposed (pers. commun., N. Lawrence, Fisheries Development Division, 1990).

Demersal fishes are harvested by Antillean Z-traps, hand lines, gill nets, and occasionally trammel nets, although the use of the latter gear is prohibited by law and is decreasing (pers. commun., N. Lawrence, Fisheries Development Division, 1990). Traps are the most frequently used gear and are constructed of wire mesh on a wood frame, although traditional woven bamboo traps are also used on the west coast. Demersal fishing activities occur primarily on the east coast where the island shelf is most extensive. Seining is the most common fishing activity on the west coast, targeting small, schooling pelagic fishes such as gar, ballahoo, and jacks. Gear is worked from beaches or, most commonly, from small rowed canoes. Other harvested marine species include spiny lobster (taken in the same traps as demersal fishes), conch, turtles, seamoss, and sea urchins (Lawrence, *et al.*, 1988). Whales are not hunted by the local fishing fleet, but dolphins and pilot whales are occasionally killed for their meat.

The fishing fleet traditionally has been based almost entirely upon open canoes and keelboats propelled by oars or outboard engines. Recently there has been increasing use of fiberglass, reinforced plastic vessels and traditional vessels strengthened with this material. Somewhat larger plywood boats are used in a few locations, but the Newtown fishing cooperative was recently obliged to sell its 19.8 m (65 ft) steel vessel due to difficulties with maintenance. There are 42 landing sites distributed around the entire coast, most of which are identified in Figure 5.1(3). Scotts Head has the greatest concentration of fishing vessels, followed by Pottersville, Portsmouth, and Newtown. Foreign vessels from neighboring islands are frequently seen fishing in Dominican waters, but no systematic information has been collected on these activities.

## COASTAL RESOURCE MANAGEMENT AND DEVELOPMENT

Comprehensive planning for coastal resource development appears to have been largely confined to the fisheries sector. In early 1979, Dominica's fishing fleet consisted of an estimated 500 boats and 2,500 full- and part-time fishermen. Later that year, Hurricane David destroyed approximately 90 percent of the fleet. In the past decade, various incentives (particularly a million-dollar credit facility) have stimulated recovery to the current estimate of 765 vessels operated by 1,850 fishermen (Lawrence, 1988).

Current fisheries development strategy focuses on providing more fish for domestic consumption through the introduction of fiberglass "transition" fishing craft to encourage fishermen to move from traditional canoes to more versatile and seaworthy vessels. These efforts are coupled with a FAO-sponsored project to improve ten landing sites that will provide efficient, community-based facilities to support the development program. FAO has also provided a master fisherman to assist with training activities including the introduction of fish aggregating devices (FADs).

Other foreign assistance with fisheries development includes a semi-commer-

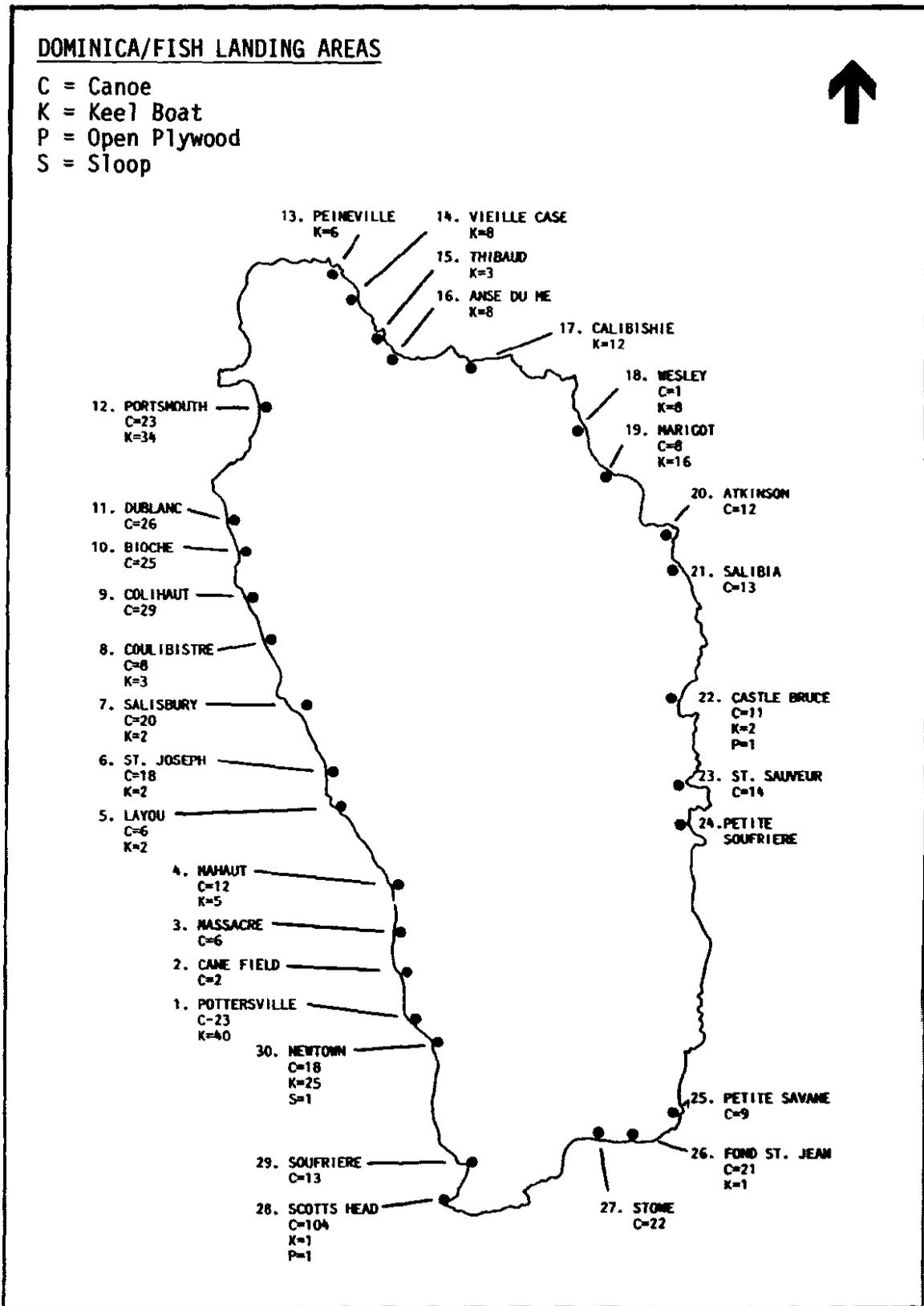


Figure 5.1(3). Dominican fish landing sites (source: Lawrence, et al., 1988).

cial, longlining vessel provided by Taiwan that is used to train Dominican fishermen (55-60 annually) and for exploratory fishing operations. Taiwanese assistance has also been provided for development of prawn (*Macrobrachium rosenbergii*) aquaculture as a means of generating supplemental revenue appropriate for low-income farmers. Additional aquaculture development plans call for introduction of hybrid talapia and possibly seamoss cultivation. ICOD has provided the services of a fisheries development adviser, while CIDA funds have been used for small grants to fishing cooperatives for icemakers, boat sheds, etc. The United States Coast Guard is providing some help in controlling illegal fishing, and OECS is providing help with surveillance aircraft on a limited basis.

Superficially, it might appear that considerably more attention is devoted to the development of the fishing industry than to the management of the resources upon which this industry is based. But, in fact, the current emphasis upon developing better capability to harvest offshore resources may be the most effective short-term means of reducing pressure on nearshore stocks that have repeatedly been identified as overexploited (e.g., CIDE, 1988). The need for effective management of deep-water resources and shared stocks, of course, cannot be ignored, but this must be accomplished at a regional (and in some cases hemispheric) level. An OAS-sponsored fishery data collection program was in operation from 1984 to February of 1986 and was re-established in June of 1987 with support from the OECS Fisheries Desk in St. Vincent.

Other management activities related to coastal resources include the national parks program, which has a marine component at the Cabrits National Park, a coastal monitoring program to measure beaches and waves on a regular basis (Cambers, 1989), and an active Pesticide Control Board (see also Section 11 of the Profile). Civil service personnel charged with natural resource management are among the most experienced and personally motivated in the region. Their efforts, however, have tended in the past to be site and or theme specific, i.e., not guided by a

synoptic strategy for the management and development of coastal and marine resources.

The need for such a strategy is underscored by recent Government-sponsored plans for development of the coastal zone. Proposals for new port facilities for Portsmouth and Roseau at a cost of EC\$24 million were announced in 1989. The existing port at Woodbridge Bay, north of Roseau, will be extended by 300 feet to accommodate cruise ship traffic, and a new container park for containerized cargo is also being built at the Roseau facility.

In early 1990 ground-breaking ceremonies launched construction for an EC\$7.1 million cruise ship dock, reception terminal, and dock facility at Prince Rupert's Bay, north of Portsmouth. This new port, the only one in the Eastern Caribbean where passengers will disembark directly into a national park (i.e., the Cabrits National Park), will include a 300 foot cruise ship berth for the northern end of the island. A new marina is also planned for the Indian River area adjacent to Portsmouth, the island's first small boat harbor suitable for attracting yachting traffic. Despite the proximity of these projects to the Cabrits National Park, which includes substantial marine as well as terrestrial/historic components, no Environmental Impact Assessments were undertaken. In the case of the proposed marina, the environmental implications of this development are not inconsequential. One of the two most important wetlands in Dominica, Glanvillia swamp, will be affected by the project; this area of mixed *Pterocarpus* swamp is important for a variety of shorebirds, cranes, herons, egrets and duck, as well as for high densities of various crab species and ground lizards.

There are additional indications that Dominica's marine resources will be subjected to increasing and varied demands in the near future. (For information on the ports of Dominica and the role of the Port Authority, see Section 7.3 of the Profile.) Recreational scuba diving, for example, appears to have substantial potential as an economically viable industry, and it is noteworthy that the country's combination of outstanding underwater and terrestrial sites is increasingly cited as one

of its major attractions (e.g., Gleason, 1989). Dominica's proximity to sperm whale calving areas provides additional potential for marine tourism activities. Among the most popular commercial dive sites are Scotts Head, an underwater hot freshwater spring south of Pointe Michel, a cave at Pointe Guignard, and the Cabrits. Several ship wreck sites are frequently visited, including a tug and barge near Canefield, an iron-hulled sailing vessel at Toucari, and a World War One gunboat at Capucin Point. Recreational diving, however, has been widely associated elsewhere with degradation of popular sites (e.g., Rogers, 1987; Tilmant, 1987). A dedicated management effort will be needed to avoid similar impacts in Dominica.

## LEGISLATION

The Territorial Sea, Contiguous Zone, Exclusive Economic and Fishery Zones Act of 1981 establishes 12, 24, and 200 nautical mile boundaries for the first three zones, respectively, and defines a fishery zone bounded by the seaward extent of the territorial sea and exclusive economic zone. In theory, this legislation provides the basis for resolving resource allocation disputes such as the controversy surrounding the large and productive fishing bank ("Macuba") located 9-12 mi from the coast which is extensively used by French fishermen as well as Dominicans. In practice, however, such resolutions have not been easily attained.

The Fisheries Act of 1987 requires the Chief Fisheries Officer to prepare a plan for the development and management of fisheries. It provides for the licensing of foreign and domestic fishing vessels and fish processing establishments, and for the designation of local Fisheries Management Areas and organizations to represent local fishermen (called Local Fisheries Management Authorities). The broadly-based legislation also includes provisions for the leasing of land, foreshore, and sea bed for aquaculture and for the declaration of marine reserves; it authorizes fisheries research, prohibits the use of explosives or chemicals for fishing, and provides for the promulgation of regulations.

Fisheries Regulations which came into effect in October 1989 generally reflect provisions recommended by OECS workshops during 1984 and 1985 and require registration of all vessels operating in Dominican waters. Minimum safety requirements established by the regulations should help efforts to introduce improved fishing craft to the local fleet.

The Beach Control Ordinance, enacted in 1966, establishes a system for managing removal of sand and stones from beaches. The Ordinance is currently administered by the Physical Planning Unit, which relies on village councils to provide information on the permissible extent of mining for specific beaches. The Ordinance also provides seldom-imposed penalties for illegal removal of beach material.

There are no comprehensive coastal zone management regulations or subdivision requirements in Dominica and no legally adopted land use plan, except in the National Park. However, Dominica is a member of the International Maritime Organization, and it has ratified the Cartagena Convention on marine pollution prevention. The reader is referred to Section 8.2.3 of the Profile for a discussion of the need for legislation to control marine/coastal pollution.

## 5.2 PROBLEMS AND ISSUES

### LONG-RANGE PLANNING AND GROWTH MANAGEMENT

As is the case with most of the world's populated areas, Dominica is under considerable pressure to identify national strategies for protecting natural resources while simultaneously achieving economic development. The underlying problem is that long-term, public sector management goals are often incompatible with private sector development objectives, and immediate economic benefits are often more readily associated with national growth and development. Such a conflict was potentially developing in the area of the Cabrits swamp, a site within

## SOME IMPACTS OF HUMAN ACTIVITY ON COASTAL RESOURCES

ACTIVITY	IMPACT
<b>Agriculture</b>	<ul style="list-style-type: none"> <li>* toxicity to many species from pesticides, fertilizers, and waste effluents carried by run-off</li> </ul>
<b>Boating</b>	<ul style="list-style-type: none"> <li>• anchor damage to reefs and seagrass meadows</li> <li>• sewage impacts in areas with limited circulation</li> </ul>
<b>Construction</b>	<ul style="list-style-type: none"> <li>* mechanical damage to reefs and seagrass meadows from dredging</li> <li>• smothering of bottom communities and light reduction due to sediment loading from dredging and inadequate run-off control on construction sites</li> </ul>
<b>Fishing</b>	<ul style="list-style-type: none"> <li>• destruction of coral by fish traps</li> <li>• depletion of important grazers by overfishing</li> <li>• widespread coral damage where explosives are used</li> </ul>
<b>Industry</b>	<ul style="list-style-type: none"> <li>• toxic effects and oxygen depletion by nutrients, heavy metals, and other chemicals in sewage</li> <li>• death or stress in some species caused by elevated temperatures from heated effluent from power generators, factories, distilleries and agro-processing plants</li> </ul>
<b>Residential and Hotel Development</b>	<ul style="list-style-type: none"> <li>* smothering of bottom communities by sediment from poor erosion control</li> <li>* toxic effects from household chemicals in sewage</li> <li>• oxygen depletion and overgrowth of some species caused by nutrients in sewage</li> <li>• toxic and mechanical damage from solid waste disposal in coastal waters</li> </ul>
<b>SCUBA Diving</b>	<ul style="list-style-type: none"> <li>• mechanical damage to corals through diver contact</li> <li>• depletion of large fishes by spearfishing</li> </ul>
<b>Shipping</b>	<ul style="list-style-type: none"> <li>* toxic effects of petroleum and other chemical spills</li> <li>• damage to corals and seagrasses from anchors and accidental groundings</li> <li>• oxygen depletion from sewage disposal</li> <li>• injury to some species through entanglement or ingestion of solid waste dumped into the sea</li> </ul>

the Cabrits National Park where Government had previously sold a parcel of land for a planned resort development which is now likely to be dropped and the land repurchased.

Adverse impacts associated with *ad hoc* development in Dominica's coastal zone are described in numerous reports and studies. CIDE (1988) describes problems with transportation, sewage, and solid waste disposal in coastal communities, stating, for example, "It is already . . . obvious that Roseau . . . has far outgrown itself. Its urban infrastructure has become badly strained." Some coastal waters are heavily polluted by litter (cloth, cans, bottles, cardboard, paper, plastic) and heavy silting (GOCD, 1990a). Similar problems are described in Cambers (1985) and Fabien (1989). There is a tendency to focus upon these problems selectively, but they all reflect the absence of comprehensive development control guidelines and policies committed to maintaining the quality of coastal resources (see also Section 9 of the Profile).

Without such guidelines and policies, degradation issues can only be expected to worsen. Existing problems will inevitably be accompanied by conflicts between resource user groups. James (1987) has documented one such conflict between recreational sea bathers and stone crushing operations at Rock-A-Way Beach. Potential tourist activities at Scotts Head offer prospects for similar clashes, given the area's present use as a major landing site for fishing vessels.

It is encouraging that Government's commitment to developing tourism includes a stated intention to "enhance and preserve the cultural and natural resources of the country" (Boo, 1990). Yet, significant problems have already been linked to tourist activity including litter (exacerbated by the lack of adequate disposal facilities), garbage dumping from cruise ships, flower collecting, and a lack of "nature-orientation" among cruise ship passengers (Boo, 1990).

Possible adverse impacts notwithstanding, tourism development does offer potential for increasing local awareness about the value of natural and cultural resources and

for providing incentives for their protection. Dominica is presently at a critical juncture in its development; more synoptic and long-range planning, focusing on critical land use decisions, is required to address the issues discussed in the following sub-sections and to provide a basis for evaluating specific resource development proposals.

## WATER QUALITY

Inadequate provision for waste disposal is probably the most serious immediate threat to Dominica's coastal resources. An estimated 60 percent of households in the country are without satisfactory facilities for disposal of sewage and refuse (Fabien, 1989). The Roseau sewer system has no treatment facility, and most sewer outfalls are located adjacent to beaches and piers used by fishermen in the downtown area. Particularly on the west coast, soil conditions make individual treatment facilities impractical, and most houses in the small villages simply dump their liquid wastes into the streams or sea (CIDE, 1988). Inadequate refuse collection and land-fill facilities have caused widespread indiscriminate dumping at unauthorized locations (although a new solid waste collection and disposal system has been implemented along the west coast). Waste management problems continue to pose serious risks to human health as well as the coastal environment (see also Section 8).

Water quality is also jeopardized by sediment loading resulting in part from accelerated erosion and landslides caused by deforestation of steep slopes. This run-off also poses an unevaluated risk of non-point source pollution from agricultural chemicals and pesticides (see also Section 3.2 of the Profile). A similar risk is associated with impervious surfaces in urban and industrial areas. Unless remedial measures are taken, problems of contaminated run-off and waste management are likely to worsen with development of additional support facilities for tourism (e.g., the proposed construction of a 400-room hotel at Soufriere, near Sulphur Springs).

## MANAGEMENT OF PHYSICAL RESOURCES

Cambers (1989) reports "considerable" erosion of beaches on the north and east coasts following Hurricanes Gabrielle and Hugo in 1989. These natural impacts are exacerbated by sand mining, a practice which legally requires a permit under the Beach Control Ordinance of 1966. Because there is no regular surveillance or monitoring directed toward sand mining, however, there have been no prosecutions for unauthorized sand removal. Cambers (n.d.) reports that the Department of Public Works frequently engages in sand mining without requisite permits.

The practice of locating hard structures (e.g., hotels) directly on beaches also contributes to coastal erosion. There is no uniform set-back policy, and steep terrain occurs close to shore along much of the coast making set-backs difficult. The latter circumstance does not apply to many embayments, particularly in the vicinity of Portsmouth where set-back guidelines are urgently needed to avoid accelerated erosion.

Sand mining and nearshore construction can be expected to increase with intensified development of tourist facilities. Increased coastal erosion obviously will adversely affect the tourist industry itself, as well as fishermen who use beaches as landing sites.

## MANAGEMENT OF LIVING MARINE RESOURCES

Although their status has not been rigorously assessed, nearshore fishery stocks are probably being exploited close to or beyond sustainable levels (Goodwin, *et al.*, 1985). The Fisheries Development Division is concerned with the extensive capture of juveniles in trap fisheries and particularly in nearshore seine fisheries. While the current fishery development strategy targeted toward offshore resources should help reduce pressure on nearshore stocks in general, some species (e.g., spiny lobster, sea turtles, and conch) will continue to be exploited and require implementation of management mea-

asures provided in the Fishery Regulations of 1989.

The problem of managing offshore fish resources is complicated by the migratory nature of the stocks and the participation of foreign vessels in the fisheries, but the need to manage these stocks is well illustrated by the decline of Atlantic swordfish (Berkeley and Waugh, 1989). Fish landings throughout the Eastern Caribbean have fluctuated markedly in recent years, from a remarkable high in 1988 to a decline in 1989 that approached 40 percent in some cases (OECS, 1989). Both extremes may be influenced by increased exploitation from local and foreign fleets, as well as fluctuations in migratory patterns (possibly caused by unusual weather conditions). Whatever the cause, these fluctuations underscore an element of uncertainty.

Prudence should dictate caution in developing offshore fishing fleets targeted toward unpredictable resources, but the customary approach is to move quickly to secure some portion of the common property resource. The result is that fishery resources face a greater threat of overexploitation and the fishing industry faces increased vulnerability to economic disaster. The introduction of "transitional" vessels, coupled with low-cost means of increasing harvest efficiency (such as FADs) is a reasonable policy, but it needs to be coupled with vigorous efforts to secure regional management of shared pelagic stocks.

At least equal attention should be directed to the potential overexploitation associated with increased tourism. Diver-related damage to reefs is discussed above in Section 5.1. Anchor damage to coral reefs and seagrass beds is a frequent accompaniment of coastal tourism, as is the collection of corals, live shells, and other organisms for curios. The potential for boat tours that include whale and dolphin watching has been recognized, particularly between the Layou Estuary and Portsmouth, where sperm whales are often seen inshore, and in the vicinity of Scotts Head and Soufriere, where spinner dolphins are also frequently seen close to shore. But such activity also carries the potential for disturbing the animals to such an extent that they abandon the area. Without specific provisions

for mitigation, these types of impact are virtually certain. They will be particularly severe in Dominica because the limited extent of the country's coastal resources provides little buffer capacity.

### 5.3 POLICY RECOMMENDATIONS

\* A comprehensive coastal zone management (CZM) program should be implemented to provide overall guidance for specific development and management activities. This program should include, among others, the following elements:

- procedures to ensure water quality for multiple uses, e.g., fisheries habitat, human contact, and waste disposal;
- port development and improved port management;
- construction and maintenance of sea defenses;
- implementation of impact assessment procedures for development projects in the coastal zone;
- a policy on oil spills and dumping of hazardous wastes;
- management of protected areas;
- waterfront renewal;
- increased recreational opportunities, including marine tourism; and
- coordinated and broad-based participation in coastal resources management.

Emphasis should *not* be on regulation alone, as experience suggests that a program emphasizing education, incentives, technical assistance, cost-sharing, and cooperation will be more effective than a proliferation of rules and penalties.

Some early first components of a CZM program might include a marine recreational facilities plan, contingency planning for oil and toxic material spills, and a coastal water and beach sand monitoring program. Consideration also needs to be given to designing a permit system targeted at coastal developments, legislation to support the CZM program, training and other assistance for GOCD staff to implement a CZM program, monitoring and enforcement procedures to regulate development in the coastal zone, and a public education campaign focused specifically on coastal environments and their importance to national development.

Initial steps in planning a coastal zone management program for Dominica should include the following:

- (1) Analysis of the existing coastal resource system, including identification of the most significant problems and collation of prior research and available data;
- (2) Ranking of problems and targeting of issues which require priority attention;
- (3) Development of action plans including compliance schedules and a financial strategy.

Specific attention should be given to indicators of marine resource carrying capacity, particularly within the tourism industry and for marine recreational areas. Opportunities for optimizing carrying capacity should be considered, for example: protected access (e.g., walkways), visitor education, strict control of extractive activities, regulation of moorings, tour operator licensing and training, and education of other industry participants (taxi drivers, hoteliers, etc.) (OECS, 1986).

\* Provision should be made for essential infrastructure (especially sewerage and solid waste facilities, usually sited in the coastal zone) in advance of major development affecting the marine environment (e.g., tourism). At least partial recovery of capital costs could be achieved through user fees, es-

pecially for new developments that place high demands on such services. Particular attention should be paid to development of public infrastructure and facilities (e.g., docks, small boat harbors, dry storage facilities) in ways that are compatible with the overall goals of a coastal zone management program.

- Steps need to be taken to control upland erosion and sources of sediment loading (such as construction sites) which impact on the marine environment. The extent of non-point source pollution, particularly from agricultural run-off, needs to be assessed and steps taken to protect water quality.

- \* Current sand mining practices should be reviewed. If these practices are determined to have significant adverse impacts, alternative sources of construction aggregate should be evaluated. Measures to protect beach vegetation need to be established, and an appropriate coastal setback should be implemented and enforced.

- \* In view of the uncertain status and management difficulties associated with migratory pelagic stocks, fisheries development activities should continue to be directed toward providing multiple options, including aquaculture and habitat enhancement. In addition to supplementing food supplies, aquaculture might provide an opportunity to develop curio or ornamental fish trades without jeopardizing wild stocks.

Artificial reefs could provide additional alternative sites for nearshore fishing for recreational as well as artisanal fishermen.

Fishermen in Salisbury have traditionally fished on alternate days and in some cases haul their traps only once per week, suggesting that other voluntary management measures might be acceptable, such as a system of rotating closures based on artificial reefs that could allow heavily fished areas to repopulate. Goodwin (1985), in a report prepared for FAO, suggests that there may also be potential for enhanced spiny lobster production through the use of artificial shelters, an approach that has recently shown promise in Antigua. (See also Section 8.1.2 for a discussion of recent attempts by the Fisheries Development Division to use derelict vehicles for construction of artificial reefs, as one means of combating a growing solid waste problem in the country.)

- An environmental impact assessment, as part of the planning and land use optimization process, should be required for all large coastal development projects. The cumulative effects of such projects need to be assessed rather than a case-by-case analysis of each project in isolation. One option might be to strengthen the Physical Planning Division (PPD) and designate it as the GOCD lead agency responsible for impact assessment in the country. Alternatively, GOCD might choose to establish a CZM Development Advisory/Project Review Board to operate parallel to the PPD within the framework of the Economic Development Unit. In either case, a formal evaluation process should be established whereby other agencies have an opportunity for input into review procedures, perhaps including veto power over development projects in critical areas.

## SECTION 6 ENERGY

### 6.1 OVERVIEW

From an energy perspective, Dominica has the distinction of being first in the region on several counts. First, Dominica's "ecosystem productivity" (or measured net annual production of biomass by various ecosystem types) is the highest in the OECS group -- at nearly five times that of Antigua and three times that of Grenada (Robertson, 1985). Dominica's net average ecosystem production is, in fact, 9.5 thousand BTU/square meter/year.

Secondly, the combination of steep, rugged terrain and the orogenic (rain-producing) effect of high elevation in the interior produces sufficient water flow from selected watersheds for Dominica to have taken the lead in the region in producing electricity with water-driven units. The first two hydro-turbines were introduced in 1952 to generate electricity for Roseau. These two generators, located at Trafalgar, have a capacity of 320 kW each and replaced the old Government-operated diesel generators.

Until the 1960's, the national electricity network existed only on the west coast and extended from St. Joseph to Soufriere/Scotts Head. Another 320 kW turbo-generator was installed at Trafalgar, and in 1967, the second hydropower station was commissioned at Padu on the Roseau River downstream from Trafalgar. The Padu station has two 940 kW generating units and, along with Trafalgar, was able to meet the energy requirements of Dominica for a number of years (Bellmann, *et al.*, 1987).

By the end of the 1970's, the power network was gradually extended to reach villages and communities in the southwest, west, north and northeast of the island. However, in 1979, Hurricane David caused a massive disruption of Dominica's power system and heavily damaged the transmission and distribution network. By mid-1983, with a loan of EC\$1.6 million from the Caribbean Development Bank, the system was restored in size

and capacity to the pre-hurricane level (Bellmann, *et al.*, 1987).

Dominica Electricity Services (DOMLEC) was established in 1949 by the Colonial Development Corporation, and until 1983 ownership was shared by GOCD (49 percent) and the Commonwealth Development Corporation (51 percent). The company is now totally owned by GOCD and has the exclusive license for generation, transmission and distribution of electricity in the country (Bellmann, *et al.*, 1987).

### ELECTRICITY

Electricity consumption has been rapidly increasing in Dominica. In 1989 a total of 1,202 new customers were added to the national grid, and electricity sales increased by 8.4 percent. Total generation was 29.8 GWh and average peak demand was 6.8 MW, an increase of 9.3 percent and 13.6 percent, respectively, over 1988 (pers. commun., R. Bruney, Engineering Mngr., DOMLEC, 1990). See Table 6.1(1) and Figure 6.1(1).

This demand increase has been prompted by recent expansions in the distribution system. Beginning in 1985, an 11 kV transmission line was extended to the eastern portion of the island through implementation of the East Coast Rural Electrification Program, which included among its objectives construction of 22.5 miles of transmission lines and 60 miles of distribution lines (Bellmann *et al.*, 1987). To date, virtually all east coast communities have been connected to the DOMLEC grid (see Figure 6.1(2)).

Total *effective* generating capacity stands at 7.8 MW, which means that, at present, there is insufficient reserve capacity to meet peak demand at all times (pers. commun., R. Bruney, Engineering Mngr., DOMLEC, 1990). However, significant expansions in the system are being developed

**Table 6.1(1). Dominica Electric Services Limited, operating statistics for the years 1985 - 1989.**

	<u>1989</u>	<u>1988</u>	<u>1987</u>	<u>1986</u>	<u>1985</u>
<b>Generating Plant (kW)</b>					
Installed Capacity - Hydro	2,840	2,840	2,840	2,840	2,840
- Diesel	6,522	4,822	4,822	4,222	3,310
<b>TOTAL</b>	<b>9,362</b>	<b>7,662</b>	<b>7,662</b>	<b>7,062</b>	<b>6,150</b>
<b>Effective Capacity</b>					
- Hydro (Dry Season)	1,900	1,900	1,900	1,900	1,900
- Diesel	5,960	4,460	4,460	3,860	2,660
<b>TOTAL</b>	<b>7,860</b>	<b>6,360</b>	<b>6,360</b>	<b>5,760</b>	<b>4,560</b>
<b>Peak Demand (kW)</b>					
	6,830	6,010	5,450	4,790	4,300
- Growth (%)	13.6	10.3	13.8	11.4	6.2
<b>Production (kWh x 1000)</b>					
Gross Generation - Hydro	14,182	15,678	13,746	13,292	14,193
- Diesel	18,372	14,117	12,786	10,121	7,702
<b>TOTAL</b>	<b>32,554</b>	<b>29,795</b>	<b>26,532</b>	<b>23,413</b>	<b>21,895</b>
- Growth (%)	9.3	12.3	13.3	6.9	8.3
<b>Diesel Fuel used</b>					
in generation (Imp. Gal.)	1,088,661	858,546	813,196	679,040	543,175
kWh/Imp. Gal.	16.9	16.4	15.7	14.9	14.2

(continued)

Table 6.1(1) (continued). Dominica Electricity Services Limited, operating statistics.

	<u>1989</u>	<u>1988</u>	<u>1987</u>	<u>1986</u>	<u>1985</u>
Sales (kWh x 1000)					
- Domestic	14,671	13,769	12,496	10,758	9,656
- Commercial	6,125	5,695	5,501	5,378	5,521
- Hotel	1,078	774	611	-	-
- Industrial	1,518	1,395	1,239	1,365	1,328
- General Lighting	2,856	2,599	2,348	2,061	1,370
- Street Lighting	400	366	319	302	280
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TOTAL	26,648	24,588	22,513	19,864	18,155
	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
- Growth (%)	8.4	9.2	13.3	9.4	11.5
Power Station and Office Use (kWh x 1000)	874	727	710	570	445
Losses (kWh x 1000)	5,032	4,480	3,306	2,979	3,295
Losses (% of total Gen.)	15.5	15.0	12.5	12.7	15.0
Load Factor $\frac{\text{Avg. Load}}{\text{Max. Demand}}$	0.54	0.57	0.56	0.56	0.58
Number of Consumers at Year End					
- Domestic	15,813	14,770	13,547	11,977	10,796
- Commercial	949	859	780	726	636
- Hotel	31	24	24	-	-
- Industrial	51	50	50	39	38
- General Lighting	742	692	607	575	531
- Street Lighting	117	106	91	66	62
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TOTAL	17,703	16,501	15,099	13,383	12,065
	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
- Growth (%)	7.3	9.3	12.8	10.9	9.8
Number of Permanent Employees	150	143	136	132	129
Number of Consumers/Employee	118	115	106	101	94

Source: DOMLEC, 1988; pers. commun., R. Bruney, Engineering Mgr., DOMLEC, 1990.

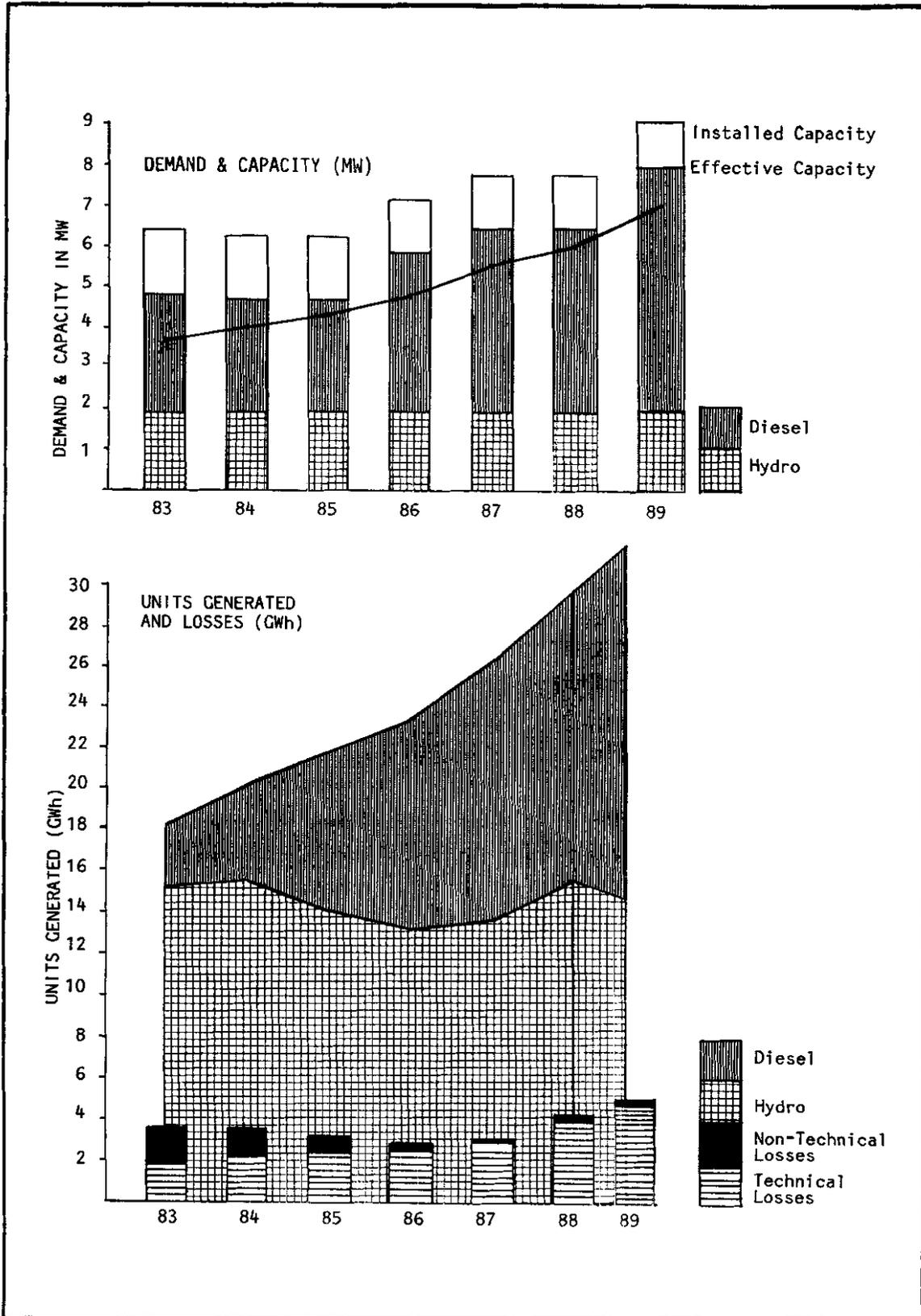


Figure 6.1(1). Electrical power trends, Dominica (source: DOMLEC, 1988; pers. commun., R. Bruney, Engineering Mngr., DOMLEC, 1990).

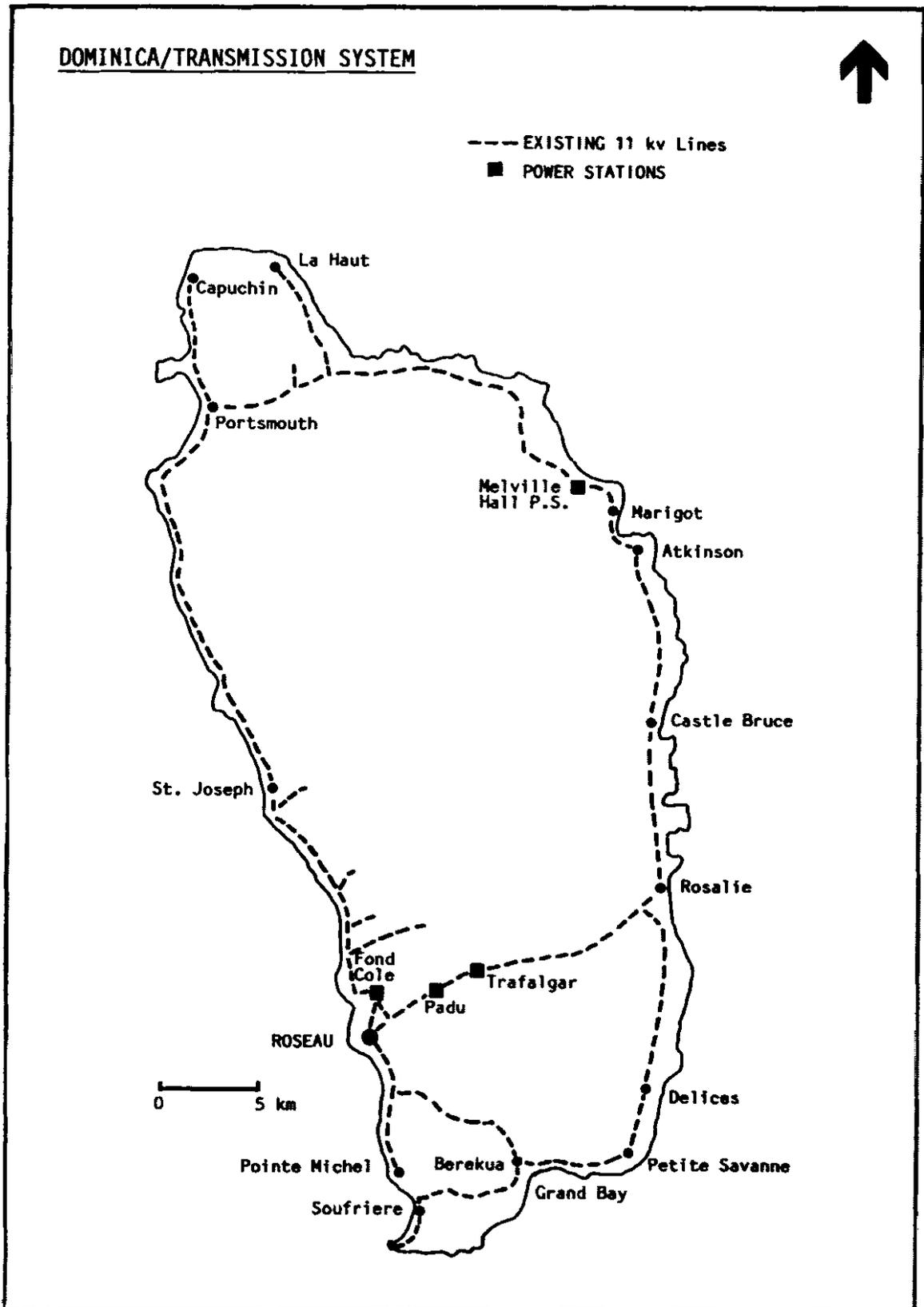


Figure 6.1(2). Existing transmission system and power station locations, Dominica (source: Shawinigan and Lavalin, 1984; pers. commun., S. Govindaraj, Hydroelectric Project Manager, UNDP/DOMLEC, 1990).

which are expected to widen the gap between capacity and demand until 1995/1996 and provide required room for maintenance and/or breakdowns in the system.

Details on the existing generation system and its component capacity are provided in Table 6.1(2). Also see the sidebar on page 118 on hydropower expansion.

## IMPORTED FUELS

As shown in Table 6.1(1) and Figure 6.1(1), present electrical generating capacity is met primarily through diesel combustion rather than hydropower, whereas in 1978 almost 90 percent of total demand (17.358 GWh) was met through hydro (GOCD, 1988b). Since 1984 the amount of fuel used annually in generation has more than tripled

Table 6.1(2). Capacity and components of existing electrical generation system, Dominica.

STATION	INSTALLED CAPACITY	EFFECTIVE (Dry Season) <sup>1</sup> CAPACITY
Trafalgar Hydropower Station 3 generation units, each of 320 kW maximum (this station is presently out of operation due to the Hydropower Expansion Project)	960 kW	700 kW
Padu Hydropower Station 2 generation units, each of 940 kW maximum	1,880 kW	1,200 kW
Melville Hall Diesel Station - 3 existing generators - new unit	470 kW (680) <sup>2</sup>	360 kW
Fond Cole Diesel Station 6 generators	6,052 kW	5,600 kW
<b>TOTAL (existing)</b>	<b>9,362 kW</b>	<b>7,860 kW</b>

1 Depending on water flow, conveyance efficiency, etc. for hydro and on ambient temperature, relative humidity, ageing for diesel.

2 To be installed June 1990.

Sources: pers. commun., F. Hamlet and R. Bruney, DOMLEC; S. Govindaraj, UNDP Project Manager, Hydroelectric Expansion Program/DOMLEC, 1990.

(from 317,542 to 1,088,661 imperial gallons in 1989). In 1989, 27.6 percent of all money collected by DOMLEC was spent on imported diesel fuel (about EC\$4.0 million), more than for any other company expense. This figure, however, still amounts to only a fraction of Dominica's total imports (1.6 percent), valued at more than EC\$236 million in 1988 (GOCD, 1988b).

The use of gasoline (primarily in the transportation sector) also has expanded significantly in recent years, due to a substantial increase in the number of registered vehicles on the island from (4,270 to 6,900 between 1978 and 1988) and to an increase in the number of drivers on the island (2,037 new drivers between 1984 and 1987). Gasoline imports in 1987 were valued at EC\$4.22 million, whereas in 1978 they amounted to only EC\$1.487 million (GOCD, 1988b).

Liquid propane gas (LPG) is an important domestic fuel, often used in conjunction with other fuels such as charcoal or firewood as an energy source for cooking. Based on a surveyed sample population, some 67 percent of rural households and 85 percent of urban (Roseau) households use LPG for cooking. It also is used for refrigeration. The total amount of LPG imported to Dominica in 1986 was 829 tons (Bellmann, *et al.*, 1987).

In 1980/81, approximately 65 percent of Dominican households relied on kerosene for lighting, according to the population census cited in Bellmann, *et al.* (1987) (it should be noted that the electricity distribution grid had been devastated in 1979 by Hurricane David, and it took three years to be fully reinstated). Only five percent used the fuel for cooking. In 1986 a total of 954,000 liters were imported, about the same amount imported every year since 1980 (Bellmann, *et al.*, 1987). However, it is likely that the quantity used has dropped off since 1986 and will continue to do so as the rural electrification program generates an expansion in electrical lighting.

## BIOMASS FUELS

Wood and charcoal remain important fuel sources in Dominica. In fact, slightly over

70 percent of all households use charcoal as the main fuel for cooking purposes (78 percent urban and 69 percent rural). Additionally, firewood consumption in rural areas is reported at approximately 40 percent (Bellmann, *et al.*, 1987). Annual wood consumption for both fuelwood and charcoal production is estimated at 15,000 cubic meters (10,000 tons) by Butler (1982), but Bellmann, *et al.* (1987) cite an estimate for charcoal production *alone* of 32,000 tons. Most of the charcoal is produced in earth pits which are relatively inefficient, particularly during the rainy season when they are difficult to operate. Butler's (1982) survey identified about 210 charcoal producers on the island.

Biogas production has proven to be a promising source of energy (cooking gas) on farms that generate a sufficient amount of manure or other biodegradable material that can be used as a raw material. About 12 farmers have set up "Borda" biogas plants with assistance from the Biogas Extension Program operated by CARDI, the Ministry of Agriculture, and the Small Projects Assistance Team (SPAT). The program is assisted by the German Appropriate Technology Exchange (GATE) through the Caribbean Development Bank (Rabess, 1989). For a biogas unit to produce enough gas to cook for a household of six, the manure of at least 3-5 cows, 10-20 pigs, or 200 chickens must be available (*The New Chronicle*, 1988). Other organic material, including food scraps or human feces, can also be used. The slurry produced as a by-product of the biogas unit is an effective fertilizer. Potential additional uses of biogas include electricity generation and refrigerator operation (two farms presently use biogas for refrigeration; pers. commun., G. Robin, CARDI, 1990).

Additional information on biomass energy, and on household energy consumption patterns is provided in Bellmann, *et al.* (1987).

## OTHER ENERGY SOURCES

Solar water heaters are imported to Dominica by Marinor Enterprises, Ltd. for hotel and domestic use. Although their use is limited at present, there is a developing trend

## THE HYDRO EXPANSION PROJECT

Overall hydropower expansion will include two additional generating units at the Trafalgar generating site, each with a capacity of 1,760 kW, and a 1,320 kW station under construction at Laudat, a new site located at a higher elevation within the same watershed. It is hoped that these works, when completed, will reverse the present ratio of hydro to diesel production from about 40:60 to 60:40 (pers. commun., F. Hamlet, DOMLEC Generation Engineer, 1990).

The project essentially consists of these two major sections, Laudat and New Trafalgar, each with an assortment of hydraulic and civil works; a schematic layout is provided in Figure 6.1(3). The main works of the Laudat section include the Clarke's River diversion weir and pipeline which will divert water from Clarke's River into Freshwater Lake (located in a different watershed) via the existing Three Streams Canal. A dam and associated civil works are under construction at the south end of Freshwater Lake. When complete, a woodstave pipeline will extend from the dam to a newly constructed surge tank above Laudat. Water from the tank will flow via a steel pipeline to the Laudat Power Station, the construction of which began in early January, 1990.

The New Trafalgar section includes a balancing tank at Laudat to receive flow from the Laudat station and (via a new pipeline) from the existing Titou intake which diverts flow from the Roseau River below its source at Freshwater Lake. From the new balancing tank, water will be directed to the old and new Trafalgar power stations. The new station is being built within the compound of Old Trafalgar Station, although a control tank will be sited partially outside. The existing steel pipeline from the Old Trafalgar Station to the Padu Power Station will be redirected through the control tank with provision made for a second pipeline to the Padu Station in the event expansions are sought at a later date. A recent progress report on the project can be found in Dominica's *New Chronicle* newspaper (23 February, 1990).

The overall project cost is currently estimated at US\$23.33 million (pers. commun., F. Hamlet, DOMLEC Generation Engineer, 1990), but many authorities feel additional cost overruns are likely. Almost all project funds have been borrowed, as shown in Table 6.1(3). The project is being undertaken through five main contracts, each of which is financed separately by the four external lending agencies and by CIDA.

which suggests their use may gradually be taking hold in the country (pers. commun., R. Bruney, Engineering Mngr., DOMLEC, 1990).

Future development of geothermal energy resources is now being actively pursued as one alternative for the next phase of generation expansion. Analyses of geothermal potential suggest that five MW of electricity could be generated (GOCD, 1985) and, since this projection is well beyond the immediate needs of the country, could be developed

in units of one to two MW and added to the present system in phases as demand increases. Development of these resources might also be feasible in the immediate future if external markets for this power source (i.e., neighboring islands) can be secured.

The latest National Structure Plan for Dominica (GOCD, 1985) reports that a low priority should be placed on geothermal development for the near future. However, a more recent paper by DOMLEC (Jabbal, 1988) suggests otherwise. In fact, it outlines a

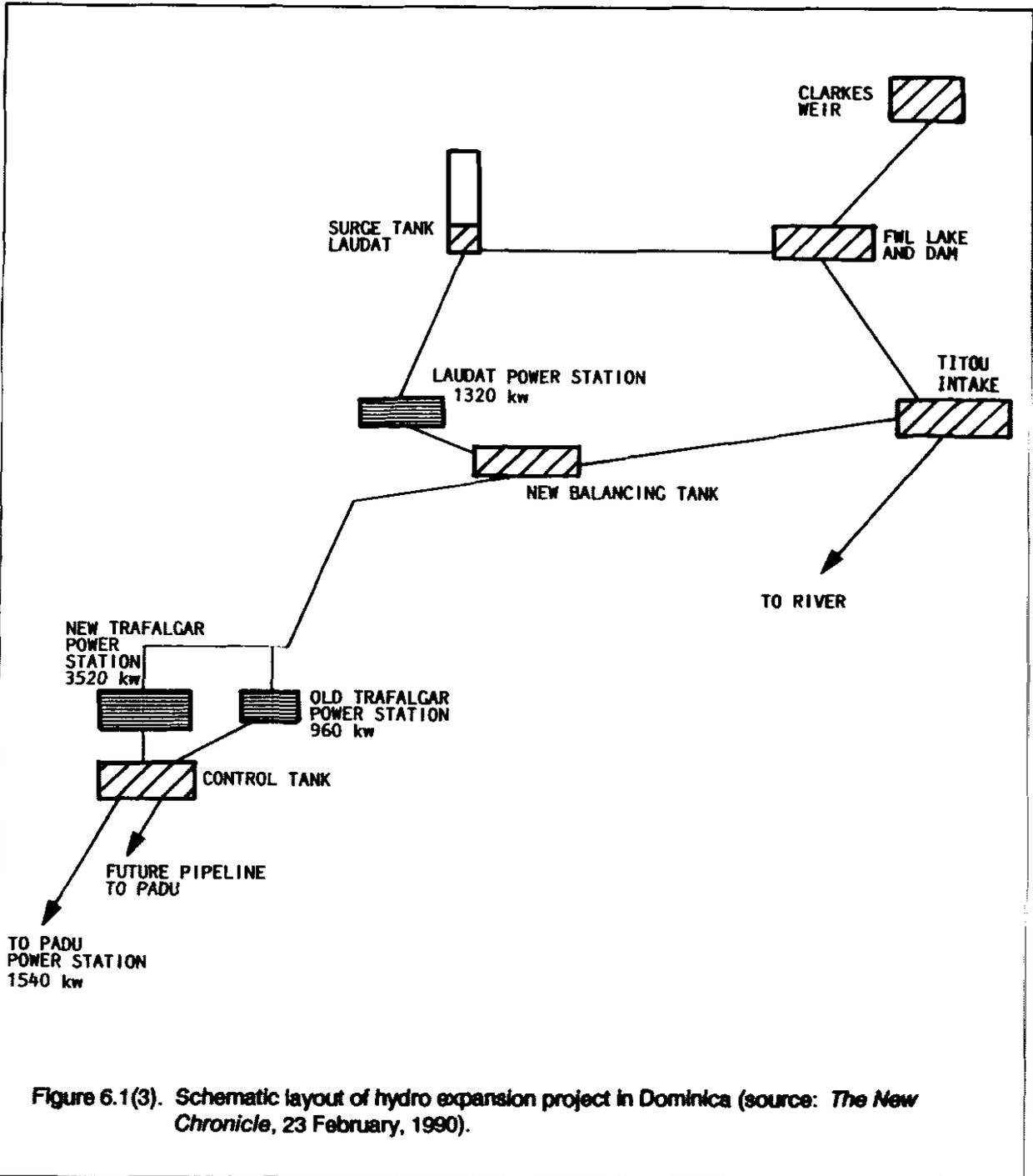


Figure 6.1(3). Schematic layout of hydro expansion project in Dominica (source: *The New Chronicle*, 23 February, 1990).

tentative schedule for more thorough investigations of geothermal potential, i.e., exploratory drilling to a depth of 800 to 1,500 meters and for final commissioning of a geothermal plant as early as the mid-1990's.

#### INSTITUTIONS AND LEGISLATION

Electricity is generated and distributed by Dominica Electricity Services, Ltd. (DOMLEC) which until 1983 was a joint venture between the Government of Dominica and the Commonwealth Develop-

Table 6.1(3). Funding sources for the Hydroelectric Expansion Project.

Funding Source	Terms	Amount(million US\$)
IDA (World Bank)	loan	3.00
CDB	loan	5.26
CCCE (France)	loan	3.39
European Investment Bank	loan	4.30
Local Bank	loan	2.00
CIDA	grant	1.86
DOMLEC	(In-kind)	2.23
GOCD	(In-kind)	1.29
		<hr/>
	TOTAL	23.33

Source: pers. commun., F. Hamlet, DOMLEC Generation Engineer, 1990.

ment Corporation. The latter then transferred its shares to the national Government which since has made shares available for public purchase (GOCD, 1985). Additional management of Dominica's electrical services (e.g., energy utilization in public facilities) is handled by the Ministry of Communication and Works through its Electrical Division. Apart from electricity generation and utilization, the Division of Agriculture (MOA) plays a role in the energy sector in the development of biogas energy sources (as discussed earlier in this section), and the Ministry of Trade deals with importation of diesel, gasoline, LPG and other petroleum products.

According to Stack (1988), the following legislation pertains to energy in Dominica:

- the Public Utility Commission Act (No. 28 of 1972);
- the Geothermal Energy Act (No. 24 of 1974); and
- the Electricity Supply Act (No. 7 of 1976).

Under the Electricity Supply Act, the Government maintains statutory authority to assign priority to hydropower generation over any other use of waters in designated stretches of the Roseau and Mural (a Roseau tributary) River systems (including all tributaries). In effect, no other uses of waters within these areas are permitted (Stack, 1988).

## 6.2 PROBLEMS AND ISSUES

### THE HYDROELECTRIC EXPANSION PROJECT

The potential environmental impacts of the hydro expansion project have been neither extensively nor intensively studied. The anticipated and observed (in the case of construction) impacts are described in a series of brief reports and memoranda, all of which were prepared once project planning was completed or the project itself was well under way (e.g., Scheele, 1989b and 1989c; undated/anonymous report in the files of DOMLEC entitled "Hydroelectric Expansion

Project -- Environmental Considerations of Major Civil Works in the Upper Roseau River Basin").

The degree to which environmental concerns were actually addressed at earlier stages of project conception and planning -- i.e., the phase during which they might be most usefully addressed -- can be surmised through an examination of the project feasibility study (Shawinigan and Lavalin, 1984). The study report, which is several hundred pages in length, contains approximately three pages of discussion on environmental matters and no reference to any other environmental impact studies being or having been undertaken. However, the study's Terms of Reference indicate that environmental effects were to be "thoroughly investigated," although they seemingly were not.

The following is a brief outline of major environmental impacts of the project as articulated by various local observers and concerned officials and as confirmed by Scheele (1989b and 1989c) and others.

#### (1) Impacts During Construction

- Soil erosion and sedimentation. According to the subjective assessments of the Forestry Division and Scheele (1989c), "a significant amount of soil erosion has occurred thus far in the construction process" (Scheele, 1989c).
- Landslides, primarily along the roads and tracks utilized by the construction vehicles.
- Quarrying for dam construction next to Freshwater Lake (20,000 cubic meters).
- Displacement of vegetation (along Freshwater Lake shoreline and elsewhere); more clearing than necessary has occurred in some locations.

- Displacement of research-related vegetation plots along the Lake shoreline.
- Visual impact in various locations within and near Morne Trois Pitons National Park.
- Significant restriction of access to and from the town of Laudat due to road degradation and a subsequent decline in the number of tourist visitations.

#### (2) Impacts During Operation (anticipated)

- Hydrological changes;
- Inter-basin stream transfer (Clarke's River normally flows into the Rosalie River and thus to the east coast);
- Water level changes at Freshwater Lake;
- Seasonal and diurnal effect on discharge (water flow) over Trafalgar Falls (degree of change will depend on operating regime at a given time);
- Water quality impacts;
- Negative impacts on waterfowl (waders, herons, and ducks);
- Possible increase in human risks, due to enhanced landslide potential and to the creation of a reservoir in an area of geological/seismological instability.

In 1989, once construction was well under way, a consultant was hired by UNDP to advise the Government of Dominica, particularly the Forestry and Wildlife Division, on techniques for managing and monitoring project impacts during construction. Additionally, the consultant is preparing an Environmental Impact Statement (EIS), scheduled for completion in December, 1990 (Scheele, 1989b, 1989c). Reportedly, a total of

US\$80,000 will be spent on the work of the UNDP consultant (pers. commun., S. Govindaraj, UNDP Hydro Project Manager, 1990).

While these more recent impact assessment efforts are useful, the cost for preparing the Environmental Impact Statement is very small if viewed within the context of total project costs (even *before* the likely cost overruns) and is reflective of a low level of environmental considerations in the overall project scheme. Furthermore, the EIS will be completed around the same time as projected completion of the construction phase, thus substantially diminishing the effectiveness of the EIS as a proactive project evaluation tool.

Several other important issues relevant to the hydro expansion project should be noted. First, most of the impacts described will occur within the confines of the Morne Trois Pitons National Park, the location of many of the hydro project works. This raises questions about aesthetic impacts, particularly as these relate to concurrent GOCD tourism objectives for the expansion of nature tourism in the country. This issue of non-conforming uses within the National Park is discussed in more detail in Section 2.1.2 of the Profile.

Secondly, the degree to which the hydro expansion project was evaluated (i.e., in comparison to other energy alternatives and with specific reference to both demand management and national energy conservation goals) is an important issue for Dominican resource managers. In retrospect, there is little evidence that either conservation, demand management or the matter of energy alternatives was given much attention in early discussions which led to development of the current hydro project.

Finally, a more significant, although controversial issue, arises from the hydro project's economic feasibility study, specifically as it related to the most obvious alternative, i.e., the expansion of diesel-generating capacity. Some of the current criticism in this regard, of course, arises from the clarity of hindsight. Nevertheless, the problem is relatively simple.

The feasibility assessment by Shawinigan and Lavalin (1984) was conducted on the basis of an assumed oil price structure that has subsequently proven to be off the mark. At that time, the firm compared various hydro development configurations with a scheme involving diesel-fired generation units. This comparison assumed a diesel fuel price of US\$52 per barrel and, at the time, the sensitivity analysis conducted reduced this price by only ten percent. In late 1985, however, just after the study was completed, the price of oil fell by approximately 50 percent. By March 1990, the price paid by DOMLEC had increased slightly but was still only US\$37.00/barrel. Theoretically, if the original assessment had foreseen the possibility of diesel costs significantly below the US\$52.00/barrel figure, it is argued by some that a decision against hydropower and for diesel generation might have been reached. However, since no impact assessment was undertaken at the time regarding the risks associated with greatly expanded imports of diesel fuel, there is some doubt about the validity of using only the market price of oil as reflecting the true net landed cost to Dominica.

In 1986, a "cost effectiveness review" was conducted by Shawinigan and Lavalin to determine whether oil price charges, as well as postponement of the "on-power" date for the Laudat section to 1989, would affect project viability. This review (Shawinigan and Lavalin, 1986) reports that the project remains cost effective relative to an all-diesel expansion for discount rates up to 11.4 percent for the lowest load forecast considered and for the lowest oil cost scenario.

It is beyond the scope of the Environmental Profile project to complete a detailed assessment of the Shawinigan and Lavalin cost effectiveness review (1986) or of the earlier feasibility analyses (Shawinigan and Lavalin, 1984). Suffice it to note that an additional independent economic study might have been worthwhile to confirm the feasibility of the project, including consideration of possible (or likely) cost overruns, lower load growth rates, and so forth. Construction work on the project is already substantially off schedule relative to what was assumed in the feasibility studies.

Furthermore, as with most feasibility studies, the Shawinigan and Lavalin assessments (1984; 1986) were conducted on the basis of fairly narrow, economic criteria. The additional environmental costs of the project have not yet been fully accounted for. At present, environmental costs are externalized and borne by the community and have not been in any way internalized as a cost of the project.

#### SUITABILITY OF THE COUNTRY'S PRESENT ENERGY PATH

A more general but nevertheless important issue confronting Dominica and other OECS countries in the energy sector is the extent to which the current pattern of energy development is suited to small, insular environments and to the process of attaining national economic self-reliance and resource sustainability. A significant amount of money and effort has been earmarked for a very large-scale project (by Dominican standards), the Hydroelectric Expansion Project, which will, as a side effect, increase the country's foreign debt and, to some extent, will also increase the country's dependence on imported hardware and expertise for system maintenance.

However, an important national argument can be made that this particular project will significantly *reduce dependency*, i.e., dependency on imported oil, which is certainly the situation confronting most OECS countries. Although DOMLEC's diesel imports amount to only a small share of total imports by value -- roughly 1.6 percent -- the dependency argument is not based only on a consideration of oil import costs which are at present not substantial. As one local observer has noted, it is important that the country does not depend too heavily upon an external energy source, in spite of the possibility that the external source is less expensive. Just as it is difficult to assess the cost of environmental and other adverse impacts of the hydroelectric project, it is likewise difficult to assess the benefits of the independence and security provided by lessening dependence on external energy sources (pers. commun., V. Sylvester, Electrical Engineer, Min. of Communications and Works, 1990).

The extent to which alternative and/or small-scale, decentralized forms of energy have been considered or promoted in Dominica is not clear, although there was a study undertaken in the early 1980's which looked at the feasibility of small-scale hydroelectric installations (Wason Consultants, Ltd., 1982). However, such efforts do not appear to have been substantial, nor have they been a part of a comprehensive energy development policy for the country. In many respects, Dominica is better suited than any other country in the region for the development and use of such energy forms (see Robertson, 1985).

There is a very high ratio of natural to commercial energy flow in Dominica compared to other Eastern Caribbean islands (see Figure 6.2(1)). A large indigenous pool of energy clearly exists. Admittedly, more understanding, assessment and feasibility analysis of these resources are required before they can be used for the benefit of more significant segments of the Dominican population.

Biogas, for example, has proven potential in Dominica. Wood and charcoal resources can be utilized more efficiently, particularly in view of the high degree of wood wastage that coincides with land clearing on the island (see also Sections 2 and 3). Investigations of wind energy potential in the Eastern Caribbean, conducted by the Commonwealth Science Council (Lamming, 1985), revealed that the potential of this resource is greater than was anticipated. Such potential is not so surprising perhaps in view of the fact that wind energy (mechanical) was used for hundreds of years in the Caribbean for grinding sugar cane and meeting other industrial needs. Finally, a study completed by Lawrence, *et al.* (1982) of the National Rural Electric Cooperative Association (U.S.), concluded that the east coast of Dominica possesses the necessary physical attributes for small, decentralized hydropower systems.

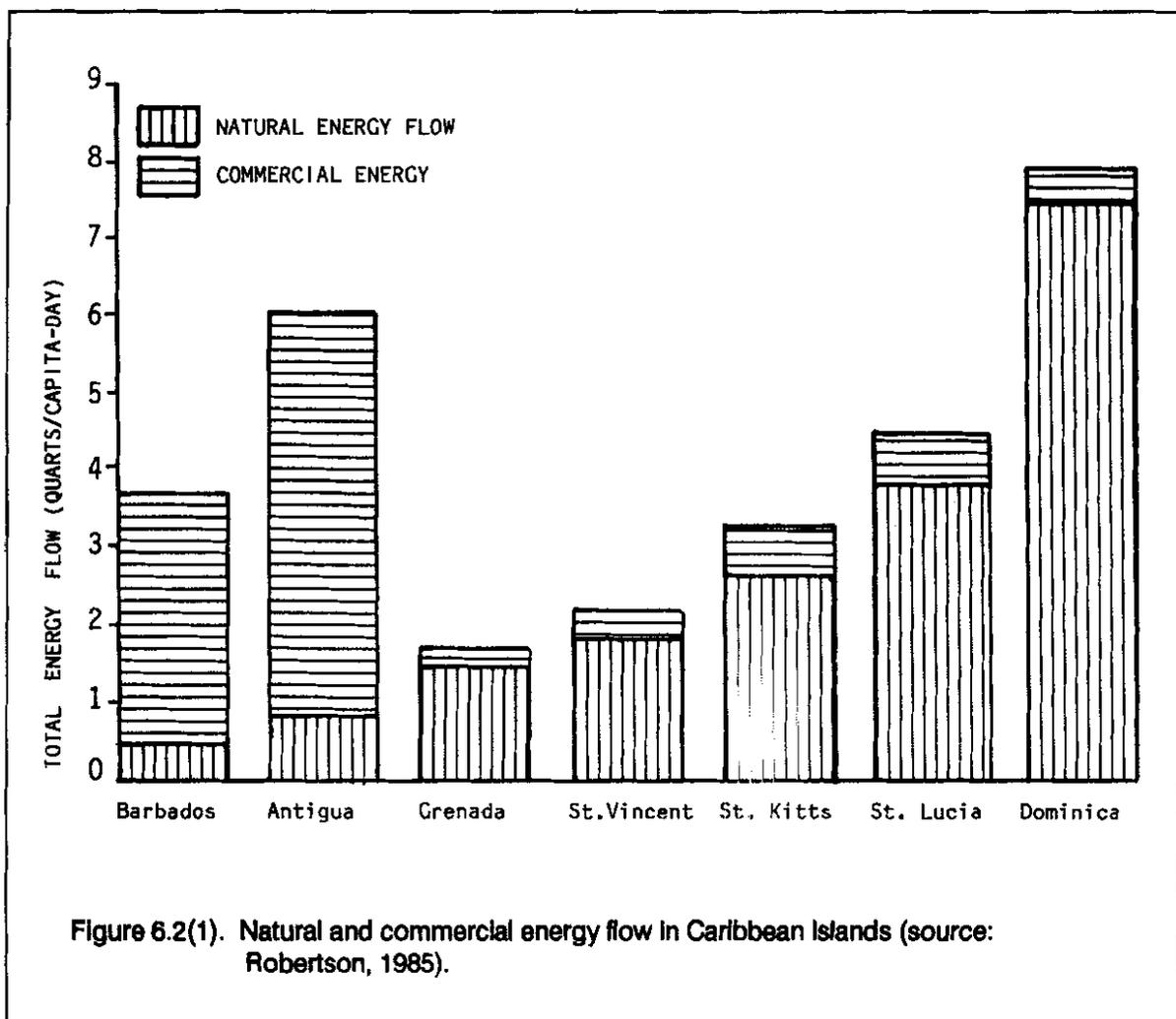
#### INSTITUTIONAL RESPONSIBILITY FOR ENERGY POLICY

At present no single agency is responsible for energy policy matters in

Dominica. DOMLEC is responsible for the generation and transmission of electricity via the national grid system; the Ministry of Communication and Works has some responsibility for electrical system utilization through its Electrical Division (e.g., inspection and certification of wiring and transmission installations and electrical maintenance in Government buildings); the Ministry of Trade deals with the regulation and pricing of petroleum imports such as diesel, gasoline, and LPG. None of these agencies, however, has responsibility for the broader aspects of energy policy formulation and evaluation. Reportedly, a three-person "Inter-ministerial Energy Committee" was established in 1988 to satisfy requirements attached to a loan from IDA and to deal with policy matters. However, the committee has been for all practical

purposes non-functional since its establishment.

Therefore at present, much of the country's energy-related policy formulation and decision-making, at least as they pertain to the generation of electrical energy, is centralized in a single, large electrical utility, DOMLEC, which understandably has its own perspective or biases in determining what is feasible or optimal with regard to energy development. Unfortunately, in the absence of a Government Energy Office, this situation will probably mean that consideration of smaller scale, decentralized, renewable energy options -- i.e., those which comprise a "soft energy path" -- will not receive as much attention as they deserve.



### 6.3 POLICY RECOMMENDATIONS

#### MECHANISM FOR REVIEWING ENERGY ALTERNATIVES AND ESTABLISHING ENERGY POLICY

Improved inter-agency coordination for energy policy concerns, e.g., long-term planning, more formalized consideration of alternative energy approaches, and feasibility studies, might be achieved if GOCD were to consider establishment of an Energy Unit within the EDU or, alternatively, an inter-agency Energy Policy and Development Board/Committee charged specifically with formulating long-term energy policy goals and programs.

Since limited funding is available in Dominica for research and development activities *per se*, the primary focus of Government relative to alternative energy sources should be on assessing the local applicability of technologies and approaches which have been employed successfully elsewhere, in environments and countries similar to Dominica. Such assessments could be formally integrated as a part of the ongoing planning responsibilities of the EDU and could be linked to similar efforts in other OECS countries as well as to regional programs. As noted by Kristoferson, *et al.* (1985), in small island developing nations, the best hope for progress in the energy sector lies in pooling what meager resources are available.

#### NEED FOR IMPROVED ENVIRONMENTAL INPUT

An environmental impact assessment, as part of the country's planning and land use optimization process, should be required for all large-scale energy projects. One option might be to strengthen the Physical Planning Division (PPD) and designate it as the GOCD lead agency responsible for impact assessment in the country (see also Section 5). Whatever mechanism is selected, a formal evaluation process needs to be established whereby all relevant agencies of Government have an opportunity for input into review procedures

before decisions about large-scale energy development projects are made.

The Government of Dominica may eventually choose to develop its geothermal resources, as recommended in the report by DOMLEC's general manager (Jabbal, 1988). In light of the potential for significant environmental impacts, as discussed in more detail in the St. Lucia Country Environmental Profile (CCA/IRF, 1988), the incorporation of environmental considerations at the earliest stages of program development is particularly important. In the specific case of Dominica's geothermal resources, this needs to be done as soon as possible since the "program conception" stage may even now be coming to an end -- given the fact that financial comparisons (e.g., additional hydropower or diesel generation vs. geothermal power) have already been made (see Jabbal, 1988).

With specific reference to the Hydroelectric Expansion Project and an *ex post facto* attempt to minimize environmental impacts, Scheele (1989c) has recommended (among other things) that provision be made for additional equipment as well as training for selected Forestry Division staff members (in freshwater biology and landscaping). These are deemed necessary for managing impacts during the operational phase and carry a total estimated cost of EC\$460,000 (Scheele, 1989c).

#### EXPANDED USE OF BIOMASS AND OTHER PROVEN "SOFT ENERGY" RESOURCES

It is not difficult to argue the case for reducing Dominica's energy dependency on imported fuel by encouraging a wider, more efficient use of local energy sources, especially of the renewable kind -- namely, biomass. Fuelwood and charcoal resources, for example, are worthy of further attention.

Charcoal and firewood harvesting are not necessarily damaging to most forest ecosystems; the important variable is how much biomass per year for any given area can safely be removed. Where charcoal is produced as a by-product of land-clearing activi-

ties, there might even be a positive benefit since the cleared biomass, if burned on the site for its nuisance value, would be wasted. While the traditional earth kiln is not very efficient, it is simple, and charcoal production by this method requires very little capital investment (e.g., an axe, shovel, rake, and cutlass). A charcoal producer can live on the income from his/her efforts, which are admittedly labor-intensive but socially useful.

Charcoal is produced from wood because it has a higher calorific (heat) output per unit weight and is thus more valuable (also per unit weight) than fuelwood on the open market. Firewood (because it is much heavier) generally must be gathered close to where it will be sold and/or used as it can rarely support transportation costs and remain competitive with other available fuels. However, for charcoal production, the type of wood used is important. Some cannot withstand the intense heat required to produce charcoal. Therefore, waste wood resulting from land clearing activities may be more efficient if used as firewood rather than for the production of charcoal.

When producing charcoal from wood, a great deal of the latter is wasted due primarily to kiln and process inefficiencies. But this is not an insoluble problem and could be dealt with even without substantially changing the systems currently employed. For example, Nelson in OAS (1987) reports that firewood is generally stacked for only a few days before it is put, insufficiently dry, into a charcoal kiln. Furthermore, in traditional earth kilns, it is difficult to restrict combustion to only that portion of the total wood supply required to generate sufficient heat to char the remainder. Since the conversion efficiency of charcoaling is primarily a function of the wood moisture content and of the technology employed for the pyrolysis process, there is room for considerable increases in efficiency and thus for less wastage of the country's wood (and other biomass) resources. Furthermore, for the traditional biomass fuels of firewood and charcoal, gains in efficiency could also be made through some combination of extension services, a licensing strategy, and a program for assisting charcoal producers in moving the more efficient metal kilns from place to place.

At one time the Division of Forestry and Wildlife experimented with the use of transportable metal kilns for more efficient charcoal production, but since the mid-1980's the program has essentially been terminated and the kilns were sold off in 1989 (pers. commun., R. Charles, Forest Officer, 1990). There are those who believe that a program like this should be reestablished, but others express concern about the possibility of excessive wood harvesting and its implications for accelerated deforestation. The solution to this dilemma lies in improved monitoring and resource management strategies. It is worth repeating at this point that Dominica has the highest biomass productivity in the Eastern Caribbean.

As part of his proposed forestry policy for Dominica, Prins (1987) has identified several objectives that pertain to biomass energy. These include restoring fuelwood supplies in wood energy deficient parts of the island and developing wood-based energy systems for small industries in rural areas.

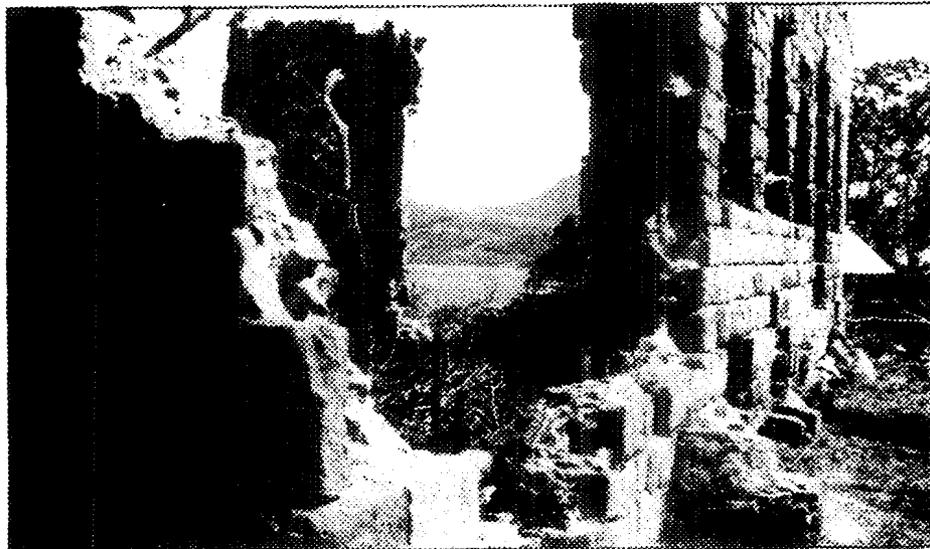
Furthermore, as suggested earlier in this chapter, the use of biogas is proving to be an inexpensive source of cooking fuel and quality fertilizer on Dominican farms. As such, its use promotes introduction of waste management systems based on the internal recycling of domestic and agricultural waste within given farm units; reportedly, this has led to "considerable enhancement" of hygienic conditions (Biogas Team, 1986). GOCD should continue to work with CARDI and others in securing necessary financial and technical support for biogas production systems. A team of Dominicans already are trained in the construction of biogas plants.

Xavier (1986) recommends that education on biogas technology be integrated with the Ministry of Agriculture's extension program. Since many alternative energy systems, in addition to biogas, will likely prove more feasible for the rural sector, the Ministry's extension staff should play a substantial role in, and be closely affiliated with, such experimentation.

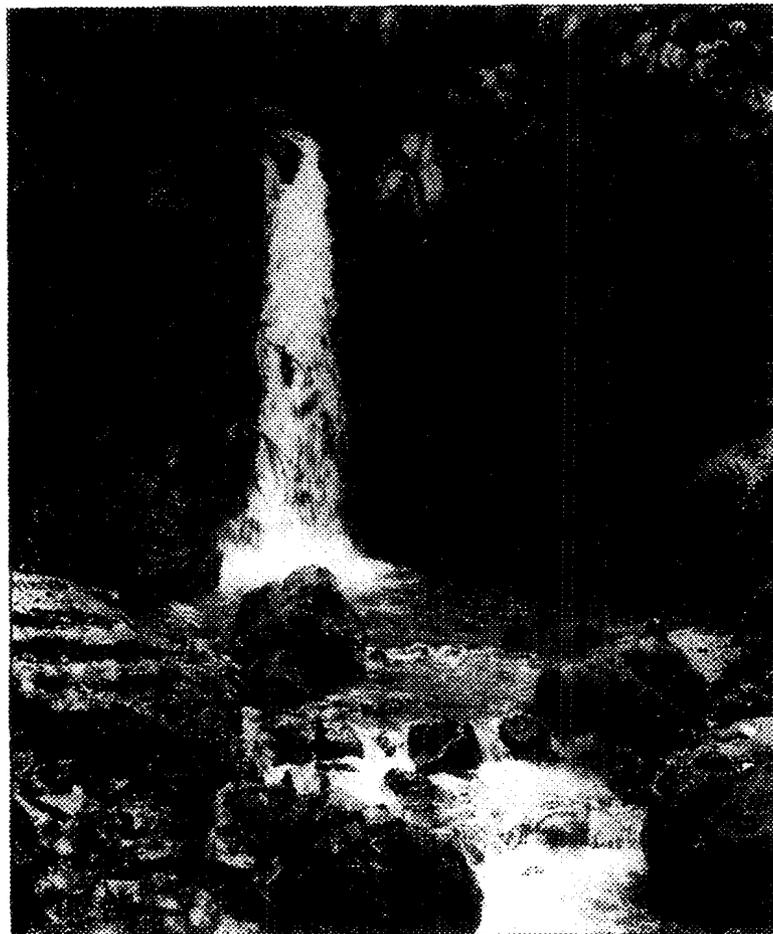
By virtue of its location, Dominica has great potential for solar energy use. The

solar energy theoretically available on a typical Caribbean island amounts to about six kWh of energy per day for every square meter of available land (Headley, 1986, in Bellmann *et al.*, 1987). Mountainous areas with excessive cloud cover and all areas during occasional overcast conditions are, of course,

exceptions to this rule. Nevertheless, this energy source has potential for a wide variety of applications, and any barriers to the expanded use of solar energy, such as import tariffs on solar equipment, should be removed.



The Cabrits National Park is a unique protected area which has significantly expanded the island's tourism resource base. The Park includes within its boundaries a remarkable assemblage of woodlands, marine sites and historic features, including picturesque ruins of one of the most impressive military fortifications in the West Indies.



The Emerald Pool, one of Dominica's many tourism attractions which have earned the country its reputation as the region's "nature island".

## SECTION 7 INDUSTRY, TOURISM, AND TRANSPORTATION

This chapter of the Profile focuses on three aspects of Dominica's business and industry sector, namely, manufacturing, agro-industry and tourism, all of which have been targeted for expansion by Government in more recent development planning schemes. These sectors are associated with change, as the country seeks to diversify and expand its development priorities beyond a more traditional rural and agricultural base. Since all of these activities are dependent on the sea and air transport infrastructure, a brief review of current development planning for these facilities is also examined, in part since passenger and cargo terminal facilities often have significant environmental impacts in both the short and longer term.

### 7.1 MANUFACTURING AND AGRO-INDUSTRY

#### 7.1.1 Overview

Manufacturing is still a small but steadily growing sector in Dominica, characterized by enclave and assembly-type manufacturing (centering around export-oriented activities) and by agro-based processing industries, focused on coconut and citrus products. The processing of coconut (as soap and oil goods) surpasses all other industrial development, with soap products alone being the second largest contributor to export earnings after bananas (see also Section 1.3.3). Because of the small size of the domestic market, industrial expansion relies heavily on the development of export markets; it has also restricted the location of industries to the Roseau area, near to shipping facilities.

According to Government statistics (GOCD, 1988b), manufacturing activities accounted for 6.1 percent of total gross domestic product (GDP) in 1978; by 1987 this proportion had increased to 8.0 percent. Furthermore, between 1978 and 1987, manufacturing's share of GDP, valued at factor cost in *constant* prices, increased from EC\$5.85 million to EC\$9.83 million. Employment in the

sector expanded from 1,359 to 2,955 between 1983 and 1989, a not insignificant increase although these figures represent less than ten percent of total employment for the years indicated.

The sector is dominated by agro-processing and, in particular, by Dominica Coconut Products Limited, the island's sole producer of soap and coconut oil; citrus processing is carried out at the island's single plant, Dominica Agro-Industries Limited (see also Sections 1.3.3 and 3.1.2). Other industrial activities include the production of garments, cardboard boxes, mattresses, pre-fabricated homes, beverages and other processed foods, and furniture. The spectrum of manufacturing and agro-industrial enterprises operational in Dominica in 1988 is provided in Table 7.1(1). The total value of these products represents about 26 percent of the 1988 value for all domestic exports (GOCD, 1988b) (the bulk of export revenues continues to be earned by the export of crops, principally bananas). In 1988 soap products realized approximately EC\$25 million in export earnings, an increase of almost 19 percent or EC\$4 million over prior year receipts (Eastern Caribbean Central Bank, 1989).

Despite its relatively small overall contribution to the economy, manufacturing is receiving increasing attention from GOCD, along with tourism and agricultural diversification, as one means of expanding the national economy. Emphasis has been placed on attracting light manufacturing industries for export production (i.e., enclave industries) and on the promotion of activities that exploit natural resources, such as forests and water (UNDP, 1986). This approach was recommended by the World Bank as early as 1983 when Bank analysts suggested that Dominica could further diversify its productive capacity through continued exploitation of the country's natural resources and attraction of labor-intensive industry, the latter to take advantage of the unemployed and underemployed, relatively low-cost labor force (World Bank, 1983a). For the immediate future, significant growth in the sector will depend on foreign

Table 7.1(1). Composition of domestic exports for manufactured products, 1988.

ITEM	QUANTITY IN TONNES	F.O.B. VALUE IN EC\$	PERCENT OF TOTAL
Toilet Soap	4,929	13,177,772	34.4
Household Soap	2,343	12,077,785	31.5
Garments (exclusive of gloves)	627	2,660,965	7.0
Gloves	162	1,368,924	3.6
Bay Oil	22	1,360,570	3.6
Coconut (Copra) Oil Crude	1,113	1,354,309	3.5
Paints and Varnishes	139	1,040,335	2.7
Grapefruit Juice Concentrate	128	714,280	1.9
Galvanized Sheets	246	683,656	1.8
Hot Sauces	234	661,205	1.7
Prefabricated Houses	255	634,505	1.7
Vegetable Saps and Extracts	56	603,003	1.6
Glycerols and Glycerols Lyes	260	405,331	1.1
Candles	47	222,909	0.6
Syrups	23	153,480	0.4
Stoves	14	139,549	0.4
Spring Water	153	117,197	0.3
Footwear	4	104,777	0.3
Other		793,232	2.1
<b>Totals</b>	<b>10,755</b>	<b>38,273,784</b>	<b>100.0</b>

Source: GOCD, 1988b.

investment, although the expansion of an indigenous manufacturing sector is considered vital to the country's long-term development objectives (UNDP, 1986).

Industrial promotion is handled principally by the National Development Corporation (NDC) and the Agricultural, Industrial, and Development Bank (AIDB), both of which are state institutions. Through the two agencies, Government has been engaged in a program of factory shell construction as an incentive for attracting investment. These facilities (currently totaling in excess of 110,000 square feet of space) are subsequently subdivided and leased for industrial activities.

The current objectives and programs of the NDC were outlined in a recent supplement in the local press (*The New Chronicle*, 23 March, 1990), prepared in part to describe the activities of 'Industry Week' 1990. It was reported that the NDC is presently focusing on small business with special attention being paid to handicraft development and its promotion as a small business. The emphasis on handicrafts (e.g., the manufacture of rugs and other local products) is appropriate to overall GOCD sector plans to utilize local natural resources for the further development of indigenous industries.

Table 7.1(2). Dominican companies assisted by the National Development Corporation, 1990.

Company	Activity	Employment
Emerald Corporation Ltd.	Spring Water Bottling	24
Cello's Furniture	Furniture and Woodworking	10
Shillingford Estates	Rum Production	50
Industrial Enterprises Ltd.	Foam and Foam Products, Appliance Assembly	7
Windward Islands Aloe Ltd.	Aloe Vera Production and Processing	23
Home Industries Co-op. Soc. Ltd.	Furniture and Woodworking	21
Corona Developments	Fruit Juice and Concentrates	9
Dominica Timbers Ltd.	Sawmilling	40
Super Timber Products Ltd.	Prefabricated Houses and Housing Components	30
Caamin Ceramics	Ceramic Products	3
Caribbean Republic Foods Ltd.	Rice and Cornmeal	7
Harris Paints (D/ca) Ltd.	Paints/Varnishes/Lacquer	21
Karibeah Enterprises	Sauces	2
E.H. Charles and Co. Ltd.	Housing Components	7
Ogheden Industries Ltd.	Furniture and Woodworking	6
Natural Fibre Prod. & Perfumery Ent. Ltd	Straw/Fibre Products	4
Raffoul Furniture Co. Ltd.	Furniture and Woodworking, Mattresses	40
P.H. Williams and Co. Ltd.	Sand, Blocks, Aggregate	50
Dominica Brake and Clutch Ltd.	Machine Shop	4
Bottlers (D/ca) Ltd.	Beverage Bottling	36
Dominica Coconut Products Ltd.	Soap and Oils	187
Canefield Bakery	Bread and Cakes	5
Photo Studio Depex	Photo Graphic Services	6
Paul Joseph & Co. Ltd.	Pasta Products, Plastic Bags	19
Moreau's Manufacturing Centre	Garments	16
Refresh Co. Ltd.	Cosmetics and Detergents Manufacture	25
ABC Container (D/ca) Ltd.	Cardboard Cartons	29
D/ca Essential Oils and Spices	Bay Oil, Bay Rum Ginger Farms	
Co-Op. Soc. Ltd.	Cut Flowers and Ornamental Plants	5
E & B Bakery	Bread and Cakes	5
Benjaahoe Plastic Co. Ltd.	Moulded Plastic Shoes	7
P.W. Bellot & Co. Ltd.	Agro-Process., Juices, Jams, Jellies, Pepper Sauces	35
North-Eastern Timbers Co-op. Soc. Ltd.	Sawmill, Furniture, Prefabricated Houses	70
D/ca Agro Industries Ltd.	Fruit-Juice Concentrates	22
Josephine Gabriel and Co. Ltd.	Beverage Bottling	53
Belle of the Caribbean	Ceramics	2
International Garments Ltd.	Ladies and Childrens Wear	26
Gloves (D/ca) Ltd.	Disposable and Industrial Gloves	173
Silver Star Textile Co. Ltd.	Apparel Manufacture	220
Marinor Enterprises	Solar Water Heaters; Metal Fabrication	18
Gas Supplies	Pure Oxygen	1
Eagle Farms Products	Pork Products	6
Candle Industries Co-op. Soc. Ltd.	Candle Production	18
Merrill Wallace	Laundry Services	3
Davis Brothers Ltd.	Housing Components	5
Island Computer Products	Computer Assembly and Services	4

Source: Dominica National Development Corporation, 1990.

A list of manufacturing companies presently assisted by the NDC, along with their activities and employment levels, is provided in Table 7.1(2). Most industry currently is concentrated in Roseau and its environs, e.g., the Canefield Industrial Estate. The latter is one of six areas in Dominica identified for industrial development. The other areas are Melville Hall, Picard (Portsmouth), Jimmit, Check Hall, and Geneva, but substantial development has only taken place at Canefield, Jimmit, and Portsmouth. The most recent National Structure Plan (GOCD, 1985) proposes that Portsmouth be promoted and developed as the country's "major industrial center," a recommendation based in part on the fact that it is the only community on the island with a fairly substantial amount of undeveloped flat land.

### 7.1.2 Issues and Recommendations

Industrial pollution is not a major problem in Dominica at the present time, primarily because the industrial base remains small. However, the processing of coconuts into edible oils, soaps, animal feeds and other by-products does generate a high volume of waste products which are customarily discharged into the coastal environment. Archer (1984) points out that although waste (effluent) loads from the industrial processing of coconuts are comparatively low for COD, BOD, and suspended solids, they nevertheless pose a "serious threat" to the aquatic environment and to public health because, almost without exception, liquid industrial waste is discharged into rivers and streams within close proximity of the coasts and the sea.

Archer's (1984) estimated quantities of industrial pollutants in Dominica (Table 7.1(3)) are seriously in need of an update, if only to reflect new industries and to adjust for the growth of outputs by those industries with more significant waste streams -- some as effluents and some as solid waste. Unfortunately, other than Archer's (1984) preliminary report produced for PAHO (which also includes useful volumetric estimates of domestic sewage and solid waste streams), no more re-

cent study has been done to determine waste generation by industries or to assess the effects of those wastes on both the riverine and coastal environments of Dominica.

Agro-processing industries generally have a less pernicious effect on the aquatic environment, i.e., oxygen depletion and solids input. Distillery wastes are among the most "offending" in this regard and are discharged into streams that already are polluted by domestic wastes. Perhaps a more significant problem associated with the agro-processing sector is the generation of solid organic by-products which are dumped in streams and ravines, over precipices, and along roadsides and shorelines (see also Section 8). In the Roseau area this problem is particularly evident in relation to citrus rinds. Such organic waste, despite its solid nature, can also have a eutrophic effect on streams. Of course, it also has a negative aesthetic impact, and in populated areas it poses a risk to public health by serving to attract disease vectors.

Expanded efforts could be made to actually use organic industrial "waste" as a resource, by processing it into animal feed, compost, and/or biogas (see also Sections 6 and 8). The same is true for the massive quantities of rejected bananas which are left to rot throughout the island. In the Bahamas, for example, distillery waste from a brewery is being used as a feed supplement for farm animals (Huls, 1989), while in St. Vincent bagasse from the sugar industry is utilized to produce biogas (Archer, 1984). In Dominica, there is great potential for expanding such waste exchanges, but this will require a cooperative effort by farmers, industrialists, local communities, and the national government. The development of waste exchanges contributes not only to pollution reduction but also to better management of the agricultural and energy sectors.

Toxic waste loads from Dominican industry do not appear to be high (Archer, 1984). The only companies which appear to handle toxic substances are the paint company and the oil companies, but these are not actually manufacturing or chemically processing these substances *per se* (pers. commun., J.

Table 7.1(3). Dominica industrial waste disposal and its impact on the coast and sea.

Types of Industry/ Process	Total Waste Volume 10 <sup>3</sup> m <sup>3</sup> /yr.	Total Waste Loads/ Contaminants tons/yr.	Air Pollution	Impact On Coast and Sea	Remarks
Rum	64.12	BOD <sub>5</sub> 200.1 COD 197.3 SS 310.5	Burning dumps are major air pollution contributors.	Most industrial waste is disposed into rivers, and eventually reaches the ocean. Toxic content of waste not really high, but comparatively high COD, BOD, and solids could have an effect on marine biota in localized areas on the coast.	Better control required over the disposal of waste into rivers and onto the coast.
Soft Drinks		TDS 1,336.0	Domestic, industrial, and agricultural waste incinerated.		
Citrus Juices		Oil 24.1			
Jams					
Soaps		Total 2,068.0			
Cooking Oil					
Animal Feed					

Source: Archer, 1984; see especially Tables 6, 8, and 9 (Appendix 1).

Fabien, Chief Environmental Health Officer, 1990).

Effective management of natural resources targeted for industrial development (e.g., water for export, timber for wood products) will become increasingly important as the country expands efforts to exploit such resources commercially. GOCD agencies involved in industrial development appear to be cognizant of the need for sustainable resource management in the expansion of resource-based industries. For example, the NDC has stated that:

*Natural resources, by virtue of their need for conservation, require careful planning for their utilization. In promoting activities in Timber [sic] and other wood products, the Corporation will en-*

*sure that investors adhere to forestry regulations. Given the quantity of water available in Dominica, greater regard will be paid to promote it as an export commodity, both bottled and in bulk. All projects in these investment areas will be screened, and must take particular cognizance of factors related to impact on the environment. (The New Chronicle, 23 March, 1990).*

It is recommended that this general statement of good intentions by the National Development Corporation be translated into an official policy directive that only industries which are relatively non-polluting will be assisted through NDC programs and support systems.

Finally, the process of industrial development in targeted areas must remain sensitive to existing or projected activities which are potentially non-compatible or could result in resource user conflicts. For example, plans for tourism expansion in an area such as Portsmouth may be jeopardized by industrial development which is not properly planned and managed. Pollution of swimming areas, uncontrolled waste disposal, accelerated noise and congestion, and the aesthetic quality of the area are among potential impacts which will need to be addressed.

## 7.2 TOURISM

### 7.2.1 Overview

Dominica's tourism product is not typical of most other Caribbean destinations, perhaps most significantly because of the limited availability of white sandy beaches which North American and European visitors generally prefer. On the other hand, the island does offer a variety of unique attractions (e.g., spectacular scenery, rain forest hikes, hot springs, good diving, and national parks) which, when marketed as a "package," have earned Dominica its reputation as the region's "nature island."

Tourism development in Dominica has focused on the island's strengths: unspoiled environment, natural scenic attractions, adventure holidays, uniqueness of product. At the same time, growth in the sector has had to confront a number of significant constraints: lack of adequate feeder services between major gateways and Dominica, no night aircraft landing facilities, inadequate services for cruise ships and yachts, undeveloped cultural and historical attractions, poor access to many sites (Dominica Tourist Board, n.d.). Despite these problems (many of which are currently being addressed in Government development plans), tourism has been growing steadily over the past decade, as illustrated for the most recent six year period by Table 7.2(1). The Division of Tourism reports a continued increase in tourist arrivals for 1989, up 9.4 percent over 1988 and reaching a total just under 37,000 by year's end

(although cruise ship arrivals were sharply down). The same source quotes a 50 percent increase in hotel rooms over the last three years, from 354 to 531 in 12 hotels, 14 guest houses and 13 apartments (News Release dated 7 May, 1990, Division of Tourism, NDC).

While growing, tourism is not yet a major component of the Dominican economy. Citing a 1986 Caribbean Tourism Research and Development Center study, a recent report from the World Wildlife Fund reports tourism's contribution to Dominica's gross national product at 25.6 percent, or just over US\$10 million (EC\$27 million) for 1986 (Boo, 1990). It is most likely that the reporter meant to refer to an estimate of tourism's contribution to *foreign exchange earnings*, since the Gross Domestic Product for Dominica in 1986 was approximately EC\$250 million. Such figures demonstrate that tourism is a powerful foreign exchange earner, roughly equivalent to 60 percent of recent foreign exchange earnings from bananas.

Equally significant is the size of the "domestic value added" component of tourism expenditures. In this respect, Dominica fares better than other tourist destinations in the Eastern Caribbean with much larger tourism sectors. That is, the local "multiplier" for tourism in Dominica is higher than in most other Eastern Caribbean destinations. For example, a significant proportion of total tourist expenditures for food in Dominica is used to buy local produce, whereas in a more developed tourist island like St. Thomas most food is imported from other Caribbean islands or the continental U.S., meaning that tourist expenditures quickly leave the island to pay for imported food. A central objective, therefore, for future development of tourism in Dominica should be to maintain or increase the local-value-added component of tourist expenditures, as is emphasized in the Government's "Tourism Policy" (GOCD, n.d.).

Many of the constraints which have been identified as limiting development of the tourism industry in Dominica (see above) are currently being addressed by Government. Upgraded facilities will be provided at Wood-

Table 7.2(1). Total visitor arrivals in Dominica by category, 1984 - 1989.

Category	1984	1985	1986	1987	1988	1989
Tourists	22,207	21,453	24,410	26,676	31,784	n.a.
Cruise Passengers <sup>1</sup>	3,216	6,602	11,454	12,080	n.a.	n.a.
Excursionists	1,892	859	655	1,485	n.a.	n.a.
<b>Totals</b>	<b>27,315</b>	<b>28,914</b>	<b>36,519</b>	<b>40,241</b>	<b>33,732<sup>2</sup></b>	<b>36,909<sup>2</sup></b>

<sup>1</sup> The publication *Caribbean Update* (July 1990) reported that cruise ship passenger arrivals fell from 4,294 in 1988 to 3,700 in 1989, but does not indicate its source for these figures. The Director of Tourism reports that cruise ship arrivals fell some 60 percent but was compensated for by increased arrivals of stay-over visitors, which brought the 1989 total to the reported figure of 36,909 in 1989 (pers. commun., Marie-Jose Edwards, 1990).

<sup>2</sup> News Release (7 May, 1990), Ministry of Tourism and Trade and the Division of Tourism, National Development Corporation, Roseau, Dominica.

Source: except as indicated in footnote 2, all figures are from CTO, 1989.

bridge Bay (north of Roseau) by extending the main dock to a total of 800 feet in length and by widening it by 20 feet to a total of 60 feet, in part to facilitate improved cruise ship utilization. Additionally, a new 300 foot cruise ship berth, with tourist reception center, is now under construction at the Cabrits, north of Portsmouth. This facility will accommodate cruise ship traffic in the north of the island and will improve access to the national park at the Cabrits. Finally, formal studies are underway for a new jet airport at Woodford Hill in the northeastern part of the country, which would provide Dominica with direct international links for jet aircraft for the first time in its history.

Tourism sites are also being upgraded, primarily with funds provided by the European Economic Community. A total grant of EC\$1.6 million from the EEC is being used for the production of new promo-

tional literature and for site improvement. To date, trails to the Boiling Lake, Indian River, Trafalgar Falls, Middleham area, Cabrits, Soufriere Sulphur Springs, Wotten Waven Sulphur Spring, L'escalier Tete Chien (Carib Territory), Emerald Pool, Morne Diablotin, and Morne Trois Pitons have been upgraded.

Within Government, tourism promotion is the responsibility of the Division of Tourism within the National Development Corporation. The NDC was created as a new statutory body in 1988 by merging the former Industrial Development Corporation and the Dominica Tourist Board. The former head of the Tourist Board is now the Director of Tourism. Given the large number of tourist attractions which are natural areas or are situated within the country's two national parks, tourism officials have traditionally worked closely with staff at the Forestry and Wildlife Division (see also Section 11).

## 7.2.2 Issues and Recommendations

### NATURE TOURISM

In 1971, Shankland Cox and Associates -- town planners of London and Jamaica -- produced a tourism development strategy for Dominica. That study was the first attempt by a professional consulting firm to assess the contemporary (i.e., modern day) tourism potential of Dominica. In that report, the authors emphasized the importance of nature tourism development to the country, stating:

*The most significant attraction of Dominica is the unspoilt quality of the island as a whole, and more specifically, the forests, mountains and coastline. Paradoxically, therefore, the most important action to be taken in developing the island's attractions is nothing, or rather, to protect the natural attractions from action which could be injurious (Shankland Cox and Associates, 1971).*

Nature travel, also called ecotourism, is a booming industry worldwide. Only more recently have attempts been made to examine the negative effects of nature tourism on host countries. One such attempt just published by the World Wildlife Fund-US and entitled *Ecotourism: The Potentials and Pitfalls* (Boo, 1990) uses Dominica as one of five case studies to report on this growing phenomenon. The study poses the question, "Can tourism be a means for conservation?" -- and looks at how an ecotourism approach can enhance local conservation efforts by linking resource protection strategies to the generation of foreign exchange earnings. In some countries, a portion of tourism-generated revenues have even been specifically earmarked to support resource conservation programs. At the same time, the study warns about the often excessive demands tourists can place on delicate ecosystems which over the long term might destroy the very attractions that first drew visitors.

In Dominica, the WWF report indicates that, although there are no valid scientific studies which assess the impact of tourism

on natural areas, informal discussions with national park personnel, tour operators and local residents in the vicinity of tourism sites indicate that some impacts are occurring, e.g., accumulation of litter. The report claims that many persons involved with the nature tourism industry in Dominica believe cruise ship passengers are less sensitive to the island's natural environment and therefore potentially represent the most destructive component of the country's tourism base. The author identifies four major obstacles to the growth of nature tourism in Dominica (Boo, 1990):

- inadequate funding for park maintenance;
- lack of tourism infrastructure in the park;
- lack of trained guides;
- a lack of international promotion for tourism.

In Dominica, Boo (1990) points out it is difficult to calculate the exact economic contribution of nature tourism, in part because statistics are not collected at any protected site. However, given that the majority of tourist attractions on the island are nature-oriented, any overall increase in tourism can safely be said to reflect an increasing interest in (and impact upon) the country's natural areas.

Clearly, Dominica's touristic future lies in the development of a more comprehensive, nature-based tourism experience. Nevertheless, the island does not enjoy an exclusive or totally unique comparative advantage over other OECS states such as St. Lucia or St. Vincent and the Grenadines. Competing in this market, which remains largely undifferentiated to all but the most knowledgeable traveler, will require formulation of very specialized, targeted merchandising tactics as well as cooperative public and private sector support for promotional strategies. The development of new promotional literature is already underway, assisted in part with funding from the European Economic Community. It is also important that Dominica ensures that

other development activities in the country do not conflict with its attempts to expand nature tourism and will not degrade or diminish the value of the very amenities and natural areas which it is promoting in its ecotourism thrust.

Dominica already recognizes that those amenities and attractions linked to ecotourism need to be upgraded or more fully developed in order for the country to remain competitive. As indicated above, hiking trails to and facilities at the most popular visitor sites are being improved and appropriate interpretive literature prepared under an EEC tourism facilities enhancement grant. The country also needs to explore options for the development of appropriately-sited and professionally-maintained campgrounds which offer a low-cost nature tourism experience with a high local-value-added component as well as a high tourist-return rate (i.e., the percent of tourists who come back in succeeding years). On the island of St. John in the nearby U.S. Virgin Islands, campgrounds have been successfully and profitably operated both within the Virgin Islands National Park (at Cinnamon Bay) and as a private sector venture adjacent to the National Park (at Maho Bay).

The potential for developing "natural history tourism" -- i.e., tourism catering to a very special clientele of research scientists and natural history investigators -- also needs to be explored by tourism planners in Dominica. Development of a research/nature center serving Dominica and the National Park System has been proposed by both GOCD officials and in various studies for at least a decade (see Towle, 1979b; Evans, 1986b, 1988 and 1989; and ICBP, 1990). The establishment of the Archbold Center for Tropical Studies at Springfield Plantation (see Section 11) provides one opportunity for achieving this objective.

## **7.3 TRANSPORTATION**

### **7.3.1 Overview**

Although blessed with a luxuriantly vegetated landscape and a more than gener-

ous natural supply of rainfall and exotic, colorful flora and fauna, Dominica -- unlike other OECS states -- has had to make do with a limited inventory of beaches (due to the boldness of the sea/land coastal interface) and, more importantly, with the absence of a good natural harbor near its capital and center of commerce, Roseau. Insularity has its price, and the need for ready access by sea for export and import trade has for over two centuries been met in Dominica by the traditional but inefficient and costly practice of vessels anchoring offshore, with cargo discharged from shore in an array of small barge-like "lighters" -- both at Portsmouth in the north and Roseau in the south. But scheduling for this kind of operation was always at the mercy of wind and sea swell conditions, and, as vessel size increased and incoming and outgoing cargo volumes rose, the need for an "alongside pier" facility, especially for Roseau, became obvious, despite the cost and difficulty.

Development of the basic pier and service installations at Roseau was undertaken initially by the Port and Harbor Division of the Ministry of Communications and Works, but a formal, autonomous management unit, the Dominica Port Authority, was established in 1972 with jurisdiction over three ports of entry:

- Woodbridge Bay, one mile north of Roseau;
- Portsmouth (Longhouse, Prince Rupert Bay); and
- Anse-de-Mai on the northeast coast.

The enabling legislation (Act No. 18 of 1972) gave to the newly established Port Authority the following functions:

- To operate the ports in the public interest;
- To regulate and control navigation;

Table 7.3(1). Dominica Port Authority cargo volume, 1978-1989.

YEAR	CARGO DISCHARGED (Tons)	CARGO LOADED (Tons)	TOTAL TONS <sup>1</sup>
1978/79	65,280	46,262	111,542
1979/80	78,456	17,040	95,496
1980/81	84,431	26,871	111,302
1981/82	77,719	42,835	120,554
1982/83	79,611	45,779	125,390
1983/84	81,233	46,133	127,366
1984/85	96,261	43,848	140,109
1985/86	97,627	55,319	152,946
1986/87	115,658	86,628	202,286
1987/88	132,867	97,266	230,133
1988/89	155,617	102,682	258,299

<sup>1</sup> Metric tonnes after 1981/82

Source: Dominica Port Authority.

- To maintain, improve and regulate services and facilities at designated ports; and
- To provide pilotage services, beacons, buoys and other navigational services.

Cargo throughput from 1978 to 1989 is displayed in Table 7.3(1) (note the visible effect of Hurricane David in 1979 and Allen in 1980). Container traffic (all at Woodbridge) had grown by 1989 to 64,000 tons (in 2,382 containers) and represented 39 percent of all cargo handled for the year.

Despite the small area available to and occupied by Port Authority facilities at Woodbridge, the operation is remarkably efficient, and the Authority is rapidly reducing its previous start-up and hurricane damage repair deficit. Plans for immediate expansion of its facilities, both at Portsmouth for cruise ships and yachts and at Woodbridge for all shipping and container handling as well as cruise ships, are in train and discussed in the next section.

## 7.3.2 Issues and Recommendations

### FACILITIES EXPANSION

The need for improved efficiencies and lower costs as well as better services for new levels of commodity export traffic (e.g., bananas, citrus, and soap and other manufactured and processed products like rum, bottled water, paint and furniture) had increased pressure at all of Dominica's port facilities by the end of the 1980's. From a different direction, the country's tourism industry, came pressure to expand the frequency of cruise ship visits by improvement of docking and passenger handling facilities.

Not everyone agrees that solving the "access" question is more important than the "improvement of amenities" issue. Some tourism experts argue that the nature tourist, which Dominica's tourism policy favors, is essentially unflustered and not deterred by the slight inconveniences and delays in getting to Dominica via indirect routings. This argu-

ment maintains that the access barrier is really a net-like filter, keeping out those looking for an easy, more conventional holiday experience and letting through a different class of tourists more appreciative of Dominica's environmental and cultural milieu.

The improvement of marine cargo handling facilities and an upgraded airport have become important national objectives for, it is argued, such improvements will benefit residents more than tourists. As a consequence, since the early 1980's, the Government has embarked on a facilities enhancement program which:

- methodically improved port infrastructure and enabled the Port Authority to operate more efficiently;
- gradually converted a small "light plane" airport at Canefield, just north of Roseau, into a full-service airport suitable for medium-size, non-jet aircraft; and
- rebuilt the island's road network (with assistance from international donors) at a cost of over EC\$60 million.

## NEW PROSPECTS AND PROBLEMS

Current transportation facility expansion projects include the following:

- Construction of a 300 foot cruise ship berth with reception center for tourists at the Cabrits, Portsmouth;
- Extension of the main wharf at Woodbridge Bay by 300 feet to a total of 800 feet and widening of the extension by 20 feet to 60 feet;
- Construction of an expanded container park at Woodbridge Bay which will provide some 2.5 acres of container storage space and will extend 350 feet in a southerly direction.

The well-known firm of Novaport Limited, of Halifax, Nova Scotia, is chief consultant for all three projects, projected at a cost of EC\$24 million (*Caribbean Update*, 1989). The Woodbridge Bay Wharf extension and container port are scheduled for completion in the summer of 1991 and the Cabrits cruise ship dock by the end of 1990.

Similar modernization, although on a much grander scale, is proposed by GOCD for airport facilities. It has been argued that neither the Melville Hall Airport, 35 miles northeast of Roseau, or the more modern but short runway facility at Canefield, have sufficient land for proper approaches or for runway extension and facilities expansion to permit the use of even small jet aircraft. Therefore a suitable site has been selected, and British consultants have prepared a design concept for a jet port at Woodford Hill in the extreme northeast of the island, about four miles north of the Melville Hall Airport.

There are important environmental implications associated with the proposal for a new airport. Although construction of the airport facility alone should not result in a serious loss of forest lands, a proposed road, connecting the west coast with the airport, would bisect the Northern Forest Reserve. This penetration road could conceivably increase pressure for agricultural development of forest lands on either side of the road, with subsequent negative impacts on the rain forest and on the habitat of the imperial parrot.

All of these new facilities have potential for greatly improved, sector-specific efficiencies in the movement of people and goods – incoming and outgoing. But because they involve development activities which are substantial in size and semi-permanent in nature, affect large areas, and usually create new or expanded employment nodal (or focal) points, careful advance planning *vis a vis* projected social and environmental impacts is required. Although it is never too late for such evaluations, it is unfortunate that they were not done at the very beginning of the conceptual planning process for all of these major development projects.

## SECTION 8 POLLUTION AND PUBLIC HEALTH

### 8.1 OVERVIEW

Natural resource pollution within an island ecosystem can have severe negative impacts on the health of the human, animal and plant organisms that inhabit the system. This section of the Profile focuses on the pollution of Dominica's terrestrial and aquatic (freshwater/marine) resources, on air pollution, and on the impacts of pollution -- real or potential -- on the health of the island's inhabitants.

The pollution problems discussed have been identified as the most critical, but they are not necessarily the only environmental health issues confronting the country. Indeed, the process of linking public health problems to environmental causative agents is a difficult and complex one since a given illness or disease may be linked to several causes with no one polluting agent being catastrophic in triggering illness or disease. However, the combined bio-accumulative effect of many polluting agents in sufficient quantities is normally the sequence which induces public health problems.

Dominica is a developing country with limited financial and human resources and, as such, is not fully equipped to deal with certain levels and types of pollutants. In the absence of adequate facilities or systems for the management of waste or for the regulation of chemical use (e.g., pesticides), there is great potential for adverse pollution effects on the health of Dominica's residents as well as on the country's natural resources.

#### 8.1.1 Status of Public Health

The status of health in a developing country like Dominica can readily be assessed on the basis of several parameters.

(1) Population growth (see also Section 1.3.2 of the Profile for an overview of demographic trends in Dominica). The annual rate of population increase is regulated

by both birth and death rates. During the post-World War Two period (1946-1960), the natural rate of increase in Dominica rose from 1.5 percent to 3.2 percent primarily due to a decline in the crude death rate from 20.9/thousand in 1946 to 14.9/thousand in 1960. This correlated with improvements in maternal/child health care that resulted in a dramatic reduction in the infant mortality rate, from 119.4/thousand to 67.3/thousand. The decade between 1960 to 1970 showed a drop in the rate of natural increase to 1.5 percent, a trend which continued during the 1970's and can be attributed to a drop in the fertility rate as a result of Family Planning Programs executed through the Health Department (Bouvier, 1984).

Presently the population rate of natural increase shows small decreases between 1984 and 1986 (see Table 8.1(1)). This is in part a consequence of improvements in the health care system with the infant mortality rate reaching a low of 15.1 in 1986. Furthermore, life expectancy has been projected to increase from 68 to 74 years for women and from 61 to 66 for men (GOCD, 1989c). Thus, the numbers of young and old have increased which means that if population size is not to substantially increase, fertility rates must be further decreased.

Population growth appears to have slowed down during the 1980's to 1.5 percent annually. Presently the population of Dominica stands at slightly over 80,000 (see Table 8.1(1) and Table 1.3(1)). According to Bouvier (1984), the contributing factors for this slow growth rate are decreased fertility and high emigration rates. The potential for rapid increases in the total population therefore exists if fertility rates increase and/or emigration rates begin to fall (see also Section 1.3.2). Rapid increases in population would result in additional demands on the health care system and on the level of social services presently available to Dominicans and could adversely affect the general status of public health in the country.

Table 8.1(1). Dominica vital statistics, 1984 - 1990.

Population Statistics	1990 <sup>1</sup>	1986	1985	1984
Mid-year Population	85,000	80,469	79,624	78,501
Fertility Rate	N/A	93.4	96.3	101.4
Birth Rate (1/1000)	26.1	21.4	21.4	21.8
Crude Death Rate (1/1000)	5.4	6.1	5.9	5.5
Rate of Natural Increase (1/1000)	20.0	15.3	15.5	16.3
Neonatal Death Rate (1/1000)	14.0	11.0	14.7	19.8
Infant Mortality (0-1 yr) (1/1000)	N/A	15.1	18.8	23.9
Maternal Mortality Rate (1/1000)	N/A	0.6	1.2	0.6
Death Rate Children (1-4 yrs)	N/A	1.9	1.4	0.3

<sup>1</sup> Estimates by the Population Reference Bureau, Washington, D.C.

Source: GOCD, 1989(d); Population Reference Bureau, 1990.

Table 8.1(2). Sewage disposal or treatment facilities available to district households.

Health District	Population	%PL	%ST	%CL	TOTAL
Roseau*	23,402	38	37	12	87
St. Joseph*	6,026	10	26	7	43
Portsmouth*	10,267	36	12	6	54
Marigot	9,487	57	11	1	69
Castle Bruce	4,343	67	8	N/A	75
La Plaine	4,392	68	14	1	83
Grand Bay	6,068	63	13	2	78

\* Indicates communities along west coast.

KEY: (PL) pit latrines; (ST) septic tanks; (CL) communal latrines

Source: GOCD, Environmental Health Department, 1987.

Presently about half of Dominica's total population lives in west coast communities, primarily in the two urban areas of Roseau and Portsmouth (see Table 8.1(2)). This concentration of people and its potential for altering natural habitats have implications for both the natural resource planner and the public health planner.

**(2) Infant/maternal mortality rates.**

The infant mortality rate declined from 23.9 per thousand in 1984 to 15.1 in 1986 but rose again to 18.5 in 1987 (GOCD, 1987). Three percent of the 1989 admissions to the children's ward at the Princess Margaret Hospital were for gastroenteritis and malnutrition; in 1985 this figure stood at 3.5 percent. Maternal mortality rates appear to have decreased by 50 percent between 1985-86, from 1.2 per thousand to 0.6 (see Table 8.1(1)).

**(3) Malnutrition of children.**

A School Health Program attempts to meet the health needs of school age children through regular visitations to primary schools in each of the seven health districts. A survey of the health status of school children of 22 primary schools in the Roseau health district revealed that in terms of nutrition, 3 percent of beginners, i.e., 4-5 year olds, had unsatisfactory growth and physical development indicative of malnourishment/underweight or overweight. Among the school leavers, i.e., 10-12 year olds, 3 percent also had unsatisfactory physical growth and development patterns indicative of overweight/underweight problems (GOCD, 1989d). Prior to this report a survey was done in 1985 by the Nutrition Unit in the Ministry of Health on children 0-5 years in all seven health districts which identified malnutrition rates of 6.4 percent or less (St. Claire, 1987).

**(4) Population Affected by Communicable Diseases.** The reporting and recording of communicable diseases of importance to public health administration are two of the more important responsibilities of Primary Health Care (PHC) staff. The importance of screening/diagnosing and treatment activities at PHC centers, coupled with health education and preventive care programs, can be observed through a recorded general improvement in the health of Dominican citizens.

The incidence of typhoid fever, dysentery and pulmonary tuberculosis appears to be declining. However, typhoid fever is still endemic and its rate of incidence remains one of the highest in the region (see Tables 8.1(3) and 8.1(4)). The incidence of gastroenteritis/diarrhea seems to be increasing, particularly among children under 5 years of age; however, its severity is declining primarily as a result of treatment with oral rehydration salts.

Helminthic infestations remain a chronic problem among children. A random sample carried out on children between 2-10 years old revealed that among five areas studied, Soufriere and Scotts Head appear to have the highest rate of infestation of many of the helminths investigated. For example, the incidence of ascaris (roundworms) was 77.8 percent and 72.7 percent in Soufriere and Scotts Head, respectively, while in Mahaut this rate was less than 1 percent (see Table 8.1(5)). All three communities are part of the Roseau Health District.

The low rates of infestation in a given location may be correlated to the presence of improved sewage disposal facilities. Where communal sewage disposal facilities are inadequate to meet the needs of the community, people are forced to use the sea, rivers or bushes to dispose of excreta. Under these conditions, the cycle of reinfestation tends to be perpetuated. Helminths such as hookworms and ascaris also can be readily acquired by children who walk barefooted or play in moist soil contaminated with excreta and, in general, in areas of poor sanitary conditions or lacking pipe-borne clean water.

Health statistics for 1986 revealed that an average of 85 percent of children in each district were immunized against pulmonary tuberculosis, poliomyelitis, diphtheria/whooping cough/tetanus, and measles. Such high inoculation figures are due to mandatory immunization for children entering primary school and to the seemingly effective educational efforts of PHC personnel. In 1982 the immunization rate was between 35-70 percent (GOCD, 1989d).

Table 8.1(3). Diseases of public health importance in Dominica.

YEAR	NUMBER OF CASES REPORTED					
	Pulm. T.B.	Typhoid Fever	Dysentery	Gastro Ent./Diarrhea	Dengue	Hemorrhagic Conjunctivitis
1978	10	38	5	133	-	-
1979	NA	30	-	-	-	-
1980	28	17	-	82	-	-
1981	26	65	-	67	-	-
1982	24	32	-	56	-	-
1983	16	36	-	63	-	-
1984	5	26	12	180	-	-
1985	8	25	3	182	-	-
1986	35	9	3	294	8	53
1987	27	20	1	438	-	-

Source: GOCD, 1989(d).

Table 8.1(4). Notification of infectious diseases in the region: annual incidence rates per 100,000 for selected years.

Country	Years	Typhoid Fever	Leptospirosis	Gastro- Enteritis	Pulmonary T.B.
Antigua/Barbuda	1980/1984	1.3/1.3	-	-/51.0	10.7/13.8
Barbados	1980/1984	0.4/0.39	21.0/12.0	7.8/7.1	25.3/3.9
Dominica	1980/1984	21.3/12.0	-	9.8/21.0	25.0/6.0
Guyana	1980/1984	7.2/22.0	2.4/-	27.0/30.0	14.0/19.0
Jamaica	1980/1984	7.3/29.0	5.4/13.0	50.0/59.0	6.4/6.4
St. Lucia	1980/1984	5.8/14.0	-	44.0/58.0	34.2/43.0
Trinidad/Tobago	1980/1984	2.4/2.1	0.91/3.9	75.0/130.0	7.5/9.0

Source: PAHO, 1986.

Table 8.1(5). Percentage of helminth infestation in 2 - 10 year olds in selected villages of Dominica.

Type of Helminth	Soufriere	Scotts Head	Grand Bay	Mahout	St. Joseph
Ascaris (round worm)	77.8	72.7	28.1	0.63	10.4
Trichuris	81.5	85.2	33.7	27.2	34.0
Hookworm	14.8	6.8	3.4	0.63	-
Entamoeba histolytica	25.9	20.6	12.9	9.5	11.1

Source: St. Claire, 1987.

(5) **Mortality rates from chronic diseases.** The mortality rate for adults from chronic diseases was 99.8 percent of the total number of deaths in 1986. The main cause of deaths in that year was heart disease/hypertension (24 percent), followed by malignant neoplasms/cancers (18 percent). Other causes of death included diseases of the respiratory system, asthma, and diabetes. As these conditions are often stress-induced, it could be inferred that Dominican adults are now experiencing a more stressful lifestyle, one more generally associated with more developed countries, and that this is having an impact on general health conditions in the country.

The overall health status of the island's population appears to be improving in that most conditions of public health concern, affecting young and old, are showing declining rates of incidence. However, there are still areas where further improvements are needed. The incidence of helminthic infestations among children of school age needs to be addressed, for this health problem can increase the morbidity levels of affected children by lowering their resistance and predisposing them to more serious health problems. The high incidence level of typhoid fever also needs to be curtailed. The incidence of various types of cancers and respiratory problems such as asthma also appears to be increasing (GOCD, 1987).

#### PRIMARY HEALTH CARE SYSTEM (PHC)

The health services delivery system most closely associated with the treatment of primary health concerns at the community level is the Primary Health Care (PHC) system. It encompasses the entire island, which has been divided into seven health districts: Roseau, St. Joseph, Portsmouth, Marigot, Castle Bruce, LaPlaine, and Grand Bay. If utilized efficiently, the PHC system is an excellent vehicle for delivery of health care to most nationals.

The national health policy in Dominica is consistent with that of the World Health Organization's declaration of 'Health for All by the Year 2000', i.e., it seeks to ensure that all Dominicans will have access to the best health care possible by 2000 (GOCD, 1989d). The infrastructure, physical and human, through which this goal is to be achieved is the PHC system, which is operated by the Department of Health in the Ministry of Health and Social Security. The following services are available through the PHC (GOCD, 1989d):

- Promotion of adequate nutrition (dietary counsel);
- Adequate supply of safe water (Environmental Health);

- Basic sanitation (Environmental Health);
- Immunization against infectious diseases;
- Health education on the prevention and control of diseases;
- Appropriate treatment for communicable diseases and injuries; and
- Provision of essential drugs.

These services are provided in a network of Type I, II, and III health centers situated throughout the seven health districts. Each Type III health care facility is usually staffed by health personnel such as a medical doctor, a nurse/midwife or both, a dietary assistant, an environmental health officer and a dispenser/pharmacist assistant.

#### **ENVIRONMENTAL HEALTH UNIT**

At the district level the environmental health officer, a staff member of the Environmental Health Unit, is part of the health team. The services provided by this Unit, an important component of the PHC system, are (GOCD, 1989d):

- Water supply, with reference to the provision of adequate quantities of safe water that are readily accessible;
- Solid waste management and liquid waste (sewage) disposal;
- Insect and vector control;
- Food hygiene;
- Occupational and institutional health, dealing in particular with physical, chemical and biological hazards; and
- Environmental health aspects of sea, air and land transport.

In general, the primary health care system in Dominica is responsible for monitoring pollution levels in some areas of the physical environment (see also Section 11) and for preventing, diagnosing and treating illnesses/diseases resulting from pollutants -- chemical or biological -- in the environment.

#### **8.1.2 Pollution Types and Their Management**

##### **SOLID WASTE**

Dominica's topography, its high annual rainfall (particularly in the central and eastern communities), and rapid population increases in communities along the west coast have increased the difficulty of developing an effective solid waste management system for Dominica. Very little suitable space is available for safe and suitable sanitary landfills. Additionally, some communities are not easily accessible by vehicles, thus increasing collection and disposal difficulties.

The Roseau Health District, estimated to have a population of over 23,000, generates about 15 tons of solid waste daily, both residential and commercial (Fabien, 1988). Historically, it was the responsibility of the Roseau City Council to collect and dispose of solid waste generated within the city and its immediate environs, e.g., Goodwill and Newtown. A truck collection system was used for carrying out these responsibilities, but the program was poorly managed with problems including inadequate vehicles, manpower and funds to effectively implement these services. Funding was obtained directly through taxes imposed on city residents. Presently, solid waste from Roseau town is collected from "skips" (large trash containers) and deposited at the Woodbridge Bay sanitary landfill.

The health district of Portsmouth includes areas that are heavily dependent on agriculture. The town also has a central refuse collection system which is very inefficient and has no specified landfill for the disposal of solid waste. Therefore, disposal oc-

curs through open dumping on the beach close to the Belle Hall and Cabrits areas.

In some rural communities open dumping occurs at designated sites, which usually are not well sited, planned or managed. Responsibility for maintaining approved dumping sites lies with the local government of the villages, while the management of these sites (from a public health perspective) is the responsibility of the district environmental health officer. There is no central collection service for the rural areas. More frequently, informal dumping takes place wherever it is convenient -- in ravines, over precipices, in rivers/streams and in coastal/marine areas. Rural sources of solid waste include waste generated from commercial and household activities as well as the activities of boxing plants, bay leaf and rum distilleries, auto repair garages, furniture making enterprises, and all construction sites.

Random solid waste disposal is especially egregious in the rural health districts of Grand Bay, Marigot, Castle Bruce and La Plaine. The St. Joseph Health District also has serious disposal problems resulting from open dumping on nearby west coast beaches and over cliffs into the sea. There is no organized system of refuse disposal in these districts. Dumping of solid waste has taken place even within the Cabrits National Park, on the edge of Douglas Bay and Cabrits swamp, where it detracts from the area's tourist value and also presents a health hazard.

Outside of the municipal area in the Roseau Valley and southern areas of the Roseau district, uncontrolled open dumping occurs along the coast (Pointe Michel, Soufriere and Scotts Head), over precipices as well as almost randomly on land and in rivers -- particularly the Roseau River. Between 1986 and 1988, west coast villages from Pointe Michel in the south to Colihaut in the north were allocated a refuse collection vehicle, and wastes from these communities were disposed at the Woodbridge Bay sanitary landfill. Government has also started work on another landfill in the Pointe Round area to serve the town of Portsmouth (Fabien, 1990).

Recently, as part of the activities for the Year(s) of Environment and Shelter (YES) 1989-90 program, a new solid waste management system has been planned and is presently in the process of being implemented by the Environmental Health Unit in collaboration with the Roseau City Council and the Public Works Department. The objectives of this system are (Xavier, 1989):

- To standardize storage containers (skips) used by households, institutions and business places.
- To install skips at strategic areas throughout communities.
- To design a collection system aimed at hauling refuse to sanitary landfills.
- To provide alternative disposal systems for large rural communities not served by collection systems.
- To promote other satisfactory methods of disposal in remote communities.
- To educate the general public on appropriate methods of solid waste management.

The new solid waste management system would provide for (1) storage of refuse, (2) its collection and (3) its final disposal at landfills or other designated areas. Since both the general public and personnel of the designated management agencies will be affected, adequate education and/or training of both groups is considered important. If managed efficiently, this system has the potential to adequately address solid waste disposal problems in most communities, at least in the near future.

Derelict vehicles are an increasing problem because of large increases in the importation of vehicles. Abandoned vehicles can be found throughout the island, with vacant lots, river banks, ravines, and beach front areas being the most common sites. These

create breeding areas for disease-carrying vectors and are also used as disposal sites for trash. Unfortunately, they are also popular among children as informal play areas.

The Fisheries Division has developed a project to use derelict vehicles to create artificial reefs on the west coast. This effort involves the removal of all corrosive materials such as batteries, engines, oil containers and gas tanks from abandoned vehicles and then using the metal shells for artificial reef generation. In 1988 the shells of several derelict vehicles were deposited in the marine area north of Fond Cole/Woodbridge Bay. Monitoring of the site is ongoing and has revealed an increase in the proliferation of many species of reef fishes, resulting in increased fishing activities by fishermen. Therefore, plans are being made to declare the area restricted for fishing and to demarcate other locations where fishermen from the area can fish (pers. commun., N. Lawrence, Advisor, Fisheries Development Division, 1990).

## **SEWAGE**

Dominica has a centralized liquid waste collection system in the Roseau Health District only. Other areas around the island use either septic tanks, pit latrines, communal facilities/public conveniences, or no system at all (see Table 8.1(2)).

According to Archer (1984), prior to 1983 approximately 40 percent of the population had no disposal facilities available to them or used communal latrines. The remaining 60 percent used private facilities: 2 percent - bucket privies; 15 percent - water closets connected to sewer systems and septic tanks; 42 percent - pit latrines (PAHO, 1986). Today these percentages have dropped, but systems still are not adequate to meet the demands of the population they serve, and therefore significant numbers of Dominicans still dispose of raw sewage in the sea and rivers and openly on land.

All along the west coast, it is very difficult to construct pit privies or install effective septic tank systems as the ground is very rocky. This naturally compounds sewage

pollution and management problems in what is the most populated region of the country.

The sewage collection system that serves Roseau, Goodwill, and some sections of Pottersville has ten outfalls that discharge untreated sewage into the immediate coastal/marine areas of the town; one of these outfalls originates from the Princess Margaret Hospital. These coastal areas are frequently used by local residents for fishing, bathing and other recreational activities. Domestic waste water from non-sewage sources is collected in open drains and also discharged into the marine environment.

Other methods of excreta disposal used in the Roseau/Canefield/Goodwill area are septic tanks and latrines. However, many households have none of these methods of disposal available to them, with the result that additional raw sewage is deposited into the Roseau River and the sea. Archer (1984, Table 3B) stated that 2,415 tons per year of pollutants are carried to the coastal and marine areas of the island as a result of discharges of excreta and septic tank effluent and sludge; this figure was based on the then assumed population base of approximately 75,000. This serious public health problem will be further discussed in Section 8.2 below.

The existing centralized sewage collection system is more than 50 years old and inadequate to meet the demands of a growing population. Overloaded and backed up manholes with raw sewage discharging into the streets can frequently be observed in Roseau. Septic tanks are poorly maintained (i.e., rarely pumped or cleaned out), usually resulting in only partial treatment of the effluent and contamination of the immediate surrounding soil. Pit latrines are usually poorly erected and likely to be destroyed by high winds. At least one external expert observer considered sewage pollution the most serious problem affecting the island's coastal zone (CIDE, 1988).

## **WATER SUPPLY**

Water supply management island-wide is the responsibility of the Dominica

Water and Sewerage Company (DOWASCO), a privately-owned company. Presently, DOWASCO is engaged in upgrading existing water supplies as well as expanding supplies to areas that are not serviced. Liquid waste disposal is also included in the responsibilities of the newly-created (1989) company, but the issuance of a license from Government for this service is still pending; therefore, sewage disposal remains the responsibility of local governments in all the health districts (see also Section 11).

The Environmental Health Unit is responsible for monitoring potable water quality throughout the island. About 10 percent of the population in Dominica had no potable water supply in 1987, whether through direct piped connections or indirectly through easy access to stand pipes (see Table 8.1(6)). In most of the seven health districts, 90 percent of the population has adequate access to piped potable water. In the Marigot and Castle Bruce districts, however, only 51 percent and 50 percent of the population, respectively, have such access. On average, the country's urban communities appear to have a more extensive supply of piped water than the rural areas. This, of course, is important to the maintenance of general levels of sanitation which will differ between urban and rural areas. Furthermore, it is clear that more attention has been paid to providing an adequate water supply for the population than to sewerage services, a situation which is typical of Third World countries.

## AGRICULTURAL WASTE

As discussed in more detail in Section 3, Dominica's economy is heavily dependent on agriculture -- primarily bananas, coconuts and citrus. Like many other small islands that are heavily involved in agro-production, large amounts of waste are generated by these activities, and adequate disposal of such wastes is another critical resource management problem for the country. The types of wastes/pollutants generated through agricultural activity can be classified as organic, solid and chemical.

Organic wastes include plant material from weeding and brush clearing activities and spoiled produce, fruits, banana stalks, and coconut husks, shells, etc. These are usually disposed of in a haphazard manner in the fields. The Chief Medical Officer indicated in his 1987 annual report that his department received numerous complaints about the open dumping of surplus bananas all over the island. On the banks of the Roseau River in Copt Hall heavy equipment had to be used to remove this nuisance and bring the situation under control.

In some cases farm animals (cows, goats, pigs, chickens) are tethered or housed close to drains in fields or on slopes where their waste can easily be washed into rivers, ravines and subsequently the sea. This can result in high BOD levels in fresh and marine waters since oxygen is depleted in these waters during the break-down of animal wastes. It can also result in increased levels of coliform bacteria in these waters.

Solid waste generated by agricultural activities includes empty pesticide bottles, used fertilizer bags, empty fruit boxes, and plastic bags used to protect banana bunches as well as those used to package them. These are dumped openly in the fields, usually indiscriminately, resulting in proliferation of rodents and other disease-carrying vectors. Discarded plastic bags provide space for the collection of stagnant water that breeds mosquitoes; other types of solid waste provide dark, warm places for rodents to breed their young. In general, agricultural fields are convenient places for rodents, mosquitos and flies to thrive since food, water and breeding places are readily available.

Agricultural (non-point-source) pollution results from excess nutrients leached from cultivated fields where chemical fertilizers have previously been applied. These surplus nitrate and phosphate compounds are transported downslope by surface run-off and infiltration into nearby streams, rivers and ultimately the nearshore marine environment.

Most of the crops grown in Dominica are infested by pests at one stage or another

Table 8.1(6). Potable water supply by percentages for Dominica's seven health districts in 1987.

District	% Direct Supply*	% Indirect Supply**	TOTAL
Roseau	68	23	91
St. Joseph	31	60	91
Portsmouth	24	75	89
Marigot	11	40	51
Castle Bruce	15	35	50
La Plaine	18	59	77
Grand Bay	20	70	90

\* Water piped into houses

\*\* Water collected from standpipes

Source: GOCD, 1987.

in their growth cycle; citrus is affected by fiddler beetles, slugs, fruit moths, and nematodes, to name a few; bananas and plantains by fungus (sigatoka) borers, nematodes and slugs; coconuts by mites, borers and rats; vegetables by nematodes, rats and cutworms. Farm animals are affected too -- cows, sheep and goats by ticks, sheep by mites, and poultry by lice.

Different groups of pesticides are used for controlling the above-mentioned pests (see Tables 8.1 (7) and 8.1(8)). These pose a substantial pollution and human health risk, both through the application process and through poor management of stored or left-over pesticide mixtures. Herbicides are also widely used to control weeds and unwanted vegetation.

Tables 8.1(7) and 8.1(8) need to be used with great caution. Despite a concerted research effort launched by the CEP project team, including interviews with representatives of the Pesticides Control Board and the Dominica Banana Marketing Board, supplemented by interviews with CARDI and CACP experts, there are no consistent import volume

figures for several major biocides, and tabular data are greatly disordered. For example, data obtained by DeGeorges in 1989 from the same agencies regarding specific chemicals for specific years differ significantly from data obtained by the CEP research staff in 1990.

It is fair to say, however, that herbicide and pesticide imports have risen significantly in the past half decade, as is documented in Table 8.1(8), for example:

1985	approximately 140,000 lbs. (Rainey, <i>et al.</i> , 1987)
1986	approximately 157,000 lbs. (DeGeorges, 1989)
1987	approximately 1,000,000 lbs. (DeGeorges, 1989)
1988	approximately 857,000 lbs. (DeGeorges, 1989) OR approximately 700,000 (DBMC, 1990)
1989	approximately 650,000 lbs (DBMC, 1990).

Dominica has a Pesticides Control Board comprising a chairperson and four members. Its functions are regulated through

Table 8.1(7). Primary pesticides used in the Dominica banana industry, 1985.

Common Name	Trademark	Application	Amount Issued or Applied in 1985
benomyl	Benlate	fungicide	3,960 kg
tridemorph	Calbin	fungicide	6,000 l
thiophanate methyl	Sigma	fungicide	3,307 l <sup>1</sup>
thiabendazole	Mertect	fungicide	
spray oil	Spraytex	carrier	
carbofuran	Furadan	nematicide	
oxamyl	Vydate	nematicide	4,671 l
ethoprop	Mocap	nematicide	8,310 kg
pirimiphos-ethyl	Primicid	insecticide	
paraquat	Gramoxone	herbicide	42,378 l <sup>2</sup>

<sup>1</sup>Six hundred liters was aerially sprayed, the remainder by ground crews.

<sup>2</sup>Of the total for paraquat, 28,918 liters was ICI Gramoxone.

Source: Rainey, et al., 1987.

Table 8.1(8). Dominican imports of selected pesticides, 1988 and 1989.

	1988	1989
Round-Up	--	720 liters
Reglone	--	48 liters
Paraquat (Pillarxome)	40,000 liters	119,825 liters
Gramoxone	41,010 liters	20,000 liters
Benomyl	4,000 kilograms	2,700 kilograms
Calbin	7,680 kilograms (1)	4,320 kilograms (3)
Sigma	10,950 liters (1)	5,500 liters (3)
Primicid	6,157 liters	26,300 liters
	[9,000 liters] (2)	[4,500 liters] (3)
Vydate	37,100 liters	1,100 liters
Furadan	156,670 kilograms	100,000 kilograms
Mocap	67,455 kilograms	58,320 kilograms
	[79,920 kilograms] (2)	[38,880 kilograms] (3)
Nemacur	--	1,250 kilograms

(1) DBMC figures as quoted in DeGeorges (1989).

(2) DeGeorges (1989) data differs from DBMC figures provided to CEP team.

(3) DeGeorges (1989) data from January-August 1989 only (i.e., 8 months only).

Source: Except as indicated in footnotes 1, 2, and 3 all figures were obtained from the Dominica Banana Marketing Corporation by the CEP team.

the Pesticides Control Act (No. 15, 1974) and Pesticides Control Regulations which deal with registration, licensing and labeling of pesticides. The Ministry of Agriculture also operates a small Produce Chemistry Laboratory which performs pesticide residue analyses in addition to other responsibilities (see also Section 11).

Testing for pesticides in fresh and marine water as well as in plant/animal tissues and food products has been conducted on numerous occasions with no detection of significant levels of pesticide residue (pers. commun., C. Bellot, Government Produce Chemist, Ministry of Agriculture, 1990). However, there are no formal, mandated monitoring procedures for the testing of pesticides and fertilizer residues.

Recently (January 1990), a group of consultants from the Consortium for International Crop Protection (CICP) conducted an environmental assessment for USAID focusing on fertilizer and pesticide residues in streams, estuaries and potable pipe-borne water. These consultants reported that samples of water were tested to detect paraquat, glyphosphate, carbamates, organochlorides and organophosphates, with the result that no detectable levels were found (see Table 8.1(9)). Similar tests were conducted by CIDA researchers in 1985, and similar results were obtained (DeGeorges, 1989). CICP investigators have expressed some concern, however, over concentration levels in wildlife, particularly of organochlorides (pers. commun., J. Mann, CICP, 1990). Additional water samples were tested by CICP researchers for nutrient concentrations, i.e., nitrogen and phosphate levels. Eighteen samples were taken during a two-week period, with results showing only slightly detectable nutrient levels after heavy rainfall and therefore no cause for concern at the present time (pers. commun., P. Ross, CICP, 1990). See Table 8.1(10) and also Section 3.2.5 of the Profile.

While the episodic information gathered from the above research is valuable and reassuring, it is far from being a satisfactory baseline, and further and more regular monitoring of pesticide and fertilizer residues is

necessary so that changes or fluctuations in concentrations over time (and reflecting seasonal changes in farming practices) can be recorded. Furthermore, pesticide residue in all agricultural products should be regularly monitored, as should both pesticide and nutrient levels in soils and in coastal aquatic systems.

One of the side effects of Hurricane David of 1979 on agriculture was the increase in pest infestation of crops (fruits and vegetables). Hurricanes create air turbulence over large areas that results in the displacement of pests in places where they usually do not have natural predators. Over time natural predators may emerge, but crops can be severely damaged in the interim. In Dominica, the post-hurricane situation resulted in a greater use of pesticides (Clarendon and Hill, 1980).

According to Clarendon and Hill (1980), few deaths have been reported due to improper handling of pesticides although some cases of over-exposure have been reported. Furthermore, while some deaths have occurred as a result of poor labeling and storage of pesticides, most of the reported deaths involving pesticides were the result of deliberate ingestion and the agent used was usually gramoxone. Misuse of pesticides appears to be quite common in Dominica, although many cases are not reported. Individuals working with companies that import pesticides are required by the Pesticides Control Board to visit a physician annually for a complete physical examination. However, the results/findings of these exams are not disclosed to the Board.

## INDUSTRIAL WASTE

Dominica is not as highly industrialized as many other Caribbean islands such as Jamaica, Trinidad, and Barbados, although there is some industrial activity located primarily on the west coast (see Section 7.1).

Furthermore, the presence of fast-flowing streams (with higher than average levels of dissolved oxygen and generally modest levels of nutrient loading), along with the washing-down effect of higher than average run-off from frequent rainfall, all tend to

Table 8.1(9). Results of fresh water sampled for pesticides by CIGP, January 1990.

Pesticide	Level Detected
Organochlorides	< 1 ppb
Carbamates	1 - 20 ppb
Organophosphates	< 1 ppm
Paraquat	< 3 ppb
Glyphosate	Approx. 40 ppb

Source: Personal communication, J. Mann, CIGP, 1990.

Table 8.1(10). Sample locations for pesticides and nutrients, 1990, by CIGP.

Location	Pesticides	Nutrients
<u>Environmental Samples:</u>		
*Pagua River (mouth and head)	X	X
Antrim Water Catchment	X	-
*Mouth of Lough River (also sediment)	X	X
Melville Hall River	-	X
<u>Potable Water:</u>		
Snug Corner Catchment	X	-
River Douce Catchment	X	-
Canefield Tap Water (Antrim Catchment)	X	-

\* indicates areas sampled for pesticides and nutrients.

Source: Personal communication, J. Mann and P. Ross, CIGP, 1990.

reduce the aggregate effect of many point source and non-point source pollution "inputs" to the system in Dominica.

But this also means Dominica's up-land pollutants reach the sea coast faster, spend less "treatment" time en route (underground or in stream and river systems), and, upon arrival, at least at the more pollution-stressed leeward coast, confront a classic case of nearshore impoundment due to the island wake effect. This results from recirculating current gyres on down-current, down-wind, steep-to shorelines such as those between Portsmouth and Soufriere on the Caribbean coast, in the lee or "wind shadow" of the Morne Diablotin and Morne Trois Pitons ridges.

Waste discharges in the leeward zone, therefore, have a tendency to occasionally remain in the area for longer periods of time than would normally be expected, given the steady, westerly flowing currents in the general region of the Windward Island group. This is why there is concern for all industrial discharges in the central west coast area of the island.

The industries most likely to have an adverse effect on the environment and human health are those involved in the production or processing of:

- Distillery spirits
- Soft drinks (dyes used)
- Citrus juices
- Pepper sauce
- Jams and jellies
- Soap/detergents
- Cooking oil
- Animal feed
- Gloves/garments
- Paint (dyes and solvents used).

Other industrial activities of concern include:

- Mining operations (pumice)
- Construction operations
- Block making
- Furniture making
- Body works (mechanical operations)
- Tobacco factory

- Box making.

Air pollution is of limited concern in Dominica due to its small industrial base, few vehicles, and the presence of strong and steady prevailing winds. However, some air pollution is emitted from industries which burn fossil fuels as an energy source for production, e.g., those producing citrus juices, jams, jellies, pepper sauce, cooking oil, animal feed, soap/detergent, and rum. The burning of fossil fuels results in emissions to the air of sulfur oxides, carbon monoxide, nitrogen oxides, and -- if leaded fuel is used -- lead.

In industries engaged in furniture making or in the production of other products from wood, particles are emitted into the air which may be inhaled into the lungs of workers. Aerosol painting in construction and auto body shops is also a source of potentially hazardous pollutants.

Indoor air pollution also occurs in factories, offices, print shops (where lead emission occurs), and other commercial establishments that are not well ventilated. Such indoor pollutants occur in high concentrations where garments are manufactured.

Agro-industries generate liquid and solid wastes in significant amounts. For instance, Dominica Agro-Industries Limited (DAI), which processes limes and grapefruits, generates about 10,000 gallons of liquid waste during periods of processing which extend from the first week in January to the first week in April for grapefruits, five working days weekly, and from the first week in July to the first week in November, for two half-days weekly for limes. During the past year the amount of solid waste generated through grapefruit processing was 1,800 tons, while the figure for limes was 200 tons, all of which was used as animal (livestock) feed. The amount of grapefruit waste generated, however, poses a significant disposal problem.

Initially DAI's waste was deposited at the sanitary landfill at Woodbridge Bay, but due to the inaccessibility of the landfill on wet days and other problems, another site was identified with the approval of environmental health officials and the Roseau City Council.

This alternative site is located at Silver Lake, away from the banks of the Roseau River, where leaching would be minimal, and away from the nearby residential area (pers. commun. E. Lambert, General Mngr., DAI, 1990).

This waste is dumped openly and left to decompose. Liquid waste is diluted with river water at a ratio of 1:10 pulp to water and discharged slowly into the Roseau River close to the factory. As a result of this dilution process, the pH of the waste is increased from between 3.5-4.5 to 6-6.8. According to DAI's general manager (pers. comm., E. Lambert, 1990), chemicals are not used in the neutralization process.

One area of concern, however, is the disposal of liquid pulp waste into the river which, during decomposition, can cause depletion in dissolved oxygen. Presently, the amount discharged is not enough to cause adverse impacts. However, with the factory's projected increase in processing to approximately 8,000 tons of grapefruits in 1991, more liquid pulp waste will be generated and discharged into the Roseau River. There is undoubtedly some yet-to-be-determined upper limit on how much the river can safely handle.

Alternatives for the disposal and/or use of liquid and solid wastes as a result of agro-industrial processing will have to be identified, especially since these industries are expected to expand in the future. For example, the use of solid wastes to generate biogas to meet energy needs is an option already being explored in the country (see Section 6). Other products could be manufactured from liquid and solid wastes, e.g., citrus peel can be used as animal feed or to manufacture distilled oil (something which is already being done on a small scale); while liquid citrus waste could be used to make citrus molasses and frozen pulp added to juices to make them appear fresh (pers. commun., E. Lambert, General Mngr., DAI, 1990).

Some constraint to development of any of these alternatives lies in the fact that large amounts of fruit are needed for processing in order to profitably manufacture

such products. This would suggest the need for an increase in productivity of the agricultural products now being processed before these alternative waste disposal methods become more commercially feasible.

Much of the liquid waste generated by the island's industries is discharged into rivers/streams and the sea. According to available data, soap and rum industries appear to generate the most waste with the volume of waste from rum being significantly higher per production unit per year than soap (see Table 8.1(11)). Rum manufacturing waste generated per year has a much higher BOD level (220 kg/m<sup>3</sup> waste water) (at 27,000 cubic meters/year) than that generated by the soap factory, Dominica Coconut Products (DCP), (13.5 kg/m<sup>3</sup> waste water) (at 21,000 cubic meters/year). Distilleries also have an extraordinarily high discharge of suspended solids in the form of dead yeast cells (slops). On the other hand, the DCP factory produces detergents and cooking oil which can have a high COD level in waste water discharges (Archer, 1984). Other types of industrial pollutants include nutrients from restaurants, as well as emollients, oils, and other chemicals such as those used in photo processing, dry cleaning, and printing.

Another type of waste discharged to rivers and the sea is the dye used in garment manufacturing, paint manufacturing and the printing of boxes produced by ABC Containers. Waste oils from large diesel electric generators and similar, discarded petroleum products generated by the auto repair industry also drain directly into aquatic/marine environments. Oil and other types of emulsions can reduce the dissolved oxygen content of stagnant water as well as increase BOD and COD levels. Furthermore, they do not biodegrade readily. For these reasons, as well as others, they are highly toxic to aquatic plants and animals.

Tar ball sampling on beaches is undertaken by the Environmental Health Unit which reports that significant amounts of tar have been retrieved from the Atlantic coast beaches over the past two years of monitoring, as opposed to lesser amounts collected on the

Table 8.1(11). Water pollution and waste loads from industrial effluents in Dominica, 1982.

Industry-Process	Waste Volume 10 <sup>3</sup> m <sup>3</sup> /yr	BOD <sub>5</sub> kg/unit	COD kg/unit
Rum	22.13	220	-
Soft Drinks	12.38	2.5	-
Pepper Sauce	1.96	5.0	-
Soap	21.4	13.5	24.5
Detergents	-	5.3	7.9
Cooking Oil	0.253	7.5	55.0

Source: Archer, 1984.

Caribbean coast (pers. commun., J. Scotland, EHO, Ministry of Health, 1990). This is indicative of sea-borne pollution sources rather than land-based sources.

## 8.2 PROBLEMS AND ISSUES

### 8.2.1 Effects of Land and Water Pollution on Public Health

#### LIQUID WASTE (SEWAGE)

As noted in this chapter, much of the sewage/excreta and solid waste generated by households in Dominica is disposed of untreated in rivers and the marine/coastal environment and on land.

Raw sewage disposal into fresh water and marine areas threatens humans as well as animals by exposing them to water-borne diseases such as helminthic infestations, typhoid fever, viral hepatitis, gastroenteritis and dysentery. Infected individuals usually transmit infections to others and perpetuate the cycle of disease. In some cases animals serve as intermediate hosts.

The population of urban areas is most likely to be affected by poor sewage disposal practices. In 1980 the incidence of typhoid fever was 21/100,000 -- the highest in the Caribbean region for that year (see Table 8.1(4)). Other water-borne diseases, as discussed in Section 8.1.1, are common causes of morbidity and mortality, primarily among young children (GOCD, 1989d).

Periodic outbreaks of "eye, ear, nose and throat" (EENT) infections may be attributable to sewage contamination of fresh and marine water used for bathing and washing (WHO, 1973). For example, in 1986 there was an outbreak of hemorrhagic conjunctivitis (red eye disease) that affected large sections of the population (see Table 8.1(3)).

Tests can be used to determine the contamination levels of water by sewage. *E. Coli*/Fecal Coliform is a bacterium which normally inhabits the large intestine of mammals and is invariably found in large numbers in fecal matter. It is not normally found in water, and, therefore, its presence indicates fecal (human or animal) contamination. Tests for fecal coliform numbers can be used to indicate levels of water contamination.

The Environmental Health Unit of the Ministry of Health and DOWASCO have conducted such tests to determine sewage and chemical levels in potable water from stand pipes in different parts of the country. Based on data obtained and recorded in Table 8.2(1), it was found that water-borne stand pipes at Marigot, Concord, and Atkinson violated National and WHO standards for safe drinking water. For example, the Marigot district sample test results (Table 8.2(1)) for fecal streptococci (FS) and total coliforms (TC) are indicative of heavy contamination from soil, animal and vegetative matter, while fecal coliforms (FC) indicate contamination from human sources (similar comments could be made for some of the samples taken in Roseau). It is not unrelated that 31 percent of households in the Marigot area have no adequate sewage disposal facilities (see Table 8.1(2)).

Monitoring of marine water at Woodbridge Bay, where Roseau's sewage outfalls are located, including the one which directs liquid waste from the Princess Margaret Hospital, revealed in most cases fecal coliform counts of between 300 and TNTC (too numerous to count) colonies per 100 ml (see Table 8.2(2)). This indicates high levels of pollution from sewage of human origin in the bay which, in some areas, is used for swimming by local residents.

Raw sewage in waterways also poses a health risk when fish and crayfish from the streams are harvested for human consumption. The inshore coastal waters and embayments near Roseau, where the sewage outfalls are located, are frequently used for fishing. Furthermore, in the lower reaches of most streams and rivers, where they reach the sea and are affected by tidal action, some chemical pollutants from upstream or introduced by tidal flushing can accumulate in shellfish which, when consumed, can produce symptoms of toxicity. Other chemical "spills" have resulted in fish kills, suggesting that something more toxic than domestic waste is being carelessly disposed of.

## SOLID WASTE MANAGEMENT

According to the Chief Environmental Health Officer (pers. commun., J. Fabien, 1990), the new solid waste management system, introduced at the end of 1989, has the potential to meet the present needs of the population; however, the plan is still in very early stages of implementation, and at this point an evaluation would be premature.

In the meanwhile, some basic community health problems persist, such as the continuation of poor solid waste disposal practices which can accelerate the proliferation of disease-carrying vectors such as flies which transmit diarrhea (e.g., gastroenteritis is transmitted by flies as are many other communicable diseases), dysentery, typhoid, cholera and conjunctivitis; mosquitos which transmit malaria, dengue, yellow fever; and rodents which transmit leptospirosis and salmonellosis (see Table 8.1(3)).

When dumped in water, solid waste causes stagnation, encouraging the breeding of insect vectors. Furthermore, solid waste is not only aesthetically unpleasant, but affects the psychological well-being of residents in the areas impacted - who usually have to bear annoyances created by others. For instance, some Elms Hall residents are affected after heavy rainfall by solid waste disposed of over a cliff by residents of Kings Hill who live above them. Large amounts of this waste washes down into the yards of many Elms Hall residents.

### 8.2.2 Effects of Air and Noise Pollution on Public Health

## AIR POLLUTION

Allergic reactions as well as skin and lung cancers are frequently associated with exposure to aerosol pesticides and aerially-delivered fungicides, burning of fossil fuels, and frequent burning of solid waste material with toxic substances from domestic, agricultural, and industrial activities.

Table 8.2(1). Results of potable water quality monitoring in four health districts in Dominica (piped water).

Sampling Date	Health District	FC/100 ml	FS/100 ml	TC/100 ml
2/Oct./89	<u>Marigot</u>	70	600	1,400
	Concord #1	60	230	1,300
	Concord #2	20	70	1,300
	Atkinson #1	40	60	3,200
	Atkinson #2	80	100	2,900
5/Dec./89	<u>Portsmouth/Bense</u>			
	(Simon Spring) #1	0	0	500
	(Simon Spring) #2	0	0	540
3/Dec./89	<u>Grand Bay</u>			
	Ravine Banane	0	0	40
	<u>Roseau</u>			
16/Oct./89	DOWASCO Lab	16	0	204
30/Oct./89		8	-	TNTC
7/Nov./89		128	820	TNTC
13/Dec./89		8	-	4
17/Oct./89	Kennedy Ave.	56	0	156
9/Nov./89		8	80	908
20/Dec./89		24	-	640
9/Nov./89	Customs	28	220	364
20/Dec./89		4	-	16
17/Oct./89	Cnr. Ship & Long Lane	4	4	80

**ABBREVIATIONS USED:**

FC	Faecal Coliforms
FS	Faecal Streptococci
TC	Total Coliforms
TNTC	Too Numerous To Count

**Water Quality Standards for Drinking Water:**

National Faecal Coliform (FC): 1/100 ml on average  
DOWASCO Faecal Coliform (FC): 50/100 ml on average  
WHO/UNEP Faecal Coliform (FC): 0/100 ml on average

Source: Dominica Environmental Health Office, 1990.

Table 8.2(1). Results of coastal water quality monitoring in Roseau.

Sampling Date	Source/Outfall	FC/100 ml	FS/100 ml	TC/100 ml
30/Aug./89	King George V St.	40	300	1,500
	Roseau River Mouth	240	260	1,800
	Charles Avenue	300	270	2,100
*11/July/89	Kennedy Avenue	> 5,100	> 984	TNTC
	Princess Margaret Hosp.	> 4,070	> 1,230	> 1,200
	King George V St.	> 300	> 200	-
	Pottersville	TNTC	TNTC	TNTC

\* Rained night before and morning of sampling.

TNTC = Too numerous to count

FC = Faecal coliforms

FS = Faecal streptococci

TC = Total coliforms

International Standards for Coastal Water Quality:

California beaches	TC < 1,000/100 ml in 80% of samples
New York beaches	FC < 500/100 ml in 50% of samples
EEC beaches (ideal)	FC < 100/100 ml in 80% of samples
Brazil beaches	TC < 5,000/100 ml
WHO/UNEP	FC 100/100 ml in 50% of samples

Source: Dominica Environmental Health Office, 1990.

In Dominica malignant neoplasms (cancer tumors) are the second leading cause of death among adults, the rate of malignant neoplasms being 88/100,000 in 1986/87 (GOCD, 1989d). Although the misuse of and exposure to pesticides and other agents discussed in this chapter are common, no direct correlation has yet been made between the increasing incidence of cancer and exposure to these pollutants island-wide. More study is needed.

Lead particles emitted into the air from automobiles (and any kind of lead ingestion or inhalation) predisposes adults to high blood pressure, while children are likely to suffer from mental retardation, learning

disabilities and congenital birth defects. Most of the fuel used in automobiles in Dominica is leaded, and virtually everyone is exposed to the effects of lead in the air. However, research is needed to establish whether or not this is a problem in the state.

It is commonly believed that the country does not presently have a problem with air pollution since the prevailing winds appear to adequately disperse and dilute air pollutants fairly quickly. Furthermore, few factories that emit pollutants are located in heavily populated areas. However, there was one recently recorded incident in which emissions from the Dominica Agro-Industry (DAI) factory affected students and staff of

the Dominica Grammar School located downwind from the factory. The school had to be closed on several occasions. Complaints of ear, eye, nose and throat (EENT) irritations were voiced.

Subsequently, overseas experts were called in to investigate the matter -- an epidemiologist from Trinidad and a mechanical engineer. Both concluded that nothing harmful was coming from the stack of the factory. In any case, mitigative measures have been taken, i.e., replacement of several burner parts and raising the stack 15 feet (pers. commun., E. Lambert, DAI General Mgr., 1990). These measures have reduced complaints of EENT irritation from persons at the school, at least for the time being; nevertheless, further study is needed to assess the full extent of industrial air pollution in the country.

## NOISE POLLUTION

Noise pollution is a new problem of increasing concern in Dominica. Noise as a result of building construction and machinery noise in shops and places of manufacturing and/or repair activities is of primary concern, particularly if these activities are located close to residential areas, commercial places, schools, the hospital, or hotels. Complaints about noise-generating activities from places of entertainment located in residential areas also are common.

Frequent exposure to high levels of noise can affect individuals physiologically (by causing increases in blood pressure, heart rate, hearing loss, insomnia, speech disturbances and headaches) and psychologically (by promoting irritability, increased levels of anxiety and stress among affected persons).

Many communities around the island are affected in this regard. A noise control act has been drafted to address this problem, but it is presently awaiting debate and review by Parliament. There is need for further study to identify the effects of noise pollution on public health in Dominica since preventive measures usually are more effective than curative ones.

## 8.2.3 Legislation

**Public Health Act (1968).** The abatement or control of environmental pollution and other activities which may affect public health is regulated by the provisions of the Public Health Act, now over 20 years old.

This Act makes provisions for the prosecution of offenses that are likely to be injurious to health or expose the public to communicable diseases. Provision is made for prosecution of "nuisances" committed under the act, but enforcement is difficult because the concepts are so outdated (see also Section 11).

The Public Health Act needs to be updated either through amendments to the original legislation or through the formulation of new legislation that can adequately control existing and future pollution problems. As discussed in Section 11, present plans call for the repeal of the 1968 legislation and its replacement by a new act.

**Pesticides Control Act (1974).** This act needs to be revised to mandate that all farmers and other persons who come into frequent contact with pesticides and other hazardous chemicals should have medical examinations at least annually *and* that the reports of these examinations be made available to the Pesticide Control Board for documentation of incidence rates and imposition of more effective control measures, if necessary. Regulations also should specify that the Pesticide Control Board certify appropriate and safe areas for the storage of biocides and that adequate training for workers handling these materials be mandated.

**Water and Sewerage Act (1989).** This new legislation created the Dominica Water and Sewerage Company (DOWASCO), a state-owned private company which is directed to provide potable water and sewerage services for the country. Authority has been granted to DOWASCO for water management, including water conservation and the preservation and protection of water catchment areas. Additionally, the Act gives the Minister power to implement

measures to control pollution of freshwater resources whether such pollution is caused by waste discharges and/or agricultural activities (see also Sections 4 and 11).

**Litter Act (1990).** This legislation was enacted specifically to make provisions for the abatement of nuisances caused by the littering of public places. The Act provides for the prosecution of persons who litter and makes specific reference to such solid waste materials as rubbish, derelict vehicles, dead animals, and bottles. It is too early to know how rigorously the law will be enforced or how effective it will be in discouraging the indiscriminate disposal of solid waste by individuals and commercial enterprises, as is now common throughout the island.

**Marine/coastal Pollution.** At present, there is no legislation to control the pollution of marine and coastal areas (see also Section 5.1.6 of the Profile). Only the provisions of the now-outdated Public Health Act offer a basis for pollution abatement and control in these waters. Perhaps the provisions of the proposed new public health law will address present-day concerns about coastal water quality and marine pollution. Or, alternatively, such issues could be addressed in a new coastal zone management program for Dominica, including legislation, as discussed in more detail in Section 5.3 of the Profile.

### **8.3 POLICY RECOMMENDATIONS**

#### **GENERAL**

**Financing.** None of the issues addressed in this chapter have simple, low cost, quick and easy solutions. All the tasks outlined in the recommendation section -- for waste management, pollution control, environmental protection, and health maintenance (for the ecosystem's floral and faunal as well as its human communities) -- add up to a monumental undertaking for the state. If GOCD were to be asked only to determine the best course of action, this would be a sizeable task, but it must also make decisions relative to the design, funding and implementa-

tion of an entire "package" of programs, many of which are discussed in this chapter. The needed governmental initiatives and public and private partnerships to address waste streams, pollution loading, and ecosystem and public health risks in a timely manner will take an extraordinary combination of good science, good politics, good government and good sense. In this decade of the 1990's, with islands like Dominica seeing new levels of imported toxins and chemicals, new kinds of material technology (packaging among others), and unprecedented volumes of trash and garbage, it is almost certain that financing for needed waste management and pollution control measures is one of the most critical elements in any action agenda. The development of new and innovative means of raising revenues is necessary to reduce the burden on the Government treasury.

Possible options that need to be examined for incorporation into some national financing strategy include:

- charging a levy to all hotels for waste collection and treatment services;

- selling franchises to private waste collectors for designated collection areas (with different fee schedules for urban, rural, industrial areas);

- charging all industrial and commercial users for waste collection and disposal (including tippage fees at all waste disposal sites);

- billing polluters for cleanup and restoration costs;

- setting industrial pollution discharge fees (based on waste flow rates and the nature of the pollutant discharged);

- setting and collecting penalties for illegal waste disposal and for permit violations; and

- legislating incentives for recycling and reducing waste pollution and then licensing collection franchises for various waste stream items with local use or intrinsic export value potential.

**Pollution Literacy Campaign.** The public education programs of YES and the Ministry of Health should be expanded and should be directed at both children and adults regarding environmental pollution, proper waste storage and disposal, and general cleanliness (for communities, roadways, landscape, and common property). These educational efforts could be but a piece of a larger campaign to mobilize the citizens, industry, the agriculture sector, churches, and others in a "pollution literacy campaign". Specific programs could be prepared for implementation by the Dominica Banana Marketing Corporation, agricultural extension agents, service organizations, the Port Authority, shipping lines, etc. The most likely coordinating vehicle for such outreach/public awareness/educational efforts is the YES Committee (see Section 11 for description of YES).

#### **POLLUTION REVIEW**

The quantitative and systemic aspects of environmental pollution in Dominica are not sufficiently well documented to permit the proper development of either remedial or regulatory measures. It would, therefore, be appropriate to assemble an interdisciplinary team to conduct a national pollution assessment. Such an effort should establish the basic dimensions of each waste stream, identifying and quantifying sources and causative agents, volumes, flow rates, destinations, impacts, and projections covering:

- point (i.e., industry) and non-point (i.e., agriculture) sources;
- pesticides, herbicides, and agro-chemical inputs;
- industrial chemicals (e.g., imports, storage, use, risk, disposal, impacts);
- interaction, i.e., aggregates and additive effects;
- bio-accumulation effects (over time).

This national profile could use the workbook methodology laid out in WHO Publication No. 62, "Rapid Assessment of Sources of Air, Water and Land Pollution," as a preliminary framework (this manual was used by Archer, 1984).

#### **SOLID WASTE**

The lines of responsibility are not clear regarding the following:

- siting of dump sites,
- acquisition of necessary land,
- execution of feasibility studies in source reduction and recycling initiatives, and
- exploration of alternative means of disposal.

The new solid waste management plan, being put together under the aegis of the YES Committee (with implementation scheduled as a collaborative effort of the Environmental Health Unit, the Roseau City Council and the Public Works Department), needs to address these very important accountability and coordination issues. There is a need to identify the agency which is to be charged with specific responsibilities for all aspects of the operation of a disposal site and sanitary landfill, including who has the authority to charge fees for waste disposal. If fees are collected, as is recommended above, they should be earmarked for a special account used for the operation and maintenance of equipment at landfill sites or for the purchase of new sites.

Collection of garbage should be turned over to private companies which would charge a fee for the service, something which is not presently done. DOWASCO might be the appropriate agency to license such companies, with authority to rescind franchises if collectors do not perform satisfactorily.

The solid waste management plan now under preparation should cover a preliminary period of five to ten years. From a financial viewpoint, in the short term, properly

operated sanitary landfills are likely to be the most attractive option for solid waste disposal. However, strategies to reduce the quantity of solid waste and to promote a variety of recycling options also need to be explored -- ideally as a collaboration between Government, the retail trade sector, and other commercial and industrial waste generators, in order to ensure that such schemes are organized on economically defensible grounds.

## LIQUID WASTE

The most cost-effective *and* ecologically sound sewage disposal option needs to be identified and then implemented for all urban and village areas of Dominica as soon as possible. Given the fact that it is crucial to prevent both public health hazards and nutrient enrichment of nearshore waters, and taking into consideration existing technological and financial constraints, that option is likely to be preliminary treatment combined with a long outfall which discharges into deep water in an area of strong currents. WHO favors such ocean outfalls for island areas where energy costs to run standard sewage treatment plants are very high. Such waste disposal systems should be designed to be easily upgraded to a higher level of treatment should this prove to be necessary later.

Priority should be given to rehabilitation of the existing centralized sewage collection facilities and to evaluation of the best option for sewage treatment for urban areas. There has been some discussion of assistance from a French development agency (FAPA) for sewage treatment facilities in the Cane-field area, but there are no similar plans for other areas.

Self-help programs in rural communities for liquid and solid waste management need to be encouraged. Where possible, composting and biogas systems could be encouraged as an appropriate technology for biodegradable solid waste and sewage. Dominica's well-developed network of self-help groups, rural development organizations, and NGOs (see Section 11.4) could be called on for assistance in organizing rural communities.

## MONITORING AND STANDARDS

A long-term water quality and marine biological monitoring program should be designed and implemented by the Environmental Health Unit in order to:

- gather baseline data,
- determine the impacts of liquid waste disposal in urban areas and at industrial sites, and
- identify areas requiring remedial action.

Laboratory and personnel capabilities in the country will have to be upgraded in order to accomplish this, and perhaps additional assistance from CEHI, CARDI, or CICP would need to be secured.

National standards and criteria for water quality are needed. New public health legislation (reportedly in train, see Section 11) is urgently required. Funding should be identified to support a research initiative on the correlation (if any) between environmental pollution and major public health problems.

An oil and hazardous materials spill contingency plan should be written and implemented. Legislation is needed to require proper disposal of waste automotive oil and hazardous materials, and facilities to accomplish this must be provided.

## BIOCIDES (Pesticides and Herbicides)

As a matter of considerable urgency, a complete overhaul of the record-keeping systems at the Dominica Banana Marketing Corporation and the Pesticide Control Board is needed, with a view to rationalizing and harmonizing data on the importation and sale of pesticides in the country. Distributors should be required to report quantities sold and major users to report quantities applied in the field.

The Ministry of Agriculture should closely monitor international market require-

ments for the production of fruits and vegetables using acceptable biocides, i.e., those that have residue levels which fall within internationally acceptable tolerances. Local pesticide application practices may need modification.

The Ministry of Agriculture should explore ways to upgrade the existing analytical laboratory and train an additional technician in extraction of biocide residues from samples (produce, meat, fish, human blood/urine or environmental samples such as water and sediment). Extracted samples can be frozen and stored for weeks prior to analysis. Monitoring programs should start with sampling for biocide residues in produce and in drinking water. Analysis can then be conducted by the Caribbean Environmental Health Institute at its laboratories in St. Lucia.

When an additional chemist is trained in biocide residue analysis, the biocide monitoring program could be expanded to include regular samplings from farm workers and the environment (including "indicator" animal species). The environmental sampling capabilities of DOWASCO and the Ministry of Health also need to be strengthened with support for equipment and training. It is possible that one centralized laboratory might be more

efficient and reliable for a country the size of Dominica.

GOCD should expand upon earlier local initiatives to examine options to reduce the amount of biocides used in agro-industries. The methods of Integrated Pest Management (IPM) may be preferable, whereby the objectives of pest control are accomplished by employing a wider spectrum of chemical agents and biological techniques as an alternative to the saturation of crops with toxic compounds.

## TRAINING

Agricultural extension agents and representatives of local rural development NGOs and farmers organizations should be trained to certify farmers in the safe use of biocides. Training programs should emphasize the use of visual instructional methods (e.g., videos rather than lectures) and should make a concerted effort to involve the children of farmers through schools and youth clubs. Pest control operators who spray buildings and the environment to control insects, as well as pesticide control inspectors, should also receive training in the safe use of biocides.

## SECTION 9 PHYSICAL PLANNING AND LANDSCAPE

### 9.1 OVERVIEW

In Dominica, physical planning as it relates to land use change and development is the responsibility of the Physical Planning Division (PPD) of the Economic Development Unit (EDU), Ministry of Finance and Economic Development. While the EDU, as the "parent" agency, is technically responsible for physical planning, most of the staff of the EDU *per se* perform functions which are quite unrelated to physical planning, land use planning, or town and country planning -- as these terms are used almost interchangeably in the Eastern Caribbean. Thus, although the Physical Planning Division is one of two units or sections within the EDU (the other unit concerned with economic development planning), it operates in some ways quite apart from the EDU and its primary functions (Bourne, 1989); see also Section 11.3 of the Profile.

The Physical Planning Division is responsible for the administration of the Town and Country Planning Act, enforcement of land sub-division and building regulations, and administration of the Beach Control Ordinance. The Division also provides advice to central and local government authorities on matters of land use and building control, including:

- construction of safe, aesthetically pleasing buildings;
- establishment of livable residential areas; and
- protection and enhancement of the environment, including coastal zones.

The Town and Country Planning Act (No. 17 of 1975) is the substantive planning and development legislation for the country, but it is scheduled to be repealed and replaced by a new law (pers. commun., D. Bhagowtee, UNDP Legal Advisor, 1990). The present legislation requires preparation of National Plans (e.g., GOCD, 1976 and GOCD, 1985)

and written statements of national planning and development policy. Unfortunately, a national policy or plan for the spatial and physical aspects of development has not yet been prepared. The Act also authorizes regional, local, and sector specific plans for land use and development.

Planning permission is required for any land development project, but exemptions may be made by the Minister (of Finance and Economic Development), for example, under the terms of a development order. In processing planning applications, the following agencies or individuals are reportedly consulted on an "as required" basis: Environmental Health Division, Chief Fire Officer, National Water Services (now called DOWASCO), the Ministry of Communications and Works, and the Ministry of Agriculture (Bourne, 1989), but only Environmental Health routinely receives all applications, for approval of liquid waste disposal systems. For the purpose of processing planning applications, the island has been divided into 14 areas, with each area being assigned to one of four Development Control Officers (Soler, 1988).

It should be noted that the National Structure Plans, first prepared in 1975 and updated a decade later in 1985, have not received official approval. According to Bourne (1989), they are, nonetheless, referred to and used as a basis for planning judgements and decision-making. However, Soler (1988) claims that the National Structure Plan is "neither use[d] as a reference nor as a basis for policy recommendations." Presumably, both authors may be correct, with the Structure Plans being used more by technical planners within Government than by political decision-makers.

The most recent plan (GOCD, 1985) contains numerous guidelines, including a series of standards and criteria for urban and rural settlement growth. These deal with

questions of slope, settlement patterns, population densities, space requirements for different uses (e.g., recreation, industry, institutions) and infrastructural needs.

Detailed physical plans have been prepared and finalized for only selected areas within greater Roseau (e.g., the Pound area, Bath Estate, and existing squatter settlements) and for some of the industrial estate areas which are under development. There is no overall physical plan for the island or even for large sections of it. A master plan was prepared for the greater Roseau area in 1970, but since this document is so out of date, it can no longer be considered particularly relevant. A plan was also prepared for the town of Portsmouth, considered a critical growth area, but it has not yet received final approval.

In recent years Dominica has experienced what might be termed a "construction boom", particularly in the growth of residential housing. In 1987, for example, almost 47 percent more building permits were issued than in the previous year (*The New Chronicle*, 25 March, 1988, Roseau, Dominica), with this growth phenomenon continuing into 1988. In 1989, development activities dropped off somewhat as the number and value of permits decreased by 12 percent and 6.7 percent, respectively, in comparison with 1988. The construction industry remains strong, but the recent trend "points to a possible decline in building starts during the coming months" (GOCD, 1990b).

In 1989 a total of 561 permits were issued with a total estimated value of EC\$63,726 million. New buildings accounted for 74.3 percent of all 1989 permits, with additions or alterations accounting for the remainder. Residential buildings accounted for 87.3 percent of all permits issued for new buildings and 66.6 percent of their total value.

Almost half (48 percent) of all permits and just under two-thirds (63 percent) of the total value of such construction were for projects in the southwestern district, i.e., the area extending from Loubiere to Tarou and as far inland as Laudat. In terms of actual construction starts in 1989, 55.9 percent of those recorded occurred in this district. In

comparison, only 7.9 percent of all starts occurred in the area covering the Carib Territory to Delices.

It is estimated that the number of authorized and recorded building starts (which do not include extensions to buildings) represent only 75 percent of all actual building starts. A considerable amount of unauthorized construction is therefore occurring, particularly of small buildings in rural areas (GOCD, 1990b).

The island's rugged topography manifests a major constraint to the development of human settlements and agriculture. Table 9.1(1) dramatically illustrates how little flat land for development is available in Dominica. Most existing communities have no room for expansion except through hillside residential development or density increases in already built-up areas. Using a gradient of less than 15 percent as the suitability criterion for vacant land available for industries or playing fields, an analysis of 51 settlements revealed the following (GOCD, 1985):

- 41 percent (21 settlements) had less than 2 acres each;
- 18 percent (9 settlements) had 2-4 acres each;
- 16 percent (8 settlements) had 4-6 acres each;
- 6 percent (3 settlements) had 6-8 acres each;
- 20 percent (10 settlements) had more than 8 acres each.

Portsmouth is the only major settlement with a substantial amount of reasonably flat land available for expansion.

The Roseau area in particular is under strong development pressures, and problems leading to congestion and urban sprawl are increasingly associated with the capital city. Because of the shortage of flat land, the sprawl is occurring primarily in a linear pattern along the coastline. Relatively

Table 9.1(1). Percentage of land by dominant slope class, Dominica.

DEGREE OF SLOPE	PERCENTAGE OF LAND
2 degrees or less	1
3 - 10 degrees	1
11 - 20 degrees	12
21 - 30 degrees	22
More than 31 degrees	64

Source: Atkins Land and Water Management, 1983, as simplified from Lang, 1967.

scarce pockets of flat land on hilly areas near the town and in small coastal headlands are becoming increasingly attractive sites for development (Soler, 1988). The preparation of an updated master plan for Roseau is now imperative if rational development and land use in the greater Roseau area are to be ensured for future generations of Dominicans.

## 9.2 PROBLEMS AND ISSUES

### NEED FOR MORE EFFECTIVE PHYSICAL PLANNING

The Physical Planning Division has been vested with only limited control over the broader planning/regulatory aspects of major development projects and programs. As noted by Lausche (1986a), most large-scale projects are in the public sector, and in practice little influence is exerted over them by the physical planning process; for example, the planning phases for the country's hydroelectric expansion project (see Section 6) did not provide for input from senior physical planning officials. Essentially, this means that the PPD has been relegated to reviewing subdivision plans and to performing site-level planning functions such as preparing and drawing land use plans for specific areas that are under development. Bourne (1989) writes that "major developments . . . tend first to get approval at a higher level and then filter down to

the planning department for the physical planning 'trimmings'". This means, unfortunately, that matters of primary concern to the physical planner -- such as the location, scale, and timing of development as well as environmental and land suitability issues -- will most likely be pre-empted or ignored.

The current situation in Dominica *vis a vis* physical planning raises a larger issue, namely, the extent to which land use planning should be emphasized in the development process, particularly in a country which is growing and faces difficult choices about resource allocation and management of the physical environment. In many of the more developed Eastern Caribbean countries, the physical planning office has assumed a more substantial role in this process than is currently the case in Dominica.

With little latitude to provide more substantive input in the overall planning process, the PPD has less opportunity to develop and refine its capabilities and skills. Additionally, the size of the Division's staff is considered inadequate, even for the functions it is required to perform at present (Bourne, 1989; Soler, 1988).

Enforcement of planning legislation and regulations is another serious problem. The Town and Country Planning Act provides for enforcement action against breaches of planning control. A notice must be served requiring that a developer cease his or her ac-

tivity within 28 days. Failing this, the matter can be reviewed in court, and if found guilty, the developer can be fined for each day unauthorized activity continues after issuance of the court order. On average, less than one notice per week is issued (pers. commun., I. Baptiste, PPD, 1990). While some cases involving violations have gone to court, the small size of PPD staff limits follow-up actions required to ensure that violations are corrected; Soler (1988) claims only one unauthorized building was demolished.

## QUALITY OF LANDSCAPE

The importance of both natural and man-made landscapes in enhancing the quality of life is often overlooked in Third World countries, including those of the Caribbean (Hudson, 1986). Even less appreciated is the fact that an enhanced landscape is an important economic resource, despite the difficulties associated with assigning a monetary value to "quality of life" measures.

Hudson (1986) notes that "landscape disfigurement and the spread of placelessness, by destroying scenery and regional character which give pleasure and inspiration, make these diminishing resources even more precious. This has important economic implications because the income-generating potential of the remaining attractive areas is enhanced by the depletion of the resource elsewhere." In other words, as attractive landscapes become scarcer, people will increasingly pay higher prices for the privilege of enjoying fine landscapes. This has been an important factor in the growth of tourism in tropical insular environments such as the Caribbean. Climate, of course, has been a major attraction in drawing visitors to the region, but there is little doubt that the renowned tropical beauty of the Caribbean, like the majestic grandeur of the Alps or the picturesque charm of the Mediterranean, has also been one of the region's marketable commodities.

The need to ensure that such beauty is preserved, and even enhanced in built-up areas, should not be underemphasized. The landscape of many West Indian tourist destinations is becoming increasingly degraded,

and, in fact, islands such as Barbados and Jamaica are now losing potential visitors who perceive them as "spoiled" (Hudson, 1986). Thus, Dominica's relatively pristine environment can only become of growing economic importance as an attraction to visitors -- but only if developments are sensitive to aesthetics.

Some local observers have already noted evidence of a growing lack of awareness and concern for landscape preservation in their country, particularly in built-up, more urbanized areas. Perhaps nowhere is this issue better illustrated than in the spirited controversy which presently surrounds the country's 100-year old Botanical Garden. Occupying approximately 40 acres of "green space" in Roseau -- the largest tract of semi-open land in the city -- the "Gardens" as it is locally known is currently celebrating the centennial of its establishment. Over the years, encroachment onto Garden lands has taken place, including the erection of a number of buildings and storage areas primarily housing Government offices and services. In the 1960's and 1970's, the Gardens were a popular cricket ground known throughout the Caribbean, and it is a more recent proposal, to construct an improved facility and grounds for playing cricket in the Gardens, which has spearheaded a heated local debate over the preservation of this popular place of tranquility and beauty in the midst of Roseau's urbanized environment.

Dominica's Botanical Garden is not unlike others in the Lesser Antilles, where the very existence of these sites has remained mostly a low key, behind the scenes, inherited historical fact. Their full potential has been underappreciated in national development schemes -- except when, as in the case of Dominica, governments have cast an envious eye in the direction of their "unused" landscaped grounds and open spaces. More recently, many in the Caribbean, as in Dominica, have become more vocal in questioning the process which undervalues these green gardens and have begun to call for a revitalization of the botanic garden concept in the region -- making the gardens, in the words of one believer, a kind of focusing device or environmental talisman to keep each island's

memory green and to celebrate each islander's subtle pact with nature in the tropics (Towle, 1989).

### SQUATTER SETTLEMENTS

At present there are about 150-200 squatter households in the capital of Roseau, concentrated within three districts (two primary ones), and about 15 in the Canefield area. These settlements emerged mostly in the aftermath of Hurricane David when many people were left homeless. Generally, these shelters provide substandard housing for the inhabitants and lack basic sanitary facilities i.e., for sewage disposal, which increases public health risks.

The Ministry of Communications, Works, and Housing -- with PPD input in preparing squatter upgrading strategies and development approaches -- is involved in "regularizing" this situation by offering secure land title to squatters and providing other infrastructure improvements to the community; such actions, while important, defer the larger issue of how to improve the overall quality of housing for low-income families, in particular. Furthermore, to date, only about 10-15 percent of the Roseau squatters have been dealt with (pers. commun., I. Baptiste, PPD, 1990).

The presence of the Roseau squatter settlements and the generally crowded conditions in the urban area draw attention to the continuing need for expanded programs to meet the housing requirements of Dominicans. An up-to-date summary of the country's housing requirements is provided in a summary report ("The Challenge of Providing Shelter") in a new publication, *Island Treasure*, recently released by the Public Awareness Sub-Committee of the Government's YES Program (YES, 1990a). That report projects a shortfall in Dominica's housing requirements in the year 2000 of over 7,000 units. The subject of "shelter" is one of the two key components of GOCD's newly-launched (1989), multi-year program called YES (for Years of Environment and Shelter), an effort which is discussed in more detail in Section 11.3 of the Profile.

## 9.3 POLICY RECOMMENDATIONS

### STRENGTHENING THE PHYSICAL PLANNING PROCESS

As is also discussed in Section 11.6 of the Profile, the physical planning structure and process need to be strengthened in Dominica. New planning legislation is reportedly being formulated which will address many of the issues raised in this section and in Section 11 concerning presently-constituted planning and development control procedures. The fact that the Physical Planning Division presently is a part of the Economic Development Unit suggests that GOCD recognizes the importance of integrating physical and economic planning. Unfortunately, despite this organizational structure, physical planning as an integrative process is not well established within the Dominican Government, and there is limited opportunity for systematic coordination across departmental lines in the physical planning process (see also Section 11.3 of the Profile).

The PPD had little or no input for many of the major development projects presently underway or currently in planning stages in the country. Examples include the Hydroelectric Expansion Project, the proposed cruise ship berth at Portsmouth, the proposed new airport at Woodford Hill, the proposed improvements for a cricket facility and playing grounds in the Botanical Gardens, and the proposed St. Joseph - Governor/Wesley Road which would transect the Northern and Central Forest Reserves by connecting the St. Joseph area to the northeast coast. All such projects have varying impacts on the physical, natural, and human environments. Therefore, the technical expertise of the Government's physical planners, along with other GOCD experts, should be sought at the very earliest stages of project planning and evaluation for all major development activities undertaken in Dominica -- preferably as part of a formal Environmental Impact Assessment process.

Additionally, implementation of improved project coordination procedures, as outlined in Section 11, should include an op-

portunity for input by the Physical Planning Division in decisions concerning the siting of recreational facilities. Existing playing fields, for example, were reportedly poorly planned in most communities (pers. commun., H. Shillingford, Sports Division, 1990). Similarly, natural disaster planning efforts should include a major role for a strengthened Physical Planning Unit.

## **PHYSICAL PLANNING APPROACHES AND PRIORITIES**

The most recent National Structure Plan (GOCD, 1985) proposes that the island's seven administrative districts (see Figure 9.3(1)) be utilized as the basic units for sub-national planning. This approach differs from the earlier National Structure Plan compiled in 1976 with UNDP assistance which suggested that only three regions form the basis for planning efforts. The updated proposal appears to represent a more rational approach based on greater decentralization and thus a greater role for local community organizations. In fact, each district already has a District Development Officer and a District Development Assistant who deal with district-level development issues and problems.

Recommendations made by the former Senior Physical Planner in a report entitled "Proposals for the Restructuring of Planning and Development Control Administration in Dominica" emphasize the need for Planning Advisory Committees at each planning level (regional, district, local). Such a structure, the author maintains, will ensure a role for local government bodies and private citizens in the planning process (Baptiste, cited in Soler, 1988).

Wirt (1988) notes that local government bodies have a well established tradition in Dominica, providing a framework for socio-economic development which could serve as a model for other Caribbean states. Wirt, an OAS consultant, maintains that Village Councils can help in expeditiously improving conditions in settlements if they are given more training in project identification, budgeting, proposal preparation, and implementation of project activities. The substantial distances of

many communities from the seat of national government in Roseau also justifies the strengthening of local governments for certain functions in order to improve administrative efficiency.

According to Soler (1988), some development control functions already are being handled by local government authorities, in part because PPD control officers do not have adequate time for appraisal of development control applications received from outlying areas. He recommends that consideration be given to formalizing existing, informal relations between the PPD and local governments, including well-defined procedures for the assistance to be provided by local authorities.

The National Structure Plan (GOCD, 1985) calls for the drafting of plans for districts and district centers as soon as possible, if necessary with technical assistance. As noted by Soler (1988), the district plans should be consistent with the National Structure Plan and "must reflect a certain level of comprehensiveness in order [for] complexities of territorial issues . . ." to be effectively addressed.

Key priorities at the district level include the identification of potential production areas and routes for feeder roads, as well as the establishment of procedures to provide adequate community-level services and facilities, given the dispersed settlement patterns characteristic of Dominica. With regard to district centers, it is stressed that Roseau and Portsmouth should receive top priority (GOCD, 1985).

## **ENVIRONMENTAL IMPACT ASSESSMENT**

Very few environmental impact studies have been undertaken to date in Dominica. All of these have been or are being conducted by outside consultants, which is not unusual in developing countries, given the limited in-country experience with Environmental Impact Assessment (EIA) procedures and the limited resources available for such investigations by local officials.

DOMINICA/Proposed Districts

( )= Population

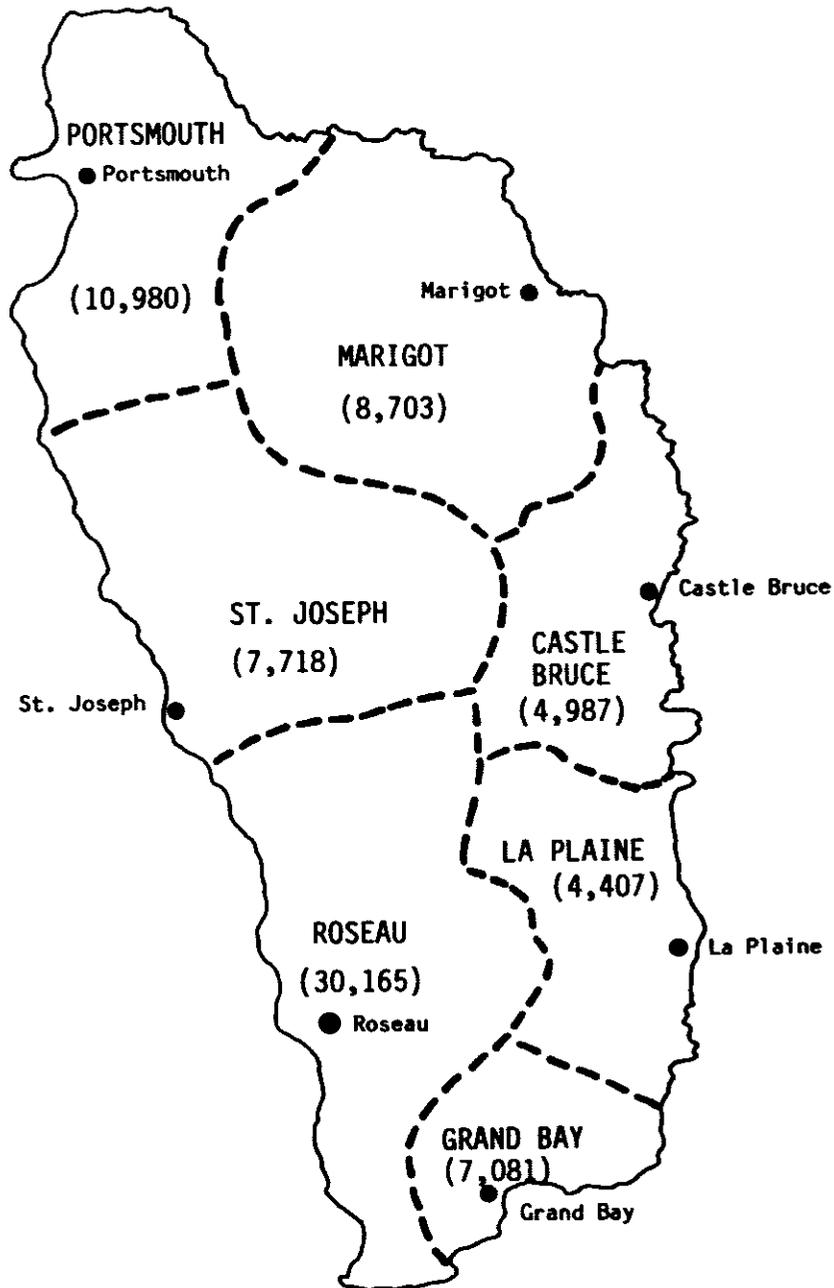


Figure 9.3(1). Proposed districts for sub-national planning (source: GOCD, 1965).

Unfortunately, virtually all of the EIAs have been initiated only after a given project has proceeded well into, or even beyond, the planning stage. The Hydroelectric Expansion Project, for example, is currently the focus of an environmental assessment, but construction of project works is almost complete (see Section 6).

Environmental Impact Assessments are designed as a *proactive* attempt to analyze the projected impacts of a development project, and thus much of the effectiveness of this planning tool is defeated if it is initiated after the project design, or even the project conceptualization, stage. In general, the simplest and most cost-effective way of minimizing the environmental impacts of development activities is through the upfront development of a design that is sensitive to the environmental implications of proposed activities from the very beginning. Remedial measures, if applied after the event, often are prohibitively expensive.

Legislation is needed in Dominica to require the preparation of EIAs for all major projects (public or private sector), especially those within the coastal zone, within the boundaries of designated protected areas, or affecting other critical areas identified in this Profile. As pointed out by Ahmad and Sammy (1985), such an assessment does not have to be highly complex and comprehensive in order to be useful. The aim should be primarily to ensure that environmental concerns are in fact addressed when it is most feasible to do so, i.e., at a very early stage in project development.

The institutional capacity for interpreting and later carrying out the technical aspects of environmental impact assessment needs to be created within an appropriate unit of Government; the most logical unit might be the Physical Planning Division, but the Forestry Division has historically taken the lead on environmental matters in the country. It may be that a legislative basis for EIAs as part of the planning process already exists.

Soler (1988) writes that a planning application may involve "special requirements" from the prospective developer, including an evaluation of the "estimated impact [of the proposed development] . . . on the natural ecology . . ."

The National Structure Plan (GOCD, 1985) recommended that an Environmental Protection Unit be established. This recommendation has not yet been acted upon, but serious consideration should be given to its creation within a strengthened Physical Planning Division or, alternatively, within the Forestry and Wildlife Division. In any event, the size and technical skills of the PPD staff would have to be upgraded if this division of Government were to undertake responsibilities for environmental impact assessment.

#### **LOCAL RESOURCE MATERIALS FOR HOUSING CONSTRUCTION**

A study conducted by Ortega (1983) found that a variety of readily available raw products in Dominica have great potential as building materials. These include timber and clay, as well as lime, sulphur, pumice and bamboo. Timber traditionally has been used as a construction material, and, reportedly, the development of clay brick has been assisted by France. However, the other four materials have not yet received much attention for expanded use. Lime and sulphur are binding agents that could reduce the need for imported cement. Pumice is a lightweight aggregate with excellent heat insulation properties. Bamboo, which is very resistant to tension, has potential to replace reinforcement bars in housing construction.

These materials should be considered for further development and use as a means of reducing imports while increasing linkages between the local construction/building industry and resource production/management sectors. Ortega (1983) offers more specific suggestions on how development of these materials could proceed, but these may need to be brought up to date.

## SECTION 10 PROTECTION OF HISTORICAL HERITAGE

### 10.1 OVERVIEW

Unlike its sister islands in the Windward group, Dominica did not pursue the "national trust" model adopted in other Caribbean islands in the 1960's and 1970's and therefore lacks this centralizing force for resource protection and development. What Dominica does have is an informal network of cooperating institutions and individuals, both inside and external to Government, dedicated to the preservation and management of the country's historical and cultural heritage. Although less structured in its approach, this "network" has nonetheless successfully engineered the establishment of a national park which includes within its boundaries the country's most spectacular historic site.

The story of the development of the Cabrits National Park is an outstanding example of what can be accomplished when the resources of Government and external development assistance agencies are linked with community aspirations and local NGO program objectives. Unfortunately, it is a relatively isolated example, for the country lacks a broad base of support for historical resource management programs. There is no officially designated institution (like a national trust) to assume custodial responsibilities for the country's historical and cultural heritage; there is no antiquities legislation *per se* to protect surviving historical and archaeological resources; and there has been no attempt at an integrated, long-term strategy designed to incorporate these resources within a comprehensive management framework outside of the Cabrits National Park.

#### HISTORICAL, ARCHAEOLOGICAL AND ARCHITECTURAL FEATURES

**Military Sites.** Dominica's primary coastal fortifications were laid out by the British for the defense of the island. Of the country's two coasts, the leeward side needed to be well-defended, while the more rugged

windward coast offered less accessibility to an enemy. Primary fortifications on the Caribbean coast were established at the Cabrits in the north and around Roseau in the south, with a line of signal stations placed from Scotts Head, south of Roseau, to the Cabrits. When the British had completed their efforts, 235 cannons of varying types and sizes were pointing seaward from the coastal areas, awaiting any approaching enemy (Honychurch, 1984).

The most significant of the coastal fortifications was the military complex on Dominica's northwest coast known as the Cabrits, an area which covers an entire peninsula comprising two steep hills separated by a narrow valley. The Cabrits Peninsula (formerly known as Prince Rupert's Head) is located just north of the island's second principal town, Portsmouth. Construction of the fortified garrison was carried out between 1770 and 1795, primarily by the British although additions were made by the French during their occupation from 1778-1783. Together they amassed a garrison including one fort (Fort Shirley), seven gun batteries, seven cisterns, powder magazines, ordnance storehouses, barracks and officers' quarters to house and provide for over 600 men on regular duty. The best preserved and most accessible group of buildings at the Cabrits is Fort Shirley, located at the southern end of the central valley, overlooking Prince Rupert's Bay which it once defended.

No major battles were fought at the Cabrits, but Fort Shirley was the scene of one of the most dramatic events in Caribbean history, the 1802 mutiny of the Eighth West Indian Regiment, an Afro-West Indian unit which took control of the garrison for three days in protest against conditions at the fort. In ranking the significance of the Cabrits as a Caribbean military site, historians have compared its importance to Brimstone Hill in St. Kitts and English Harbor in Antigua (Buisseret and Clark, 1971).

Although the Cabrits dominates the list of historical monuments in Dominica, other military sites can also be identified. The most significant, after the Cabrits, is Fort Young in Roseau, now the site of a semicircular hotel of the same name. Although constructed (and reconstructed after Hurricane David) with discretion and sensitivity, military historians Buisseret and Clark (1971) reported that it is now difficult to discern the original layout of this once important battery. Other military sites are Melville Battery, one of a series of defenses built to protect Roseau; Morne Bruce, built on a hill above Roseau for the defense of that town; and Fort Cashacrou, located on the Scotts Head peninsula and site of one of the old signal stations along the leeward coast. Fort Cashacrou was included within a proposed Government plan in the early 1980's to create a touristic and recreational area for the Soufriere/Scotts Head area in the southwest of the island.

**Plantation Sites.** The "golden age of sugar" did not affect Dominica as significantly as elsewhere in the region, in part because the island's mountainous terrain limited sugar cultivation and in part because colonization came later in comparison to other places in the West Indies. Thus, the remains of colonial plantation estates in Dominica are not as extensive as in other West Indian islands. There are, for example, no grand estate houses as in Barbados or Jamaica; most British estates were run by managers and little money was spent on these dwellings (Honychurch, 1988).

The country was once rich in water mills used for crushing sugar cane, some of which were operational as recently as 20-30 years ago. Hurricane David (1979) caused extensive damage to old industrial works, and the best surviving examples of water mills can now be found at Castle Comfort, Hampstead, Layou, and River Estate (Honychurch, 1988). The mill at Canefield is one of the largest as well as the oldest surviving sugar mill on the island; it was the last used to produce sugar, although it continued in operation earlier in this century for the processing of lime juice. Today, the Old Mill houses a cultural center and museum under the auspices of the Government's Division of Culture.

**Architecture.** Examples of vernacular architecture can still be found throughout the island; traditional Creole houses lend a distinctive atmosphere to the country's primary towns, Portsmouth and Roseau. Almost twenty years ago historians Buisseret and Clark (1971) remarked on the survival of vernacular architectural features in Roseau, a fact they attributed to the relative underdevelopment of the town in comparison to other island capitals in the Eastern Caribbean. They were particularly impressed with the deeply-projecting cantilevered balconies to be found in the town, often supported on remarkably little material except a diagonal brace. At about the same time, Shankland, Cox and Associates (1971), in its tourism development plan for Dominica, proposed that an historic district be established in Roseau to protect its unique architectural features.

An historic building inventory of the town thirteen years later (Cloyd, 1984) found that some of the streets proposed for the historic district were totally devoid of any historic buildings. In his survey, Cloyd identified, mapped and provided preliminary recommendations for the restoration/preservation of approximately 200 buildings largely centered in the "old town" area recommended by Shankland, Cox and Associates for historic district status. Cloyd also included some preliminary guidelines for preserving the historic character of the town. There has been little follow-up to Cloyd's general recommendations or to the recommendation to establish an historic district. Nevertheless, much of the uniqueness of Roseau's architectural heritage remains, principally because the town has not developed as rapidly as others in the Eastern Caribbean.

**Archaeological Sites.** Known archaeological sites have been informally identified by Honychurch in his publication on Dominican culture (Honychurch, 1988). Only two excavations have reportedly been carried out, one in 1977 at Soufriere and the most recent in 1989 at Capucine, with artifacts retained by the National Cultural Council, (pers. commun., L. Honychurch, The Dominica Institute, 1990).

**Surveys of Historic Sites.** In addition to archaeological sites, Honychurch (1988) identifies other places of historical and cultural interest in Dominica (see Figure 10.1(1)). No official "registry" of historic places exists, however, but one should be established to assist planners and resource managers.

## THE CABRITS NATIONAL PARK

For decades, successive Dominican Governments have deliberated over various development options for the remains of the Cabrits garrison and, more particularly, Fort Shirley. The site and its surrounding, gently sloping valley land have been used at various times as an agricultural center, a quarantine station, and an experimental teak forestry project, and it almost became the island's leper home (Honychurch, 1983). Since the 1960's several tourism-oriented proposals for the Cabrits/Portsmouth area have come under consideration by Government; by the late 1970's, the Forestry and Parks Service had taken the lead in planning for the development of the area as a multi-use site, including its designation as a national park and provision of recreational, educational, and visitor facilities.

With initial financial assistance from the World Wildlife Fund-US and the support of the Dominica Conservation Association, the National Park Service stepped up brush-clearing and restoration work at the site in 1982, including the opening of trails and establishment of a small museum at Fort Shirley. In 1984, with the assistance of the Eastern Caribbean Natural Area Management Program (ECNAMP), a report entitled *Cabrits 2000* was released which outlined development concepts for the proposed Cabrits National Park. The report was prepared by ECNAMP in consultation with a coordinating and advisory committee made up of government and non-government members. The proposed development scenario called for adaptive use restoration of historic structures within the park, construction of a cruise ship dock and terminal to provide visitors for park facilities, and creation of a Cabrits Founda-

tion, a non-profit, non-government entity to take the lead for commercial development and activities within the park. Although no official management plan has yet been developed for the Cabrits National Park, the 1984 *Cabrits 2000* report is generally recognized as the policy document for the development of the site.

A later study focusing on development proposals for the Cabrits (by this time designated a National Park) was carried out in 1989 by Arthur Young International for the Caribbean Conservation Association. The Cabrits "pre-feasibility study" was part of a larger regional effort funded by CDB to examine the development potential of selected historic sites in the Eastern Caribbean. Fifteen major projects were proposed for the Cabrits during the period 1989 to 1998, including infrastructural works and amenity provisions as well as marketing, promotion, interpretation, and management activities. Some funding has been forthcoming as a result of the Arthur Young report, obtained through CIDA's small projects Mission Administered Funds Program in Barbados (pers. commun., L. Honychurch, The Dominica Institute, 1990).

In December of 1986, the Cabrits National Park (Dominica's second national park) was legally established. Comprising a total of 1,313 acres, the Park includes the two hills of the Cabrits Peninsula, the freshwater swamp which connects the peninsular park to the mainland, and Toucari and Douglas Bays. The 260 acres of land designated for inclusion in the Park incorporate the historic ruins as well as a representative sample of dry forest lands, the last significant tract of this ecosystem type on state-owned land. The adjacent marine park encompasses some 1,053 acres surrounding the peninsula and up to the mouth of the Lamothe River (see Figure 10.1(2)). Management of the Cabrits National Park falls under the jurisdiction of the Dominica National Parks Service; additionally, the services of an independent historian-researcher, acting in consultation with the Parks Service, were obtained to assist with such activities as establishment of the Fort Shirley Museum.

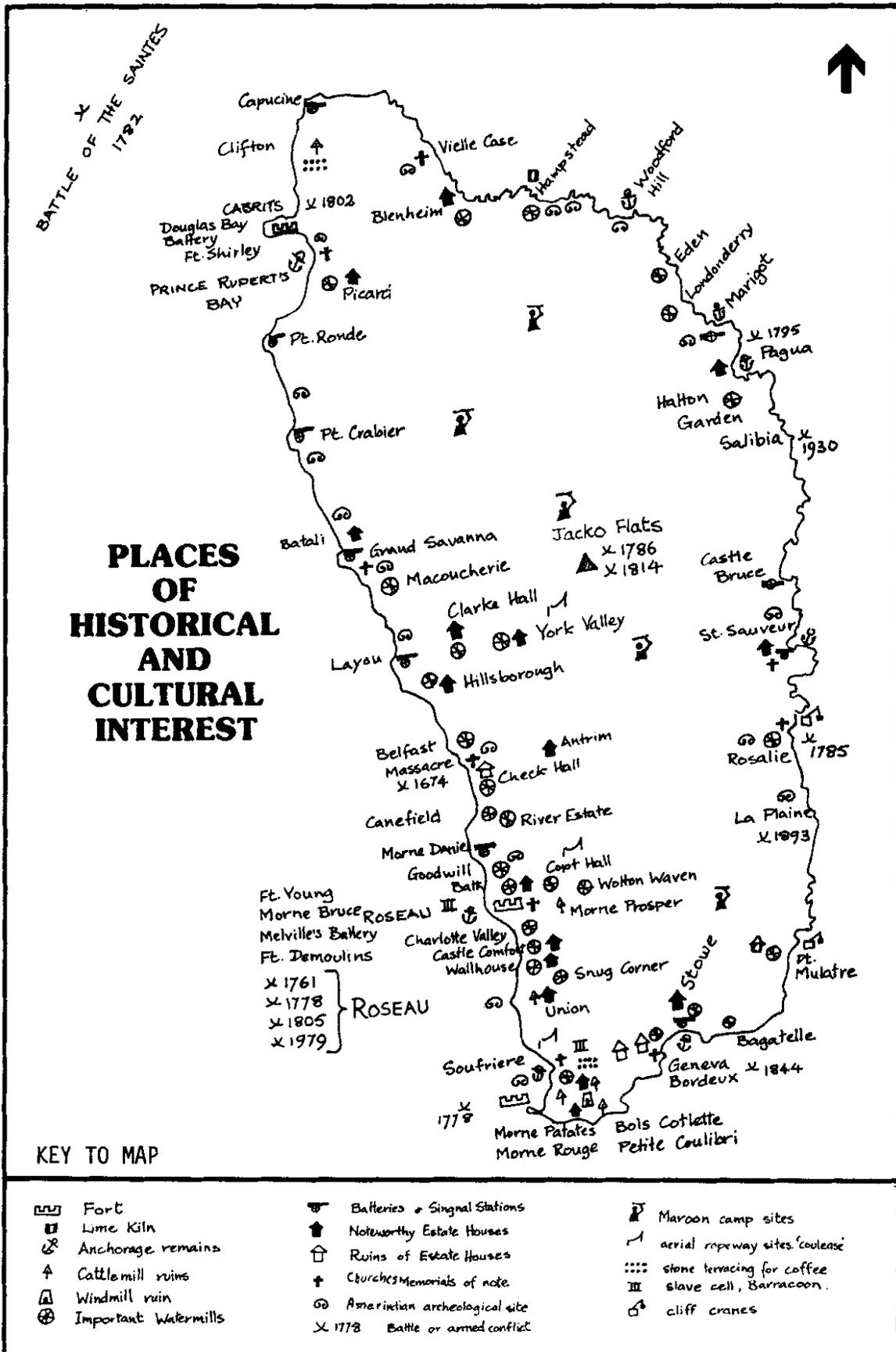


Figure 10.1(1). Places of historical and cultural interest in Dominica (source: Honychurch, 1988).

The assistance of a long list of regional and international organizations was acknowledged by the Forestry and Parks Service at the time of the Park's establishment, including: ECNAMP, IRF, CCA, WWF-US, IUCN, the U.S. National Park Service, Parks Canada, Canadian Nature Federation, and CIDA.

The creation of the Cabrits National Park is viewed locally as an important step both as a conservation/protection strategy and as an added attraction for the island's tourism base. The Park contains within its boundaries remarkable woodland, marine and historic features. Its peninsular shape provides discreteness and protection; while its location -- adjacent to the town of Portsmouth and to a coastal area selected by Government for tourism -- provides options for direct linkages both to the developing tourist industry and to the country's second largest urban community. In mid-January 1990, groundbreaking ceremonies took place for construction of an EC\$7.1 million cruise ship berth, reception terminal, and dock facility at Prince Rupert's Bay, scheduled to be completed by the end of the year. It will be the only port in the Eastern Caribbean where passengers disembark directly into a national park (in St. John, cruise ship passengers are ferried ashore to the Virgin Islands National Park from anchored ships).

## MUSEUMS

Dominica reportedly had an established museum as early as 1911 when a group of private individuals organized what was then known as the Victoria Museum in a building formerly occupied by the Victoria Memorial Library (Dom. Cons. Soc., 1974; Aspinall, 1923). In a 1989 survey of museum development in the English-speaking Caribbean, Cummins reports that in 1931 the Directors of the Library were instrumental in establishing an independent new museum in the old library building when funds were received from the Carnegie Corporation for construction of a new library in the Victoria Memorial Gardens. That small museum remained in place until 1953 when the building was taken over

by Government for other purposes, and exhibits were stored in the basement of the Public Library.

By 1971 interest had revived in the re-establishment of the original Victoria Museum, and Government, through the Ministry of Education and Health, contacted the Caribbean Conservation Association for assistance. Local interest culminated in the launching of an educational exhibit on early Dominican history as part of the 1971 National Day Celebrations. A proposal for the establishment of a National Museum for Dominica was prepared by the CCA Executive Director (who was a former curator of the Guyana National Museum), and preliminary funding was identified from the U.S.-based Conservation Foundation. Unfortunately, Government action on the Museum proposal was postponed, and little progress was made (Cummins, 1989).

In 1974 the Dominica Conservation Society (a predecessor to the present Dominica Conservation Association) prepared a plan which outlined a system of museums for the country collectively referred to as the Dominica Museum Service, along with a set of specific goals for the next decade. An OAS museum consultant visiting the country almost ten years later (Whiting, 1983) found that while no action had been taken on the 1974 proposal, it was extremely well thought out and could still be used by the Government as an action plan. The same might be said today, some six years after Whiting's visit.

The proposal conceived in 1974 linked the development of a museum system to the emerging National Park System, with some museum facilities serving in an ancillary fashion as visitor centers with interpretive displays for national park sites. A central museum was recommended for Roseau with the Victoria Museum supplemented by another larger building to serve as Museum Headquarters (several Government buildings were suggested for this purpose). A series of smaller or sub-museums was also contemplated, each to reflect the peculiar history and natural features of selected sites.

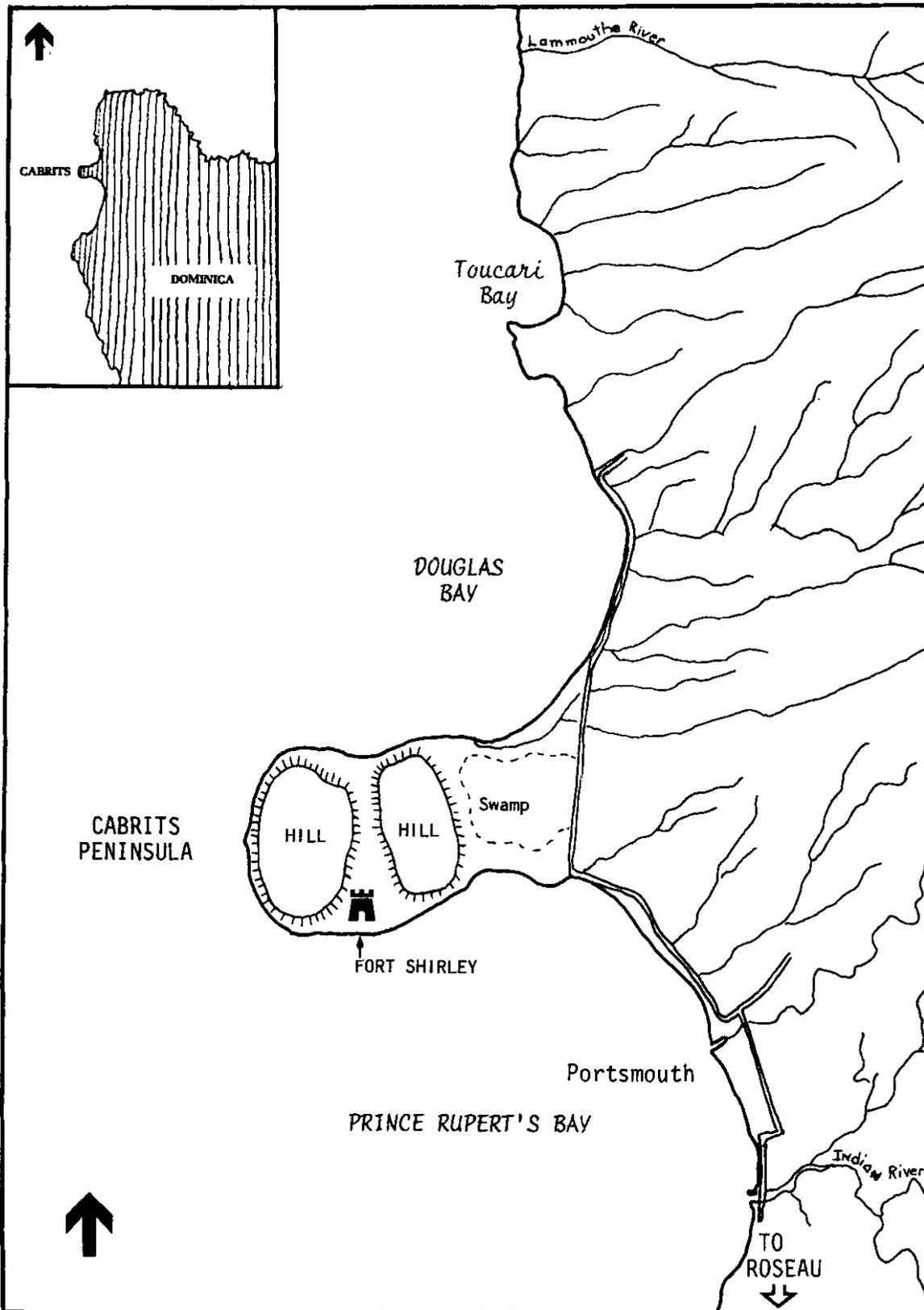


Figure 10.1(2). Location map of the Cabrits National Park, Dominica.

While these ambitious plans from a decade and a half ago never were fully realized, Dominica does support two small museums which were established since the museum proposals of the 1970's. At the initiative of a local writer/historian, a museum was established at Fort Shirley in 1982. It was opened in conjunction with celebrations marking the anniversary of the regionally important "Battle of the Saints", fought between French and British fleets on 12 April, 1782 within sight of the ramparts of the Cabrits. Future plans call for Fort Shirley to be developed as the interpretive center for the entire Cabrits National Park. The first museum, while small in size, highlighted the natural and historical aspects of the Park and was housed in a restored building which formerly served as a guardhouse during British occupation of the garrison. The museum was later moved to the restored Powder Magazines.

A second museum opened in 1988 at the Old Mill Cultural Center in Canefield just north of Roseau. The museum wing to the Cultural Center is housed in a former sugar boiling house and includes a small museum shop in addition to exhibits on the island's natural history, folk history, cultural influences, and historical development.

The Cultural Center also houses the offices of Dominica's Division of Culture which was established in 1978 to encourage a national cultural consciousness which, in Dominica, is thought by many to be unmatched in other Eastern Caribbean islands. Dominican "cultural nationalism" had its roots in the 1960's when, under the leadership of the country's Premier, National Day was promoted as an annual cultural festival, bringing together village groups in folk dances and other musical and artistic competitions, a tradition which continues to the present (Honychurch, 1984).

## 10.2 PROBLEMS AND ISSUES

While the recent establishment of the Cabrits National Park provides a unique opportunity for the protection and adaptive use of the country's most important historical

landmark, Dominica lacks a comprehensive management framework for its historical/cultural resource base. Specifically:

(1) The country needs a comprehensive, systematic, and official inventory of extant historical/archaeological sites and cultural landmarks which classifies and evaluates the potential value of these resources to the development of the country. Priorities need to be established for areas at high risk, and resources need to be evaluated on a site-by-site basis to determine potential for tourism development, for educational programs, for inclusion in the national park system, etc.

(2) Historical and archaeological resources are without protection, unless they fall within the boundaries of a legislated national park. To date, two such parks have been established, and only one includes the historical resources located at a single site.

(3) There is no one agency responsible for historical/cultural heritage in the country. While informal working relationships between relevant GOCD agencies and local as well as externally-based NGOs have worked in the past (particularly with reference to the establishment of the Cabrits Park), the need for better coordination has also been noted by Government officials, some calling for development of a "National Cultural Policy" which would bring together all aspects of national heritage protection under one comprehensive, operational program (Whiting, 1983).

When planning for the establishment of the Dominica National Park System was underway in the late 1960's and early 1970's, an underlying premise put forth by park planners was that the proposed park system would include areas of "historical or archaeological significance" (Maximea, n.d.). Earmarked for possible inclusion were sites designated as National Military Parks (e.g., the Cabrits, Fort Cashacrou, and Morne Bruce). Other buildings, sites, features, or areas were to fall under

an "historic area" classification within the proposed park system; areas suggested were: the Carib Reserve, the Portsmouth Town Center, Melville Battery, Fort Young, and water mills (as a generic category). In the intervening years, only the proposed "military park" at the Cabrits has received national park designation, and no alternative system for protecting, managing or developing other sites has yet been developed.

### 10.3 POLICY RECOMMENDATIONS

● Antiquities legislation is needed to provide for both restoration and protection of the nation's historical and cultural resources. Such legislation might include establishment of a Registry of Historic Places which could also require a comprehensive inventory and evaluation of historical/cultural resources and would afford some protection to national landmarks, historic sites, or architectural features not easily included at the present time within the National Park System. Criteria would need to be set for selection and certification of Registry sites and standards established for development of such sites. Authority would need to be vested in a designated agency to control development and use of protected sites. At the present time, such authority might be vested in the National Cultural Council or the National Parks Service within the Ministry of Agriculture.

\* While informal cooperation between agencies of Government, often in accord with local NGOs and individuals, has worked well in the past in establishing a national park system, supporting cultural activities, and promoting some museum development, it needs to be recognized that:

(1) redundancy of effort by various interest groups is less likely to occur in the presence of (i) a broader policy base for the protection of historical/cultural resources and (ii) centralization of control/management functions in one agency; and

(2) while informal networks of cooperation often provide opportunity for flexible, innovative development, they are also more tenuous because they are frequently based on personal rather than institutionalized relationships.

The need for better inter-agency coordination for policy development and planning has been pointed out by GOCD officials in the past (Whiting, 1983), but no action has been taken to provide more formal lines of communication, coordination and cooperation between relevant agencies (e.g., the National Parks Service, the Division of Culture, the National Cultural Council, and the Public Library and Archives). In the absence of a National Trust, the recently revitalized Dominica Conservation Association (see Section 11) has the potential to become yet another concerned party with complementary program goals and objectives.

\* It is not too late to consider an "historic district" policy for designated areas in Roseau and Portsmouth, and Government might review earlier recommendations for the establishment of such a district in Roseau (Cloyd, 1984). Further consideration should be given to development of a Government policy which encourages adaptive use and restoration strategies by the employment of economic incentives and to the adoption of design controls for new construction in the town areas, perhaps along the lines of the recently released OAS recommendations for St. John's, Antigua (OAS, 1989).

## **SECTION 11      INSTITUTIONAL FRAMEWORK FOR ENVIRONMENTAL MANAGEMENT**

### **11.1    GOVERNMENT ORGANIZATION**

The Commonwealth of Dominica is a sovereign democratic republic within the British Commonwealth of Nations. The Head of State is a non-executive President who is elected for a five-year term by the House of Assembly on the joint nomination of the Prime Minister and the Leader of the Opposition.

The President appoints as Prime Minister the elected member of the House who commands the support of the majority of its elected members. The President also appoints other ministers on the advice of the Prime Minister. Executive power is exercised by the Cabinet headed by the Prime Minister; legislative power is vested in the Parliament.

The unicameral House of Assembly comprises 31 members -- one representative elected by universal adult suffrage from each of the 21 constituencies, one ex-officio member (the Attorney-General), and nine senators who are generally appointed by the President on the advice of the Prime Minister (five senators) and the Leader of the Opposition (four senators). If the Attorney General is an elected representative from one of the 21 constituencies (as has been the case for over a decade), the membership of the Assembly drops to 30.

The country's legal system is based on English Common Law.

Following the election in 1990, the administration of Government was re-organized as follows:

- Ministry of Finance and Economic Development
- Ministry of Legal Affairs, Information, and Public Relations
- Ministry of External Affairs and OECS Unity

- Ministry of Agriculture and the Environment
- Ministry of Trade, Industry and Tourism
- Ministry of Labor and Immigration
- Ministry of Education and Sports
- Ministry of Health and Social Security
- Ministry of Communications, Works and Housing.
- Ministry of Community Development and Social Affairs.

The city of Roseau and town of Portsmouth are administered by a city and town council, respectively, which are empowered to make by-laws and regulations and to levy taxation on property. Village councils (of which there are 34 at present) are part-nominated and part-elected and have legal status as corporate bodies to oversee public responsibilities in smaller, rural communities. There is also a Carib Council, whose chairman is the Carib Chief, elected by the population in the Carib Territory.

At another level, District Associations of village councils represent an extension of the Central Government administration into local government areas. The Associations (in seven districts) do not have statutory authority, but they assist the village councils in the performance of their duties.

The Central Government's coordinating, service agency for liaison with local communities is the Division of Local Government and Community Development in the Ministry of Community Development and Social Affairs. Given the size and topography of Dominica, the need for an effective system of local government administration is imperative

and is reflected in Government's attention to this sector.

## 11.2 HISTORICAL DEVELOPMENT OF AN ADMINISTRATIVE FRAMEWORK FOR ENVIRONMENTAL MANAGEMENT

The institutional base of natural resource management in Dominica dates to the late 1940's with the establishment of a Forestry Department in 1949. The inception, during this period and into the 1950's, of a forest management program -- including designation of forest reserves and establishment of a corps of forest guards and rangers -- provided the basis for later forest conservation initiatives in the 1970's, ultimately culminating in the creation of the Morne Trois Pitons National Park in 1975, a protected area rich in natural resources and features.

Today the Division of Forestry and Wildlife is the primary resource conservation unit within the Government of Dominica, with responsibilities not only for the management of forests and wildlife but also of two National Parks as well as an ambitious environmental education program. The Division is recognized throughout the Eastern Caribbean as an effective professional unit which has, over time, assumed a leadership role for environmental concerns within Government.

The foundation for land use and development control in the OECS countries is usually found within local planning legislation which, in turn, has the potential to influence national policies regarding resource management (Lausche, 1986a). In Dominica, as in neighboring Eastern Caribbean islands, the basis for planning and development control was laid in the late 1970's when, with the assistance of a UNDP-sponsored, region-wide Physical Planning Project, new legislation -- the Town and Country Planning Act -- was drafted in 1975 and a National Structure Plan was prepared the following year in compliance with that legislation. The Plan was updated a decade later and is used as an overall guide by

local planners, although it has not been officially sanctioned.

Additionally, during the early years of the 1980's, Government received assistance from the United Nations to evaluate and make recommendations on the structure and internal capacity of the Economic Development Unit (EDU), housed within the Ministry of Finance. The project was aimed at strengthening the EDU as the key development planning agency in Government responsible for project planning and evaluation, macro-economic analysis, and sectorial planning. The Physical Planning Sub-Unit is located within the EDU.

More recently, with the designation of the years 1989-90 as the *Years of Environment and Shelter* (YES) by the Prime Minister and the establishment of a broadly-based, public and private sector committee to provide institutional support for YES activities, Dominica has re-focused national attention on environmental concerns. This action, coming not long after the designation of Dominica's second National Park (the Cabrits National Park) in late 1986 and followed by the recent rejuvenation of the private sector Dominica Conservation Association in 1990, speaks well for the importance of conservation concerns in a country richly blessed with an extraordinary natural environment.

Nevertheless, many institutional challenges still confront Dominica in the resource management sector. For example, a number of problems have been identified in the physical planning process which impede the advancement of effective development control procedures. Furthermore, interdepartmental coordination for resource management responsibilities is weak, particularly in view of the fact that Dominica lacks an integrative development control authority as found in many neighboring OECS countries. The environmental monitoring and enforcement capacity of Government is also weak, in part exacerbated by the size of the island and the difficulty of the central administration in Roseau controlling development activities elsewhere in a country dominated by rugged topography and a road system which is extremely difficult to maintain.

Yet, given the example Dominica has already set in the region in such areas as parks management and resource conservation and given the promise of the YES Committee as one example of a forward-looking approach to environmental coordination, it is clear that an institutional foundation already exists upon which to build initiatives and programs for system reform and for the strengthening of resource conservation and management practices in Dominica.

### **11.3 GOVERNMENT INSTITUTIONS CONCERNED WITH ENVIRONMENTAL MANAGEMENT**

No single Government agency in Dominica is charged with responsibility for the environment, although the Division of Forestry and Wildlife has traditionally taken the lead for environmental affairs in the country. The "environment" was only recently added to the portfolio of the Minister of Agriculture, Fisheries, Lands, Forestry and Wildlife, and the Environment, following the elections in 1990. At present, resource management functions are dispersed among a number of departments of Government, which are identified in Table 11.3(1) along with key institutional responsibilities and enabling or relevant legislation.

A recent study by OAS/OECS-NRMP (Bourne, 1989) identifies and discusses the structure of GOCD departments dealing with natural resource management. An earlier report by Lausche (1986a), prepared for OECS-NRMP, provides an overview of the legislative framework for environmental management. The Lausche study is now somewhat outdated due to changes which have occurred since her 1986 fact-finding trip; the Bourne report, although more recently published, is also outdated (the basic field work having been completed two years earlier) and furthermore, according to many in Government, is not always accurate in the information it conveys.

Under the Law Revision Act (No. 8 of 1986), a Commission was established under the Ministry of Legal Affairs to carry out a revision of the Laws of Dominica, and a revised

edition of the written laws is expected to be published in 1991. Of particular relevance to the natural resource management sector was passage of the Court Fees and Fines Act (No. 13 of 1987) which authorizes the Commission to increase "fines" in national laws enacted prior to this legislation; a prescribed scale is set out in Section 3 of the Act. Lausche (1986a) points out that outdated penalties in environmental legislation is one of the most pervasive problems in much of the Caribbean and severely limits the effectiveness of enforcement procedures.

A discussion of the key divisions of Government with environmental responsibilities and of important environmental legislation follows.

### **PLANNING AND DEVELOPMENT CONTROL**

Planning and development control functions in Dominica are housed in the Economic Development Unit (EDU) within the Ministry of Finance and Economic Development. The EDU is further subdivided into two sub-units, one for economic development planning and a second for physical planning.

Relative to economic development planning, all projects are channeled through the EDU's Projects Section for evaluation by a team of project officers. Macro-economic and sector analysis is carried out in a section of the same name headed by a development economist. This section is primarily concerned with sector planning, analyzing economic data for forecasting, and identifying economic trends.

The Physical Planning Sub-Unit, identified as the Physical Planning Division (PPD), provides Government with technical staff for development control and for physical planning. For its daily operations, the PPD is structured in three sub-sections: Development Control with five staff members; Land Use Planning with three staff members and Administration with five staff members (Solier, 1988).

**Table 11.3(1). GOCD agencies with resource management functions, with principal legislation and key responsibilities.**

AGENCY	RESOURCE MANAGEMENT LEGISLATION	RESOURCE MANAGEMENT RESPONSIBILITIES
<b><u>MINISTRY OF FINANCE AND ECONOMIC DEVELOPMENT</u></b>		
- Economic Development Unit/Physical Planning Division	Town and Country Planning Act (No. 17, 1975) Beach Control Ordinance (No. 21, 1966)	Responsibility for development control and physical planning; administers sand removal permits
- Development and Planning Corporation	Development and Planning Corporation Act (No. 19, 1972)	Decision-making authority for planning and development control; Corporation has delegated much of its authority to a Technical Committee
<b><u>MINISTRY OF AGRICULTURE AND THE ENVIRONMENT</u></b>		
- Agriculture	Agricultural Small Tenancies Ordinance (Cap. 74, 1953)	Soil and water conservation
- Pesticide Control Board	Pesticides Control Act (No. 15, 1974), as amended (No. 4, 1987), with Regulations on Labeling (1986) and Licensing and Registration of Pesticides (1987)	Enforcement of Pesticides Control Act and Regulations
- Lands and Surveys Division	Crown Lands Ordinance (Cap. 169, 1960) Crown Lands Regulations (SRO No. 49, 1960; No. 28, 1961; No. 13, 1963)	Responsible for the survey and mapping of Government lands, for the administration of Government lands, and for carrying out surveys for other Ministries
- Forestry and Wildlife Division	Forests Ordinance, 1958 (Cap. 80) Forest Rules (SRO No. 17, 1972) Stewart Hall Water Catchment Rules (SRO No. 11, 1975) Forestry and Wildlife Act (No. 12, 1976) Forestry and Wildlife (Amendment) Act (No. 35, 1982) Botanic Gardens Ordinance (Cap. 166, 1889) National Parks and Protected Areas Act (No. 16, 1975) Cabrits National Park (SRO No. 54, 1986)	Protection and management of the nation's forests and wildlife; watershed management; environ- mental education; management of national parks

Table 11.3(1) [continued]. GOCD agencies with resource management functions, with principal legislation and key responsibilities.

AGENCY	RESOURCE MANAGEMENT LEGISLATION	RESOURCE MANAGEMENT RESPONSIBILITIES
- Fisheries Development Division	Fisheries Act (No. 11, 1987)	Promotion and management of fisheries; fisheries research; protection and management of marine reserves
<b><u>MINISTRY OF TRADE, INDUSTRY AND TOURISM</u></b>		
- National Development Corporation	National Development Corporation Act (No. 17, 1988)	Promote and support tourism and industrial development
<b><u>MINISTRY OF HEALTH AND SOCIAL SECURITY</u></b>		
- Environmental Health Unit	Public Health Act (No. 15, 1968), with Regulations (SRO No. 49, 1949; No. 14, 1954; No. 43, 1954)	Maintenance of environmental health, pollution control, waste management
<b><u>MINISTRY OF COMMUNICATIONS, WORKS AND HOUSING</u></b>		
- Minister	Water and Sewerage Act (No. 17, 1989)	Issue water and sewerage licenses to the Dominica Water and Sewerage Company, Ltd.
<b><u>MINISTRY OF COMMUNITY DEVELOPMENT AND SOCIAL AFFAIRS</u></b>		
- Cultural Division	Culture Act (No. 22, 1981)	Promote an awareness of the country's cultural heritage and an appreciation of traditional folklore, arts and crafts
- National Culture Council		
- Village Councils	Village Councils Ordinance (Cap. 190)	Responsibility within their jurisdic- tions for sanitation, waste re- moval, nuisance abatement, beach control
- Local Government and Community Development Division		Assist local governments in carrying out their responsibilities, including such areas as disaster preparedness

The legislative authority for PPD planning and development control functions is found in the **Town and Country Planning Act** (No. 17, 1975), which requires preparation of a national structure plan; authorizes regional, sector-specific, and local plans for land use control; and requires the submission of applications for approval of development activities defined under the law. This Act has been undergoing review and revision for several years (Lausche, 1986a) as Government seeks to identify policies and procedures to strengthen the physical planning process. New legislation which will repeal and replace the existing planning law is still reportedly "in the pipeline" (pers. comm., D. Bhagowtee, UNDP Legal Advisor, Min. of Legal Aff., 1990).

The **Development and Planning Corporation Act** (No. 19 of 1972) created a statutory body, the **Development and Planning Corporation**, as the country's planning authority, legislated to make decisions on planning applications and to enforce development control. At present, the Corporation has effectively delegated the exercise of much of its authority to a **Technical Committee** chaired by the EDU (see below).

The development planning and control process in Dominica was described in a recent OAS study (Soler, 1988). For the purpose of processing applications for development approval, the country has been divided into 14 areas; each area has been assigned to one of the Development Control Officers (DCO), of which there are four in addition to the Chief Technical Officer (CTO). All applications are reviewed by the relevant DCO, with general supervision and coordination provided by the CTO including transmittal of findings to either the **Technical Staff Committee** (comprised of in-house staff at the PPD) for minor applications or to the **Technical Committee** for decisions on major development applications. The latter committee is headed by the Senior Physical Planner with other membership slots filled by technical persons from within and external to the PPD.

In addition to the review and processing of development applications, the PPD administers the granting of permits for the removal of sand and other materials from

beaches and rivers in accordance with the **Beach Control Ordinance** (No. 21 of 1966). At this time, there is no effective mechanism for monitoring and enforcement once permits are issued. However, this matter is reportedly under review.

A **Dominica National Structure Plan**, as called for under the **Town and Country Planning Act** of 1975, was first developed in 1976 and updated by the EDU in 1985. There is, however, no country-wide land use plan to accompany the **National Structure Plan**, although detailed physical development plans have been prepared for selected areas in and around the capital. The absence of an accepted physical planning framework makes the task of the PPD more difficult. It also produces a process which can appear discretionary and even arbitrary and thereby diminishes confidence in physical planning decisions both within Government and among the general public.

The **Physical Planning Division** has prepared a guide for submitting planning applications which provides direction to potential developers about the application/approval process. A **Building Code** was also recently developed by the PPD.

Most large-scale development projects are undertaken in the public sector, but Lausche (1986a), for one, reports that the physical planning process has little influence on such efforts. Furthermore, under existing legislation, Lausche (1986a) points out that subdivisions and agricultural land use and conversion are excluded from the development control process. Soler (1988) notes that major developments are sometimes approved at a higher level in Government and then submitted to the PPD for minor technical evaluations. These studies and others (e.g., Baptiste, n.d., quoted in Soler, 1988) have suggested the need for revised planning and development control legislation, including regulations which provide more detailed guidelines for controlling development in the country.

It has also been suggested that some decentralization of the planning system, with a possible sub-office in the north of the island,

would improve the process by (1) speeding up application review procedures and (2) reducing the time spent by Development Control Officers away from Roseau for on-site monitoring and review visits. At the present time, on their periodic inspection visits, DCOs meet informally with Village Councils concerning such matters as enforcement of the Beach Control Ordinance or violations of the Town and Country Planning Act.

A central weakness in the planning and development control process as presently structured in Dominica is the limited opportunity for systematic coordination across ministries. Although applications are routinely referred to the Chief Environmental Health Officer within the Ministry of Health for approval and may additionally be referred on a case-by-case basis to other relevant departments, there are no standardized or required procedures for interdepartmental coordination on development applications. Such coordination as may occur is done at the level of the Technical Committee. Furthermore, there are no automatic requirements for an environmental impact assessment of development proposals or procedures which require that such a review be carried out by the PPD in consultation with those Government agencies in a position to provide technical input.

## AGRICULTURE

The **Agricultural Small Tenancies Ordinance** (Cap. 74, 1953) governs conditions for tenancies on small agricultural plots, including requirements for maintaining standards of good husbandry, protecting trees, and applying soil conservation measures. These provisions are employed by Government to promote and guide soil and water conservation practices (pers. commun., E. Williams, Permanent Secretary, MOA, 1990). Active research for the **Ministry of Agriculture (MOA)** is conducted by **CARDI** (see Section 11.5). **CARDI** is heavily funded by **CARICOM/GOCD** and therefore has been recognized as the appropriate agency to conduct agricultural research in the country. It works in close collaboration with the **MOA**.

The Ministry of Agriculture has an active program for pesticide control. Enabling legislation, the **Pesticides Control Act** (No. 15, 1974), has been amended and updated to provide regulations on labeling and packaging and on the licensing and registration of pesticides. To implement the legislation, a **Pesticide Control Board** was established. Members include the Government's **Produce Chemist**, who chairs the Board, the **Ministry of Agriculture's CTO**, the **Chief Medical Officer**, and two additional persons, one of whom is not a government employee. The Board meets quarterly, and its primary responsibility is to regulate the importation and use of pesticides in the country. It is assisted by one part-time **Pesticide Control Inspector**, appointed by the Minister, who carries out periodic inspections of facilities selling and handling pesticides.

The Ministry also operates a small **Produce Chemistry Laboratory** which performs pesticide residue analyses in addition to other responsibilities, i.e., soil and water testing, certification laboratory for export produce. The laboratory is one of the best equipped in the **OECS** countries with equipment provided by **FAO** and **CIDA**. The facility is headed by a **Produce Chemist** with training in pesticide testing and is further staffed with a laboratory assistant who is also trained to do pesticide testing. To increase the productivity of the laboratory, it has been pointed out that a second chemist is needed as well as increased incentives to ensure retention of trained technicians (DeGeorges, 1989).

Several statutory bodies have been created in the agricultural sector which have responsibilities broadly linked to resource development and resource management functions. The **Dominica Banana Marketing Corporation (DBMC)** was established by legislation in 1984 with the primary objective of promoting the banana industry and providing services to banana growers in areas such as marketing, credit, pest and disease control, research, and insurance. The **DBMC** is managed by a nine member board, three of whom are appointed by the Minister on the advice of the **Dominica Banana Growers Association**, with the additional six members representing **Trade and Agriculture** and the

business section (one of whom must be a bank official). This Board meets regularly. The Corporation maintains working relationships with the Pesticide Control Board, the National Development Corporation, and the Ministry of Agriculture.

The **Dominica Export Import Agency (DEXIA)** is a Government body which replaced the **Dominica Agricultural Marketing Board** when legislation for the latter was repealed. DEXIA's responsibilities extend beyond bananas to include the marketing of other fruits, vegetables, root crops and agricultural produce sold in both local and external markets. The **Dominica Banana Growers Association (DBGA)** provides assistance to its members in the form of training, education, and implementation of good husbandry practices.

#### LANDS AND SURVEYS DIVISION

The **Crown Lands Ordinance** (Cap. 169, 1960; changed to **State Lands Ordinance** in 1967) and related regulations (see Table 11.3(1)) provide the legislative base for governing the sale or lease of state-owned land. Like other legislation, these laws are undergoing review as part of the Government's Law Revision Project.

The **Lands and Surveys Division** (within the Ministry of Agriculture) is charged with responsibility for carrying out surveys and producing maps of Government lands and for administering such lands, including leases and sales. Additionally, the Division executes surveys on behalf of other Government ministries. The Director of the Division is the Commissioner of Lands.

Dominica lacks a cadastral survey which makes the work of this Division of Government more difficult. A further problem for the Division is the lack of legislative authority requiring private surveyors to submit their plans to a Government authority for review (Bourne, 1989).

Under the existing legislation, Government may make additional regulations governing land use practices on the remaining

state-held lands. Lausche (1986a) suggests that some of these lands may be unsuitable for agriculture or only capable of supporting cultivation if sound soil and water conservation practices are employed. Regulations could, therefore, be enacted which control land use when such lands are sold, leased or transferred; monitoring and enforcement would, however, be difficult. For example, at the present time, land allocation decisions are often made by the Commissioner of Lands based on pre-existing squatting or illegal settlement of Government lands, rather than on the basis of an accepted physical development plan for rural lands or a sound land use policy which incorporates environmental impact considerations (Bourne, 1989). Prins (1987) points out that lack of adequate coordination between the Lands and Surveys Division and the Forestry and Wildlife Division has in the past limited input by Forestry in the land allocations decisions made by Lands and Surveys and has increased the number of cases of Government land being sold in environmentally sensitive areas. Reportedly, this situation is now improving.

#### FORESTRY AND WILDLIFE DIVISION

As Table 11.3(1) clearly indicates, the resource development, management, and conservation responsibilities of the **Forestry and Wildlife Division** (within the Ministry of Agriculture) are substantial. Equally, its legislative mandate (Table 11.3(1)) gives to this unit of Government a broad array of environmental duties ranging from watershed protection to environmental education to parks management -- in addition to more traditional, now 40 year-old responsibilities related to development of the nation's forests.

The central role played by the Forestry and Wildlife Division in the conservation of Dominica's natural resources is perhaps best exemplified by the fact that all of the country's legally designated protected areas are under the management control of the Division (see Table 11.3(2)). In other Eastern Caribbean countries, these responsibilities are often shared by more than one government agency and/or a National Trust. Furthermore, the size of Government hold-

Table 11.3(2). Protected areas, Commonwealth of Dominica, managed by the Division of Forestry and Wildlife.

NAME OF AREA	SIZE (ha)	YEAR ESTABLISHED OR PROPOSED	
<u>Forest Reserves</u>			
Central Forest Reserve	410	1972	(established)
Northern Forest Reserve	8,814	1977	(established)
<u>Protected Forests</u>			
Stewart Hall Water Catchment	318 *	1975	(established)
<u>National Parks</u>			
Morne Trois Pitons National Park	6,840 **	1975	(established)
Cabrits National Park	531	1986	(established)
<u>Wildlife Reserves</u>			
Parrot Reserve (Project Sisserou)	81	1989	(proposed)

Source: Adapted and updated from World Conservation Monitoring Center, 1988, except as noted below.

\* Source: National Water Services (DOWASCO), 1986 Water Catchment Reports.

\*\* F. Gregoire, Dir. of Forestry and Wildlife reports this figure at 6,872 ha (pers. comm., 1990).

ings in protected status is substantial and makes Dominica a regional leader for parks and protected area programs.

The Division is headed by a Director, currently a graduate forester, whose primary responsibilities are related to the administration, planning, and development of forests and national parks. He is also the Division's liaison with other GOCD departments and ministries and is the coordinator of donor-sponsored development activities in forestry, parks and tourism (Prins, 1987). The Deputy Director position had not been filled for some time and was eliminated in 1987. The Division presently comprises five sections:

- Forest Utilization, focusing on the commercial utilization of

Dominica's publicly and privately owned forests, headed by a Forest Officer;

- Conservation, Protection and Reserve Maintenance, including responsibility for forest reserves, wildlife protection, and enforcement of forestry laws, headed by an Assistant Forest Officer;
- Silviculture, Research, Reforestation and Agroforestry, also headed by an Assistant Forest Officer;
- Parks Section, headed by the Superintendent of Parks, who is responsible for the development and

management of natural and historical parks and protected areas;

Natural Resources Management and Environmental Education, headed by a Forest Officer.

Dominica has one of the best trained, most professional forestry divisions in the Eastern Caribbean. Its complement of professionals includes two holders of Bachelor of Forestry Degrees and two holders of Bachelor of Natural Resource Management Degrees, all obtained at North American Universities (Prins, 1987). While Dominica is indeed fortunate to have such a highly competent forestry staff, one study (Prins, 1987) noted the significant gap in training and educational levels between headquarters staff, consisting mainly of Forest Officers and Assistant Forest Officers, and field staff composed primarily of Forest Rangers and Forest Guards. Prins (1987), an OAS consultant, concluded that as Forest Rangers and Forest Guards spend less time on policing and patrolling and more time on forest management activities, the headquarters staff will need to provide better professional direction to the staff in the field.

Given the central importance of the Forestry and Wildlife Division in coordinating the environmental management functions of Government, the lack of formal mechanisms for systematic and regular coordination with other departments of Government (as pointed out by Lausche, 1986a and Prins, 1987) is a serious institutional weakness which needs to be addressed. In particular, such linkages need to be strengthened in areas affecting land use planning, development control decision-making, tourism and the allocation of state-owned lands. Prins (1987) and others have also noted that the Forestry Division is seriously lacking in facilities and equipment, which makes implementation of its substantial resource management responsibilities more difficult.

A more detailed discussion of the primary resource management responsibilities of the Forestry and Wildlife Division follows.

**(1) Forest Management.** Legislative authority for the management of Dominica's

forests is found in the **Forests Ordinance** (Cap 80) which provides for the declaration of forest reserves on Crown lands and the declaration of protected forests on private land. **Forest Rules** (SRO No. 17, 1972) made pursuant to the Ordinance specify which actions are prohibited in forest reserves and provide details on licensing and permits for forest harvesting. The Ordinance authorizes the establishment of protected forests on private land in order to prevent soil erosion and flooding and to maintain water supplies. One water catchment area on private land has been declared a "protected forest" under the Ordinance, i.e., **Stewart Hall Water Catchment** (SRO No. 11, 1975), but it has not been well-managed (see Section 4.3 of the Profile).

The Division of Forestry and Wildlife is charged with implementation of this body of legislation and with execution of the country's forestry policies. The Director states that the overall objective of the Division relative to forest management is twofold, namely, to guide the development of forest resources for maximum social and economic benefit while at the same time managing the resource base so as to protect it from adverse environmental impacts (pers. comm., F. Gregoire, Dir. of Forestry and Wildlife Div., 1990). The forest management work of the Division emphasizes the following:

- establishment and protection of forest reserves;
- controlling forest development to ensure the sustained use of forest resources;
- research on forest utilization practices and silviculture;
- extension work in conservation and silviculture (pers. comm., F. Gregoire, 1990).

**(2) Wildlife Management.** Responsibility for wildlife management and protection rests with the Forestry and Wildlife Division under the **Forestry and Wildlife Act** (No. 12 of 1976), which also established the Division as it is presently constituted. The Act focuses on protecting wild fauna and on managing

forest habitat for the protection of wildlife. Forestry and Wildlife personnel are charged with enforcement responsibilities. A carefully monitored hunting season was established by the legislation, and maximum penalties for violation of the Act presently stand at EC\$5,000 and three years imprisonment for violations relating to parrots and EC\$400 and/or three months in jail for violations pertaining to other species.

This legislation also authorizes the creation of wildlife reserves, and in 1989 approximately 200 acres in the Syndicate/Dyer Estate area were identified and proposed for establishment as a parrot reserve (see also Section 2.2 of the Profile). This action was part of a larger wildlife protection and education program implemented by the Forestry Division with external assistance from the RARE Center for Tropical Bird Conservation and the International Council for Bird Preservation (ICBP). Designated *Project Sisserou*, after the national bird, the Sisserou Parrot, this program has focused on public education about Dominica's endangered wildlife, research, and fund raising for the purchase of forest lands for the parrot reserve.

Lausche (1986a) points out that no regulations have been enacted to the wildlife protection legislation and that, since the Act also includes protection for turtles, regulations for turtle taking not only need to be implemented but also should be separated out and responsibility for enforcement transferred from Forestry. She also recommends that Dominica become a party to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), a recommendation which has also been made by Johnson (1988), Evans (1988), and Butler (1989) and is supported by the Forestry and Wildlife Division.

**(3) National Parks Management.** In the 1960's, international and local concern over identifying a more effective means of preserving Dominica's rain forests led to discussions between the Dominican Government and donor assistance agencies concerning the feasibility of establishing a national park system. In 1969, a three-person planning team from the Conservation Foundation, a North

American-based NGO, was the first of many groups to work with Government on examining the potential for national park development in Dominica. Its report, *Dominica: A Chance for A Choice*, published in 1970, represented a formal assessment of promising park options along with recommendations for establishment of a national park system (see also Weber, 1973). In the early 1970's, CIDA provided financial and technical assistance to support park initiatives, with its aid channeled through a Canadian NGO, the Canadian Nature Federation. CNF/CIDA support focused on park planning, development of infrastructure and access trails, environmental interpretation, and staff training (Wright, 1985). Expatriate professional assistance continued on behalf of Dominican parks into the 1980's, and today the budgetary requirements of the Dominica Parks Service are almost entirely dependent on grants and loans from donor agencies (Prins, 1987).

The **National Parks and Protected Areas Act (No. 16, 1975)** provides the legal basis for Dominica's forward-looking parks and protected areas system. The Act authorizes the Minister of Agriculture to designate Government lands as protected areas for the preservation of natural features, for the conservation of historic sites and landmarks, and for the development of recreational areas. Two national parks have been established, each requiring a different set of management criteria.

The first, the **Morne Trois Pitons National Park**, was established in 1975 in the highlands of south-central Dominica (see also Section 2.1). The Park includes almost 1,000 acres of rain forest donated by a part-time Dominican resident of long standing, Mr. John D. Archbold. This donation, known as the Archbold Preserve, was important because it represented an extensive area of rain forest within the Park and thus provided an opportunity to include a key ecosystem in the Park without requiring the Government to forego potential revenue from Crown Lands (Wright, 1985). The Archbold Preserve (formerly Middleham Estate) was held by The Nature Conservancy (a U.S. NGO) from 1974 to 1982 when an official transfer of ownership to the Commonwealth of Dominica was executed.

The second park, the Cabrits National Park on the northwest coast just outside of the town of Portsmouth, was established in 1986 (see also Section 10) and incorporates within its boundaries both marine and terrestrial areas, a representative sample of dry forest vegetation, one of the country's two most important wetlands, and the ruins of the nation's most significant historical monument. A cruise ship dock is being constructed within the Park (scheduled for completion by the end of 1990), in order to facilitate visitor use of the area.

Lausche in 1986 and McHenry and Gane in 1988 have pointed out the need for regulations to the National Parks Act to address critical issues such as prohibited and permitted activities within park boundaries. FAO consultants (McHenry and Gane, 1988) drafted a proposed amendment to the Parks legislation, making only minor changes but adding a set of regulations. No action has yet been taken on this proposal. GOCD also has not implemented a provision in the original legislation calling for the establishment of a National Parks Advisory Council, although this is still reportedly under consideration.

The 1975 Parks Act gives authority to the Director of National Parks to prepare park management plans for approval by the Minister. A ten year management plan for the Morne Trois Pitons National Park was recently drafted with assistance from the OAS (Scheele, 1989). No similar document exists for the Cabrits National Park, although a 1984 development report, *Cabrits 2000*, prepared with the assistance of ECNAMP, a St. Croix-based NGO, is generally recognized as the policy development document for the site.

Administration of national parks is the responsibility of the Dominica Parks Service, a separate unit within the Forestry and Wildlife Division. The head of the unit serves as the Superintendent of Parks. The responsibilities of the Park Service are varied, ranging from nature conservation in the Morne Trois Pitons Park to the restoration and maintenance of Fort Shirley in the Cabrits National Park. In addition, this section is responsible for the Botanical Gardens and other urban parks in Roseau. Because of these

wide-ranging responsibilities, the unit employs the largest labor force of all the sections within the Forestry and Wildlife Division (Prins, 1987).

The Botanical Gardens Ordinance (Cap. 166, 1889) provided for the establishment of Dominica's Botanical Gardens. The centennial of the Gardens' creation is currently being celebrated, while at the same time the site has become the subject of controversy concerning appropriate use of the area (see also Section 9.2 of the Profile). The Botanical Gardens are classified as state lands but have not been included, by designation, in the National Park System. The 100-year old Botanical Gardens Ordinance is not adequate to prevent encroachment, and therefore local debate continues over present and proposed use of the site. The Forestry and Wildlife Division as well as the Division of Agriculture and its supporting services are presently housed in buildings within the Botanical Gardens. Long-term plans call for the relocation of the Agriculture Division outside the Gardens and for establishment of an interpretive center within the Gardens (pers. commun., R. Charles, Forestry and Wildlife Div., 1990).

**(4) Environmental Education.** The Forestry and Wildlife Division has spear-headed local efforts to introduce environmental education materials into Dominican schools. A dozen booklets on a variety of natural history subjects, some focused specifically on the National Parks, were first introduced in 1978 and continue to be used to the present time. The popular Forestry tabloid, *Vwa Diablotin*, was produced for two years (1983-84) and appealed to both a school-age and general public audience. Funding was provided by USAID, CIDA and local businesses. With more recent (1989) support from the RARE Center and again from local businesses, the monthly publication of *Vwa Diablotin* has been revived. Additionally, a special issue of the publication was produced in 1989, representing a reprinting of highlights from earlier issues (GOCD, 1989).

Over the years, the Environmental Education section of the Forestry Division has initiated and provided leadership for a wide variety of public education programs, includ-

ing radio broadcasts, newspaper articles, field trips, audio-visual presentations, workshops and seminars, exhibitions, and sponsorship of special events such as Forestry Week, Parrot Week, tree planting ceremonies, and clean-up campaigns (Charles, 1989). Interpretive materials have also been developed for use at National Park facilities.

## **FISHERIES DEVELOPMENT DIVISION**

The Fisheries Development Division (FDD) of the Ministry of Agriculture is a relatively small but growing unit with responsibilities to oversee the optimal utilization of marine resources. The Division's core staff (eight established positions) is trained to execute day-to-day operations and is supported by additional personnel in the areas of data collection, aquaculture extension services, exploratory fishing, and research. The Division is presently undergoing organizational restructuring in order to enable it to better meet increasing demands, e.g., responsibility for the country's Exclusive Economic Zone (EEZ) and the coastal zone. The reorganization, which is in keeping with OECS's Fisheries Administration and Institutional Enhancement Program, will focus on increasing staff size and improving the professional competence of personnel. The creation of specific units within the Division to deal with stock assessment, conservation, etc. is also anticipated.

Despite the fact that the Division is small with limited personnel, its ongoing work goes beyond direct interaction with fishermen, including programs of public awareness on endangered species, marine reserve establishment and conservation, and coastal zone management (GOCD, 1990a).

Much of the work of the Division is mandated by the provisions of the Fisheries Act (No. 11, 1987). The Act provides a broad framework for marine resource management and is supported by Fisheries Regulations enacted in October 1989 (see Section 5.1 of the Profile). The Dominican legislation is part of an FAO/OECS-supported initiative which dates to 1984 and was designed to enhance

harmonization of fisheries legislation within the sub-region.

It is the intention and desire of the Division's staff to increase its involvement in environmental issues and programs (pers. commun., N. Lawrence, 1990). The FDD is the designated chairman of the country's Disaster Preparedness Committee for Oil Spills and Contingency Plans. Furthermore, existing legislation gives the Division the authority to demarcate Fishing Priority Areas and Fish Nursery Areas and to establish marine reserves. To date, no marine reserves have been designated, although the Cabrits National Park, managed by the Forestry and Wildlife Division, has a significant marine component. The Fisheries Division is currently working on the establishment of a marine reserve in the Soufriere/Scotts Head Bay area.

In the past, the Division has collaborated with other agencies in addressing a number of environmental concerns, including whale monitoring in the waters around Dominica, a survey and inventory of coral reefs along the west coast (1987), establishment of artificial reefs, and implementation of turtle watch programs. Additionally, there is room for collaboration between the FDD and the Forestry and Wildlife Division in the management of the marine areas within the Cabrits National Park.

## **NATIONAL DEVELOPMENT CORPORATION**

The National Development Corporation Act (No. 17, 1988) created a new statutory body -- the National Development Corporation (NDC) -- by merging the former Industrial Development Corporation and the Dominica Tourist Board. The NDC currently comprises two divisions, the Division of Tourism and the Division of Industry, each headed by a Director. The Corporation is responsible to the Ministry of Trade, Industry and Tourism.

NDC's policy-making governing Board is comprised of a Chairman and a Deputy Chairman (the latter slot currently va-

cant) plus six other public and private sector persons. No representative of the Forestry Division currently serves on the Board, despite the fact that this Division has generally functioned as the implementing arm for physical development projects on behalf of the old Tourist Board. The Director of the Forestry and Wildlife Division formerly was a member of the now-defunct Tourist Board.

Dominica is the only OECS country to have merged the tourism and the industrial development sectors. Lausche noted previously (1986a), when this consolidation was first suggested, that the merger could diminish efforts by the Tourism Division to focus on natural resource protection as an important consideration in tourism promotion. She stressed the need for continued strong linkages with the Forestry Division which, at least at the present time, is feasible given the fact that the present Director of the NDC's Tourism Division formerly occupied the post of Parks Interpreter within the Forestry Division and has received formal training in natural resource management.

The Forestry and Wildlife Division is presently coordinating the improvement of facilities at twelve tourist sites around the island, five of which -- Emerald Pool, Middleham, Morne Trois Pitons, Cabrits, and Boiling Lake -- are found within the National Park System. Funding for this Site Upgrading Component of a larger Tourism Development Project is being provided by the European Development Fund (Christian, 1989).

## **ENVIRONMENTAL HEALTH**

The **Public Health Act** (No. 15, 1968), with Regulations, provide the basis for pollution control and waste management in Dominica. This Act follows the colonial pattern common to the region of using "nuisance" violations for pollution control, but enforcement is difficult because concepts are outdated.

Lausche (1986a) reports that there is interest on the part of Ministry of Health officials in updating the public health legislation with a new law and standards more responsive

to current environmental health problems. The 1968 Public Health Act has been omitted from the Law Revision Project; present plans call for its repeal and replacement by a new act (pers. comm., D. Bhagowtee, UNDP Legal Advisor, Min. of Legal Aff., 1990).

In her 1986 review of environmental legislation, Lausche notes that, while new standards for pollution control and waste management are needed, consideration must also be given to existing institutional capacity and available resources if such standards are to be effective. She reports that there has been some discussion within Government to set up an interdepartmental advisory council to help set standards for environmental quality, but no statutory powers for such a body have yet been defined.

Implementation of environmental health responsibilities is divided between (1) the Chief Environmental Health Officer and staff of the **Ministry of Health** and (2) local government authorities (see also Local Government sub-section below). Environmental Health Officers are responsible for pollution control related to potable drinking water quality and waste disposal, including enforcement. The Health Ministry is also routinely consulted by the Physical Planning Division of the EDU in processing development applications. Lausche (1986a) recommends that consideration should be given to strengthening the authority of Environmental Health in the development control process by the establishment of environmental standards which development projects would have to meet before approval of planning applications could be issued.

## **DOMINICA WATER AND SEWERAGE COMPANY, LTD.**

Until 1986, water supply management in Dominica was the responsibility of the Central Water Authority, a statutory body established under the Central Water Authority Act of 1967. In 1986, under the Central Water Authority (Repeal and Vesting of Property) Act, the Authority was disbanded, and its functions and assets were transferred to Government. The management of water supply

services was delegated to a public water utility, the National Water Services, operating under the Ministry of Communications and Works.

This arrangement lasted for only a short time, and in 1989 a new privatization of water supply management was accomplished with the establishment of the *Dominica Water and Sewerage Company, Ltd. (DOWASCO)*, a registered, privately-owned company which will make shares available for public sale at a future date. The *Water and Sewerage Act (No. 17, 1989)* established the Company to provide water supply and sewerage services for Dominica under licenses issued by the *Minister of Communications, Works and Housing*. A license has been granted for water services for a period of 25 years commencing with the enactment of the 1989 law; a license date for sewerage services is still pending but expected to be issued by the end of 1990.

Under the *Water and Sewerage Act*, water management authority for the country has been granted to DOWASCO, which includes among its functions water conservation and the preservation and protection of catchment areas. Relative to catchment areas under the control of Government (either state land or protected forests), these responsibilities are shared with the *Forestry and Wildlife Division*; the latter is represented on the DOWASCO Board, which should facilitate communication between the public-sector Division and the private-sector Company. DOWASCO also shares responsibility with the *Ministry of Health* for preventing pollution of water resources and for ensuring maintenance of a safe water supply. It is not readily clear what lines of coordination have been established between *Environmental Health* and DOWASCO, although Section 4 of the authorizing legislation provides for the appointment of a *Water and Sewerage Advisory Council*. The appointment of the Council is recommended as this body could greatly facilitate coordination among the various agencies with water sector responsibilities. Section 4 of the Profile discusses in more detail the legislative authority and institutional responsibilities of DOWASCO as well as its current

initiatives for improving and protecting the country's water system.

At the present time, CIDA is providing substantial support to Government for a water sector rehabilitation project. This program focuses on institution building, personnel training, and rehabilitation of systems. CIDA monies have also supported establishment of a DOWASCO water testing laboratory.

## CULTURE

The *Cultural Division* of the *Ministry of Community Development and Social Affairs* was set up in the late 1970's to encourage a national cultural consciousness. The Division's responsibilities include promotion of culture and traditional art forms; assistance to other Government departments, educational groups and NGOs in the promotion of culture; facilitation of training opportunities for local artists and craftsmen; and coordination of research efforts relative to Dominica's history and culture.

The Division is housed in the *Old Mill Cultural Center* just outside of Roseau. The site of the largest surviving sugar mill in the country, the Old Mill was restored following Hurricane David in 1979 with funds provided by USAID and opened as the center of cultural activities in 1985. In addition to the offices of the Cultural Division, the Old Mill Cultural Center houses a museum as well as a workshop for wood carving and sculpture.

The Cultural Division works closely with the *National Culture Council (NCC)*, established by the *Culture Act* in 1981 (No. 22). Although created by an act of Parliament, the Council functions in many ways like an NGO. It provides policy direction and supervision for the programs and activities of the Cultural Division and is responsible for the operations of the Old Mill Cultural Center. Under the enabling legislation, the NCC has authority to recommend measures for the development and enhancement of culture in Dominica and to raise and administer funds for cultural programs. The Council undertook publication of the most comprehensive

overview of Dominican culture, *Our Island Culture* by Lennox Honychurch, first published in 1982 and reissued in 1988.

The NCC works with the private sector Dominica Institute to develop historic sites within the boundaries of the Cabrits National Park. These activities are carried out under the overall policy direction of the Forestry Division, which has jurisdiction over all of Dominica's national parks.

Dominica does not have a National Trust and therefore relies on an informal network of institutions to support and promote the development of cultural and historical resources; chief among these are the Cultural Division, the National Culture Council, and the National Park Service. More information is provided in Section 10 of the Profile.

#### **LOCAL GOVERNMENTS**

The Central Government's coordinating agency for liaison with local communities is the **Division of Local Government and Community Development**, housed within the Ministry of Community Development and Social Affairs. The Division is headed by the Local Government Commissioner.

This Division oversees development of a nation-wide system of local government and provides a link between local communities and the Central Government. Its mandate includes disaster preparedness among those activities it coordinates with local government units.

The present local government system comprises one City Council in Roseau, one Town Council in Portsmouth, and 34 Village Councils plus the one Carib Council. The Councils operate under by-laws which are approved by the Minister and may include measures to protect local water supplies and for the disposal of waste. Nuisance abatement (as defined under the Public Health Act) is delegated to local authorities who presumably work with Environmental Health officials when pollution threats to public health have been identified. The daily responsibility of

cleaning privies and drains also is the responsibility of local authorities (Lausche, 1986a).

Local authorities are routinely consulted by Development Control Officers from the Physical Planning Division of the EDU regarding building plans in their respective areas and violations of the Beach Control Ordinance or the Town and Country Planning Act (Soler, 1988; Bourne, 1989). There are no formal mechanisms, however, which require that such consultations take place.

#### **YEARS OF ENVIRONMENT AND SHELTER (YES) COMMITTEE**

The Government of the Commonwealth of Dominica declared 1989 and 1990 as *Years of Environment and Shelter (YES)*, with the theme "Comfortable Living in Clean Surroundings" providing direction for this two year, multi-faceted effort. Although YES was developed out of a concern about issues of public health and well-being, its activities have focused specifically on housing and environment concerns (Gregoire, 1989; YES, 1990a).

The YES program theme was given institutional structure with the formation of the YES Core Committee, whose members were appointed by the Prime Minister and include both public and private sector persons. A number of sub-committees were formed in order to enable the Committee to carry out its primary functions, namely, the coordination of YES program activities, advising Government on policy matters related to YES themes, and encouraging the involvement of the public and private sectors in YES programs. The YES Committee is chaired by the Director of the Forestry and Wildlife Division, and the Deputy Chairman is the CTO for Housing within the Ministry of Communications, Works and Housing. An Executive Secretary coordinates and manages the operational functions of the Committee, while Government provided EC\$50,000 for YES activities for the fiscal year ending June 30, 1989 and an additional EC\$382,000 for the period ending June 30, 1990 (YES, 1990b). In early 1990, the YES Committee was selected as the executing local organization for the Dominica

Country Environmental Profile (CEP) Project.

At the present time, the YES committee has no legislative mandate and functions primarily as an advisory body to Government while simultaneously carrying out programmatic activities appropriate to its dual thematic initiatives -- housing and the environment. Its present mandate is scheduled to expire at the end of 1990 -- although it had initially been established as a one year program which was extended to at least a second year of activity.

Since the absence of a formal coordination mechanism for environmental management within Government appears to be a key institutional problem in Dominica (see below, Section 11.6), the extension of the YES Committee's tenure beyond 1990 could be an important step at this time. Equally important (if its tenure were extended) would be the strengthening of the terms of reference for YES, in order to improve its coordination authority among those GOCD agencies involved in resource management, pollution control, and environmental protection activities.

#### 11.4 THE NON-GOVERNMENT SECTOR IN ENVIRONMENTAL MANAGEMENT

Many of the non-governmental organizations (NGOs) in Dominica were born as self-help groups in the post-Hurricane David period in the early 1980's and represented a private sector response to the need for rehabilitation and recovery following the country's worst natural disaster in recent memory. Furthermore, the country's strong village-based and predominantly rural lifestyle have led to the development of a viable network of rural development organizations whose programs are focused on assisting the populations of rural communities. Many of these programs and activities have an active resource management component.

In the more traditional conservation sector, because Dominica does not have a

National Trust, it has relied more heavily on the public sector to perform many of the functions often assumed by National Trusts in other Eastern Caribbean countries. For example, the Forestry and Wildlife Division, specifically its National Parks Section and its Natural Resource Management and Environmental Education Section, have taken the lead in the establishment of protected area programs and in the promulgation of environmental education materials.

The primary conservation NGO in the country is the *Dominica Conservation Association (DCA)*. Formally organized in the early 1980's, the Association's emergence at that time was actually a revival of the long dormant *Dominica Conservation Society* which was first established in the early 1960's. The DCA initially re-emerged as a "forestry association" but later interest shifted to a broader-based conservation agenda. Peak membership did not exceed 50, and the group went into a period of inactivity in the mid-1980's (Towle, *et al.*, 1987).

In 1987, at the time of an IRF-sponsored survey of NGOs in Eastern Caribbean countries, there appeared to be diverse opinions about the direction which a reactivated DCA should take. At one end of the spectrum were those who questioned the need for a strong private sector conservation group, given the presence of an active and professional Forestry and Parks staff within Government. Those of this opinion suggested that the appointment of a National Parks Advisory Council, as called for under the 1975 National Parks Act, would fulfill the need for an independent conservation voice in Dominica. Others envisioned a reconstituted DCA as a parks-focused group (e.g., a "Friends of the Park" organization) which would concentrate its efforts on building and supporting the national parks system. Still others wanted to see a more traditional conservation organization emerge, one which would carry out a program of conservation education and public outreach, focused on field trips, publications and related activities (Towle, *et al.*, 1987).

More recently, with incentive funding under a grant from the Caribbean Conservation Association through its MacArthur

Foundation-funded "Caribbean Heritage Program," the DCA has been formally re-activated. CCA funds will be used to support a DCA office/headquarters and employ a program coordinator for a period of three years. New officers have been elected, and the first AGM in many years was held in late 1989. Yet to be determined are DCA institutional priorities and program directions which it is in the process of developing through preparation of a one to three year institutional development plan.

The DCA has an exciting challenge ahead of it in the next three years as it takes steps to identify its new role in the Dominican NGO sector and as it strives to build a viable organization which can survive institutionally once the CCA funding has ended.

One of the self-help groups to emerge in the aftermath of Hurricane David was the **Dominica Hucksters Association**, launched in 1981 to represent the interests of inter-island traders engaged in the marketing of fruits and agricultural produce. Dominica has a long tradition of exporting surplus agricultural products to neighboring islands, such exports primarily handled by individual operators (Finisterre and Renard, 1987). The Association has received generous support from Government in the form of office and warehouse space as well as duty-free concessions. The group has also received significant external aid and technical assistance. In the area of resource management, the Association has implemented an experimental agricultural waste recycling project with funding provided by FAO and Island Resources Foundation.

**Small Projects Assistance Team (SPAT)** is widely acknowledged as a non-government development agency with an excellent record in promoting participatory programs for rural communities (Finisterre and Renard, 1987). Like the Hucksters Association, it was formed following Hurricane David (registered in 1981) as a coordinating group to assist self-help groups to achieve economic self-sufficiency at the local level. It has received funding from both European and North American NGOs and operates an office, library and documentation center

(including video taping capabilities) in Roseau.

SPAT's monthly publication, entitled *Koudmen*, has on occasion focused on environmental issues. It also ran an environment "camp" in the summer of 1989 for 8- to 11-year-old-children and has sponsored community meetings and produced a video on the use of pesticides. SPAT recently set aside EC\$10,000 for small environmental projects, but thus far the response level has not been significant (pers. comm., J. Peltier and R. Green, SPAT, 1990). The organization is part of a collaborative network of NGOs in Dominica which also includes the National Development Foundation, Social Center, Movement for Cultural Awareness, Development Alternatives International and others. SPAT is a formal member of the Dominica Conservation Association and has a representative on the Board of the Association, thus providing an important link between Dominica's leading non-governmental conservation organization and the island's strong rural development network.

**The Small Lumber Producers Group** is an association of small-scale sawyers which has received external assistance in developing a not-for-profit lumber purchasing and marketing corporation. The objective of this program, funded primarily by the World Wildlife Fund-US through the Eastern Caribbean Natural Area Management Program (now known as CANARI), is to improve the application of forest resource conservation techniques within a small business context. No more than 40 sawyers are members, but further membership development is currently limited due to lack of adequate facilities (pers. comm., R. LaRonde, Director, 1990). In April 1989, the group was incorporated as Cottage Forest Industries, with a Board of Directors including among its members the Director of Forestry and Wildlife, the General Manager of the NDC and the President of the DCA (CANARI, 1990).

Two business sector NGOs have demonstrated some interest in environmental issues in Dominica. The **Hotel Association**, representing the country's small hotels and guesthouses, has been engaged in promoting

terpart voice for environmental concerns in the private sector, in order to complement, support and strengthen those environmental policy initiatives coming from within the Government.

**11.5 DONOR-SUPPORTED RESOURCE MANAGEMENT PROGRAMS**

**11.5.1 Planning, Research and Training**

The Organization of Eastern Caribbean States' Natural Resources Management Project (OECs-NRMP) was set up in 1986 as a cooperative program of OECs with OAS and GTZ (the German Agency for Technical Cooperation). Its overall program objective is to improve the capacity of OECs member countries to plan and manage natural resource management programs. OECs/NRMP activities in Dominica have focused on efforts to assess and improve rural land use; more recently, OECs-NRMP is helping GOCD to develop a model for evaluating the importance of natural resources to the country's economic growth. Dominica was also included in various regional surveys sponsored by OECs-NRMP, e.g., environmental legislation (Lausche, 1986a), self-help organizations (Finistere and Renard, 1987) and GOCD resource management agencies (Bourne, 1989).

The Caribbean Agricultural Research and Development Institute (CARDI) is the agricultural research arm of CARICOM. With primary laboratories located in Trinidad, CARDI also maintains representatives and a full program in each member island, including Dominica. CARDI is heavily funded by CARICOM/GOCD and therefore has been recognized as the appropriate agency to conduct agricultural research in Dominica.

The Windward Islands Banana Growers Association, known regionally as WINBAN, provides assistance to the respective growers associations in the islands of Dominica, Grenada, St. Lucia and St. Vincent.

Dominica's natural attractions as the core of a specialized tourism base. The group's ecotourism focus should be encouraged and linkages with traditional conservation organizations improved. The Dominica Association of Industry and Commerce spearheaded a Roseau clean-up campaign jointly sponsored by local civic organizations. The Association has also indicated an interest in exploring other environmental program options particularly as these have economic development implications (pers. comm., M. Dill, Executive Secretary, 1990).

The cooperative movement in Dominica is significant, comprising approximately 75 percent of the working population according to one recent estimate (*Koumen*, June 1989) and the highest per capita involvement of workers in the Caribbean according to another source (Finistere and Renard, 1987). Dominica's cooperatives are primarily credit unions (the largest number of members) or agricultural, fishing, and consumer cooperatives. Finistere and Renard (1987) identified 25 registered farmers cooperatives but only 3 fishermen cooperatives when they completed their survey of self-help groups in 1987. Although primarily preoccupied with economic issues, cooperatives have some potential for the mobilization of community-level resource management activities, especially in a country in which their membership is as substantial as it is in Dominica. Agricultural cooperatives, for example, can provide an outlet for encouraging better land management practices by small agricultural producers.

Dominica's has a good NGO mix in the environmental sector: one traditional conservation organization (i.e., the Dominica Conservation Association) plus more development-oriented groups with strong resource management objectives, self-help groups, and an effective network of rural development organizations with some environmental program interests. This suggests that there is a potentially stronger base for broad private sector initiatives in support of environmental goals than has been generally the case in the country. A strong tradition of environmental activism within, most notably, the Government's Forestry and Parks Service requires a coun-

through coordination of shipping and marketing for banana exports and the implementation of research activities on banana production. WINBAN operates a research center in St. Lucia, the largest agricultural research unit in the Eastern Caribbean; activities there benefit all participating islands, including Dominica.

The **Inter-American Institute for Cooperation on Agriculture (IICA)** is an intergovernmental agency comprised of member states in the Americas and the Caribbean; the Institute enjoys a specialized working relationship with OAS. Its mandate is to encourage, promote and support the efforts of member countries to improve agricultural development and to achieve rural well-being.

In Dominica, IICA's recent programs have focused on: support of small-scale sheep production, strengthening of GOCD plant protection and quarantine capabilities, improving the production/marketing capabilities of farmer organizations, and support for technology generation and transfer systems.

**Oxford University and ICBP's Multiple Land Use Project** was established in Dominica in 1982, funded by ICBP with support from other organizations, notably the Royal Society, British Ecological Society, Royal Geographical Society and National Geographic Society. Over the last nine years, about 70 persons (mainly zoologists, botanists and foresters but also agriculturalists and economists) have conducted applied environmental research under the auspices of the project. This work has been conducted in conjunction with the Division of Forestry and Wildlife and involved liaison with the Divisions of Agriculture and Lands and Surveys. The long-term aims of the Project are (1) to determine the effects of different forms of land use upon animal and plant communities and (2) to encourage economic development in ways that are compatible with environmental interests (see also sidebar, page 61).

The **John D. Archbold Center for Tropical Studies** was established in Dominica in 1989 at the site of the former Springfield Guesthouse. The 190-acre Springfield Plantation was a gift of American John Archbold,

who has had a long interest in the island and in the preservation of its biological diversity. Mr. Archbold donated the property to Clemson University in South Carolina (USA) to be used for research activities by a consortium of U.S. universities and research institutions formed by Clemson University. The Center has the potential to make an important contribution to the country, particularly if its overall research objectives are linked to the research requirements of Dominicans.

### 11.5.2 International Donor Assistance

In the area of agricultural and rural development, Dominica currently receives assistance from a variety of funders, including: **British Development Division (BDD)** for coffee, tropical fruits and spices, and tree crop development programs; from the **Canadian International Development Agency (CIDA)** for continuation of a coconut rehabilitation and development project; from the **Pan American Development Foundation** for a cocoa rehabilitation and development project; from the **European Development Fund** for fruit tree production; and from the **Republic of China (ROC)** for a pilot vegetable and rice farm. GOCD's Integrated Rural Development Project is supported in part by the **Organization of American States (OAS)** and the **International Fund for Agricultural Development (IFAD)**, while the Melville Hall Estate Development Project has received funding through the **Caribbean Development Bank (CDB)**.

The Republic of China is providing substantial support at the present time to the fisheries development efforts of GOCD, along with funds from the **European Development Fund (EDF)** (for prawn farming) and from the **United Nations Food and Agriculture Organization (FAO)**.

Within the forestry, wildlife and national parks sector, support is being provided by FAO and the **United Nations Development Program (UNDP)** for implementation of a forest management plan. FAO also sponsored a review of forestry, wildlife and national parks policy and legislation, while OAS funded

a comprehensive study of forest policy and administration, as well as preparation of a ten year management plan for the Morne Trois Pitons National Park. Wildlife conservation efforts received recent funding from the International Council for Bird Preservation (ICBP) and the RARE Center for Tropical Bird Conservation through Project Sisserou. The U.S. Agency for International Development (USAID) provided funds for the development of facilities within the National Park at Boeri and Freshwater Lake (as a part of AID's Rural Electrification Project); facilities development funding has also been forthcoming from EDF for tourist sites both within and external to the National Park System.

The development of Dominica's National Park System has a history of over 20 years of external support (in the form of both funding and technical assistance) by a variety of donor groups, primarily North American NGOs. Some of this history is reviewed in Section 11.3, but a partial list of the external NGOs and other agencies which played a role in park development in Dominica would have to include: CIDA, Canadian Nature Federation, Conservation Foundation, U.S. National Park Service, Eastern Caribbean Natural Area Management Program, Caribbean Conservation Association, Island Resources Foundation, The Nature Conservancy, IUCN, World Wildlife Fund-US and OAS. The development of the Dominican National Park System was an extraordinary effort, facilitated in large measure by the cooperation of this diverse group of sponsors working closely with Government to achieve mutually-supported objectives.

In the area of water resource management, CIDA is currently supporting a major Water Sector Program, while other water projects have recently been funded by USAID, BDD, and CDB. FAO funded a review and assessment of water resource legislation and administration in 1988. In the energy sector, major program support has been received from USAID (Rural Electrification Project for the East Coast), CDB, and OAS. Funding for the Hydroelectric Expansion Project has come in the form of grants or loans from: the World Bank, CDB, CCCE

(France), European Investment Bank, and CIDA.

UNDP provided support for initiation of the Government's Law Revision Project and has also provided funding for development planning projects which date to the country's earliest planning efforts in the late 1970's to more recent assistance for preparation of the 1985 National Structure Plan. In addition to UNDP, the Physical Planning Division received support from a technical advisor sponsored by the Commonwealth Fund for Technical Cooperation (CFTC) to assist in development of a new Building Code, and OAS sponsored a review and evaluation of the development control and physical planning process in 1988.

Two programs are currently providing assistance to Dominican NGOs. The Caribbean Conservation Association's Caribbean Heritage Program delivers direct financial support to the Dominica Conservation Association, while USAID recently awarded a matching fund grant to Island Resources Foundation for implementation of an institutional strengthening program for Eastern Caribbean NGOs, including those in Dominica.

## 11.6 POLICY RECOMMENDATIONS

Lausche (1986b) identified three legally-based requirements which facilitate the ability of governments to integrate resource management considerations into the decision-making process. They are:

- Development of procedures for the systematic inclusion of environmental data and resource management criteria in the project planning, project approval, and project evaluation process, whether the project under review is initiated by the public or private sector.
- Formulation of a national land use plan that identifies the limits and potentials for development of

the existing natural resource base in keeping with official economic and social goals.

- Establishment of an institutional structure across ministerial lines to coordinate and monitor proposed and approved development projects in order to identify sector-specific as well as cumulative environmental change.

Lausche's general conclusions could be applied to all of the OECS countries and specifically guide some of the recommendations and discussion which follow relative to the specific case of Dominica.

(1) *Improvement of the formal mechanisms within Government for inter-sectorial and inter-agency cooperation and coordination.* Improved coordination is one of the most critical issues confronting Dominica in the resource management sector. It is important because (1) resource management functions are spread among several departments of Government, only one of which has a strong, well-structured environmental focus and (2) there is no official Government body with clearly defined legal authority to institute procedures for inter-departmental, inter-sectorial collaboration in the planning and development control process, for land use decision-making, and for carrying out pollution control responsibilities.

In many OECS countries, a centralized, coordinating mechanism for environmental concerns is found, in part, in a strong development control authority. This is not the case in Dominica, where much of the decision-making authority of the Development and Planning Corporation has been delegated to a Technical Committee chaired by the Economic Development Unit. This Committee has not put in place procedures which formalize inter-departmental/inter-sectorial coordination in the review of development projects, particularly where such activities may have an impact on the natural environment.

The Forestry and Wildlife Division has assumed a central role for the coordination of many environmental management

functions within Government. However, the lack of formal mechanisms for systematic and regular communication with other departments has often meant that actions taken by other units of Government are detrimental to the resource management objectives promoted by Forestry and Parks staff (Lausche, 1986a; Prins, 1987).

In some resource management sectors, more than one unit of Government has been charged with monitoring/enforcement responsibilities, e.g., pollution control and maintenance of water quality are responsibilities of the Ministry of Health, local government authorities and DOWASCO. In this case, the problem of overlapping institutional roles is further exacerbated because the existing legislation for pollution control and waste management (the Public Health Act of 1968) is outdated and lacks specific standards.

The process for establishing more effective and regular coordination procedures needs to be addressed by GOCD, particularly in areas affecting pollution control, land use planning, and development control. The Government might consider institutionalizing the role of the YES Committee before expiration of its term at the end of 1990 and providing it with more substantive coordinating and policy setting responsibilities. At present, it represents the most active coordinating body within Government for issues related to the environment.

(2) *Strengthening the physical planning process.* Soler (1988), Lausche (1986a), and others have pointed to problems in the physical planning process as currently instituted in Dominica. The lack of an approved physical planning strategy or framework means that decisions on development applications are generally made on an *ad hoc*, case-by-case basis, a process which not only emphasizes short-term objectives rather than long-term planning goals but also gives the appearance of being subjective and even arbitrary.

Input to the process of reviewing physical development plans is generally coordinated by the Technical Committee, acting under delegated authority of the Board of the Development and Planning Corporation;

other departments of Government are consulted on an "as needed" basis. Membership on the Technical Committee is such that it permits some inter-agency review, including routine input from the Chief Environmental Health Officer. However, certain classes of development activity are outside the authority of the Physical Planning Division (e.g., agricultural land use), may be approved at a higher level of Government, or may be undertaken by another department of Government with little or no input from the PPD. Furthermore, at the present time, formal consideration of the potential environmental impacts of development projects is not required.

Given these circumstances, Government may want to consider implementation of Environmental Impact Assessment (EIA) procedures and require such impact studies for all development projects of a certain classification, whether public or private sector. Formal EIA procedures would force a more holistic integration of technical data and environmental expertise across departmental lines while guaranteeing more systematic input of environmental considerations at an early stage in the planning process. It would also ensure that the considerable environmental expertise and training of GOCD staff now housed in governmental departments other than the PPD, for example, the Forestry and Wildlife Division, would be more generally utilized in reaching decisions about the direction and scope of development activities.

In the most recent National Structure Plan (GOCD, 1985), establishment of an Environmental Protection Unit was proposed; it was suggested that the proposed unit could monitor the environmental impacts of development projects, advise on ways of mitigating adverse environmental effects, ensure compliance with existing land use plans, laws and procedures, and assist in drafting regulations and procedures for the protection of the environment. Consideration should be given to implementing this recommendation and to the feasibility of establishing the unit within an upgraded Physical Planning Division or, alternatively, within the Forestry and Wildlife Division. Responsibilities for implementing environmental impact assessment procedures could logically be centralized within the unit

(see also Section 9). While an "institutionalized" YES Committee (see above) should function as an environmental policy and coordination body within Government, the role of the Environmental Protection Unit would primarily be that of implementing, regulating, and enforcing environmental policy.

Additionally, Government should give consideration to development of a national land use plan to guide and inform decision-making about future development projects in Dominica.

(3) *Updating of public health legislation.* In a recent review of natural resource legislation in Dominica, Lausche (1986a) points out the need for an up-dating of public health legislation, noting the difficulty of pollution control procedures under the existing law. Standards, where feasible, are needed to strengthen public health legislation, but should be developed, suggests Lausche, in light of institutional capacities and resources.

Lausche also notes that there has been some discussion in Government about the establishment of an Advisory Council for Environmental Quality, to coordinate pollution control issues among responsible agencies and departments and to help set workable standards. Government is reportedly in the process of repealing the 1968 Public Health Act and replacing it with new legislation. Establishment of the proposed advisory council should be given due consideration in the law review process, for, if approved, the statutory powers of the council would need to be included in new public health legislation. Again, given the necessity for improved coordination links in Government relative to environmental management responsibilities, the establishment of the proposed Advisory Council for Environmental Quality represents one option for improving the present situation.

## CONCLUSION

The Government of the Commonwealth of Dominica is to be commended for actions taken in recent years to highlight environmental concerns, most recently with the

formulation of the YES (Years of Environment and Shelter) program, a focused attempt to heighten community awareness about environmental problems and issues. This action builds on a two decade effort by Government, supported by a broad base of international donor groups, to establish and build one of the finest National Park and Forest Reserve systems in the Eastern Caribbean. However, more remains to be done to strengthen the in-

stitutional capacity of Government to implement and carry out more effective resource management programs. In the last analysis, this will require, first, public sector consensus on general resource management goals; secondly, sufficient political will to support those goals; and, lastly, a sharing of responsibility for meeting those goals by both the public and private sectors.

## SECTION 12 KEY ENVIRONMENTAL ISSUES AND POLICY RECOMMENDATIONS

The task of examining the status of Dominica's environment, which has spanned a period of approximately eight months, and the parallel task of identifying problems and promising resource management practices, is now complete. This exercise, which involved scores of persons drawn from virtually all disciplines, ministries and sectors in the state, has served as a kind of "catchment" device for identifying a broad spectrum of environmental issues within the country.

The issues identified in the Profile will not surprise those who know Dominica well, but neither is there room for complacency. There is in fact cause for some concern -- which had been articulated long before the Environmental Profile Project was begun. Dominica's YES Committee, for example, was already engaged in a variety of community-based environmental projects and action-focussed initiatives, linking both the public and private sectors in a kind of nationwide self-help program.

Under the best of circumstances, this first Dominica Environmental Profile can be seen as an immediately useable agenda for the Government's working committee on the environment and shelter (i.e., GOCD's YES program). On the other hand, the Profile could also be seen strategically -- i.e., as a comprehensive planning document and a first step leading directly to the design and implementation of a *national conservation strategy* or its equivalent. At the very least, the document stands as an updated addendum to Dominica's national structure plan and provides new environmental guidelines for its ongoing public sector investment program. What is most needed at this juncture is a policy framework and a schedule of implementation.

There are two groups of issues addressed within the Profile. The first is derived from the sector review and analysis which constitute the preceding sections of the CEP. For the convenience of the reader, the sector-

specific issues and recommendation summaries accompany each sector overview statement and are clearly identified within each section or sub-section.

The second, smaller group of critical environmental issues and recommendations -- more national and less sectorial in scope -- has been singled out and presented in this concluding section. There is a risk in doing this, for no issue should be considered in isolation. There are important linkages, and the inter-relatedness of elements within both natural and human ecosystems constitutes an important concept for the Dominican resource manager. Solutions generally require interdisciplinary and inter-ministerial cooperation and coordination and are seldom as neat and orderly as their presentation in list form or as a single sector problem would suggest.

There are, additionally, two groups of special problems worthy of mention. Occasionally, a complex problem will appear and, in fact, prove intractable until it is attacked, creatively, aggressively and simultaneously by *both* government and private sector entities working together more or less as partners. The efficient development of a solid waste management strategy, that truly addresses all aspects of waste control, disposal and recycling, is a good example of this type of environmental problem. Secondly, some smaller, more basic problems can also appear not so much large and intractable but small and ubiquitous. This is common in small island societies like Dominica with intricate, closely-coupled, interactive ecological systems. It is especially true of places -- like Dominica -- with tightly-bounded watershed basins, densely forested, remote core areas, and linear development in the circumferential coastal zone. In such situations, it is impossible to escape a small set of four basic environmental problems that tend to pervade, affect and interact with everything else. These critical issues are as follows:

(1) *Water* -- the need to maintain and improve the island's capacity to collect and store water for domestic, industrial and agricultural use, and safeguard water quality by proper management of the watersheds and forest resources.

(2) *Soil* -- the prevention of soil loss from erosion and the maintenance and improvement of soil fertility by managing the natural woody vegetation and planting trees in accordance with sound land use practices.

(3) *Plants (Flora)* -- the safeguarding of vegetational heritage and biodiversity for present and future generations by preserving special landscapes, micro-ecosystems, plant

communities, and endangered and threatened species.

(4) *Wildlife (Fauna)* -- the protection of habitats, ranges, and food supplies and guarding against excessive hunting and harvesting of the full spectrum of domestic and migratory species, including the establishment of protected areas as necessary.

Whether an issue at hand is deforestation, chemical pollution, siting of a landfill, protecting coral reefs or disease vector control, it is virtually impossible to avoid linkages with most or all of the above critical factors. In this sense, they are generic or universal issues.

### RECOMMENDATIONS RELATED TO THE MOST CRITICAL ISSUES IDENTIFIED IN THE COUNTRY ENVIRONMENTAL PROFILE

#### (1) *POLLUTION AND PUBLIC HEALTH*

It is estimated that only 40 percent of Dominican households have suitable excreta disposal facilities. Almost all sewage generated, including that collected through a centralized system serving Roseau, is discharged untreated. Where treatment does exist, mostly in the form of septic systems, it is often ineffective, due to geologic, edaphic or topographic conditions, or to population densities that are too high.

The management of solid waste is also a serious problem, with only an estimated 40 to 45 percent of households being served by satisfactory methods of refuse collection and disposal. Improvement of solid waste management has been targeted by Government as an area requiring immediate attention, and efforts are being made to centralize services, upgrade facilities and expand public education efforts. Agricultural and agro-industrial waste products are poorly managed. For the most part, such waste is simply dumped into ravines and streams although much of it could be recycled for other purposes (e.g., energy generation, fertilization). While manufacturing and other industrial de-

velopment is not significant at the present time, the sector is growing (e.g., agro-processing industries), and there is some concern for all industrial discharges in the central west coast area of the island in particular.

In some communities, diseases and other public health problems related to water supply, sewage disposal, and generally poor sanitation are significant, particularly among children.

Agrochemical pollution does not appear to be a substantial problem as yet, but only limited, episodic studies have been carried out. At present, GOCD capabilities for local monitoring and evaluation of agrochemical pollution is very limited, and the data on types and quantities of biocides imported and used are not consistent or well-ordered.

• **Recommendation.** The quantitative and systemic aspects of environmental pollution in Dominica are not sufficiently well documented at present to permit proper development of either remedial or regulatory measures. A national pollution assessment is needed to establish the basic dimensions of each waste stream, and for identification and quantification of sources, causative agents,

volumes, flow rates, destinations, impacts, and projections. Additionally, a long-term water quality and marine biological monitoring program should be designed and implemented by the Environmental Health Unit, and assistance should be sought from regional agencies (e.g., CEHI, CARDI, OECS, CICP) for upgrading laboratory and personnel capabilities.

\* **Recommendation.** Only the provisions of the now-outdated Public Health Act provide any basis for pollution abatement and control in the country's marine and coastal waters. This legislation needs to be updated and strengthened by inclusion of national standards and criteria for water quality, pollution control and waste management. Consideration needs to be given to the country's existing institutional capabilities and technical/fiscal resources in designating both pollution control standards and oversight/regulatory responsibilities.

\* **Recommendation.** The most cost-effective *and* ecologically sound sewage disposal options need to be identified and then implemented for all urban and village areas of Dominica, particularly in areas where there is a documented high incidence of water-borne disease and related health problems (e.g., Soufriere and Scotts Head).

For urban areas, that option is likely to be preliminary treatment combined with a long ocean outfall which discharges into deep water in an area of strong, westward-moving currents. Such waste disposal systems should be designed to be easily upgraded to a higher level of treatment should this be necessary at a later date. Priority should be given to rehabilitation of the existing centralized sewage collection facilities in Roseau.

In rural areas, self-help programs for improved liquid and solid waste management need to be supported, including projects which encourage, for example, composting and use of biogas energy systems. Dominica's well-developed network of self-help groups, rural development organizations, and NGOs should be called on to assist local government officials in such efforts.

\* **Recommendation.** The new solid waste management plan, currently being prepared, should cover a preliminary period of five to ten years. Clearly defined management responsibilities need to be outlined in the plan, including designation of the agency charged with the siting and operation of landfill sites. Collection of garbage should be franchised or contracted out to private companies, regulated by a GOCD agency, and fees should be charged for waste collection and disposal. Over the long term, strategies to reduce the quantity of solid waste and to promote a variety of recycling options also need to be explored -- ideally as a collaborative effort of GOCD, the retail trade sector, and other commercial/industrial waste generators, in order to ensure that such schemes are organized on economically defensible grounds.

\* **Recommendation.** More regular monitoring of pesticide and fertilizer residues is necessary so that changes or fluctuations in concentrations over time, reflecting seasonal changes in agricultural practices, can be recorded. Pesticide residues in all agricultural products need to be regularly monitored, as should both pesticide and nutrient levels in soils and in coastal aquatic systems. The Ministry of Agriculture should seek external assistance to maintain the existing analytical laboratory and to train additional staff in procedures for biocide residue extraction.

At the same time, record-keeping systems used by the Dominica Pesticide Board and the Dominica Banana Marketing Corporation to report on the importation, sales, and application of biocides need to be upgraded and standardized.

\* **Recommendation.** Agricultural extension agents and representatives of local rural development NGOs and farmers organizations should be trained to certify farmers in the safe use of biocides. Pest control operators who spray buildings and the environment to control insects, as well as pesticide control inspectors, should also receive training in the safe use of biocides. Farmers and other persons who come into frequent contact with pesticides and other hazardous chemicals should have medical examinations at least an-

nually, and reports of these examinations should be made available to the Pesticide Control Board for documentation of incidence rates and imposition of more effective control measures, if necessary.

(2) *LAND CAPABILITY, RURAL  
LAND USE, AND WATERSHED  
MANAGEMENT*

Deforestation is considered one of the most crucial issues confronting Dominica at the present time. The problem has been exacerbated by agricultural expansion and timber harvesting, which have over time accelerated the removal of vegetation on both private and public lands. Forested state land is being sold, largely as a means to relieve agricultural land hunger, but this commonly has been done indiscriminately and with inadequate controls to protect against soil erosion and other forms of land degradation. Construction of agricultural feeder roads and the current high price for bananas are also accelerating the deforestation process, frequently in areas that should be kept under natural vegetation to protect steeply-sloping lands against erosion and soil loss.

Some observers estimate that deforestation and depletion of timber-growing stocks on privately-owned lands will occur in the near future and that, as a consequence, the country's Forest Reserves will come under increasing pressure from the timber industry. Dominica's only "protected forest" on private land (within an important water catchment area) is not well-managed, as none of the designated land use restrictions has been enforced.

Land clearing and other inappropriate land use activities in the island's water catchments are extensive (in 1985 only eight catchments were free of cultivation and in at least fourteen of them over 50 percent of the total area was under cultivation). Virtually all of Dominica's water catchments are comprised primarily of private lands; some are located entirely on privately-owned property. Given the lack of effective controls on the use of private land and the acceleration of land

clearing and other incompatible land use activities in privately-held water catchments, the island's potable water supplies are potentially at serious risk.

In many areas, the forested lands being cleared for agriculture are unsuitable for cultivation, particularly in the absence of specialized controls to protect against soil erosion. In other areas, land being cleared is in fact of sufficient capability to support sustainable cultivation, provided that appropriate conservation practices are applied. In fact, Dominica has great potential for agricultural development without substantial inroads into forest lands which are more suitable for watershed and wildlife protection, nature tourism, and sustainable forestry. Yields of existing crops on lands already cleared or otherwise disturbed could be substantially improved by better cultivation practices, more efficient use of crop harvests, and attention to improved crop quality.

**\* Recommendation.** Steps need to be taken by GOCD to ensure the protection of areas that are inappropriate for land uses *other than* wildlife conservation, watershed protection, recreation, nature tourism and biological diversity. Examples include lands too steep for sustainable cultivation, commercial forestry or other human activities; most water catchment areas, prime wildlife habitat; and other areas which are important by virtue of their scenic, floral or faunal characteristics or their overall contribution to the natural heritage of the country. Critical areas should be identified and delineated on land use maps for incorporation into the national park system, for selection as "Protected Forests," or for designation of special land use control measures under the Forest Management Plan currently being developed by GOCD with the assistance of FAO.

**• Recommendation.** Given that a full "zoning" program for agricultural land is likely to be prohibitively expensive, a more limited program for regulation of agricultural land development needs to be considered by Government. At present, only state lands within the forest reserves and national parks enjoy any degree of protection or land use restrictions. Additional "Protected Forest" zones on

private land need to be designated, where special land management practices should be required (e.g., agroforestry, contour planting, tree cropping, and terracing). Furthermore, although private landowners or tenants on agricultural lands are encouraged to protect watersheds and to maintain good husbandry practices, such standards are rarely enforced. Better zoning regulations and enforcement procedures for agricultural lands are therefore required, together with a policy to provide adequate incentives or compensation to farmers to encourage better land use practices. Such "zoning" procedures should be considered for the remaining unallocated state lands before they are distributed for agricultural uses.

\* **Recommendation.** Farming practices which do not promote environmentally sound agricultural systems are often the result of inadequate information about good husbandry procedures reaching the small farmer. In general, promotion of agroforestry techniques in selected areas should be a key component of extension efforts, while consideration should also be given to reintroducing soil conservation instruction programs for small farmers which were once operational in the country. Such efforts will require extra staff to expand current levels in the extension sector of the Ministry of Agriculture and in the Forestry and Wildlife Division. An expanded commitment to farmer education and extension services would be particularly important if land use regulations for "Protected Forests" or other protected "zones" on rural lands were to be implemented and enforced.

Incentive programs, such as those recently introduced by the Dominica Banana Marketing Corporation to improve the quality of fruit harvested, need to be encouraged, and incentives should be extended for the development of such practices as forest corridors between plantations or for restrictions on the use of steeply-sloping land for agriculture.

\* **Recommendation.** Support should be provided for improving the output, efficiency and economic contribution of the country's small sawyers. They may account for as much as 65 percent of production; the logging systems they employ are generally more appropriate and sustainable than those

of the larger-scale logging operations; and, at least within the context of the Small Lumber Producers Group, the small sawyers have attempted to integrate forest resource conservation techniques with broader economic objectives.

\* **Recommendation.** The operations of the country's relatively large-scale and mechanized timber harvesters need to be better controlled. The Forest Management Plan, currently in preparation, should outline cutting and management prescriptions designed for sustainable forestry in the Forest Reserves and on unallocated state lands. Such regulations need to be officially adopted by Government and then rigorously enforced, including termination of any logging operation found to be in violation.

\* **Recommendation.** More emphasis should be placed on promoting agroforestry and plantation forestry on private land, perhaps through implementation of incentive programs. At present, very limited plantation forestry is being practiced on private land despite the possible economic benefits of doing so in many areas (e.g., the west coast). Cooperative programs between the Divisions of Agriculture and Forestry could be developed to demonstrate to small farmers the benefits of agroforestry systems in carefully selected areas.

### (3) *COASTAL ZONE MANAGEMENT*

The coastal zone is the most heavily populated area of Dominica and figures prominently in the recreational pursuits of its citizens. Almost all industrial activities in the country are sited in the coastal zone, while further expansion of the country's growing tourism industry is dependent upon development of infrastructure in the coastal zone (e.g., port and marina facilities). The interactive linkages of CZM issues with other critical environment/development issues -- tourism and industrial expansion, port development, environmental monitoring and pollution control, to name a few -- means that management and development of the coastal zone cannot

be viewed in isolation by Dominican policy planners.

Adverse impacts associated with *ad hoc* development in Dominica's coastal zone have already been documented. The tendency has been to focus upon coastal zone problems selectively, but their increasing, cumulative visibility reflects the absence of comprehensive development control guidelines and policies committed to maintaining the quality of coastal resources. This is a situation which needs to be addressed in the near future by the Dominican Government, given the heavy use, loading, density, traffic, and habitation levels in the coastal zone.

• **Recommendation.** A comprehensive coastal zone management program should be implemented to provide overall guidance for specific development and management activities. The CZM program should include, among others, the following elements:

- procedures to ensure water quality for multiple uses, e.g., fisheries habitat, human contact, and waste disposal;
- port development and improved port management;
- construction and maintenance of sea defenses;
- waterfront renewal;
- increased recreational opportunities, including marine tourism; and
- coordinated and broad-based participation in coastal resources management.

Consideration needs to be given to the following: design of a permit system targeted at coastal development, legislation to support a CZM program, training and other assistance for GOCD staff to implement a CZM program, monitoring and enforcement procedures to regulate development in the coastal zone, and a public education campaign

focused specifically on coastal environments and their importance to national development.

(4) **GROWTH MANAGEMENT:  
PLANNING, DEVELOPMENT  
CONTROL AND RESOURCE  
PROTECTION**

Physical planning as an integrative process is not well established within the Dominican Government, and there is limited opportunity for systematic coordination across departmental lines in the physical planning and development control process. The Physical Planning Division (PPD) has been vested with only limited control over the broader planning/regulatory aspects of major development projects. Essentially the PPD has been relegated to reviewing subdivision plans and to performing site-level planning functions, while decisions on major development projects are made with little or no input from the PPD. This is unfortunate, for most such projects have significant impacts on the physical, natural and human environments of Dominica.

The planning process has also been undermined because of generally weak inter-agency and inter-sectorial coordination in the resource management sector, i.e., for development control, land use decision-making, and carrying out pollution control responsibilities. In many OECS countries, a centralized coordinating mechanism for environmental concerns is found, in part, in a strong development control authority. This is not the case in Dominica, where much of the decision-making authority of the Development and Planning Corporation has been delegated to a Technical Committee chaired by the Economic Development Unit.

The Forestry and Wildlife Division has assumed a central role for the coordination of many environmental management functions, but it lacks sufficient authority for regulating the actions of other governmental departments which might be detrimental to the resource management objectives of the Division.

Very few environmental impact studies for development projects have been undertaken to date in Dominica, and those which have been prepared were primarily initiated only after a given project had proceeded well into, or even beyond, the planning stage.

Over the last two decades Dominica has established one of the finest national park/forest reserve systems in the Eastern Caribbean. However, except for its two designated national parks -- Morne Trois Pitons National Park and the Cabrits National Park -- and the forested lands included in its two Forest Reserves, no other resources or critical sites enjoy any type of protected area status. Furthermore, the country lacks a policy for management of its historical and cultural resources (unless these fall within the boundaries of a national park), and there is no officially designated institution (like a national trust) to assume custodial and management responsibilities for the country's historical and cultural heritage.

Within the country's largest national park, competing demands for use of the resource base have intensified in recent years. Some uses of park resources have often been in direct conflict with the more traditional objectives of park land use, namely, preservation of wildlife, enhancement of biodiversity, and passive "wilderness" recreation.

\* **Recommendation.** Improved coordination is one of the most critical institutional issues confronting Dominica in the resource management sector. GOCD needs to take steps to initiate procedures for more effective and regular coordination by Government agencies with responsibilities for pollution control, land use planning and development control. GOCD might consider institutionalizing the role of the YES Committee before expiration of its term at the end of 1990 by providing it with more substantive coordinating and policy-setting responsibilities. There has also been discussion in Government about the establishment of an Advisory Council for Environmental Quality, but, at present, the YES Committee represents the most active coordinating body for issues related to the environment.

\* **Recommendation.** The role of the Physical Planning Division (PPD) in the planning and development control process needs to be strengthened. Opportunity for technical input by the physical planning staff needs to be provided at the very earliest stages of project planning and evaluation for all major development activities. GOCD's most recent National Structure Plan recommended the establishment of an Environmental Protection Unit, which might logically be located within the PPD. If the PPD were to be given more substantive planning responsibilities, including specific environmental protection functions, the size and capabilities of its staff would need to be upgraded.

\* **Recommendation.** A national land use plan needs to be prepared, focussing on achievement of sustainable development over the long term. The land use plan should attempt to guide future development into areas which are best suited for particular kinds and densities of land use, based on physical and ecological constraints as well as national social and economic priorities. Preparation of land use maps should be the initial step in the process of designing a land use and growth management plan for the nation.

\* **Recommendation.** Legislation is needed to require the preparation of Environmental Impact Assessments for all major development projects (public or private sector), especially those within the coastal zone, within the boundaries of designated protected areas, or affecting other critical areas. An institutional capability for interpreting, and later carrying out, the technical aspects of environmental impact assessment needs to be created within the PPD and other appropriate GOCD agencies.

\* **Recommendation.** Legislation is needed to provide for the protection of the nation's historical and cultural resources which are not located within the boundaries of a national park. The country needs a comprehensive, systematic and official inventory of extant historical/archaeological sites and cultural landmarks which classifies and evaluates the potential value of these resources to the overall development of the country. Authority needs to be vested in a designated

agency to provide oversight for the preservation and management of historical and cultural resources which are not protected within a national park.

• **Recommendation.** Dominica needs to arrive at a consensus concerning long-term national park objectives. The more recent

competing and often conflicting demands for use of park resources has resulted from the lack of a clear national policy on priority objectives for park development. The larger issue of defining the kind of park system desired by the country needs to be addressed at the policy-making levels of Government.

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## CARIBBEAN CONSERVATION ASSOCIATION



The *Caribbean Conservation Association (CCA)* is a regional, non-governmental, non-profit organization dedicated to promoting policies and practices which contribute to the conservation, protection and wise use of natural and cultural resources in order to enhance the quality of life for present and future generations. In fulfilling its mission, the Association establishes partnerships with organizations and groups which share common objectives; it focuses attention on activities designed to anticipate and prevent, rather than react and cure.

Established in 1967, CCA's membership comprises Governments (currently 19), Caribbean-based non-governmental organizations, and non-Caribbean institutions, as well as Associate (Individual), Sponsoring and Student members. CCA's activities span five major program areas: (1) the formulation and promotion of environmental policies and strategies; (2) information collection and dissemination services; (3) promotion of public awareness through environmental education activities; (4) research about, support for, and implementation of natural resource management projects to foster sustainable development; and (5) assistance for cultural patrimony programs.

CCA's support is derived from Caribbean Governments, membership contributions, international donor agencies, private corporations and concerned individuals. It is managed by a Board of Directors, while its day-to-day activities are supervised by a Secretariat comprising a small core of dedicated staff. For more information, write: Caribbean Conservation Association, Savannah Lodge, The Garrison, St. Michael, Barbados. Telephone: (809) 426-9635/5373; Fax: (809) 429-8483.

## ISLAND RESOURCES FOUNDATION

The *Island Resources Foundation (IRF)* is a non-governmental, non-profit research and technical assistance organization dedicated to the improvement of resource management in offshore oceanic islands. Established in 1970, its programs focus on providing workable development strategies appropriate for small island resource utilization through the application of ecological principles and systems management approaches that preserve the special qualities of island life.

Key program implementation areas include coastal and marine resource utilization, land use planning, environmental impact assessment, national park and tourism planning, cultural resource development, and resource sector policy studies. In 1986 the Foundation launched a program of assistance to non-governmental organizations in the Eastern Caribbean designed to improve the capabilities of such groups to provide private sector leadership for achieving environmental goals in the region.

Foundation funding is derived from private foundations, government agencies, international organizations, and through donations and contributions. IRF publishes research and technical reports and maintains a publications office for distribution of these documents. Its reference libraries in the Virgin Islands and Washington, D.C. are widely recognized as a unique collection of over 10,000 documents on insular systems and resource management, with a primary emphasis on the Caribbean. The Foundation is based in the U.S. Virgin Islands, with a branch office in Washington, D.C. and a program office in Antigua. For additional information, write: Island Resources Foundation, Red Hook Center Box 33, St. Thomas, U.S. Virgin Islands 00802. Telephone: (809) 775-6225; Fax: (809) 779-2022.

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