

**Dominica:
Natural
Disasters and
Economic
Development
in a Small
Island State**

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Edward Clay
Franklyn V. Michael
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The World Bank

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The World Bank



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Acronyms

AIDB	Agricultural, Industrial and Development Bank	NOAA	National Oceanographic & Atmospheric
BDD(C)	British Development Division (Caribbean)	OAS	Organization of American States
CARICOM	Caribbean Community	ODA	Overseas Development Administration (UK)
CCA	Caribbean Conservation Association	ODM	Office of Disaster Management (GoCD)
CDB	Caribbean Development Bank	OECS	Organization of Eastern Caribbean States
CDERA	Caribbean Disaster Emergency Response Agency	PAHO	Pan American Health Organization
CDMP	Caribbean Disaster Management Project	PML	probable maximum loss
CFF	Compensatory Financing Facility (IMF)	PSIP	Public Sector Investment Program
CGE	computable general equilibrium	SAC	Structural Adjustment Credit
CIDA	Canadian International Development Agency	SAF	Structural Adjustment Facility
CIMH	Caribbean Institute for Meteorology and Hydrology	SAP	Structural Adjustment Program
CPI	consumer price index	SRU	Seismic Research Unit, University of the West
CUBiC	Caribbean Uniform Building Code	UNCTAD	United Nations Conference on Trade and
DACI	Dominica Association of Industry and Commerce	UNDP	United Nations Development Program
DBMC	Dominica Banana Marketing Corporation	UNDRO	United Nations Disaster Relief Office
DCP	Dominica Coconut Products Ltd	UN-ESC	United Nations Economic and Social Council
DEXIA	Dominica Export Import Agency	USAID	United States Agency for International
DFID	Department for International Development (UK)	WINCROP	Windward Islands Crop Insurance Ltd
DMF	Disaster Management Facility (World Bank)	WTO	World Trade Organization
DPA	Dominica Port Authority		
DOMLEC	Dominica Electric Company		
DOWASCO	Dominica Water and Sewerage Company		
EC	European Commission		
EC\$	Eastern Caribbean dollars		
ECCB	Eastern Caribbean Central Bank		
ECLAC	Economic Commission for Latin America and the		
ERR	economic rate of return		
EU	European Union		
FY	financial year		
GDP	gross domestic product		
GEF	Global Environment Facility		
GNP	gross national product		
GoCD	Government of the Commonwealth of Dominica		
IADB	Inter-American Development Bank		
IDA	International Development Association (World Bank)		
IICA	Inter-American Institute for Cooperation on Agriculture		
IMF	International Monetary Fund		
MCWH	Ministry of Communications, Works and Housing (GoCD)		
NCB	National Commercial Bank		
NDFD	National Development Foundation of Dominica		
NFS	non-factor services		
NGO	non-governmental organization		

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Preface

As part of its efforts to promote disaster prevention and mitigation as an integral part of development activities, the World Bank's Disaster Management Facility (DMF) is undertaking a study on the economic and financial consequences of natural disasters, with the support of the United Kingdom's Department for International Development (DFID). The principal researchers for the study are Charlotte Benson and Edward Clay of the Overseas Development Institute (ODI) in London. Study team members from the World Bank's Disaster Management Facility include Alcira Kreimer, Margaret Arnold, Jonathan Agwe, Hager Ben-Mahmoud, and Maria-Eugenia Quintero.

The study entails a state-of-the art review and three country case studies. This document presents the findings of the first case study, undertaken in Dominica. The second case study is currently underway on disasters and public finance in Bangladesh, and the third will focus on a drought-sensitive southern African economy. A final synthesis report will draw together new evidence with that from the researchers' previous studies and other relevant literature.

The study team wishes to express its appreciation for the time so generously given and information provided during their visit by the Government of the Commonwealth of Dominica, including the then Minister of Finance, Hon. Ambrose George; the then Minister of Tourism, Hon. Charles Savarin; the then Minister of Agriculture, Planning and Development, Hon. Atherton Martin; and many officials listed in Annex E. Special thanks are also owed to Mr. Cecil Shillingford, Coordinator of the Office of National Disaster Management, for facilitating the visit to Dominica. Many others in both the public and private sectors in Dominica and Barbados, staff members of the Caribbean Development Bank (CDB), the Caribbean Disaster Emergency Response Agency (CDERA), and the Eastern Caribbean Central Bank (ECCB) also listed in Annex E provided advice and information. The team expresses its appreciation to all those listed for their helpful inputs. Special thanks are owed to Mr. Jim Dempster CBE, who prepared the maps; Dr. Lennox Honychurch, for access to his historical archives; Dr. William Aspinall, volcanologist; Ms. Polly Pattullo; and Mr. Jan Vermeiren of the Organization of American States for commenting on the draft report.

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Dominica: Natural Disasters and Economic Development in a Small Island State

EXECUTIVE SUMMARY

This country study of Dominica is the first of three studies undertaken as part of a broader research project aimed at increasing understanding of:

- the wider economic and financial impacts of natural disasters;
- factors determining the vulnerability of hazard-prone economies; and
- opportunities for mitigation.

The method of investigation is eclectic, using a mixture of quantitative and qualitative analysis to examine the economic impacts of natural hazards.

The Commonwealth of Dominica is a lower middle-income small island state in the Eastern Caribbean, of some 750 square kilometers with a population of 76,000 and per capita GDP of EC\$7,900 (US\$2,900) in 1998. Some 30% of the population was estimated as living at or below the poverty line in 1996.

Dominica is vulnerable to a wide range of natural hazards. The most common and historically most significant are tropical storms and hurricanes. Reflecting a rugged physical topography, most of the population and infrastructure are located on the coast, making Dominica particularly vulnerable to strong winds and high seas. The island is geologically extremely young and almost completely volcanic in origin. Following a volcanic alert in 1998-9, its susceptibility to future volcanic activity is also currently a major cause for concern. There is a related risk of earthquake. Landslides are a common feature of life and the landscape. Other potential hazards include drought, storm surges, floods, bush fires and tsunamis.

Many of the study findings are intuitive, even obvious. However, this is the first time that the evidence has been brought together, systematically analyzed and policy implications drawn. Dominica's economy is, with perhaps the exception of offshore financial services, highly vulnerable to tropical storms. Hurricane David in 1979 had the most catastrophic effects in modern times on the environment, economy and society, but there were severe storms too in 1989, 1995 and 1999.

The study draws a number of key conclusions:

1. **Natural hazard risks and uncertainty** - there is considerable uncertainty even about natural hazard risks, both in Dominica and more generally. For example, in 1999 the island suffered extensive damage from Hurricane Lenny, when this storm tracked from west to east on a path some 150 miles to the north. No hazard warnings were issued because storms normally approach the Caribbean from the east and are, at that distance, not expected to affect Dominica.
2. **Dynamic nature of vulnerability** - the Dominica economy's vulnerability is constantly changing, reflecting both the longer-term direction of development and capital formation in the island, and also shorter-term shifts in the structure and composition of economic activity. For example, the fall in banana production during the 1990s has (positively) reduced the potential scale of agricultural losses in a disaster. However, a more diversified agricultural sector will be less secure because crop insurance is only available for bananas, which also had an assured export market. As a further example, the scale of physical damage to the transport network is now potentially far greater and the pace of recovery could be slower due to the long-term development of a largely coastal road system without adequate sea defenses.

The study shows that a particular level or form of hazard vulnerability is not inevitable. Some sectors and sub-sectors are more vulnerable than others, whilst measures can be taken to reduce structural vulnerability. Greater integration of hazard risks into medium - and long-term economic and financial analysis and planning could substantially reduce the economy's hazard vulnerability, thus contributing to sustainable growth.

3. **Economic policy choices in disaster management** - in the immediate aftermath of a disaster, both government and the private sector face choices between the pursuit of rapid recovery and a reduction in longer-term hazard vulnerability. In Dominica, effectively by default, the emphasis has been on quick recovery because the political impetus and associated financial incentives for investing in mitigation and changes in land use have been insufficiently strong.

The study also highlights the tensions caused by the wide range of demands on public finance, including for funding to reduce physical vulnerability to natural hazards. Such tensions are particularly acute in this small island economy, with relatively high per capita infrastructure needs, in turn due to diseconomies of small scale and a relatively scattered population combined with a difficult and mountainous terrain. The study points to the need for improved information on the budgetary impact of disasters both to facilitate cost-effective allocation of resources and also to emphasize the importance of integrating hazard risk reduction into medium - and long-term economic and financial planning.

4. **Natural hazard information and risk management** – the levels and forms of hazard risk information available in Dominica have been unsatisfactory, hindering appropriate risk-averting decision making. Issues that urgently need to be addressed include ensuring sufficient investment in monitoring, assessment, mapping and dissemination activities. Public information needs to be provided in an easily understood and usable form. Achieving and sustaining such investment is particularly difficult in a small island economy, because there are economies of scale and hazard information is a regional public good.

5. **Wider implications for small island states** - the vulnerability of a small economy can alter quickly. The sources of change are structural, occurring within an open economy that is being driven now by exogenous forcing mechanisms – technological development, globalisation and climatic change.

In considering appropriate forms of disaster mitigation, it is important to recognize the physical characteristics of the island(s) which underlie the economy and society. This study reconfirms the substantial value added in disaster mitigation investment in key infrastructure. The encouragement of less vulnerable areas of activity will facilitate long-term sustainable development by buffering medium-term growth from the effects of disaster shocks.

The role of catastrophe insurance and other financial risk-spreading mechanisms in spreading and reducing risk also needs to be enhanced significantly in the Caribbean and increased use should be made of such mechanisms as a tool for promoting hazard mitigation.

Donors need to address their own problems of coherence and overstretch in working with small island states by adopting joint programs, agreeing lead agencies on projects, supporting regional solutions and reducing micro-management of projects.

Chapter 1.

Introduction and Country Profile

1.1 Background

There is a growing awareness of the economy-wide significance of natural disasters and the problems they pose for long-term development. However, recognition of these issues has been largely amongst those working within the field of disaster management and there is still limited wider appreciation of their potentially serious implications. This in part reflects the fact that most assessments of the economic impacts of disasters have concentrated on the most easily measured direct losses - that is, the financial cost of visible physical damage. This emphasis, in turn, reflects particular concerns to meet the short-term humanitarian needs of affected communities in the aftermath of a disaster and pressures to determine replacement investment requirements and insured losses. It also reflects difficulties in analyzing indirect and secondary impacts. The latter two types of impact could include, for example, effects on the flow of goods and services and changes in income distribution and the incidence of poverty as well as balance-of-payments and budgetary consequences. A further bias in the existing body of evidence relates to the fact that the relatively few studies that have examined indirect and secondary impacts have focused on the impact of a particular, often recent disaster event. The more difficult to determine longer-term cumulative consequences of a series of disasters on a particular country's development are typically overlooked. Yet, in reality, most disasters are recurrent rather than one-off events, striking a country at infrequent intervals over the course of time and potentially affecting cumulatively both the rate and pattern of development (Benson and Clay, 2000).

These biases have effectively limited the extent of information available to policy-makers on the nature and scale of a country's economic vulnerability to natural hazards. More fundamentally, they have contributed to a widespread failure to address natural hazards as a potentially serious threat to sustainable development or to appreciate the potentially high economic and social returns to mitigation despite the fact that high hazard vulnerability is by no means inevitable. Instead, to date, national, and to some extent international, efforts to promote disaster prevention and mitigation have often been confined to statements of intent.

1.2 Objectives and Methodologies

This study seeks to increase understanding of the wider economic and financial impacts of natural disasters, factors determining the vulnerability of hazard-prone economies, opportunities for mitigation and factors inhibiting their adoption. It involves the detailed analysis of the impact of natural disasters in three case-study countries. The study findings are intended to contribute towards the development of guidelines on the assessment of natural hazard vulnerability from an economic perspective. This document presents the findings of the first case study undertaken in Dominica.

The case study countries were selected to provide a range of hazard experiences in economies of varying size and complexity from different regions of the world. The first, which is the subject of this report, is Dominica, the highly disaster-prone, small-island Caribbean state. A second case study is being undertaken in Bangladesh, a large, disaster-prone Asian economy; and the third case will be conducted in a drought-affected southern African economy (provisionally Malawi).

There are considerable methodological difficulties in isolating the economic impacts of natural disasters from other internal and external factors. The study adopts and seeks to refine further an eclectic approach used in previous studies, involving a mixture of quantitative and qualitative analysis to examine the economic impacts of natural hazards (Benson and Clay, 1998; Benson, 1997a). The quantitative aspect is partial, involving a combination of regression analysis, examination of movement around trends, "before-and-after" impacts of disasters and comparisons of forecasts versus actual performance. A qualitative political economic analysis is also undertaken to place findings within the economic and social policy context of each case-study country.

Each case study focuses on the disaggregated impacts of natural disasters on various sectors of the relevant economy, including the public sector. It includes an assessment of the factors determining the extent of hazard vulnerability of the economy and of whether and why that vulnerability has changed over time. It also considers the degree of attention paid to economic issues in disaster mitigation, preparedness, relief and rehabilitation programs; how the economic consequences of disasters can be further mitigated; and the degree of attention currently attached to natural disasters and hazard risk in economic policy-making and planning, by the national government, the World Bank and other key international, regional and bilateral agencies, as relevant in each case study country.

1.3 Country Profile

The Commonwealth of Dominica is situated in the Eastern Caribbean at 15°N and 61°W. It is the largest and most northerly of the Windward Islands, with a landmass of 751 km² and measuring 47 km in length and 25 km in width. The island is of volcanic origin with rugged terrain and is the most mountainous of the eastern Caribbean islands. Its highest point, Morne Diablotin, rises to 1,447m, while Morne Trois Pitons rises to 1,424m, and two other mountains rise to over 1,200m. The topography is marked by a large number of deeply incised narrow, river valleys and steep ridges. Slopes of 30° or more are found in at least 60% of Dominica (Map 1).

The island's vegetation is dense, a consequence of its elevation and very high rainfall, which varies from about 1800 mm per year on the western coast to over 7,500 mm in the mountainous interior. The vegetation is diverse, with more than 1,000 species of tropical flowering plants. The diversity is related to the fact that more than 80% of the island receives at least 2500 mm of rain per year and much of the vegetation has been left undisturbed by humans. However, high rainfall in the mountainous non-coastal areas of the island also results in frequent localized flooding and landslides, which are recurrent annual problems.

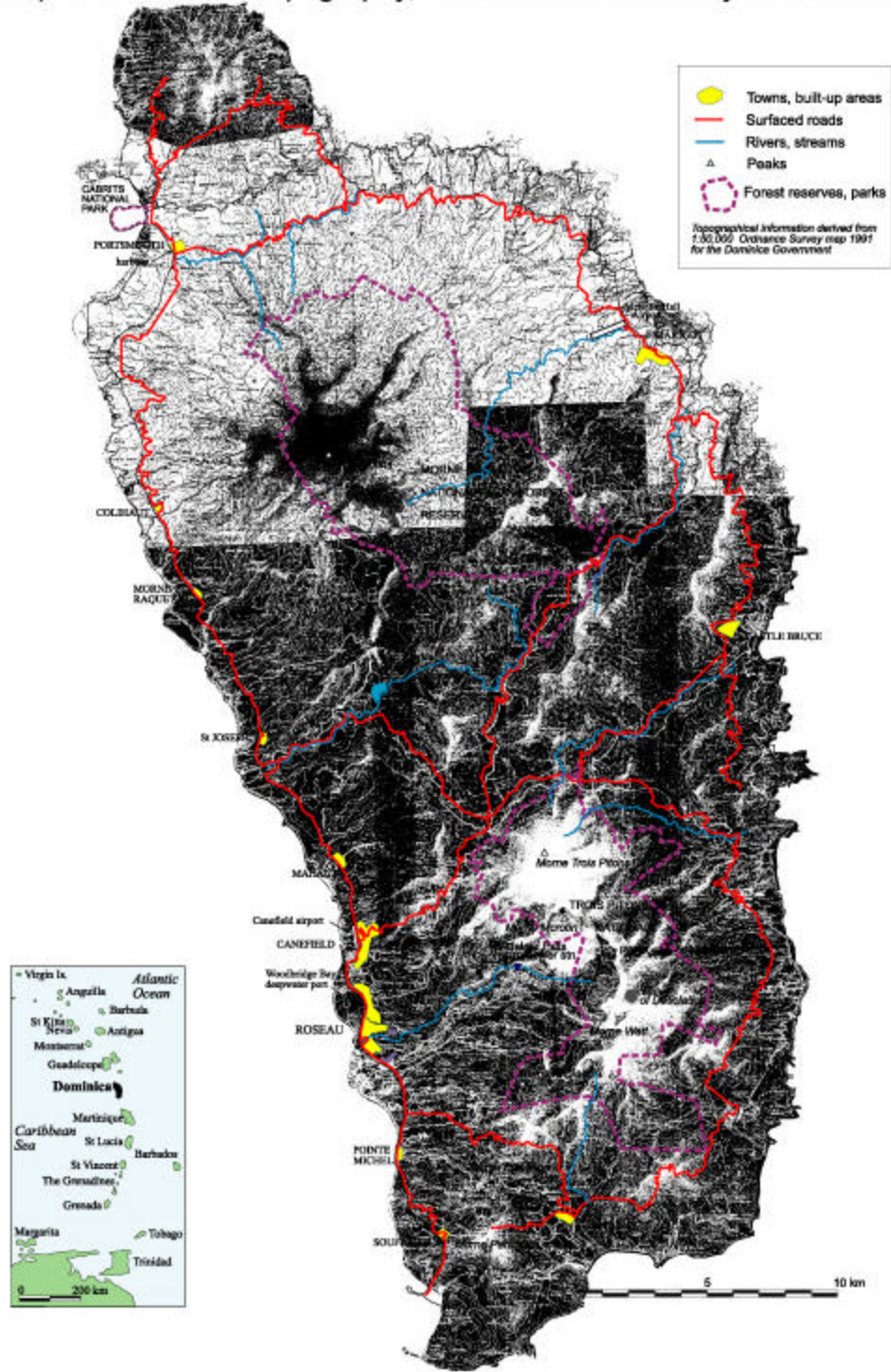
Dominica is a lower middle-income country, with an estimated population of 76,000 and per capita GDP of EC\$7,900 (US\$2,900) in 1998. Some 30% of the population was estimated as living at or below the poverty line in 1996. There is a long established pattern of net out-migration to work and settle in wealthier islands, the UK and North America. Reflecting the physical topography, most of the island's population and infrastructure are located on the coast, making Dominica particularly vulnerable to strong winds and high seas (Map 2). Some 24% of the total population resided in the Roseau city area at the 1991 census (GoCD, 1999a).¹

It is a member of various regional organizations, several of which play an important role in determining policy and economic performance. It is one of seven full members of the Organization of Eastern Caribbean States (OECS), which was formed in 1981. The OECS treaty provides for co-operation in several areas including trade, external relations, transport and communications, the judiciary and mutual defense and security (EIU, 1999). The seven full members of the OECS together with Anguilla are also members of the Eastern Caribbean Central Bank (ECCB), a monetary authority that issues a common currency, the Eastern Caribbean dollar, and conducts monetary policy on behalf of its member countries. Dominica is also a member of the wider CARICOM, which has established preferential external trade arrangements that favor members of the community.

Dominica achieved independence from the United Kingdom in November 1978. The UK's long-standing preferential arrangements on bananas, incorporated after access by the UK into the EU trading arrangements in 1973, had considerable implications for the development of Dominica. On independence Dominica also became one of the signatories to the ACP-EU Lomé Accords.

¹ All of the Caribbean island capital cities are located on the coast, with much of the commercial, industrial and residential infrastructure also in the coastal belt (Suite, 1996).

Map 1 Dominica : Topography, Communications & Major Settlements



Chapter 2

Natural Hazards and Disasters since Independence

Dominica is susceptible and vulnerable to a wide range of natural hazards.² The most common, most probable and historically most significant are tropical storms and hurricanes. The island is geologically extremely young and almost completely volcanic in origin. Following a recent volcanic alert, its susceptibility and vulnerability to volcanic activity in the future is now a major cause for concern. There is a related risk of earthquake. Landslides are a common feature of life and the landscape. Other potential hazards include drought, storm surges, floods, bush fires and tsunamis.

This study focuses on hazard events since 1978. The key events over this period have been Hurricanes David and Frederick in 1979, Allen in 1980, Hugo in 1989, the three tropical storms in 1995 and Hurricane Lenny in 1999. The Layou River landslide in 1997 and the volcano alert since September 1998 are also considered. This brief review of major events serves as a backdrop to an assessment of the environmental, economywide and sectoral impact of disasters.

2.1 Tropical Storms and Hurricanes

Dominica's location as the most northerly of the Windward Islands places it well within the Atlantic hurricane belt. Officially, the hurricane season extends from June to November but meteorologists advise that such storms could occur outside the season. Tropical storms and hurricanes occupy a prominent place in Dominica's history. Since 1978 the more physically damaging or economically and socially significant have been:

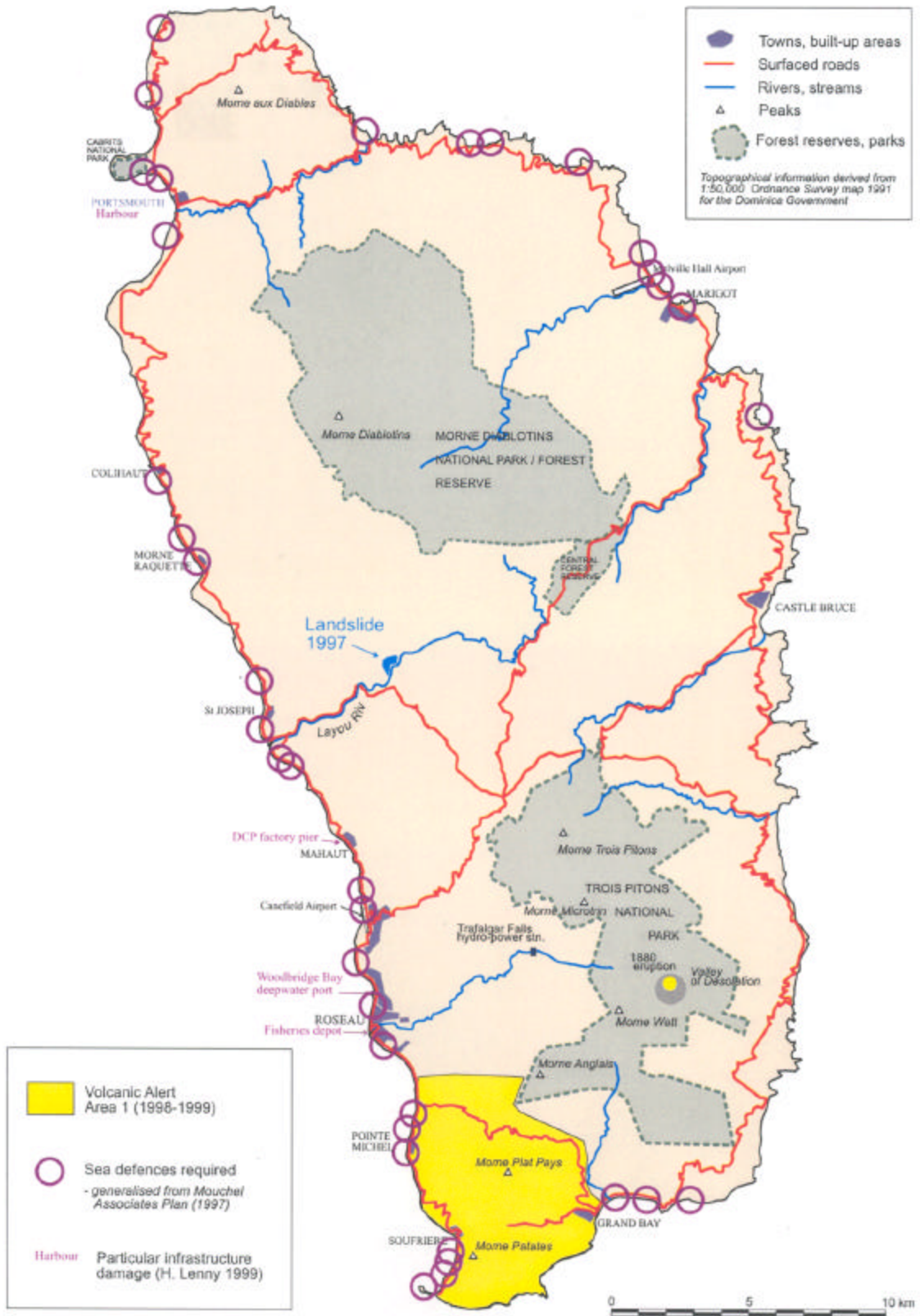
<u>Year</u>	<u>Name of hurricane³</u>
1979	David, Frederick
1980	Allen
1984	Klaus
1989	Hugo
1994	Debbie
1995	'Three storms' viz Iris, Luis, Marilyn
1999	Lenny

Hurricane David, a Category 4 hurricane, directly impacted the country and was particularly devastating, resulting in considerable world media attention and international disaster relief. Hurricane Frederick, which closely followed, and Hurricane Allen in 1980 exacerbated the effects of David. Hurricane Hugo, another Category 4 storm, dealt a glancing blow to Dominica whilst devastating St Kitts and Montserrat to the north. Three storms in 1995 had a severe cumulative impact. Hurricane Lenny, also a Category 4 storm, was unprecedented in moving from west to east across the northern Caribbean (Map 3). It caused largely coastal damage to Dominica and neighboring Guadeloupe and Martinique. The effects and impacts of these and the other serious storms are considered in later sections of the study. As there have been many potentially confusing statements about the 'unprecedented' nature of the major storms from Hurricane David onwards, a review of historical storm records is presented in Annex A.

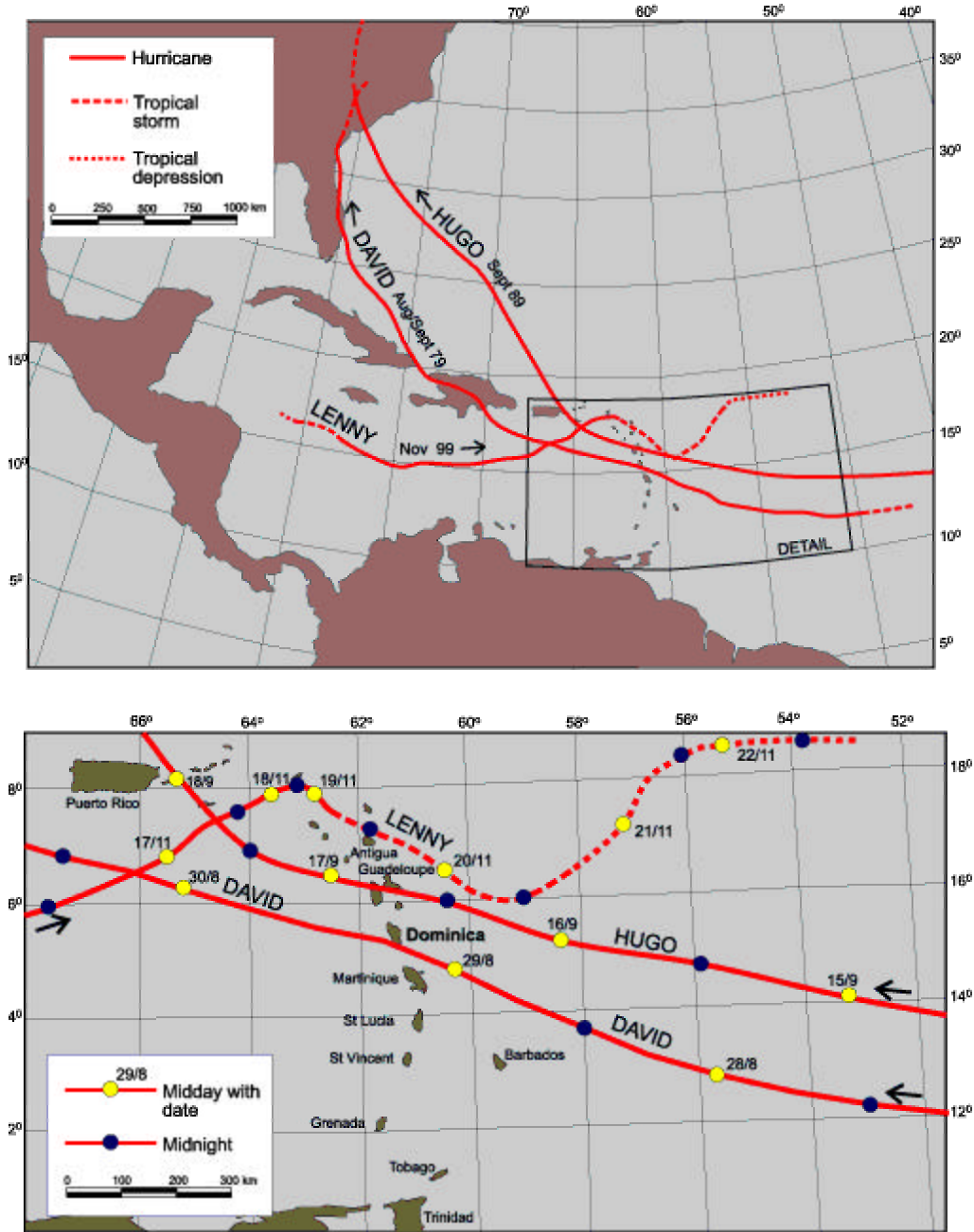
² A fuller discussion of natural hazards including the related definitions of disasters, risks and vulnerability employed in this study is provided in Annex A.

³ Debbie and Iris were named tropical storms, that is, intense depressions with sustained wind speeds in excess of 61km/hour, but less than the 119-120 km/hour to be classed as hurricane Category 1. A Category 4 hurricane such as David has sustained wind speeds in excess of 210km/hour (see Annex A Table A2.1).

Map 2 Dominica : Natural Hazard Vulnerability



Map 3 Hurricanes of Category 4 Affecting Dominica 1979 - 1999



2.2 Earthquakes

Earthquakes in Dominica derive from two separable but related forces. The Eastern Caribbean is a zone of subduction in which the Atlantic Plate pushes under the Caribbean Plate, causing tectonic earthquakes. The second source of earthquakes originates from the seismic events relating to Dominica's origin as a volcanic island, a consequence of plate-tectonic forces (Rowley, 1992). Earthquakes have not caused serious disruption in recent times. There is little publicly available information about potential hazard risks.

2.3 Volcanic Activity

Only one volcanic event in Dominica's recorded history has produced surface manifestations, an ash event in 1880 in the Valley of Desolation. However, visible signs of continuing volcanic activity are apparent, with soufrières, hot springs and lakes. Several volcanic alerts associated with periods of increased seismic activity have also occurred. The most recent one is ongoing after a series of shallow earthquake swarms that were widely felt from October 1998 to March 1999 (see below Section 5.3 and Section 13.2). The potential risk of, and vulnerability to, volcanic activity remains at a relatively high level with the focus of risk on the south of the island, where 20% of the population live (GoCD, 1999a) (Map 2). There has been no loss of life recorded due to volcanic activity.⁴

The Seismic Research Unit (SRU), University of the West Indies (UWI), St Augustine, Trinidad, has direct responsibility on behalf of the GoCD for monitoring seismic activity. After earthquake swarms began in 1998, the SRU, as discussed in Section 14.2, enhanced its level of monitoring (SRU, 1998).

2.4 Landslides and Mudslides

Many forces and features combine to make Dominica extremely vulnerable to landslides and mudslides. The most common landslides are debris flows. At least 2% of the total land area has been disturbed by landslides (De Graff, 1987; De Graff and others, 1989). Twenty-five deaths due to landslides have been recorded, including eight fatalities in the village of Bagatelle during heavy rain in 1977. Landslides have affected the Dominica Hydroelectric Expansion project: construction delays and project redesign costs are discussed further in Section 6.4.

The largest and environmentally most significant recent landslide, in the Layou River Valley, started in March 1997, culminating in a series of major events in November 1997 (Map 2). No lives were lost, although the socio-economic impact has been substantial in other ways (See Annex A.3.6).

2.5 Other Hazards

Droughts, storm surges, floods, bush fires and tsunamis have been regarded as lesser hazards in that the overall combination of their manifestations, effects and frequencies have been comparatively smaller than those of hurricanes, landslides and earthquakes. However, it must be stressed that any of these hazards could assume major proportions if there were a change in physical conditions or social activity that altered levels of vulnerability. The need to constantly reappraise risks is underlined by the growing attention accorded to drought, affecting banana production in particular (see Section 5.1). The potential for a major bush fire was also drawn to the team's attention during its visit. As the unusual eastward tracking Hurricane Lenny, apparently unprecedented in historical records, demonstrated in 1999, events that follow an exceptional pattern may be very damaging because they are not catered for in mitigation and preparedness measures.

⁴ However, excavations have revealed a pre-Columbian Arawak settlement near Soufrière in the south of the island overlain by volcanic deposits (Personal communication, Lennox Honychurch).

Chapter 3

Environment, Natural Hazards and Climate Change

3.1 Natural Hazards as an Environmental Phenomenon

Natural hazards are typically extreme and uncommon events that are part of continuing environmental processes – the climatic-hydrological cycle and geophysical processes. It is beyond the scope of this study to consider these processes in detail. There are, however, three aspects of natural disasters *as an environmental phenomenon* to which attention should be given, because of their economic and financial implications.

First, environmental resources, in the sense of visible land, sea, flora and fauna, are important economic assets. The environment, in the sense of an amenity, has value to the people of Dominica, which in principle could be quantified.⁵ These resources, beaches, forests and specific fauna, such as the Imperial parrot, the national emblem, are vulnerable to natural hazards.

The increasingly important eco-tourism sector is closely tied to Dominica's image as a 'nature island'. There is, as discussed below (Section 5.3) qualitative evidence that the level of activity and viability of that sector is linked to the actual or perceived status of key environmental resources, including the extensive forests, inland beauty spots and the very few coral reefs as well as the sand beaches with which tourist facilities are closely tied.

A second and related issue is the environmental damage that may be caused by global climatic change. Rising air and water temperatures may increase the intensity and incidence of tropical storms, bringing wind damage, severe coastal sea conditions and flooding, as well as changes in the hydrological cycle that could lead to both longer drought periods and more intense rainfall.

Third, there is the critical issue of scientific assessment and monitoring. The incidence and measurement of the physical features of hazard events, indications of potential hazards, risk mapping and prediction are all essential inputs into disaster mitigation and preparedness.

The first two of these issues are briefly considered in this chapter. Evidence is examined on the effects of natural disasters on environmental resources that are perceived as an amenity or social good, focusing on forestry, for which there is more evidence. Then hazard issues are identified that are raised by climatic change. Hazard monitoring and associated problems and costs for a small middle-income country are considered separately, in Chapter 13.

3.2 Forests and Other Amenity Resources

Dominica's reputation and image as the 'Nature Isle of the Caribbean' are based on the island's natural resource endowments - its flora, fauna and the biodiversity in the terrestrial and marine environments. These are closely associated with the surface manifestations of its volcanic origin and history, and also its exceptionally large surviving forest area.⁶

⁵ For example, Middlesex University Flood Hazard Centre has quantified experimentally the value of some environmental resources that are vulnerable to natural hazards in the UK.

⁶ 'Dominica is fortunate in having the greatest expanse of relatively undisturbed tropical forest remaining in the Caribbean. This is due, in the main, to a combination of sustained conservation efforts dating back to the 1940s' strong enforcement of forestry legislation and topographical and climatic factors, which discouraged forest exploitation and the wholesale conversion of forests to non-forest use. Dominica's natural vegetation covers 65% of the total land area...60% is privately owned' (Zamore, 1999).

Forest Impacts

Hurricanes have negative impacts on Dominica's forests and associated fauna, but very few recorded storms have had a devastating impact. The storm impact depends on the nature of the hurricane (strength and direction of winds and rainfall producing capacity), its duration and direction of approach.⁷ Hurricane David resulted in extensive damage: an estimated 5 million trees were damaged and perhaps 35-40% of the basal wood negatively affected. Hurricane Allen the following year set back regrowth by causing extensive defoliation of the soft, less resistant regrowth. No other subsequent hurricane sequence has done comparative damage. However, the comparative frequency of peripheral or direct impacts means that forests have continued to be negatively affected by tropical storms. There has been a significant storm event at least once every 3 years on average. Experts are of the view that forest gaps and adjoining forests suffer greater hurricane impact than undisturbed natural forests. In one locale, Woodford Hill, Hurricane Luis was observed to have done much more damage than the stronger, generally more devastating Hurricane David. Logging in the intervening period is thought to be the major factor predisposing the forests to storm vulnerability.

Estimates of the time it takes for the forest to recover vary. Some experts (Lugo and others, 1983) regard Dominica's forest as relatively resilient and suggest that intense damage may be virtually undetectable thirty years after the event. Certainly informants confirm that this has proved true from an eco-tourist, if not purely scientific perspective.

Five factors are identified by Zamore (1999) as major contributors to vulnerability: forest structure, species composition, reforestation, forest gaps and logging damage. Human activities such as shifting cultivation and erratic logging upset the structural balance. Reforestation with less resistant species, the opening of the canopy, damage to individual trees and collateral damage as a consequence of logging operations are also thought to have increased vulnerability

The implication is that more extensive damage to forests occurs where human activity directly impacts natural forest ecosystems. In a largely rural society with high levels of self-provisioning and local sourcing even on estates, the demand for timber for shelter, fuel, and other support activities has been high. That a comparatively large proportion of forested lands is not owned by the state also exacerbates the problems of control and protection.⁸

Taking these factors into account, Zamore has proposed a two-pronged approach to reducing vulnerability that involves both leaving most existing forests undisturbed and elsewhere developing and maintaining appropriate management systems. This would require appropriate legislation, institutional arrangements, public education and techniques that both minimize the negative impacts of species extraction and vigorously promote 'sustainable' approaches to forest management.

Enhanced environmental monitoring is required to measure the precise ecological impacts of natural hazards on forests and fauna and thus to provide the impetus for measures to reduce vulnerability. Hurricane David, in particular, prompted interest in this area. However, such investigations depended substantially on external funding and human resources, posing problems of sustainability and of how to ensure that longer-term ecological effects are monitored (see below Chapter 13).

⁷ Forestry experts such as Arlington James and Zamore (1999) report that damage includes defoliation, breaking of stems, breaking of branches and crowns and uprooting and toppling of trees. In the longer term, as forests recover, changes occur in species composition and dominance relationships. Indeed, adaptation to occasional catastrophic storm damage is presumably reflected in the evolution of Dominica's forests. The Bois Cote (*Tapura Latifolia*) has been identified as a resistant species that rapidly grows to dominate gaps created in the canopy of the rain forests. However, Zamore reports that tree fall gaps created by hurricanes increase the vulnerability of these forests to future hurricanes. (Personal communication, Arlington James, Senior Forestry Officer.)

⁸ Zamore (1999) reports 'The rate of forest loss in Dominica has been significantly increased by the sale of unallocated state lands. Subdivision and sale have continued in an ad hoc manner, largely in response to squatter pressures and without land capability studies to determine crop suitability.'

Other Environmental Impacts of Tropical Storms

Hurricanes can cause accelerated erosion to coastlines, damaging physical structures that have amenity value such as beaches and reefs. Informants drew attention to several examples of such damage on the island's west coast after Hurricane Lenny. The flooding that frequently accompanies hurricanes results in accelerated soil erosion and increased turbidity of the near shore waters. This contributes to further degradation of watersheds and a concomitant increase in vulnerability.

Hurricanes have had negative impacts on wildlife and marine life. For example, scientific studies of Imperial and Red-necked Parrot populations indicate that species numbers have taken twenty years to recover from the impact of Hurricane David.⁹ However, it is often difficult to obtain accurate information and statistical evidence and to disentangle the impacts of extreme events from other longer-term ecological factors.

The impact of hurricanes on the marine environment is accepted, but to a large extent remains poorly described, assessed and quantified. This is understandable. It is extremely difficult to establish benchmark data such as species composition, population totals and measurements of coral reefs in a small island developing state like Dominica (see above and Chapter 13).¹⁰

Other Hazards and the Environment

Landslips have environmental effects, such as damage to forests and riverine and estuarine siltation. These have only begun to be monitored since the Layou River event in 1997 (Appendix A.3.6).

The other potential source of massive environmental damage is a volcanic eruption – ash deposits, pyroclastic flows and lahars can, as the effects of the persistent Soufriere Hills eruption since 1995 on the nearby island of Montserrat demonstrate, have catastrophic impacts and preclude access to environmental assets for extended periods (Clay and others, 1999). The only possible response to an eruption is withdrawal. The only available risk reduction measure is portfolio diversification – ensuring that environment-linked developments are geographically spread and preferably, to the extent economically viable, sited in lower risk areas.

Human intervention could also become a potential source of longer term damage to environmental assets – excavation of deltaic silts for building material, pollution from human habitation and industrial activity could affect coastal marine resources, but these are longer term rather than disaster-related issues.

3.3 Climatic Change

The United Nations Global Conference on the Sustainable Development of Small Island States, in its Programme of Action, recognized inter alia, the potential hazards that climate change and environmental change may present for small island developing states such as Dominica (UN-ESC, 1999).

Changes such as more general global warming and a rise in sea levels, which is apparently already occurring in the Caribbean Sea, pose additional hazards. It may be difficult to predict the precise and specific effects of such developments. This is due firstly to the interplay of the forces of climate and secondly, because geological forces may

⁹ The Imperial or 'Sisserou' parrot (*Amazonia Imperiales*) is the 'national emblem' that appears on Dominica's flag. Following Hurricane David the numbers were drastically reduced and distribution curtailed to the Morne Diablotin National Park (Evans, 1988). However, by the late 1990s the parrots, benefiting from conservation measures, had returned to the Morne Trois Pitons National Park. Eco-tourism to Dominica includes ornithological visits to view the Imperial and Red-necked parrots (*Amazona arausiaca*) in their natural habitat.

¹⁰ For example, the natural resources sector assessment after Hurricane Lenny includes a detailed fisheries report which for the first time provides an estimate of the cost of damage to coral reefs and sea grass beds, totaling EC\$ 2.2 million (GoCD, 1999c).

be acting independently on any given land area where observations and research are being conducted. For example, sea level rise may be occurring at the same time as coastal subsidence or elevation due to geological forces acting on a small island. In such a situation, it may be impossible to ascribe the environmental changes exclusively to climate change and sea level rise.¹¹

There is considerable concern among meteorologists that a rise in global air and sea temperatures in the Caribbean basin could give rise to more frequent and more powerful hurricanes. This, of course, would pose a potentially increased hazard for Dominica. The marine environment could also be affected by climatic change. A rise in mean sea levels could make the entire coastal eco-system and shore base facilities more vulnerable to hurricane damage, especially damage by sea waves and storm surges. Even without an increase in frequency or intensity, because of higher sea levels storms could be potentially more destructive to existing societal capital stock and activity. Environmental and climatic changes would occur in a very complex milieu of natural and human settings, interacting in a dynamic manner. Environmental changes as a direct result of human activity in Dominica could make hazards such as hurricanes, drought and floods even more potentially devastating than they have been in the recent past. From a policy perspective, this is a difficult issue to address. Properly researched scientific evidence is lacking on the consequences of human intervention, but robust data may only become available retrospectively after anticipated harmful effects have already occurred. If such changes occur incrementally, then the change in an environment experiencing considerable climatic variability in the short term may be so small as to be virtually imperceptible. Over a period of several decades, the cumulative effect on Dominica could be considerable.

Against the background outlined above, it is possible to identify some of the potential effects of climatic changes and the likely hazard implications of such changes through the elaboration of scenarios based on some of the changes that are now anticipated, such as rising sea temperature and sea level. To address these widespread concerns, as for example the World Bank's Environmental Policy paper indicates (World Bank, 2000c), will require greater expenditure on scientific research and monitoring to provide robust baselines for measuring change and to make possible investigations into processes and their consequences. This issue is considered in Chapter 13.

¹¹ The Caribbean Planning for Adaptation to Global Climate Change (CPACC) Project was established to support Caribbean countries in preparing to cope with the adverse effects of global climatic change, particularly sea level rise. It includes a sea level network to measure more precisely sea level changes indicated by the small number of US and South American coastal measuring stations (www.cpacc.org). See also Chapter 13.

Chapter 4.

The Macroeconomy

4.1 Economic Performance and Natural Hazards

Dominica has a small, open economy, still heavily reliant on a single export crop, bananas, but diversifying into service activity. Agriculture and agro-processing combined continue to be the major productive sector, although agriculture's share in GDP has declined from an average of 37% in 1977-78 to 20% in 1997-98. Bananas have been the principal agricultural crop, exported to the UK under a preferential access agreement which is being phased out. There has been some limited diversification out of bananas, which still accounted for a third of total merchandise export earnings in 1997 (see Section 5.1). The agricultural sector also accounted for close to one-third of employment, according to the 1991 population census, and is an important secondary source of income.

In contrast, other private sector activity remains small, although experiencing some growth since the mid 1970s. Manufacturing output rose from 3.9% to 8.2% of GDP between 1977 and 1998. Soap products emerged as the island's largest single merchandise export (in value terms) in 1996. In the 1990s, promising growth has been observed in the island's burgeoning offshore services industry, although the sector is still small.

The economy is very open, with imports equivalent to 65% and exports to 25% of GDP in 1997.¹² Dominica has consistently run a deficit on its external visible trade account. This deficit has been partly met through tourism earnings. Tourism's contribution to GDP remains relatively low, but by the late 1990s accounted for an estimated 35% of external earnings (GoCD, 2000) (see Section 5.3).

As a small island economy with a narrow resource base and high degree of openness, Dominica is highly sensitive to changes in its external environment and exogenous shocks and faces particular challenges in achieving sustainable development. The GoCD (2000) identified two key external factors of particular concern: international developments, especially implementation of the WTO trade regime, and natural disasters. Indeed, the vulnerability of small island developing states more generally, both to natural hazards and other external shocks, is widely recognized and the challenges posed to sustainable development acknowledged. Research has demonstrated that small island developing states experience greater vulnerability than developing countries as a whole, and also that Dominica is one of the most vulnerable countries in the world, both to natural disasters and other external shocks (see Box 4.1). Thus, as the UN Economic and Social Council states, 'it is vitally important for small island developing States to undergo the transition, at the national and regional levels, towards a culture of risk reduction. Risk reduction plans should not be a mechanical process, in which a natural disaster leads to emergency response and then to remedy, but part of integrated policies to achieve social and economic stability and low risk' (UN-ESC, 1999: para 10).

¹² Comparable figures for 1978 were 72% and 40% respectively.

Box 4.1: Quantifying Vulnerability to External Shocks

Small states face a number of special disadvantages associated with size, insularity and remoteness, which in turn result in potential economic sub-optimality, a high degree of openness and limited diversification. These factors render small states particularly exposed and vulnerable to a range of external shocks, including natural hazards, causing high volatility in national incomes. Although the range of per capita incomes and rates of growth of small and large developing countries are not significantly different, the standard deviation of real per capita growth is about 25% higher amongst the former (Commonwealth Secretariat/World Bank, 2000).

There has been considerable recent interest in attempting to measure the extent of vulnerability of individual nations to external shocks. This interest has been fuelled by the fact that many small states have relatively high levels of per capita GNP, suggesting economic strength rather than - as is often, in fact, the case - frailty. This limits their access to concessional aid resources. Efforts in measurement have focused on structural vulnerability, defined as being caused by 'factors which are not under the control of national authorities when the shocks occur' (Atkins, Mazzi and Easter, 2000: 3).

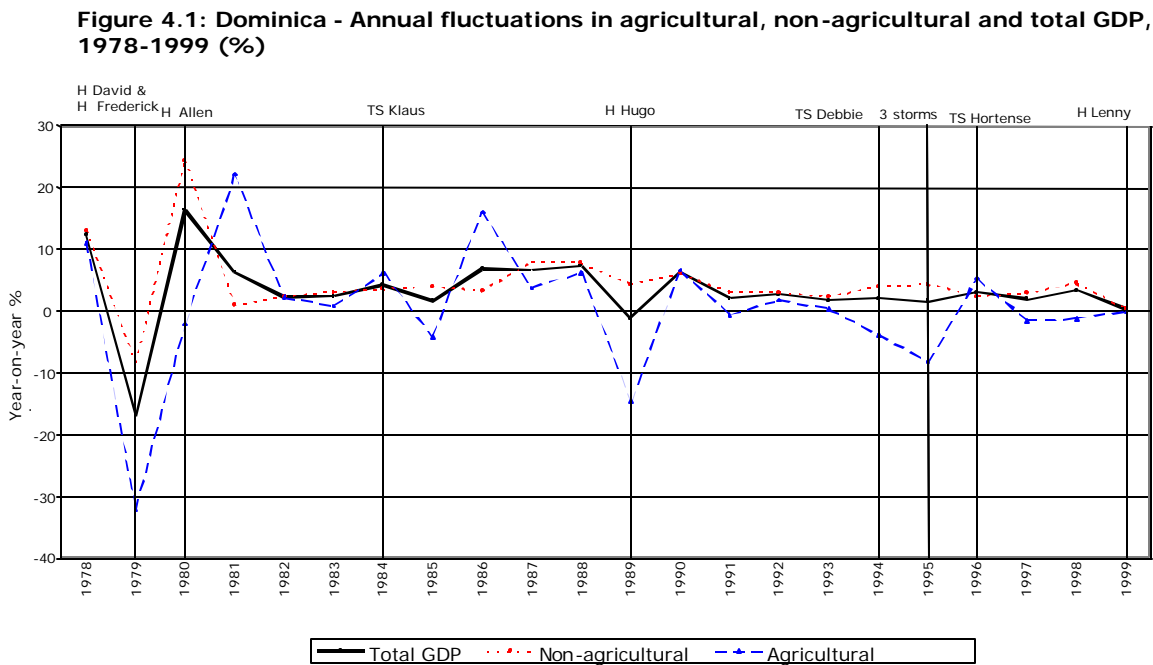
As a result, various indices of vulnerability have been developed, based on a (sometimes weighted) range of components capturing different aspects of vulnerability, including that relating to natural hazards/disasters. The way in which disaster or hazard vulnerability has been measured has varied between studies, basically reflecting poor data on the impacts of disasters as well as the complexity of factors determining hazard vulnerability. The relative ranking of different studies has also varied, highlighting the very approximate nature of the results. Nevertheless, they suggest that Dominica is highly hazard prone.

For example, one of the earliest vulnerability indices was developed by Briguglio (1995), based on size (proxied by openness to trade), insularity or remoteness (proxied by transport costs), proneness to natural disasters and environmental fragility. Proneness to natural disasters was proxied by total damage from significant disaster events (defined as exceeding 1% of GNP) occurring over the period 1970 and 1989. According to Briguglio's index, Dominica was the second most disaster-prone of the 114 countries analyzed; and the 18th most vulnerable country overall.

The Commonwealth Secretariat has also developed a model, based on three dependent variables: susceptibility to natural disasters (defined as the percentage of population affected by natural disasters cumulatively over the period 1970 to 1996), export dependence, UNCTAD's merchandise export diversification index and the overall size of GDP of a particular country. According to this index, Dominica was ranked 6th out of the 100 countries analyzed in terms of the overall Commonwealth Vulnerability Index, also making it the most vulnerable state in the Caribbean overall. In terms of vulnerability to natural disasters, it was ranked in 13th place, behind only Antigua and Barbuda in the Caribbean.

Separate work by the Commonwealth Secretariat on the development of a composite environmental index, again using natural disasters as one of a number of indicators but this time based on the total number of natural disasters over the period 1970-96 expressed relative to total land area, ranked Dominica as the 5th most disaster vulnerable country, with four smaller Caribbean states in the top five (the others being Saint Vincent, Saint Kitts and Nevis and Saint Lucia).

In the case of Dominica, natural disasters have clearly had a major impact on economic performance since 1978 (Figure 4.1).¹³ The combined impact of Hurricane David in 1979, followed closely by Hurricane Frederick and then by Hurricane Allen in 1980, was particularly devastating, reflecting both the scale of physical damage and disruption caused as well as an already weak economy. During the 1970s, economic performance had been relatively poor, in part the consequence of the world oil crisis of 1973-4 and escalating import prices. A further oil crisis occurred in 1979, and there were also mounting political difficulties in the immediate post-Independence period. As a consequence, real GDP plummeted by 17% in 1979, whilst agricultural GDP alone fell by 32% and non-agricultural GDP declined by 8.3%. Despite some recovery in non-agricultural sectors, agricultural GDP fell by a further 2.1% in 1980, so that overall GDP remained 3.3% lower than in 1978 and the visible trade deficit increased to 71% of GDP. Poor economic performance in 1980 reflected the further impact of Hurricane Allen. Hurricane David also resulted in the temporary exodus of almost 20,000 people, equivalent to about a quarter of the pre-disaster (1978) population.¹⁴ This exodus included many school-aged children and there is anecdotal evidence of skill shortages hampering reconstruction (see Section 12.1). Twenty years later the population had still not recovered to its 1978 level. These severe multiple shocks also brought intensified budgetary pressures from increasing recurrent expenditure on relief and capital costs of reconstruction (see Chapter 10 and Annex C).



Hurricane David is generally considered to have been a significant factor in forcing the country into a subsequent Structural Adjustment Program (SAP). In FY 1986/87 the GoCD adopted a SAP, supported by an arrangement under the IMF Structural Adjustment Facility (SAF) and an IDA Structural Adjustment Credit (SAC). The overall SAP was aimed at achieving a sustainable rate of economic growth, reduced unemployment, improved living standards and strengthened fiscal and balance of payments positions.¹⁵

¹³ Historical records dating back to 1763 also provide some evidence of the cumulative adverse impacts of earlier hurricanes. There was a bunching of severe hurricane events during three periods – from the mid 1760s to 1780 (6 years out of 16), from 1813 to 1834 (8 years out of 21) and from 1876 to 1893 (5 years out of 17). These periods were officially reported as ones of economic difficulty, depressed agriculture and trade (see Annex A.2).

¹⁴ The combined impacts of Hurricanes David, Frederick and Allen are discussed in more detail in subsequent chapters of this study.

¹⁵ The SAF, whose targets included increasing government savings to 2-3% of GDP and reducing the current account deficit (excluding official transfers), to 4% of GDP, was fully disbursed by November 1989. Almost all macroeconomic targets were

Relatively high rates of growth were experienced between 1986 and 1988, averaging 7.0% per annum in real terms, in part reflecting the success of the SAP as well as rapid increases in the price and volume of bananas and high levels of aid flows.¹⁶ Under its 1989/90 budget, the GoCD forecast that the economy would grow by 5% in 1989, although the agricultural sector was expected to decline by around 5% due to a fall in banana prices and a reduction in output during the banana-replanting program. Then Hurricane Hugo in September 1989 destroyed some 70% of banana production. Economic performance for the year was also adversely affected by unfavorable exchange rate movement between the EC dollar and pound sterling, resulting in a fall in the EC\$ unit price of banana exports. In consequence, overall GDP fell by 1.1% year-on-year and agricultural GDP alone by 14.6% whilst the visible trade deficit increased to EC\$130m (equivalent to 38.5% of GDP for the same year). However, non-agricultural GDP increased by 4.4%.

During the 1990s, the GDP growth rate was lower, averaging 2.4% (in real terms) between 1990 and 1998. To some extent the weaker performance reflected difficulties in the banana industry and its implications for the balance of trade deficit (particularly in the latter part of the decade) as well as a decline in concessionary financial flows. There was a 20% fall in unit banana earnings in 1993 due to changes in the EU banana regime. The 1997 WTO ruling against the EU system of issuing preferential licenses to certain banana producing countries is expected to exacerbate difficulties in the future.

Adverse weather conditions also contributed to slow growth. In 1994, real agricultural GDP declined by 3.7%, in part due to the impact of Tropical Storm Debbie in September on the banana sector as well as to deterioration in the EC\$ banana export price. Overall GDP increased by 2.2%, however, reflecting a 4.0% expansion in non-agricultural GDP. For 1995 GDP growth had initially been projected at 4.5%, reflecting the banana sector's recovery from the 1994 storm. In the event, the island experienced three damaging storms and achieved real growth of only 1.6%. The decline in agricultural production was expected to have a significant impact on the level of unemployment, increasing to as much as 30% (GoCD, 1995). Moreover, the situation was expected to be exacerbated by lack of availability of jobs in neighboring islands, which had also been affected by the storms. Nevertheless – and most significantly - in contrast to an actual decline in 1979 and 1980, there was still GDP growth because the already reduced sectoral share of agriculture meant that the economy-wide impact of crop damage was relatively less severe. There was also compensating manufacturing and service sector expansion.

Most recently in 1999 Hurricane Lenny caused considerable damage to coastal infrastructure. But, without hurricane force winds or intensified rainfall, it had relatively limited impact on agricultural production or aggregate economic performance (see Chapter 2 and Annex A.4). According to provisional GoCD estimates, GDP marginally increased by 0.4% year-on-year, with agricultural product unchanged and non-agricultural product 0.5% higher.

Regression analysis

The sensitivity of sectoral economic performance to hurricanes over the period 1978–98 has also been subjected to more formal examination using regression analysis. The purpose of this analysis was not to prove that storms affect overall economic performance – a point already demonstrated by the qualitative examination of economic performance presented above – but, rather, to quantify their impacts. This exercise is useful in trying to further understanding of the nature of impact of disasters and to draw out any implications for disaster reduction.

Using ordinary least squares techniques, annual growth rates of each of GDP, agricultural GDP and non-agricultural GDP were regressed, in turn, against several forms of a storm dummy variable series constructed to represent the possible downward impact of tropical storms and hurricanes in the year in which these occurred (See Annex B). The dummy variables were also lagged one year to examine whether storms generate prolonged economic downturns or,

achieved during the course of the SAP and a series of broad policy and institutional changes undertaken that created an improved environment for supporting economic growth (World Bank, 1992).

¹⁶ A further hurricane, Klaus, occurred in July 1984, damaging an estimated 20-25% of the 1984 banana crop (ECCB, *Quarterly Bulletin*, 1984, 2(3)). However, overall GDP for the year increased by 4.3% and agricultural GDP alone by 6.2%.

alternatively, subsequent booms. Several other explanatory variables were also tested, in part to take account of the other major form of external shock to which the Dominica economy has been exposed – namely, banana price movements.¹⁷

Certain methodological problems were encountered in identifying and quantifying an appropriate storm dummy series, immediately pointing to an important distinction between two broad categories of storm affecting Dominica. Storms have differed not only in their wind strength but also in terms of their precise path and associated levels of rainfall and sea surge. As such, their impact can be categorized either as principally affecting banana sector output or as also causing significant infrastructure damage. The 1979, 1995 and 1999 storms fall into the latter category, although Hurricane Lenny was also unusual in causing relatively little damage to the banana crop. Other tropical storms and hurricanes have principally affected the banana sub-sector. As such, they have been followed by relatively rapid economic recovery, basically linked to the rehabilitation of banana production, although the agricultural impact of Hurricane Hugo (1989) was particularly severe, also causing substantial infrastructure damage (see Chapter 6).

After establishing that other storms did not have immediate, measurable sectoral or macroeconomic impacts, the storm dummy series eventually selected only took into account the three major disaster years over the period of analysis – 1979, 1989 and 1995. Two forms of disaster dummy were tested – a composite series, with varying weight accorded to each disaster, and a series of dummy series for each of the three years, each of which was set at 1 for the relevant disaster year and 0 for other years (see Annex B).

Regressions were initially run simply with only the disaster dummies as independent variables. The best fits taking each of total GDP, agricultural GDP and non-agricultural GDP annual growth rates as the dependent variable were found in the logarithmic regressions against the individual dummy series (Table A.4.2). However, in the regressions taking GDP and non-agricultural GDP annual growth rates as the dependent variables, only the 1979 dummy series was found to be significant, with the relevant independent variable negatively correlated with the dummy variable in the current year and positively correlated with the lagged dummy variable. In the regressions taking agricultural GDP annual growth rates as the dependent variable, growth was also found to be negatively correlated with the current year dummy variable for 1989, as would be expected given the sharp fall in agricultural GDP in that year.

When additional explanatory variables were included in the analysis, the best results in the regressions for GDP and non-agricultural GDP annual growth rates (with $R^2 = 0.99$ and $R^2 = 0.96$ respectively) were again found in a logarithmic form using the individual dummy series for 1979, 1989 and 1995 together with the consumption, investment and banana export price as independent variables. The dummy series for 1989 and 1995, in both their current and lagged forms, as well as for 1979, were found to be significantly correlated with GDP annual growth rates in this revised form. In contrast, only the severe 1979 hurricane had significant implications for the performance of non-agricultural GDP. In the regressions for agricultural GDP annual growth rates, the best results (with $R^2 = 0.87$) were found in a logarithmic form using the composite dummy series, but again with consumption, investment and banana export price as additional explanatory variables. Both the current and lagged composite disaster dummy series were found to be significant in this specification.

In summary, the results of the regression analysis confirm the negative impact that major hurricanes have had on overall short-term economic performance and, particularly, on agriculture. Each of the three major storm events tested was found to have a statistically significant negative impact on both total and agricultural GDP. In fact the agricultural sector impacts may even be under-estimated. As the analysis of banana exports reported below in Chapter 7 shows, the full extent of the sensitivity of agriculture to storm impacts requires analysis on a quarterly rather than the annual basis on which national accounting data are only available for most developing economies.

¹⁷ Other explanatory variables tested were gross domestic investment, private consumption, government consumption and the average annual unit banana export price (measured in EC\$).

The results indicate that in the short-term non-agricultural GDP is less vulnerable to storms, other than the most severe events. The regression analysis also supports the finding that the impacts of hurricanes have become relatively less severe as agricultural sector product has declined as a share of GDP. But it should be borne in mind that the particular strength and path of Hurricane David made it especially devastating.

It should be noted that the above analysis has focused on the more easily measured short-term impact of disasters, relating to performance over only a few years at most. Longer-term analysis would probably indicate that the cumulative impact of disasters on non-agricultural GDP has been substantially greater, via their impact on such factors as the pace of capital accumulation. It would be naïve to conclude, based on an analysis of flow effects alone, that the non-agricultural sector is largely insensitive to natural hazards.

4.2 Economic Development Strategies

Since before Independence, the GoCD has placed a continuing, central emphasis on economic diversification, both away from banana production within the agricultural sector and also, more broadly, into non-agricultural sectors.¹⁸ This commitment to diversification has been prompted by concerns to develop a more resilient economic structure and also, more recently, by the decline in guaranteed preferential access to the European market for banana exports. As the Caribbean Conservation Association report explains (CCA, 1991: 73), diversification within the agricultural sector has additionally been predicated in part on the fact that 'emphasis upon a single crop leaves the country's agricultural sector vulnerable to natural disasters'. However, natural hazard vulnerability reduction concerns have apparently not been factored into plans for diversification more generally nor, at least in earlier years, into diversification within the agricultural sector.¹⁹ Indeed, there has apparently been little deliberate effort to reduce the overall hazard vulnerability of Dominica's economy.

Much play has been made of the opportunities created, as well as the challenges posed, by Hurricane David. For example, in the 1979 budget address it is stated that '(Dominica) has, unfortunately, since its Independence been savagely scarred by the ferocity of hurricane David. This however has, perhaps, provided the opportunity – and possibly the capital – for us to build a new nation and to achieve a greater standard of living for our people than would otherwise have been possible' (GoCD, 1979: 8). Hurricane David also offered the opportunity to advance the GoCD's diversification policy - and underlined the necessity for such a policy. The 1980/81 *Budget Address* explicitly acknowledged this opportunity, at least in the context of the agricultural sector, stating: 'in the past we have given no more than lip service to the policy of diversification. Now that we have seen the dangers of a one-crop economy we need to move rapidly to implement in a meaningful way the program for diversification in agriculture... Our efforts at diversification must include crops which are not susceptible to destruction by adverse weather, and which can be used for expansion in agro-industry' (GoCD, 1980: 9).

Despite such statements of intent, Hurricane David in fact provided further impetus to the shift into banana production. Bananas offered the quickest, low investment way to restore agricultural production and export income whilst the GoCD failed to actively promote diversification into other crops - for example, through the provision of incentives. Meanwhile, the potential for development of the services sector was not then recognized and the government felt that there was little scope for diversification in the manufacturing sector.²⁰

¹⁸ Agricultural diversification is reported to have been on Dominica's agenda since the Royal Commission of 1893 (World Bank, 1992).

¹⁹ The same report also comments that in the longer-term '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' (CCA, 1991: 71).

²⁰ The ECCB (*Quarterly Bulletin*, 1980: 13), in considering the impact of Hurricane Allen both on Dominica and also Saint Lucia and Saint Vincent, similarly noted the merits of banana production, writing that 'it is perhaps fortunate that bananas are a crop which can be rehabilitated in twelve months; there are some agricultural commodities that require a much longer period for the crop to come to fruition.' However, at the same time it also recognized the merits of diversification: 'in the interest of balanced economic growth it is prudent for territories such as these to take steps to broaden their economic base and move away from concentration solely on primary production to the fostering of secondary and tertiary industries'.

Limitations in the country's policy and planning capacity, lack of moral authority on the part of the government and as yet less than full relations with the wider donor community contributed to the GoCD's failure to exploit the opportunities presented by Hurricane David. Poor vision may also have contributed, as historically the island had swung from one dominant crop to another and this pattern was simply repeated. Following Hurricane David, senior officials established a small committee that continued in operation for two or three years, working on a strategic plan covering agriculture, infrastructure, schools, hospitals and so forth. However, this committee's efforts were largely ignored both by the GoCD and the international community. The latter mostly responded ad hoc to specific requests for emergency aid while individual donors based their response on their own assessments. Meanwhile, the still internationally inexperienced government was not fully aware of the potential external resources available for rehabilitation. Thus, between 1979 and late 1980 little was achieved other than the rapid restoration of pre-existing facilities whilst little was effectively done to stem the outflow of human capital from the island. It was not until late 1980, when more 'sensible' planning was begun, that the GoCD could begin to convince the IMF and World Bank that the situation required stabilization.

During the 1980s, the continued high profitability of banana production emerged as a key short term factor, discouraging resources from flowing into the development of a more diversified agricultural sector. Only the declining profitability of bananas in the 1990s for a combination of reasons, including the loss of previously assured preferential markets, has forced a re-examination of the composition of the agricultural sector (see Section 5.1). Infrastructure constraints, inadequate government savings and fiscal instability – themselves in part a consequence of natural disasters – have also played a role in limiting progress towards economic diversification.

The continued absence of a clear-cut growth strategy has been identified by the GoCD as an additional constraint on sustainable growth. This also represents an obstacle to the fuller consideration of natural hazard risks in the broader planning process. An integrated approach to national development planning, including between economic policy and physical planning operations, has been announced as one of the government's medium-term objectives (GoCD, 2000). Nevertheless, there remained a sense, at least amongst those interviewed in mid 2000, that the island's economic opportunities are already so limited and almost all viable economic activities are hazard prone anyway that it is simply not possible to take hazard risks into account in the formulation of broad economic strategies and policy. For instance, the GoCD's 1989/90 *Budget Address* identified several factors that 'we must constantly be watchful of' – namely, political stability, the cost of labor and labor productivity, but natural hazard risk was not mentioned.

Yet this attitude may be, at least in part, defeatist. Some sectors and sub-sectors are more hazard vulnerable than others as, for example, already discussed in relation to the fact that a proportionate decline of the agricultural sector in the economy has already played a role in reducing the impact of recent storms on short-term economic performance. The country's burgeoning international financial services sector could also play a significant role in reducing Dominica's economic vulnerability to future hazard events, indicating that there is scope for changing the economy's vulnerability.

A lack of attention to natural hazard risks in overall economic strategy and policy formulation is by no means confined to Dominica. For example, Colleymore (1992: 93) comments about the Caribbean region more broadly that 'where disaster management efforts exist, they can be described as myopic and reactive... (while) decision-makers give natural hazard consideration a low priority'. Similarly, Suite (1996: 275) states that 'the question of disasters has not assumed as important a role as it should have, either in the national physical planning process or in the economic and development calculus of the (Caribbean) region'.

Progress in incorporating hazard risk reduction into development strategy has been in part limited by informational constraints (see Chapter 13) and also by analytical difficulties in applying probabilistic data to planning and decision-making processes.²¹ Detailed long-run historical records on disasters, dating back centuries rather than decades, are

²¹ For instance, in assessing medium-term growth and balance of payments prospects for Dominica the World Bank Economic Memorandum in 1992 acknowledged the existence of hazard risks. However, although their assessment took into account the possibility of a banana export price shock, it is stated that 'other potentially more serious constraints which could result from non-

simply not available. Meanwhile, difficulties in the application of probabilistic data have been further complicated by the marked bunching of severe hurricane events within particular periods of time in Dominica (see Annex A). This bunching has also played a major role in the formation of subjective perceptions of risk, so that the importance of effective risk management has been underestimated at certain points in time. Thus the long period without a major disaster between 1930 and 1979 is frequently cited as a reason for lack of preparedness and a relaxed attitude to mitigation in the 1970s (e.g., GoCD, 1996a).

More information and analysis is also required on the economic and financial impacts of disasters in order to integrate hazard risk reduction concerns into medium - and long -term economic and financial planning. This case study has indicated some of the gaps in knowledge and ways in which these issues could be explored.

Chapter 5.

Sectoral Impacts

The economy-wide analysis in Chapter 4 shows how Dominica has been affected by extreme tropical storms, especially the catastrophic Hurricane David in 1979. This analysis also suggests that these negative effects have been most severe on the agricultural sector. In contrast, after Hurricanes David, Frederick and Allen, whose effects were cumulative, activity in the rest of the economy was less obviously subject to short-term negative impacts from subsequent hurricanes. To understand more fully these contrasting broad sectoral effects, the impacts of the more extreme events between 1979 and 1999 are explored in this chapter at a sectoral and sub-sectoral level. The exploration considers the major productive and commercial sectors of the economy, broadly as reflected in the national accounts – agriculture (including bananas, other crops, livestock and fisheries), manufacturing, tourism, construction and international financial services. Transport and public utilities are examined in Chapter 6 as part of an assessment of the impact of storms on the largely public owned infrastructure, whilst financial aspects including possible inflationary effects, banking and credit institutions are covered in Chapter 9 and public sector finance in Chapter 10. The approach adopted in this and subsequent chapters is again eclectic, combining evidence on the behavior of national accounting aggregates and other quantitative measures of economic and financial performance with qualitative evidence from interviews with present and former officials and members of the business community.

5.1 Agriculture, Livestock and Fisheries

Agricultural Vulnerability

The agriculture sector broadly defined²² is still the major productive sector of the economy, accounting for over 20% of GDP and 25% of exports of goods and services during the late 1990s. Agriculture is also the major source of livelihoods. In the 1991 Census (still the most comprehensive social survey), 30% of the economically active population were recorded as having agriculture as their primary activity. In addition, because many more include as part of their livelihoods some agricultural activity, if only self-provisioning and/or small-scale market-oriented production, probably around half of the population is still directly dependent on agriculture. Consequently, the damage caused by natural disasters to agriculture and disruption to agricultural production and markets impacts immediately and deeply on the welfare of the majority of the population.

All agricultural sub-sectors are potentially highly vulnerable to climatic hazard. Hurricanes and tropical storms as well as associated flooding and waterlogging are likely to affect all crops. The dominant crop, bananas, is especially sensitive to damage from winds of 40 mph or more, so that even the fringe impacts of less severe tropical storms can cause serious damage. Perhaps surprisingly in view of the high rainfall, crop production is also sensitive to moisture stress if there is a more extended or exceptionally low rainfall dry season. This is because there is a high proportion of continuous crop production of tubers (bananas and plantains) and root crops that exploit usually high moisture availability - but growth is quickly checked by moisture stress.

There is the further question of genetic vulnerability, which is not considered in this study. The tendency towards monocrop cultivation based on an exotic species with a narrow range of varieties leads to greater susceptibility to pests and diseases. Historically, this was a problem for coffee and limes, and remains a source of risk for bananas.

²² The GoCD includes within a single government department directorates of Agriculture, that is crops (except bananas, organized separately under the Dominica Banana Marketing Corporation), livestock, fisheries and forestry. These are also reported in the national income accounts as 'Agriculture' and separate sub-sectors within agriculture. These sub-sectors are also sometimes collectively grouped together as the renewable natural resources sector. We follow the widespread practice of referring to these sub-sectors together as 'Agriculture'.

Long Term Trends

Agriculture, although still dominant, has been rapidly declining in relative importance since Independence in 1978, and especially during the 1990s (Table 5.1). The sector product and its share of total GDP is sensitive to the variable export performance. Its share of GDP fluctuated within the range 32-38% in the fifteen years up to Independence without any marked downward trend. However, within the overall sector product there was considerable structural change away from plantation production of tree crops to owner cultivation of bananas. Subsequently, real agricultural sector product and agriculture's share of GDP has fallen substantially with each major natural disaster shock- 1979-80, 1989 and 1995- failing to recover previous levels of relative importance. Most of this decline is attributable to the crop sector, and within that total to bananas (Figure 5.1). Otherwise, there has been significant growth in only the small livestock sector. All sub-sectors were extremely negatively impacted by Hurricane David. Afterwards fisheries has been affected by capital losses of boats and equipment and typically performs more poorly in years of major hurricane shock (Figure 5.2). In the absence of more precise evidence, the post-disaster shift out of agriculture seems to be explained by a combination of a further reduction in larger-scale production (failure to invest fully in replacement), a shift of smallholders into employment in other sectors and also off-island migration. The 2001 Census will provide useful more detailed evidence on these structural changes in the economy and society.

Table 5.1 Agricultural Sector GDP: Relative Shares of Crop, Livestock, Forestry and Fisheries Sub-sectors

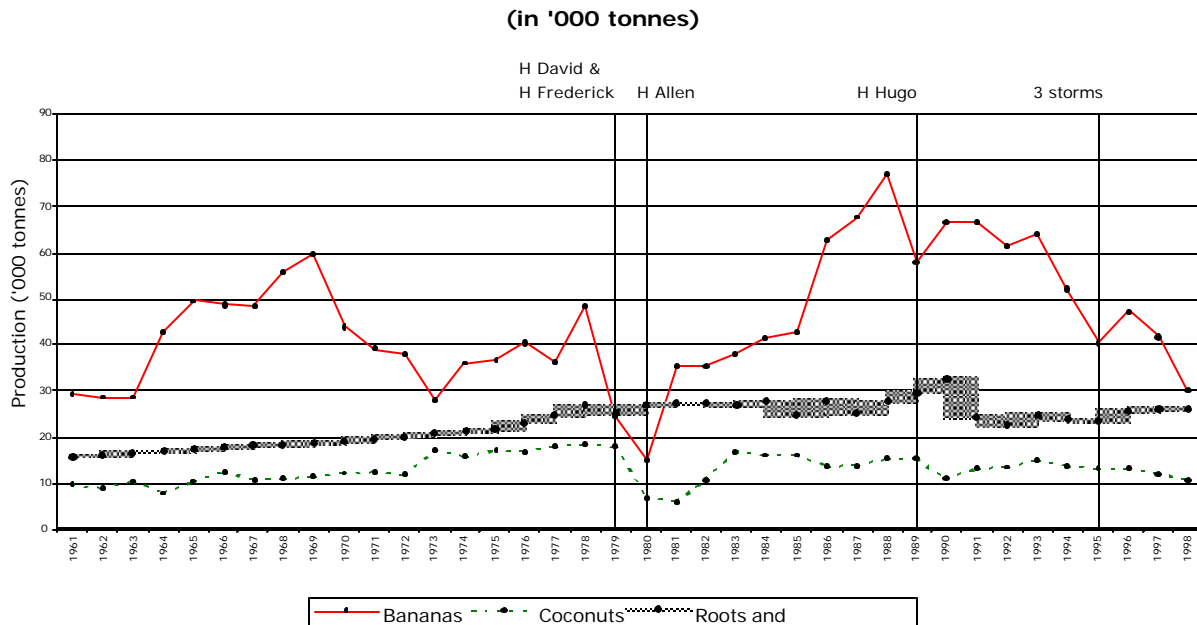
	1962	1977	1987	1997
Crops	90	84.6	83.6	82.3
Livestock	6.5	7.0
Fisheries	7.1	7.8
Forestry	...	4.3	2.8	3.1
Total Agriculture	100	100	100	100
Agriculture as % of GDP	36	38	29	19

Note: ... figures not available separately

Source: GoCD Central Statistical Office; ODA, BDD(C) Economic Survey and Projections, 1967.

Agriculture's decline has been especially marked since Hurricane Hugo. Crop sector product in real terms in the late 1990s was more than 20% below the 1988 peak level (Table A.4.1). This decline is accounted for largely by a substantial contraction in the banana sector in a period of relatively slow GDP growth, and given further impetus by exogenous external factors and climatic variability (Figure 5.1). The importance of bananas within the economy and the extreme vulnerability makes it necessary to consider its performance separately and in more detail.

Figure 5.1: Dominica - Banana, coconut and roots and tuber production, 1961-1998



Banana Sector

From the early 1950s bananas supplanted lime products as the primary export commodity, taking advantage of protected access to the UK market. Banana production in 1990 involved a range of farm size from large producers (10-100 tonnes per year) equivalent to 20-30 acres (10-15 hectares), accounting for 22% of growers and 70% of production, to many part-time and semi-subsistence producers (under 1 tonne), 36% of growers but under 1% of output. This is a continuous production highly perishable crop, which is very sensitive to storm damage (winds in excess of 40 mph), dislocation of transport and moisture stress. Continuous production with labor and recurrent inputs as a high proportion of costs is also extremely sensitive to the effects of external price shocks on profitability. Production grew rapidly in the absence of more extreme hurricane impacts up to 1979 and as the government facilitated transfer of unprofitable and closed down lime and coconut estates into owner-occupation.

Since Hurricane David in 1979 the sector has experienced considerable short run variability in production associated with tropical storms (quantified in this study), drought and external factors influencing prices. The typical pattern of storm damage has been up to complete loss of the crop followed by recovery over 9-12 months, provided growers can finance replanting and have access to inputs. Recovering production has sometimes temporarily exceeded pre-hurricane levels. These short-term effects are better captured in a quarterly rather than the annual analysis. Natural disaster impacts were compensated for by favorable price movements in the 1980s and then accentuated by declining profitability. There was a severe price shock in 1993 after the UK£ left the European Exchange Rate Mechanism, and subsequently there has been much price variability around a declining trend. The impacts of storm damage temporarily caused up to near total halt to production. These effects as well as any short-term disruption to marketing are directly reflected in a fall in export earnings. An analysis of these effects, based on quarterly data is reported in Chapter 7 on the external account.

Box 5.1: WINCROP Banana Crop Insurance Scheme

The Windward Islands Crop Insurance (1988) Ltd., or WINCROP, provides insurance for banana export growers against damage by 'windblows' and tropical storms. The scheme launched in Dominica in 1987 and extended to cover the entire export crop in Dominica, Grenada, St Lucia and St Vincent is owned by the banana marketing organizations in the four countries. In 1999 there were 12,906 'active' growers, producing 131,000 tonnes, averaging 10.1 per grower. Of these 3,038 were in Dominica, producing 27,975 tonnes, an average of 9.2 tonnes per grower. The net exposure of the company was EC\$24.6 m., the retained risk was \$3.5m and reinsured risk EC \$ 21.1. There were 16 loss events, almost 4,000 claims and a pay-out of EC\$ 2.4 m. (including 1,474 claims and EC\$ 1.1m. in Dominica), of which 90% were settled against fringe effects of Hurricane Lenny, which passed 150 miles to the north of Dominica (Map 3 and Table A.5.1.3).

The scheme, as it works in Dominica (some details are different in the other islands) provides cover of about 20% of estimated loss of deliveries. All growers pay a premium equivalent to about 5% of sales receipts, which is automatically deducted by the Dominica Banana Marketing Corporation (DBMC), with a 30% no claims bonus after 3 years. Losses are assessed by a 5% physical survey to obtain the proportion of damaged plants, and benefit is then based on 75% of average deliveries over the preceding 3 years and a value per plant of about 25% of delivery price. Payments are supposed to be made within 30 days of the submission of a claim.

The scheme is extremely important in providing a risk spreading mechanism for banana growers. The benefits are only 20% of potential losses but, as a large part of costs may include own labor and delivery, payouts enable growers to quickly rehabilitate, as reflected in rapid recovery in post-hurricane export earnings (Figure 7.2).

WINCROP does not cover damage, such as landslip or flood, unless wind related, because of difficulties in quantifying risks and losses and a lack of interest by reinsurers. It has also been unable to extend coverage to other crops or to other business on behalf of banana growers. There are legislative restrictions and rates quoted by reinsurers have been discouraging. Therefore, the decline in banana exports and a squeeze on grower profitability threatens the viability of the scheme: the ratio of overheads is rising and there are pressures to keep down premiums. For example, the no claims bonus was stopped in 1996 after losses in 1995, although reinstated in 1999. WINCROP is also vulnerable because risk is insufficiently widely spread in a year when all the islands are badly affected. For instance, in 1995 losses of EC\$ 4.7m left a claims reserve of only \$2.0m (Source: WINCROP, *Annual Reports*).

The scope of the enquiry did not extend to exploring the additional impacts of drought and moisture stress. However, this is well recognized and finally after a poor season in 1997 the European Commission committed support to a project for irrigated production as part of a regional program for enhancing productivity in prospect of loss of trade preference under the WTO.

The impacts of wind damage have been mitigated by the compulsory WINCROP insurance scheme giving growers approximately one fifth of the value of estimated lost production (Box 5.1 and Table A.5.1.3). The vulnerability to transport disruption is highlighted by the loss of one week of exports by the DBMC in November 1999 (value EC\$ 723,000), caused by the temporary closure of Woodbridge Bay port.

Banana production appears to be more sensitive to climatic variability, especially wind damage, than the previously more important tree crops, but it is also more resilient.²³ In a protected market shared with other small-scale exporters, temporary decline in exports did not threaten potential market share. These circumstances favored increasing concentration on banana production to the exclusion of other crops from the 1950s to 1980s, and led to Dominica possibly becoming more vulnerable economically to both natural hazard and extended price shocks from

²³ Bananas are susceptible to damage from wind gusts of upwards of 38 mph. They are likely to be severely damaged by sustained winds of Tropical Storm force (38 mph/61 km per hour) and above, which have had an average frequency of once every three years over 100 years (Annex A, Table A2.3). However, lime orchards and coconuts are only likely to suffer extensive damage in less frequent more intense hurricane force storms.

the 1960s onwards. The obvious mitigation strategy would be some combination of diversification within the agricultural sector and also reduced reliance on commodity production earnings. As a World Bank (1992) Economic Memorandum notes, agricultural diversification has been on Dominica's agenda ever since the Royal Commission of 1893. However, various projects to promote the expansion of other crops had very limited success (OECS, 1986). The fundamentals of rural development policy – shifting land to small scale owner-cultivators, the assured highly regulated market, the insurance scheme linked to bananas - all favored this crop, and the potential resilience in output after the effects of natural disasters or price shocks made a concentration on bananas the easiest recovery and growth strategy for government to support and producers to pursue (Box 5.2). However, a sustained profit squeeze caused by a less favorable external environment, interacting with rising labor costs in the 1990s, has made bananas less resilient in the face of climatic variability. The effect of each shock has been to accelerate overall decline rather than significant diversification of the agricultural sector (Figure 5.1). The share of bananas in total agricultural production actually rose between 1977 and 1987 from 28% to 39%, falling back to 27% in 1997 (see Table A.5.1.2).

Box 5.2: Banking on Bananas - a Short-sighted Strategy?

Following Hurricane David the Barbadian reporter, Patrick Hojos (1979), asked in a special report 'Can Dominica survive?' He answered – 'The general plan is for cash crops to be planted so that within four or five months rural farmers can reap their own fruit, while disaster aid bridges the gaps. Within a year a reasonable crop of bananas could be harvested but it will take five or six years before long-range crops like citrus, coconuts and so on are contributing.'

On the evidence for the 1980s this is what happened. Despite aspirations to diversify agriculturally, there was, in fact, an increasing concentration of crop production in bananas, making Dominica more vulnerable to the direct and passing impact of every range of tropical storm.

Other Crop Sub-sectors

There was no substantial diversification away from bananas until the 1990s (Table A.5.2). In fact the opposite occurred – Hurricane David led to increased concentration on mono-crop banana production, at odds with official policy, so that the share of bananas in value of production of the 10 main crops rose from 28% to 39% between 1977 and 1987. This development is ascribed to the resilience of bananas and the protected and assured market.

The production of tree crops was severely affected by Hurricane David. The impacts of subsequent storms has been less severe. The relatively weak performance of the coconut sector is particularly notable. Despite projects for rehabilitation, production levels had not recovered to pre-David 1978 levels by the end of the 1980s. This is explicable in the slower recovery period and unfavorable relative price movements in the 1980s. However, a reversal of the price disadvantage and an assured local market in Dominica Coconut Products (DCP) in the 1990s (see Section 5.2) has apparently had little impact on production, suggesting other restraints (Figure 5.1 and Table A 5.1.2).

Roots crops or ground provisions have proved resilient to disaster impacts (Figure 5.1). A relatively more favorable local and regional market situation has been associated with a gradual increase in production.

Overall, it should be emphasized that Dominica has one of the more diverse agricultural sectors within the Eastern Caribbean and probably the highest proportion of local sourcing of fruit and vegetables. This diverse sector has survived both disaster shock and the relatively favored position of banana production up to the late 1980s.

Livestock

The livestock sub-sector is relatively small. Poultry and pigs are traditionally the most numerous. Small flocks of goats and sheep are kept by rural families. A few head of cattle are often kept as a 'store of wealth', readily

convertible to cash for emergencies. Dominica's high rainfall, rugged terrain and limited all-weather access roads constrain production.

Hurricanes have had their most severe impact on the poultry industry. Entire flocks have been lost in major events and the associated poultry production infrastructure destroyed. Losses of pigs, cattle, sheep and goats tend to be less dramatic since there are very few large herds and the animals are often left untethered in severe weather.

The greatest expansion in livestock has been in pig production. Pigs are hardier and can survive on the fruit waste generated after a hurricane. In contrast, commercial poultry is highly vulnerable to a breakdown in normal food rations and power supply.

In this sub-sector, the main discernible statistical impact of the major hurricanes has been an increase in imports of meat and meat products in the following year. This suggests that a temporary reduction in domestic supply is made good through imports.

Fisheries

The fisheries sector is 'extremely vulnerable to hurricanes and storms. There are no naturally secure harbors and fisheries infrastructure is squeezed in between the coasts and the sea.'²⁴ Consequently, capital losses are high in every major storm.

Reports of damage to the fisheries sector prior to Hurricane Lenny were often not as comprehensive nor as detailed as those for crop production. Nevertheless, the picture that emerges from the reports that were compiled is of very severe impacts. In Hurricane David in 1979, approximately 75% of the boats were destroyed and 25% of engines were lost. Information was not available for losses caused by Hurricane Hugo, but it is known that some losses were sustained. The three storms that affected Dominica in 1995 are estimated to have wrought EC\$3.5m in damage. Hurricane Luis alone destroyed 10 fishing boats and set back the completion of the Roseau Fisheries Complex by six months, at an additional cost of EC\$2m. In 1999, a fuller assessment for Hurricane Lenny estimates infrastructure and equipment damage at EC\$4.9m, including EC\$3.4m at the Fisheries Complex in Roseau²⁵. The assessment also reports other categories of loss, including employment at EC\$0.5m and environmental resource damage to coral reefs and sea grass beds at EC\$2.2m(GoCD, 1999c).

The full economic consequences of disaster impacts on fisheries are difficult to quantify because, according to expert opinion, the landed catch is under-reported. However, production is clearly impacted and recovery is slow and weak from each major hurricane (Table A2.1 and Figure 5.2). The sector appears to be in decline. Some fishermen, lacking insurance, fail to replace damaged boats and equipment. Other longer-term factors such as higher wages elsewhere and falling fish stocks may also be contributing to the decline. Nevertheless, this sector is important to a diversified economy and provides the main livelihood of many poorer families (Box 12.1).

²⁴ Andrew Magloire, Fisheries Officer, Fisheries Development Division, personal communication.

²⁵ Hurricane Lenny demonstrated the extreme vulnerability of the Roseau Fisheries Complex. The entire ground floor of the complex was inundated by storm waves because of the facility's proximity to the sea. The siting immediately south of the Roseau River mouth, affected by siltation, may be another factor in the facility's vulnerability to high waves. Expensive and sophisticated storage, marketing and processing equipment were rendered inoperable.

Figure 5.2: Dominica - Fisheries production, 1961-1997 (tonnes)

Forestry

The direct economic exploitation of the forestry sector is circumscribed by restrictions on logging. Even before that, the level of activity was economically insignificant and so the sector is not considered in detail (Table 5.1). However, there are many issues related to environmental damage and vulnerability that have economic implications as noted above in Section 3.2. In addition, the use of forestry resources, including for hunting, is still important to rural groups, including some of the poorest, and should be considered in any social and poverty analysis (see Chapter 12).

5.2 Manufacturing

In most countries at least some aspect of the manufacturing sector is vulnerable to natural hazards, primarily via their impact on plant, equipment and inputs. Temporary breakdowns of electricity, telecommunications and transport networks, including shipping, can cause further disruption to productive and marketing activities. In addition, disasters can affect patterns and levels of consumption and thus demand for manufactured products. However, the precise nature and magnitude of all such impacts is dependent upon a number of factors, including the structure of the manufacturing sector, existing stock levels, price elasticities of demand and supply for intermediate and final consumer goods, alternative sourcing and marketing options, as well as the scale and nature of any structural mitigation measures. The extent of insurance coverage also plays a role.

The manufacturing sector realized an average real annual growth rate of 7.1% between 1977 and 1998, although declining by a provisional 17.9% in 1999. However, this growth was achieved from a very modest base, with the manufacturing sector as a percentage of GDP rising from 3.9% to 8.2% over the same period (and to a provisional 6.9% in 1999). Indeed, despite continued government incentives to encourage the development of the manufacturing sector, the GoCD (2000: 5) reports that 'the manufacturing sector is in an embryonic state', with activities heavily concentrated around the soap and detergent production by a single producer, DCP.

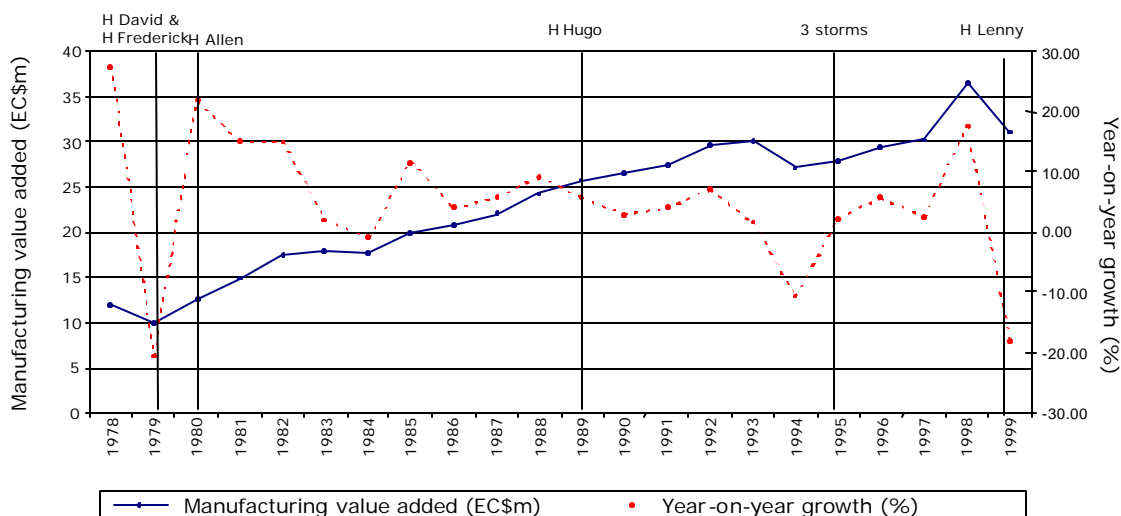
Soap and dental products, which are based on coconut processing, emerged as the island's single largest merchandise export (in value terms) in 1996, overtaking bananas. Toothpaste production also began in late 1997,

with dental cream already accounting for 12.0% of total domestic exports in value terms by 1999 (according to GoCD provisional data). Other manufacturing activities include beverage manufacturing and other agro-processing industries, a water bottling operation plant and a cardboard box production plant. The latter was initially established to provide packaging for bananas and soap but Dominica has now begun to export the boxes themselves. Activities are focused primarily around Roseau, providing relatively easy access to shipping facilities (reflecting the importance of export markets for manufacturing output) and labor markets.

The GoCD (1998) has identified a number of constraints to growth in the manufacturing sector including small domestic market size, the unavailability of international transport at competitive prices and the proliferation of sole proprietorships and partnerships. The manufacturing export sub-sector has also been discouraged by the country's external trade regime (see Chapter 7). However, natural disasters are not viewed as a major constraint to the growth of the manufacturing sector.

Manufacturing recorded a sharp fall in output in 1979, 20.6% year-on-year (Figure 5.3). This partly reflect political turmoil as well as the impact of Hurricane David. Minimal direct impacts were reported, with interruption to business of only about one week. This reflected the open design of the DCP facility which allowed winds to pass directly through its buildings; continued power supply from its independent source; and continued functioning of its private jetty.

Figure 5.3: Dominica - Manufacturing activity, 1978-1999 (at real 1990 prices)



Despite the importance of agro-processing within manufacturing overall, subsequent disasters have apparently had relatively little impact on the sector. In 1989, the year of Hurricane Hugo, a 5.7 % real rate of growth was achieved, with particularly strong performance reported in soap production, although overall manufacturing growth was somewhat lower than that in the previous year.²⁶ The manufacturing sector also achieved a positive real growth rate of 2.2% in 1995, after a 10.6% decline in 1994 due to a sharp reduction in soap production as competition in Jamaica, Dominica's main market, had strengthened. Manufacturing output early in 1995 was boosted by the production of a new line of soap, following the takeover of DCP by Colgate Palmolive early in the year, and the opening of a brewery in November. That the 1995 hurricanes had little impact on the overall manufacturing sector is confirmed by the GoCD (1995) in the post disaster assessment, which did not envisage a significant impact on the sector. There had been some initial concern that the destruction of coconut trees would lead to a shortage of copra for Dominica's largest producer, DCP. However, DCP had already begun sourcing copra from Saint Lucia because of higher domestic prices, so that the 1995 hurricanes had little impact either directly or indirectly. DCP has continued to

²⁶ In 1990, manufacturing sector growth declined to 2.9%. However, this was primarily due to strong competition in the soap sub-sector, rather than any lagged effects of Hurricane Hugo (ECCB, *Quarterly Bulletins*, 1990).

import copra as domestic production is insufficient to satisfy needs of rising soap production. Around 40% of copra requirements are now imported, from Saint Lucia and Guyana.

Provisional data for 1999 indicate a 17.9% fall in manufacturing output, but due principally to a non-disaster related decline in soap production. However, Lenny occurred in mid-November and so its impact may be reflected in reduced manufacturing output for 2000 instead. DCP's privately owned jetty was badly damaged by Hurricane Lenny and was still out of commission over six months later. DCP has been forced to rely on the main Roseau deep-water port instead, increasing shipping and port costs as well as domestic transportation costs from the factory, with associated problems of reduced output.

A more detailed examination of other individual products also indicates some sensitivity to weather conditions. For example, cardboard box production is in part dependent on the volume of bananas produced. In the first quarter of 1997, for example, a partly drought-related 36% fall in the banana production in volume terms, compared to the first quarter of 1997, led to a decline in cardboard box production.

As regards risk management, there is some evidence of structural mitigation measures. For example, DCP's jetty was constructed to withstand 20-foot (6-meter) surges – the prevailing standard at the time of construction. DCP also reports some consideration had been paid to mitigation in the design of its plant and that modifications were made because of structural flaws indicated by Hurricane David. Other physical protection measures are also in place. For example, one producer reported bunker storage of stainless steel sheets.

The Dominica Association of Industry and Commerce (DAIC) points to inadequate insurance cover as a major failure in risk management. The DAIC estimates that around 60% of the formal sector has some form of insurance, with the remainder relying on 'self-insurance' measures such as physical protection measures and the setting aside of adequate reserves. Some 10% also had business interruption insurance. There is also widespread under-insurance. The DAIC takes a proactive role in trying to increase awareness of risks and encourage better practice amongst its members (e.g., see Box 3.1).

5.3 Tourism

The progressive expansion of the tourist sector has been part of the development strategy for Dominica since the early 1980s. Assessing the impacts of natural disasters on this sector and drawing lessons for mitigation in the future are therefore especially important. The available statistical data on visitors make it difficult to isolate and quantify the effects of tropical storms.²⁷ Nevertheless, these data, combined with interview evidence, provide a qualitative assessment of the impact of natural disasters on tourist numbers and the growth of the industry between 1976 and 1998. This is complemented by a provisional assessment of the impact of hurricane Lenny, based on preliminary reports of damage and the views of informants. On the basis of these findings the longer-term consequence of natural disasters for the tourism and issues of mitigation are considered.

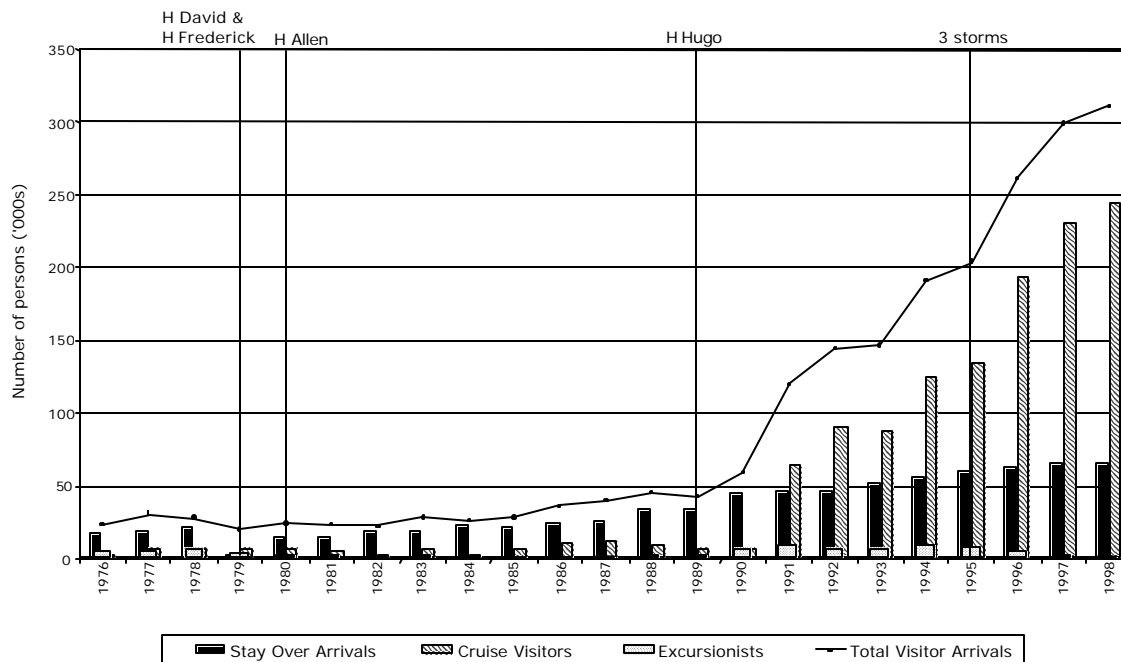
Shocks and Trends 1976-1998

Hurricane David, unsurprisingly, had a severe impact on the still-small tourist sector in 1979. It did much damage to infrastructure and facilities, putting the largest hotel in Roseau and many other guesthouses out of action. The adverse effects of this hurricane are readily visible in indicators of performance, such as visitor numbers and expenditure. In contrast, the effects of later events are more difficult to discern.

²⁷ There are annual series since 1976 for visitor arrivals, distinguishing between stayovers, day excursionists and cruise ship passengers and, more recently, students (GoCD, 1999a, Tables 13 and 16). Estimates of expenditure for each category in terms of average daily expenditure and total expenditure are also available. Stayover visitors are distinguished by type of accommodation - hotel, guesthouse and private homes - as well as students. The latter include those attending the medical school in Portsmouth since 1993. At the time of study data for 1999-2000 were not available. There are also statistics for visitor arrivals by mode of transport, sea or air.

Total visitor numbers provide a very crude measure of tourist activity (Figure 5.4).²⁸ Prior to Hurricane David there had been an increase in all categories, reaching a peak in the independence year, 1978. Subsequently, numbers of visitors in all categories declined in 1979 and 1980. The full impact of Hurricane David is probably underestimated because many visitors were involved in disaster-related travel. Visitor numbers declined by around 30% between 1978 and 1980 and did not reach 1978 levels again until 1986. Since then there has been a substantial increase in numbers, with checks in growth in 1989, 1993 and 1995 that are explicable in terms of external circumstances rather than direct effects of storm damage or disruption.

Figure 5.4: Visitors to Dominica by type, 1976-1998 (thousands)



Stay-over visitor numbers by accommodation type confirm the massive and continuing setback to tourism caused by Hurricane David and indicate the potentially devastating effect of an extreme hurricane. Numbers of visitors in private paid accommodation only again exceeded 1978 levels in 1984. The hotel sector exhibited no substantial growth in numbers between 1979 and 1989. This delayed recovery is partly explained by the slow repair to facilities. The largest hotel in Roseau was only refurbished by 1988. In addition, only one of three eco-tourist lodges, totally wrecked in 1979, was rehabilitated, returning to business in 1989 (Pattullo, 1996). The wider damage to Roseau, other amenities, cultural and ecological tourist sites reduced the island's attractiveness to visitors for several years.

Since the beginning of recovery in 1981 the number of stay-over visitors in different categories of accommodation has grown unsteadily with falls in 1985 and 1989 and stagnation in the late 1990s. But again, the timing of each downturn in numbers does not appear to be directly related to hurricanes affecting Dominica, except Hugo. However, industry informants suggested that Dominica was affected by more general uncertainty about the Eastern Caribbean as a destination caused by disasters elsewhere, so that 1989 and 1998 were relatively depressed years, with a decline in all categories of visitors except cruise ship passengers (Figure 5.4).

²⁸ Tourist expenditure as reported by the ECCB is estimated as the sum of visitor numbers in various categories, such as stay-over hotel and guest houses, day excursionists and cruise ship passengers, weighted by average expenditure in each category (ECCB, Quarterly Reports, various). These weights are of uncertain reliability and were also changed in 1984, precluding comparisons with earlier years. Because of the doubtful reliability of these values, the analysis is largely restricted to comparing numbers of visitors by category over time.

Cruise ship passengers represent the tourist category that has expanded the most, especially since the new facilities became available in Roseau and Portsmouth in 1991. Until then, numbers were small and subject to large fluctuations, almost halted after Hurricane David. The deep-water facilities were consciously constructed with a relatively high level of storm resistance. That successful investment is reflected in the number of vessels and passengers during the 1990s (GoCD, 1999, Table 17). The temporary dislocation in 1995 seems to have had minimal effect with the lowest rates of growth in 1993, minus 2.2%, and in 1998, plus 6.1%, again explicable in terms of factors other than direct hurricane impacts on Dominica.²⁹

The lower growth in 1998 in tourism numbers generally, as well as cruise ship visits, was thought to reflect the wider effects of Hurricanes Georges and Mitch on the Caribbean tourist industry, with severe dislocation to Antigua and St Kitts. Dominica is an indirect destination for many tourists, especially from Europe, and it is only one of many cruise ship ports of call.

In the 1990s an increasing proportion of visitors, apart from cruise ship passengers, arrived by sea, mostly on the ferry services linking Guadeloupe, Dominica, Martinique and St Lucia, and numbers also appear little affected by storms impacting on Dominica, indicating the success of the new terminal.

The growing importance of tourism to the economy is indicated by a comparison of estimated expenditure with GDP. Tourist expenditure increased from an estimated EC\$ 27m in 1984 and 1985, equivalent to 9 % of GDP, to EC\$ 107m in 1997, equivalent to 16%. As noted in Chapter 5 tourism also contributed around a third of external earnings by the late 1990s. A comparison of growth rates in visitor numbers over the period 1976-98 also provides some indication of the reduction in growth caused by Hurricane David. The rate of growth in stopover visitors, who proportionately generate the most local expenditure, was only 3.5% from 1976-1987, but 7.8% per annum between 1987 and 1998. There was also a massive increase between the two periods in the growth rate of cruise ship visitors from an insignificant 6.1% to 35.7% (Figure 5.4)³⁰

Hurricane Lenny

The potential vulnerability of this important and expanding sector has been most recently underscored by the still not completely documented effects of Hurricane Lenny (Map 3 and Annex A.4). In the absence of statistical information the effects of Lenny were surveyed qualitatively during the visit.

This storm caused severe damage to several west coast hotels, their private sea defenses, and boating and diving facilities. There was limited, quickly repaired damage to the cruise ship terminal. Road communications along the coast were also disrupted affecting communications with some tourist sites and commercial facilities. There was no storm warning allowing time for preparedness (these focus on wind strength not wave height and swell).³¹

The Dominican Hotel and Tourist Association (DHTA) initially undertook its own assessment of the impact of Hurricane Lenny, estimating the damage to facilities at around EC\$5m.³² This internal survey involved three civil engineers and was not dependent only on information provided by hoteliers. Subsequently, the government assessed the damage to buildings in the sector as EC\$ 0.67m, which is substantially less than hoteliers' estimates of

²⁹ The GoCD's (1995) assessment indicates that hoteliers were able to embark on rapid rehabilitation in 1995 because generally they were insured (see below Section 8.3).

³⁰ The findings of this review of visitor numbers in different categories are confirmed by regression analysis using independent dummy variables to point the main disaster shocks, in 1979, 1989 and 1995. Focusing on growth rates, or inter-year changes in stay-over visitor numbers, the number of stop-over visitors is negatively associated with dummy variables indicating all the major storms affecting the island in the year of impact and positively in the following year. In terms of individual events, only Hurricane David, and to a much more limited extent, Hurricane Hugo are associated with a decline in visitor numbers. Prior to Hurricane Lenny, there is no significant association between cruise ship passenger numbers and storm events. Excursion visitor numbers have been highly variable, presumably explained by external factors. See Appendix B for a description of the method of analysis.

³¹ Only one owner of tourist dive-day cruise boats took preventative action, on the basis of information which he obtained from the internet on the likelihood of very high seas.

³² *The Chronicle*, Roseau, 19 November 1999.

damage and insurance claims (GoCD, 1999d). Interviews with hoteliers and others in the tourist sector also indicated that there was substantial disruption to business activity in directly affected properties and on the west coast more generally, heavily dependent on diving and eco-tourism. Furthermore, there was a slow recovery in business because of uncertainty amongst some customers throughout the winter tourist season.

The sector is, in contrast to some other islands such as St. Lucia or Antigua, composed entirely of locally owned sole proprietorships and partnerships. Practice on insurance is inconsistent. Several of those affected in 1999 were underinsured and without business disruption cover because of perceived high premium costs. That practice makes the sector especially vulnerable to an extreme event. At a sectoral level, it is also too easy to focus on the impacts on and responses of businesses to damage and disruption. There were also less visible impacts on employment of full, part-time and seasonally employed staff in 1999-2000, which could not be quantified. As suggested below (Chapter 12), this highlights the need for a complementary social assessment of disaster impacts.

Volcanic Hazard and Business Uncertainty

The volcanic alert, beginning with earthquake swarms in October 1998 that continued until March 1999, provides another example of the problem of uncertainty. Informal reports and actual disaster preparedness measures were thought to indicate that the whole area south of Roseau, where business opportunities are largely in tourism, was under threat of eruption. Some business people reported that this had led some insurers to refuse cover. Some international banks, mindful of the nearby Montserrat emergency ongoing since 1995, were also reluctant to fund investments.

The DHTA felt impelled to request a meeting in October 1998 with the visiting scientists from the SRU responsible for monitoring the volcanic-seismic situation and advising the government on volcanic risk. There were expressions of continuing concern and uncertainty about volcanic hazard at the time of the study. There are no mechanisms in place or in-country scientific capacity to ensure that scientific information and advice on natural hazards are regularly provided directly by scientists through official channels or through the media on such issues (see Box 13.2).

Longer Run Costs of Natural Disasters

The major negative impact was Hurricane David, halting growth for 5 to 6 years after independence in this sector critically important to the diversification strategy of all governments. The longer run costs of that lost opportunity up to the mid 1980s are now more apparent when Dominica is confronted with the difficult adjustment to a rapidly declining banana export sector. However, the evidence is inadequate to quantify in any convincing way the overall costs of natural disasters on tourism.³³ The lack of growth in the 1980s can be partially attributed to the slow recovery in the hotel sub-sector and massive environmental damage initially reducing tourist demand, as well as poor marketing.

The infrastructure investments incorporating mitigation measures were relatively successful in supporting quite rapid growth from the late 1980s, especially in cruise ship business and sea arrivals as an alternative to restricted air access. The relatively better performance of the guesthouses and private accommodation compared with hotels also suggests that Dominica was establishing itself in the niche market of eco-tourism. Apparent under-insurance contributes to the sector's high vulnerability and a potential lack of resilience an extreme, Hurricane David type event. Uncertainties and the seasonality of employment in the tourism sector may also contribute to the difficulties of building and retaining a skilled workforce, essential for competing internationally in this service industry. Another factor is the perception of low status, so that, for instance, young women would prefer to work for the banks rather than train as hotel managers.

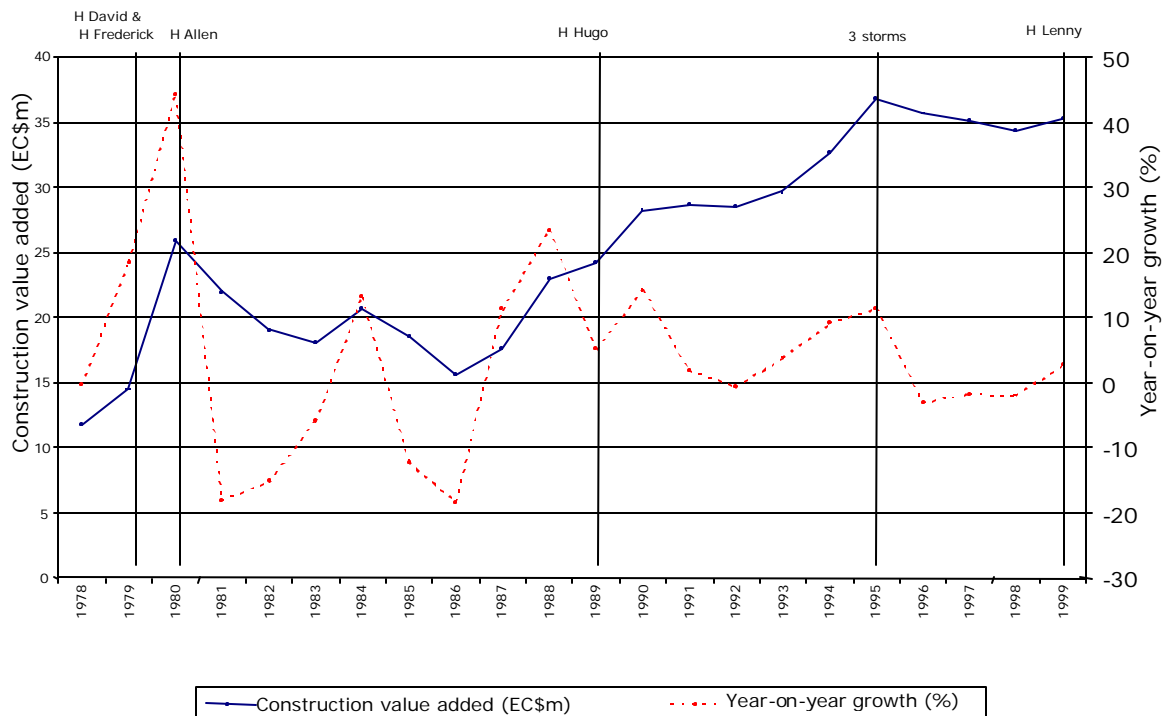
³³ The estimated visitor expenditure (Table A.5.3.1) when deflated by the CPI suggests that there was no real increase between 1978 and 1983 in the old series and between 1984 and 1986 in the new series. From 1987 to 1997 there was apparently an 11% a year real growth rate. However, that high growth rate is dependent on the accuracy of assumed cruise ship passenger expenditure on which a survey is needed.

5.4 Construction

Construction is the one industry most likely to be beneficially impacted, at least in terms of increased activity, by an actual disaster. Natural hazards potentially cause severe damage to buildings and infrastructure, resulting in considerable post-disaster construction. Some argue that in the longer term a major natural disaster can even generate a construction-led economic boom (e.g., Albala-Bertrand, 1993). However, the precise impact of a disaster depends on a number of factors, including the extent to which the reconstruction process draws on local materials and labor.

In Dominica, construction sector activity has varied considerably between years, in part reflecting the country's small size and thus the significant impact that the start or completion of individual projects can have on the overall level of activity (Figure 5.5). Intermittent storms have boosted activity, thereby playing a role in sustaining post-disaster income generating opportunities. However, there is no evidence of any wider post-disaster construction-led boom, in part perhaps because the building industry relies largely on imported materials (with the notable exception of some local stone).³⁴

Figure 5.5: Dominica - Construction activity, 1978-1999 (at real 1990 prices)



As already noted, the hurricanes affecting Dominica since Independence have varied in terms of the nature as well as level of damage they have caused. In terms of damage to housing and infrastructure, the most serious disasters have been Hurricane David in 1979, cumulatively, the three storms in 1995 and Hurricane Lenny in 1999 (see Chapter 6). Initial estimates suggested that some 60,000 people, equivalent to almost three-quarters of the pre-hurricane (1978) population, were left homeless and 13% of structures on the island totally destroyed as a consequence of Hurricane David. Subsequent surveys indicated that 8,670 of the 15,100 dwellings on the island had

³⁴ In the past there was a domestic timber company but, under its environmental policy, the GoCD no longer permits access to local forest resources. Imported materials therefore include timber.

lost their roofs. Considerable damage was also incurred to public infrastructure (see Tables 6.1, 6.2 and Annex A.3.1). In consequence, there was an 18.5% increase in construction value added in 1979, with a further 44.2% rise the following year.³⁵ The construction sector accounted for 10.7% of GDP in 1980, compared to an average 5.0% in 1977 and 1978. Imports of wood and lumber, cement and metals and metal products increased from 8.0% (in value terms) of total imports in 1978 to 17.1% in 1980, equivalent to EC\$42.9m at real 1990 prices. Fallen timber was also salvaged for use in the reconstruction process. Taxes on building materials were temporarily waived to facilitate the rehabilitation process.

The 1995 hurricanes and storms resulted in estimated losses of EC\$4.3m to the housing sector alone. 876 housing units were damaged or destroyed, most of which were inadequately insured small wooden structures belonging to low-income families (GoCD, 1995). There was an 11.3% increase in construction value added in 1995, in part reflecting post-hurricane reconstruction.³⁶

Hurricane Lenny in November 1999 inflicted considerable damage, largely along the western coast, assessed at EC\$ 2.7m to housing, EC\$ 0.65m to tourist infrastructure and hotels and EC\$ 4.2m to commercial and government buildings. The effects on the construction industry are too recent to quantify in this study, but there was widespread agreement that this event had led to substantial post-disaster reconstruction, combined with work to repair and strengthen other infrastructure.

5.5 International Financial Services

Since the mid-1990s the GoCD has been trying to establish the country as an offshore financial center, as part of its broader program of economic diversification and expansion of the island's economic base. An International Business Unit was established within the Ministry of Finance in 1996, with the initial task of establishing the necessary administrative and legislative framework for implementing, regulating and managing international financial services.

The sector has achieved rapid growth, generating government revenue in the form of fees and licenses of EC\$9.7m by 1999.³⁷ Services now offered include an economic citizenship program, offshore banking, exempt insurance and international trust services. To date the economic citizenship program has generated the most revenue, accounting for 89% of inflows to the sector and for some 15% of non-tax revenues (GoCD, 2000).

Hazard vulnerability reduction was not a factor considered by the GoCD in deciding to develop Dominica's international financial services. But as the sector is likely to be largely unaffected by natural disasters, even extreme events, it should offer some form of continued government revenue in the aftermath of disasters. This partly reflects the nature of the sector, with little reliance on physical infrastructure. The main natural disaster related threat concerns the temporary disruption of telecommunication services (see Section 6.5). Otherwise, any short-term economic shock, whether resulting from a natural disaster or some other external source, seems unlikely to affect demand for Dominica's international financial services because the sector is not linked to the domestic economy.³⁸ Moreover, under the Offshore Banking Act, offshore and onshore accounts must be kept entirely separate, effectively implying that offshore revenues are protected from any pressures on domestic financial markets.

³⁵ Data on construction activity is based on the number of housing starts, the level of construction material imports and bank lending data. However, CCA (1991) cites a 1990 GoCD estimate that indicated that only around 75% of actual building starts are authorized and recorded, with a considerable amount of unauthorized construction therefore occurring, particularly of small buildings in rural areas. Thus, true figures may be higher, especially in the aftermath of hurricanes when considerable home repairs may be undertaken.

³⁶ Ongoing work on commercial and public sector projects, which had already been reflected in a 9.1% increase in construction activity in 1994, as well as the commencement of construction of an 80-room hotel the previous year, also boosted growth in the sector (ECCB, *Quarterly Bulletins*, 1993, 13(3)).

³⁷ The contribution of the sector to GDP is not adequately captured because economic survey forms covering international financial services have yet to be drawn up.

³⁸ Under the economic citizenship program, citizens are not required to migrate to Dominica.

5.6 Sectoral Trends and Disaster Vulnerability

The economy's main area of vulnerability is agriculture. In contrast, manufacturing, international financial services and also tourism, after investments in mitigation from the mid 1980s, have been comparatively less affected by disasters. Consequently the relative decline in agriculture's share of GDP and employment should imply some reduction in economic vulnerability to any except the most extreme, catastrophic event such as a direct hit by a Category 4, Hurricane David type storm, an intense earthquake or a major volcanic eruption. There is, however, some uncertainty surrounding agriculture with the decline in banana cultivation. This crop is both highly sensitive to storm damage but also resilient and has had a substantial element of producer and macro-economic risk spreading through WINCROP and STABEX and a protected export market. Other agricultural and natural resource sub-sectors lack these risk spreading arrangements. Tourism is possibly more sensitive now to natural disaster impacts on the wider Caribbean regional tourism market. Critical factors in reducing potential economic impacts of disasters include actions to limit exposure at a sectoral level by building disaster mitigation into facilities and risk spreading through insurance (See Chapter 9). The protection of lifeline infrastructure also becomes, as discussed in Chapter 6, the key to effective disaster risk reduction.

Chapter 6.

Infrastructure and Buildings

6.1 Vulnerability, Design Standards and Costs

The vulnerability of key infrastructure to natural hazard was highlighted in Dominica by the devastating effects of Hurricane David. Almost all public utilities, water, electricity, telephones and other essential transport infrastructure, ports, roads and airports, were out of action, at least briefly. Hospitals, clinics and schools too were wrecked. The regional devastation caused by this and subsequent storms such as Hurricanes Allan and Hugo stimulated wider interest in reducing vulnerability through incorporating more effective mitigation into design and construction during reconstruction and new investments. It is also widely recognized that there are other pervasive reasons for the precarious state of key infrastructure in most of the small independent Caribbean island states. There is a lack of maintenance and repair, shortage of skilled personnel and poor fiscal performance that starves systems of funding for adequate levels of recurrent expenditure. Investment is heavily dependent on and constrained by external grant aid and official lending.

All these interrelated issues have received growing attention during the past decade, and been the subject of technical investigation and policy analysis. For example, the regional infrastructure review in 1996 by the Caribbean Development Bank (CDB) and Inter-American Development Bank (IADB) focused on financing and structural issues of organization, according recognition to the issue of disaster mitigation. These issues are now accorded priority in the documentation for the Consultative Group for the Caribbean (World Bank, 1998b). Hazard vulnerability in particular has been investigated extensively by the Caribbean Disaster Mitigation Project (CDMP), implemented by OAS and USAID funded. This program has included several insightful case studies for Dominica, including on the more general problem of wave hazard to coastal infrastructure (Wagenseil and Watson, 1996), the original design of the deep-water port (Wason, 1998) and minimizing the threat to the expanded hydro-electric system from landslide (OAS, 1996b). The GoCD, wanting to reduce the vulnerability of its coastal road network (see Section 6.5), has, with UK government (ODA-DFID) assistance, commissioned studies on mitigation investment (Mouchel, 1991, 1997).

It is beyond the scope of this study to provide further in-depth analysis on these often highly technical issues of design and construction standards. Nevertheless, evidence has continued to accumulate that there has been limited success to date in reducing the hazard vulnerability of key infrastructure, particularly as indicated by assessments of the effects of Hurricane Lenny. The issue of the considerable damage inflicted by the major storms on the island's infrastructure is not in question. However, there are issues that require elaboration and explanation. First, why was it that Dominica proved to be so vulnerable to the catastrophic Hurricane David? Was this virtually inevitable, or, as is suggested in Section 6.2, did the economy's development trajectory contribute to vulnerability? Second, the links between the damage to infrastructure and the effects that major natural disasters were found to have had on Dominica's economic performance at an economy-wide (Chapter 4) and sectoral level (Chapter 5) need to be examined. Section 6.3. seeks to complement evidence of the negative economic impacts of the major disaster shocks of 1979-80, 1989, 1995 and 1999, with approximate estimates of the rehabilitation costs resulting from these storm events. Third, the CDMP case studies have suggested that failures of infrastructure can be traced to under-investment in mitigation during design and excessive cost-minimization during construction (Vermeiren, Stichter, and Wason, 1999). These findings as they concern Dominica are restated and re-examined in sections 6.4-6.6 in the light of developments subsequent to these studies, particularly Hurricane Lenny.

6.2 Modernization and Investment in Infrastructure, 1950-1978

Dominica was transformed between 1950 and 1978 from an underdeveloped plantation cum subsistence colony into an independent middle-income economy with a GDP per capita of EC\$3,960 (US\$1,470) in 1998 prices. By 1978

there were relatively good human development indicators for health and education that reflected investments in schools, hospitals and housing, combined with key economic infrastructure.³⁹ The key lifeline infrastructure included an all-weather road network, largely coastal around almost the whole island, linking all important centers of population (Map 1). The completion of a deep-water port on the northern edge of Roseau, as well as facilities at Portsmouth, combined with the road system allowed relatively easy export of bananas, the highly perishable major crop. The two airports, although only suitable for smaller planes, and port facilities made access easy for visitors. There was a near island wide public electricity network by 1974, partially supplied by hydroelectric power, and a telecommunications system.

A critical issue in the provision of island wide lifeline infrastructure was that it was put in place relatively quickly, largely funded by UK colonial aid plus some CDB lending and Canadian aid. There were severe financial constraints because of the competition for colonial grant and highly concessional funding and those responsible for design were under pressure to maintain the lowest possible construction costs (Honychurch, 1995). Moreover, these investments occurred after a lengthy period during which the island had not experienced any direct impacts from hurricane force storms. Because of these two factors, inadequate consideration was given to disaster mitigation, as subsequently and cruelly exposed by Hurricane David.

The high costs of rehabilitation after Hurricane David and subsequent major storms have led to careful investigation into the technical sources of vulnerability. These investigations demonstrate notably in the case of the coastal road system that hazard mitigation was not sufficiently seriously considered under the pressures to provide infrastructure quickly at low initial investment cost (Section 6.4). In addition, infrastructure has been located in especially vulnerable sites where there are no protective physical features. One example is the deep-water port at Woodbridge Bay. The port facilities project out into deep water where the dock has to bear the full force of the waves. The evidence from 1995 confirms that many sites are vulnerable to a direct hit from a Category 1 hurricane, such as Marilyn, which Wagenseil and Watson (1996) estimate to be a 10-year event (see Annex A.3). Virtually all coastal infrastructure is extremely vulnerable to a direct hit such as Hurricane David, estimated as a 50-year event. Hurricane Lenny is difficult to place in this categorization of risk, because it caused 6-meter waves that would normally be associated with the center of a Category 4 hurricane close to the island in a 50 year event⁴⁰

6.3 Major Storm Damage and Rehabilitation Costs

An attempt is made in this section to provide an approximate order of magnitude of the overall cost of damage and related rehabilitation caused by the most severe storms since Independence.⁴¹ Such estimates are necessarily approximate given the incomplete and uncertain data, based largely on immediate post-storm assessments combined with some retrospective estimates of actual rehabilitation.⁴² The results of these calculations are shown in Table 6.1 in current prices for the years of impact. These costs also leave out the damage from less severe storms, as in 1984 and 1994, and landslips that are not directly associated with storms, including the 1997 Layou River event, and higher costs of construction for the expanded hydro-electricity project.

³⁹ The transformation is documented by Honychurch (1995). A qualitative sense of what this transformation in transport achieved is provided by contrasting post-independence conditions with those described by Patrick Leigh Fermor in the late 1940s – landing in Roseau from an inter-island vessel, traveling on by boat to the second center, Portsmouth, and then by mule and on foot to the east coast Carib Territory and back across the central forests to the capital (Fermor, 1950).

⁴⁰ During the period November 17-19, 1999, when affecting Dominica, Hurricane Lenny reached Category 4 in the Leeward Islands (Map 3). In Dominica, there were visual reports and photographic evidence of very high seas, on verbal evidence of up to 20 ft or 6 meters, but there was no scientific monitoring of wave sizes. (Annex A contains a description of the Hurricane Categories and historical information on their frequency, reflecting a combination of proximity and wind strength) .

⁴¹ Rehabilitation is taken to include repairs and reconstruction costs to provide broadly equivalent facilities. Some rehabilitation assessments include not only repairs but also some element of additional mitigation investment. This mitigation cost has been excluded where possible from the rehabilitation cost estimates indicated in Tables 6.1 and 6.2.

⁴² For example, there was no readily available disaggregated assessment of the damage caused by Hurricane Hugo.

Table 6.1: Housing and Infrastructure Damage from Major Tropical Storms and Rehabilitation Costs 1979-1999 (EC\$m current prices)

	Hurricane David 1979-80	Hurricane Hugo 1989	3 storms 1995	Hurricane Lenny 1999
1. Buildings				
Housing	27.0 (5.3)a	...	4.3	2.7
Public & Commercial	26.8 (8.8)a	...	8.6	8.9
(Sub-total)	53.8 (13.1)a	5.0	12.9	11.6
2. Utilities/Infrastructure				
Roads/sea defences	10.1	...	33.8	70.2 (124.7)b
Water	2.3	...	0.8	0.3
Electricity	5.0	...	0.7	0.2
Telecommunications	3.0	...	2.1	2.0
Port (DPA)	7.8	...	1.2	3.5
(Subtotal)	28.3	15.0	39.1	76.2 (130.7)b
3. Total	82.1 (44.1)a	20.0	52.0	87.8 (142.3)b

Source: ECLAC, 1979; UNDRO, 1980; Wason, 1984; Mitchell, 1994; GoCD, 1995;1999c,d; Liautaud, 2000

Notes: a. Figure in brackets includes publicly and aid funded reconstruction projects only.

b. Includes estimated full cost of road and sea defence, including mitigation measures (Liautaud, 2000).

.... Not available separately.

**Table 6.2 Hurricane Damage and Rehabilitation Costs to Infrastructure and Buildings
(EC\$m constant 1999 prices)**

	Buildings	Utilities/ Infrastructure	Total Cost
Hurricane David, 1979/80	136.8	72.0	208.8
Hurricane Hugo, 1989	6.7	20.1	26.8
3 Storms, 1995	13.5	40.9	54.4
Hurricane Lenny, 1999			
a. Excluding full upgrading	11.6	76.2	87.8
b. (Including full upgrading)	11.6	(130.7)	(142.3)
Total 1979-99 (Including upgrading)	170.0 (347.7)b	210.0 (522.3)b	380.0

Source: Table 6.1

Notes: The estimates of damage and rehabilitation costs in current prices (Table 7.1) have been converted to 1999 constant prices using the 1990 GDP deflator. Buildings include housing, public offices, schools, hospitals, private commercial and non-commercial buildings. Utilities and infrastructure includes roads and related sea defenses, electricity, water and sewage, telecommunications, DPA assets and airports.

a. Excludes full reconstruction costs of roads including upgrading sea defenses (Liautaud, 2000)

b. Includes full cost of upgrading sea defenses according to the Mouchel (1997) report modified by the Ministry of Communications, Works and Housing (GoCD, 1999d) and reassessed by Liautaud (2000).

Table 6.2 shows the major categories – building and infrastructure – in constant 1999 prices. These calculations suggest that the rehabilitation costs of major storms since 1979 amounted to around EC\$380m (US\$140m) in 1999 prices, equivalent to EC\$18m per annum, and for key economic infrastructure alone - roads, electricity, water, telecommunications and international transport links – around EC\$10m. Hurricane David, the most severe event, accounted for around 55% of total rehabilitation costs. Buildings, including social infrastructure of schools and hospitals have accounted for around 45% of total costs and economic infrastructure for 55%. However, probably around 80% of the total damage to buildings over the period of analysis was caused by Hurricane David in 1979. In contrast, the levels of damage to economic infrastructure have remained high in subsequent storms, particularly to roads and related public sea defenses. Roads and public sea defenses accounted for only 36% of total estimated reconstruction costs following Hurricane David, compared to over 80% in 1995 and 90% in 1999. Dominica Port Authority (DPA) assets, including the deep-water port at Woodbridge Bay and at Portsmouth Harbor have also continued to suffer substantial damage. Telecommunications costs have remained relatively high as well. These temporal patterns of damage and the scale of reconstruction costs raise important issues for further consideration concerning building damage and the concentration of infrastructural damage after 1979 in the road system, related public sea defenses and the ports.

6.4 Deep-water Port at Woodbridge Bay

Prior to the construction of the deep-water port at Woodbridge Bay between 1974 and 1978, Dominica had no deep-water facilities either in Roseau or Portsmouth. This port was designed to facilitate banana exports and reduce handling costs of imports. The project was 80% financed by the CDB with USAID funds. The project cost was initially estimated in 1972 at EC\$5.4m with a CDB contribution of EC\$4.32m. A social internal rate of return of 13% was

achieved by scaling down to just over half the original design. The facility was completed just prior to Hurricane David at a cost of EC\$13m, reflecting costs inflation over 5 years, financed through a CDB loan.

The port project involved a 500-ft wharf facility for ocean going vessels, provision of ancillary buildings and reclamation of 5 acres of land. It is located on an unprotected site, but some attention was given in the design to 'inconvenient swell' of up to 6ft (2 meters) in the absence of robust wave data.⁴³ The sea defenses were based on the 1971 preliminary design and feasibility study, but further modified to reduce costs. This was despite a separate ODA-funded Delft study of wave conditions made available in June 1972, which indicated the risk of a maximum significant wave of 16ft (5 meters) every 10 years. At the time of construction there had not been any major hurricane impact in Dominica for more than 20 years.

Hurricane David in 1979 extensively damaged the newly completed facilities. Trestles were damaged and the fender system lost. Half of the transit shed and the banana store were put out of commission. However, the port was only unable to operate for 2/3 days. The total rehabilitation cost of damage to all the facilities was estimated at EC\$10.6m, equivalent to 41% of the initial investment cost in constant price terms (Table 6.3). In comparison, had the original structure been designed and built to withstand Hurricane David (Category 4) winds and wave action, the initial investment cost would have been only 11% higher (Wason, 1998).

Enhanced facilities were incorporated into the restoration works. In particular, an improved fendering system was installed and concrete dolos were incorporated as sea defense works. These enhanced facilities worked well and the port was unaffected by Hurricane Hugo.

Extension to the port was undertaken in 1990-91, adding a further 300 ft to the south. The extension was Government funded, financed through local bank lending at a commercial 10% rate of interest. The DPA also took on 2.5 acres (1 ha) for expansion in container storage. The cost of the works was EC\$18.5m, which is still being repaid.

Hurricane Marilyn in 1995 caused damage to the ferry terminal and the fendering system on the western side of both the original wharf and the new extension. Overall damage assessment to all port facilities was EC\$1.4m.

Extreme sea swell problems were re-examined in a 1994 climatic vulnerability study of OECS ports, undertaken with CIDA funding. The study indicated that in more extreme wave conditions the originally 500-ft jetty would have problems withstanding uplift pressure. In response to the study, concrete overlay work was done to reinforce the 500ft deck in 1995/6, with similar work undertaken to the Portsmouth port. The upgrade cost US\$1.3m, of which \$1m was funded commercially and \$0.3m from local funding. At the time it was believed that the 1990 extension to the jetty was adequate to meet all but most extreme wave pressure. However, Hurricane Lenny in 1999 is thought to have produced swell and wave conditions equivalent to or exceeding the 5-meter level first identified in the 1972 Delft study. The upgraded original jetty was unaffected, but the storm caused extensive damage mostly to the 1990 extension, estimated at US\$1.3m.⁴⁴

This case highlights the issue of mitigation against storm damage and the returns to infrastructure investment. The original investment had an estimated return of 13% (CDB, 1972). However, the immediate damage incurred in 1979 added 41% to investment costs. Damage from Hurricane Marilyn and Lenny have also added over EC\$4.8m to the cost of the port facility. These impacts and costs of repair and further mitigation measures suggest under-investment

⁴³ The west coast of Dominica is exposed to the Caribbean Sea and relatively minor sea-swell occurs during most of the year. While there were no statistical data available as to the frequency of 'inconvenient swell', it was believed that for Woodbridge Bay, on average, the number of days when vessels would not be able to use the proposed wharf facilities would be not more than 15-20 days per year (Wason, 1998).

⁴⁴ The main damage to the port was the destruction of approximately 13,000 ft² section of reinforced concrete deck to the main wharf by wave forces on the underside of the deck. Other damage included the collapse of a 530-ft section of chainlink fence and three 33-ft high electrical poles. There was also some damage to the fender system. The asphalt concrete top course to the area around the banana shed also needs to be restored. The specific reason for failure appears to be composite deck design involving precast concrete slab units instead of an extended single section with overlay.

in mitigation of around 25% of capital costs in the original design and of around 20% in failing to reinforce the extension to the same level as the original facility in 1996. These additional costs also cast doubt on the original internal rate of return calculations.

The impacts have been largely in terms of damage to capital structure, with limited impacts on business. The most severe hurricane, David, did not prevent movement of goods, as services were quickly being restored within days of the hurricane. The recent Hurricane Lenny affected the port operations largely in terms of rescheduling. One week's banana exports were lost and the cruise ship sector disrupted for about four or five weeks.

Table 6.3: Deep-water Port, Woodbridge Bay: Investment, Rehabilitation and Mitigation Costs

Cost Item	Date	Cost in EC\$ million	
		Current prices	Constant 1999 prices
1. Original Facility	1976-79	13.1	57.7
2. Post-David rehabilitation	1979-81	10.6	22.1
3. Port Extension	1990/91	10.5	22.5
4. Post-Marilyn rehabilitation	1995/96	1.2	1.2
5. Reinforcement of original facility	1995/96	3.5	3.5
6. Post-Lenny rehabilitation	on-going	3.5	3.6

Source: DPA, CDB, Wason (1998)

This case also raises an awkward issue of economic analysis. The port was regarded as lifeline or 'necessary' infrastructure for a modern economy – sustaining exports of highly perishable top quality bananas (although now in decline) and minimizing handling costs. Economic calculations taking into account anticipated additional export volumes and cost savings indicated that the initial design (1972) was not viable. The designers, under pressure to maintain the lowest possible construction costs, therefore almost halved the scale of the facility and did not take into account a further assessment of hazards (Wason, 1998). Underestimation of hazard risk appears to have reoccurred under continued financial pressure in designing the subsequent 1990–91 extension and in failing to make the extension more hazard resistant in 1996. In contrast, the re-assessment of hazard risks and retrofitting of the original facility in 1981 and 1996 were fully vindicated in 1999. After Hurricane Lenny had put other berthing facilities out of action, the original Woodbridge Bay wharf, because of reinforcement in 1996, acted as the sole lifeline link. It served banana exports, Dom inica Coconut Products (the only significant industrial unit which had lost the use of its own jetty) and other importers, and without it there would have been economy-wide disruption (Map 2).

6.5 Sea Defenses and Storm Hazards : the Road System

The greater part of Dominica's road system is located on the narrow coastal strip of the island very near to the shoreline and so is subject to extensive damage during storms. The damage results from a combination of direct sea erosion of sea defenses and the road, plus floods and landslips.⁴⁵ The only important exception is the cross-island road linking the capital and the main airport, Melville Hall, and the rest of the north coast (Map 1). The disruption caused by storm-related damage has direct consequences for economic and social activity. Other key infrastructure - electricity, telecommunications and water transmission and distribution networks - accompany the road along the

⁴⁵ The CDMP Wave Hazard Assessment (Wagenseil and Watson, 1996) highlights the vulnerability of the Western shore to heavy storms. The shore is open, with no distinct bays; it is steep with narrow under-water shelving and talus slope. Steepness means that coastal flooding will not penetrate far inland, but it has also forced the construction of the main coastal road and other important infrastructure into precarious sites right on the shore. The repeated damage from storms since 1979 has highlighted this exposure. The potential scale of storm hazard is indicated by the CDMP study, which was undertaken in the absence of regular and reliable monitoring of waves and water levels. The study concludes that storm damage is directly related to local construction practices, which reflect the uneven distribution of risks.

narrow coastal strip and are also likely to be disrupted, as after Hurricane Lenny (Map 2). The repeated need to repair and rebuild roads and rehabilitate other key infrastructure also exerts pressure on public finances and those of separately financed utilities – an issue considered more fully below in Chapter 10.

The sea defense/road issue was highlighted by the damage caused by Hurricanes David and Allen (Table 6.1). Post-disaster assessments following these storms also exposed the difficulties of separating storm damage from the effects of poor maintenance. Moreover, subsequent storm damage showed that the post-David and Allen program of rehabilitation of EC\$10m, begun in 1980/81 failed to address seriously the problem of vulnerability of the road system. Further extensive damage was sustained in 1989, 1995 and 1999, with more localized damage also experienced as a consequence of other storms. The assessed damage from Hurricane Lenny to the roads and other key infrastructure again highlighted the inevitable damage that follows on any major storm and provides a measure of the outstanding problems of highly vulnerable sea defenses.

The record of investment in sea defenses and more robust standards for roads is in fact patchy. There have been some exemplary investments to high levels of robustness, notably the sea wall in Roseau, some of the new sections of coastal road built to higher storm resistant specifications towards Pointe Michel and the trans-island road from Roseau to Melville Hall. However, because of financing and other constraints on major public works, subsequent studies and reviews suggest that broadly the GoCD has adopted a strategy of minimum necessary repairs in the aftermath of each storm to allow resumption of normal use (see Section 10.4). In particular, the standard use of gabions as sea defense structures is good enough for ordinary weather, but they are not designed to withstand hurricane force sea conditions.⁴⁶

Damage assessments for the major hurricanes since 1979 give some approximate indication of the likely level of damage to the road system in the absence of substantial mitigation measures. The estimated total rehabilitation cost over 30 years has been around EC\$145m at current (1999) prices. In addition, as the review of utilities and buildings considered below indicates, much of the other infrastructural damage is also associated with the poor sea defenses for the coastal road network. Meanwhile, the Mouchel 1997 study estimated the cost of mitigation measures to protect against storms of up to category 3 with a return period of 10-15 years as EC\$93m. The West Coast element of the coastal protection strategy has been re-estimated at more than EC\$100m in the Ministry of Communications, Works and Housing's damage assessment for Hurricane Lenny (GoCD, 1999d) and over EC\$ 120m by the World Bank's assessment mission.

The apparent slow progress in providing sea defenses partly reflects the scale of investment financing required (Mouchel 1997 and Map 2). Other factors have also slowed the rate of action on a now widely acknowledged problem of vulnerability. There is a lack of donor coherence in addressing the vulnerability of the whole network, rather than a series of separable local problems. Reflecting this, in practice sea defense mitigation investment is being taken up piecemeal by individual donors as separate projects for specific sections of road - for example, by the CDB and DFID, or as a component of a broader disaster management project by the World Bank (See Box 13.1). The choice of road sections to be upgraded and protected may then reflect different donor priorities, such as contributing to overall economic development or targeting poorer geographical areas. The process of design and construction is also subject to the procedures of different organizations, for example for tendering for services and procurement.

6.6 Public Utilities: Telecommunications, Electricity and Water

The three key utilities were rapidly expanded in the final pre-independence era. In the case of electricity and water this expansion was undertaken through monopoly public bodies. Telecommunications was provided by the then UK government-owned Cable and Wireless Company (C & W). All three systems suffered devastation during Hurricane David, which caused almost complete short-term disruption to services. Between 1979 and 1980 both electricity

⁴⁶ Many coastal structures are built on wire gabions, baskets filled with stones. The foundation under the gabions may be concrete common casting placed over rounded cobblestones, or there may be no foundation at all. Gabions get much of their strength from friction amongst stones in the basket. The lubrication and buoyancy of storm floodwaters weaken these structures.

generation and the number of connected telephones declined by over half, reflecting both physical impacts on the networks and weakened demand due to commercial disruption. The costs of rehabilitation were considerable, as shown in Table 6.1. Repair and reconstruction were hampered by Hurricane Allan a year later (CDB, 1980). Potable water, electricity generation and distribution and telephone connections only recovered to pre-devastation levels by 1982-83. Post-storm assessments drew attention to poor maintenance, linked to weak cost recovery in supply, during the 1970s which had contributed to increased vulnerability. In the process of rehabilitation, efforts were made to reduce future vulnerability by the introduction of mitigation measures.

Telecommunications

In the case of telecommunications, the ruined network of overhead wires was extensively replaced by underground cable. The C & W headquarters and main depot in Roseau were also rebuilt according to hurricane resistant designs. The relative success of this mitigation effort is reflected in the reported cost of damage in 1995 and 1999, set beside the considerable expansion of the network from 3,120 to 19,424 connected telephones between 1978 and 1998. The overall growth of the network, both residential and commercial, shows no impact from subsequent shocks comparable to those caused by Hurricane David. The substantial damage to the network caused by Hurricane Lenny in 1999 occurred where underground and overhead cables had been installed alongside sections of coastal road damaged by the storm.

Rehabilitation and expansion with a high level of disaster mitigation have been internally financed by an international company that has been the monopoly provider of telecommunications services in Dominica and other former British colonies. Some cell phone communications are now being installed. Currently the tariffs for telecommunications are widely perceived in Dominica as high compared with North America, raising issues of competition and deregulation. From a disaster mitigation perspective, this poses a challenge of ensuring that possible technical and organizational change in the network – the introduction of cell phones or entry of additional service providers – does not jeopardize safety standards.

Electricity Supply

The power system was not restored in size and capacity to pre-David levels until mid 1983 (CCA, 1991). However, the high cost of installing the island's ring main and other critical components underground was regarded as impracticably high because of the mountainous, rocky terrain and wide dispersal of the small customer base – only 22,000 by the mid 1990s, already providing access to electricity to 93% of the population. The transmission and distribution network therefore remain highly vulnerable and require high maintenance standards.⁴⁷ The impact of Hurricane Lenny appears to exemplify the continuing problem of vulnerability of a distribution system that supplies a largely coastal population with overhead transmission following the coastal roads. The damage was comprised of a combination of broken local lines, where the road and utility distribution run together, and disrupted supply to houses also destroyed or damaged.

Nevertheless, although storms after Hurricane David have done damage to transmission and distribution, this damage has been localized and overall growth in the supply of electric power has been sustained. The main source of variability in generation has been associated with the expansion of hydroelectric capacity rather than storms.

To reduce the structural import deficit and vulnerability to price shocks, the longer-term power supply strategy has been to increase the hydro-electricity capacity.⁴⁸ After immediate post-David rehabilitation was completed that strategy was realized through the Dominica Hydro-Electricity Expansion Project, which more than doubled hydropower generation after completion in 1991/92.

⁴⁷ According to the CDB and IADB (1996) infrastructure report, maintenance is a continuing area of weakness associated with high transmission losses (about 17%) and poor financial performance.

⁴⁸ The Prime Minister stated in 1979 'I am proposing to do all in my power not only to see the electricity supply restored, but the hydro-electricity supply in particular. Dominica has ... a natural advantage which it must now exploit' (GoCD, 1979: 6).

However, hydro-systems are potentially vulnerable to landslides and flood hazards.⁴⁹ A CDMP study found that problems encountered in construction and re-assessment of landslide and flood hazard delayed the completion of the hydro-power extension project and resulted in identifiable additional costs of over EC\$1m (OAS, 1996b). Soon after completion landslide related repairs cost in excess of EC\$100,000, plus loss of revenue from reduced power generation. The original 1984 design criteria failed to reflect best available information on landslide hazard, resulting in additional costs.

The CDMP study also draws attention to the scope for hazard damage reduction and improving operational performance by regularly re-evaluating retrofitting (additional investment) as against repair options and by re-assessing maintenance schedules.⁵⁰ These are, as the ports, roads and sea defense cases have already shown, policy issues of more general relevance (see Chapter 13).

Water Supply

The Dominica Water and Sewerage Company (DOWASCO) is singled out in the CDB and IADB's (1996) infrastructure report as 'a unique publicly owned private corporation', that underwent a successful restructuring to overcome problems of debt and poor cost recovery, whilst providing near universal provision of potable water and public sewage disposal where viable.

Like the rest of Dominica's public infrastructure, its predecessor had been in dire financial straits by the mid 1970s. The water and sewage system then suffered severe damage and temporary disruption as a consequence of Hurricane David, with considerable rehabilitation costs (Table 7.1). Despite the introduction of a new tariff also in 1979, the water authority was unable to collect sufficient revenue to cover capital and recurrent costs and 'fell into a chronically dilapidated, deficit-ridden state'.

After the formation of DOWASCO in 1989 the company was turned round with revenue collection sufficient to cover both capital and recurrent expense by 1995. By the same year, the system provided some 90% of the population with access to potable water, although 45% of these use standpipes. It now has over 12,000 customers, almost all metered, with enforced monthly payment.

Domestic, industrial and commercial consumption has steadily expanded while severe tropical storms have had no significant impact on levels of use since 1980. The effects of Hurricane Lenny are consistent with the wider pattern of localized damage to infrastructure, concentrated along the route of the west coast road and includes installed facilities on exposed west coast properties. DOWASCO's detailed estimate of rehabilitation costs totaled EC\$342,000, equivalent to just under 5% of its annual revenue. This is still a significant cost to a public corporation operating under very tight financial constraints, but is much less than the massive post-David and Allen rehabilitation costs, which were equivalent to 140% of annual revenue in 1982, the first year in which more normal cost recovery had been re-established.

6.7 Buildings and Housing

Unfortunately, a detailed investigation into the impacts of storm damage and mitigation measures in this economically and socially important area is beyond the scope of this study. There is a lack of readily available satisfactory data other than some for public buildings, making it difficult to explore what has been happening. However, a few issues require attention because they relate to other aspects of this economic study. The social implications of disaster impacts on housing are discussed in Chapter 12.

⁴⁹ This was dramatically demonstrated by the effects of landslides triggered by Tropical Storm Danielle in 1986 on St Vincent, which reduced generating capacity on the island by 36%.

⁵⁰ The first example cited is the choice between repair and more costly redesign or installation of protective measures. The second example is where turbine blades are being replaced regularly earlier than their design life, due to sediment, and it may be more cost-effective to increase maintenance of intakes and other points where sediment can be removed.

There appears to have been relatively limited damage, or at least assessed damage, to the housing stock other than that incurred as a consequence of Hurricane David. However, localized damage can still be substantial and severe, as demonstrated by Hurricane Lenny in coastal and relatively poorer fishing communities. The publicly funded share of rehabilitation costs has also been relatively limited – actual public projects of EC\$5.3m after the storms in 1979 and 1980 were spread over several years. These projects in current prices for 1980 and 1981 were equivalent to only 18% of the initially assessed damage in 1979 (Table 6.1). That implies that 82% of costs were met privately by those affected.⁵¹ There was also very limited insurance cover (see Chapter 8). The apparent reduced scale of damage in subsequent storms could be accounted for by several factors. Most housing is only vulnerable to the most extreme storms (Hurricane Category 3 and above). There has been some successful investment in mitigation since 1979. Nevertheless, some communities remain highly exposed to direct sea damage.

Building standards in Dominica may have also fallen in the immediate wake of Hurricane David as construction boomed and unskilled people set up as builders. A research project funded by PAHO (Lechat and others, 1981) found that a high proportion of temporary repairs undertaken in the immediate aftermath of the hurricane were becoming semi-permanent due to lack of funding, building material and skilled labor shortages, potentially implying a long-term deterioration in the housing stock.

More positively, there is reported to have been a general increase in awareness of the importance of hurricane-proofing since Hurricane David which, coupled with a general improvement in the quality of housing stock, including greater use of imported materials, has increased the strength of newer buildings against hurricanes. The quality of public buildings is also reported to have improved in recent years, in part because of the increased use of private consultants such as engineers.

Dominica is also in the process of adopting the OECS Model Building Code as its national code. The only remaining step (which has been pending for some time) before the code becomes law is approval by the Cabinet of the related legislation and placing this before the Assembly. This development has been supported by Habitat and the CDMP.

There has also been at least one project specifically intended to reduce the vulnerability of housing to strong winds. In 1994, the National Development Foundation of Dominica (NDFD) launched a Retrofit Program, with financial support from CDMP and the Community Housing Foundation of Washington. This program, which is still on going, has three components: to provide information on retrofitting measures; to provide training to builders and artisans; and to provide seed funds for retrofitting, including in the informal sector. The first loans were made in late 1994, with increased interest in the scheme after the 1995 hurricanes demonstrated the benefits of retrofitting.

6.8 Overall Assessment

Under-investment in mitigation is a problem of multiple design failures. This is sometimes due to lack of hazard information, but also caused by the failure to utilize available information on, for example, storm hazard risk and landslide risk. Another contributory factor is excessive cost-minimization in initial investment in the public provision of modern infrastructure. The scarcity of investment funding has frequently resulted in minimal post-disaster repairs, aimed at facilitating a rapid return to normal activity rather than incorporating mitigation into rehabilitation.

The damage in different areas of key infrastructure is linked, particularly by the lack of sea protection to the road system, along which other utility networks are also located. As discussed in Section 10.4 frequent and extensive repairs to the roads place a considerable strain on the public finances.

⁵¹ The rate of inflation was highest between 1979 and 1981. As most of the rebuilding and repair was done privately in 1979-80, the share financed in public projects is substantially less than the implied 18% of rehabilitation costs, say 12-15%. Without a detailed breakdown of costs and reliable data on construction sector inflation, more precise calculations are not possible.

There has been substantial but uneven progress in reducing hazard risk in all areas of infrastructure and building. As discussed further in Chapter 13, progress has been hampered by a weak risk assessment information base, a lack of donor coherence, failures of land use planning and a reluctance to adopt and enforce adequate building codes.

Chapter 7.

External Account

In this Chapter there is a brief review of the inter-relationships between natural disaster shocks and the external account, considering first the current trade account and, second, the capital account. There are clear and direct links between disaster shocks and export earnings, that have largely come historically from primary commodities, whereas the links are more inferential for imports and especially for capital movements, relying on the interpretation by those involved in these events.

7.1 The Trade Account

The overall levels of exports and imports since 1977 in constant price terms are shown in Figure 7.1. Dominica typically has had a real trade deficit in excess of EC\$50m in constant 1990 price terms, equivalent to 12-13 % of GDP. However there have been years of substantially greater deficit associated with the considerable variability in export levels, with post-disaster surges in imports, especially in 1979-80. The components of the export account - banana earnings, non-banana exports of goods and non-factor services (NFS) are shown in Figure 7.2.

Figure 7.1 Dominica - Exports and imports of goods and services, 1977-1998
(constant 1990 Prices)

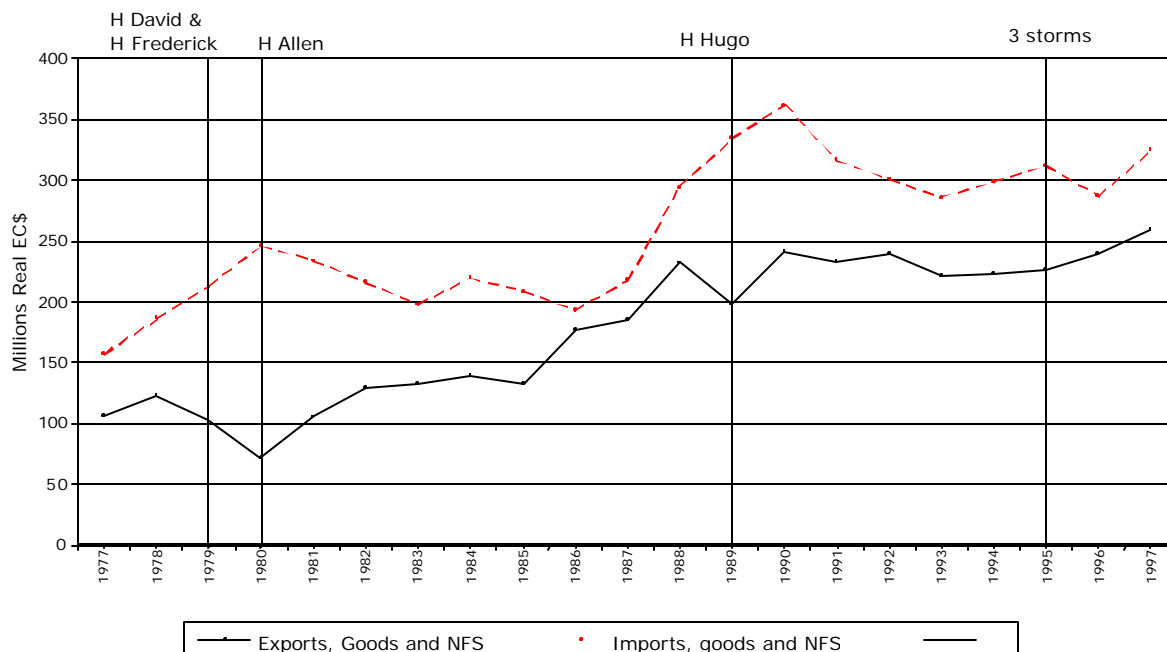
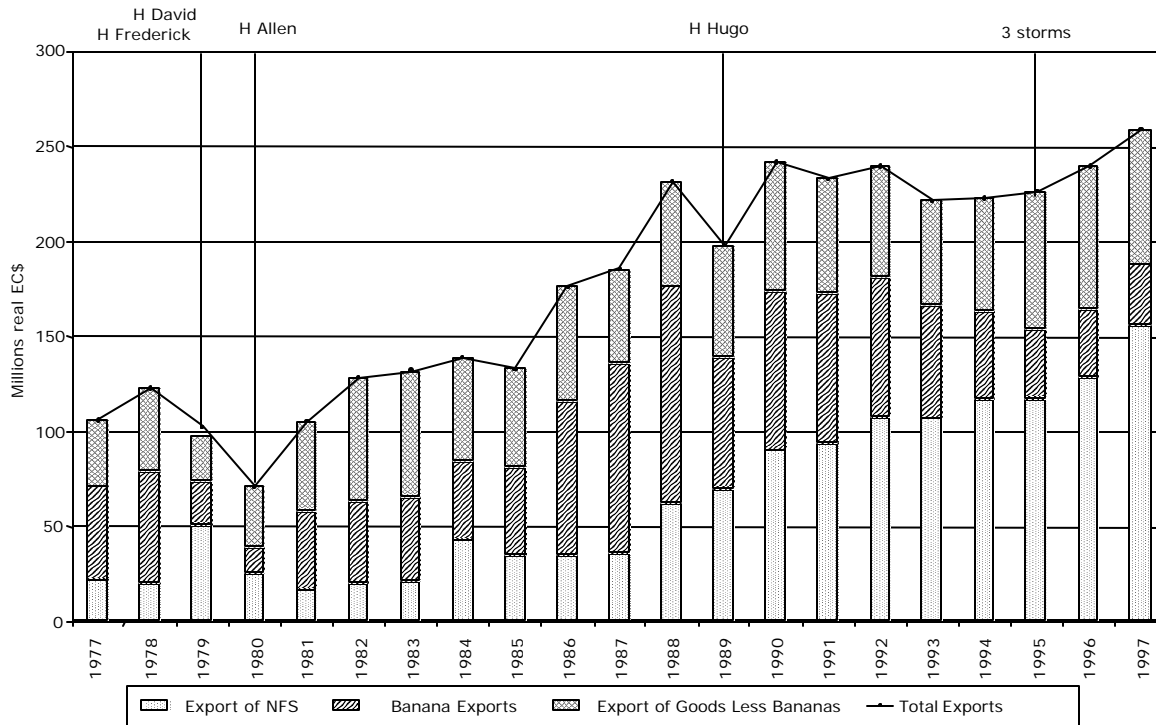


Figure 7.2: Dominica - Export earnings by category, 1977-1997 (constant 1990 prices)

During the 1979 and 1980 hurricane years there was a widening of the trade deficit which was largely due to a 50% decline in the export of goods, although NFS more than doubled in 1979. The further reduction in total exports in 1980 was largely due to a fall back to EC\$25m in NFS exports. In contrast, imports increased over the two impact years due to the import of materials and equipment to rehabilitate infrastructure and housing after the hurricanes. Food imports also rose to compensate for lower domestic production. This import surge also coincided with an oil price shock. There is a similar but less marked increase in imports after each of the subsequent major storms in 1989 and 1995.

Between 1981 and 1983 the trade deficit narrowed and this trend continued despite Hurricane Klaus in 1984 up until 1986. Total exports grew because of the rapid recovery in banana exports followed by wider recovery in exports of goods and also an increase in the export of NFS. Import totals remained fairly static over the period, possibly reflecting the end of the post-David reconstruction boom.

Between 1987 and 1990, the trade deficit increased dramatically, with only the tail end of the increase partly due to Hurricane Hugo in 1989. Overall exports increased with a rapid expansion of bananas earning to record levels until checked by Hurricane Hugo and what proved to be a reversal of the trend in prices. There was also a massive growth in NFS exports which between 1986 and 1991 increased more than three fold to EC\$84m (in constant prices). Imports increased considerably between 1987 and 1990 due to the growth in NFS imports and a consumer domestic building boom fuelled by banana earnings.

During the 1990s, a period of relatively slow overall growth, there is no clear trend in overall exports, although the value of goods dropped by 30% between 1991 and 1997. The decline in export of goods is largely explained by the depressed banana sector. These impacts are largely the result of reduced volumes of banana exports. First, Dominica is a price taker, with US\$/UK£ exchange rate movements and changes in the EU banana regime having a

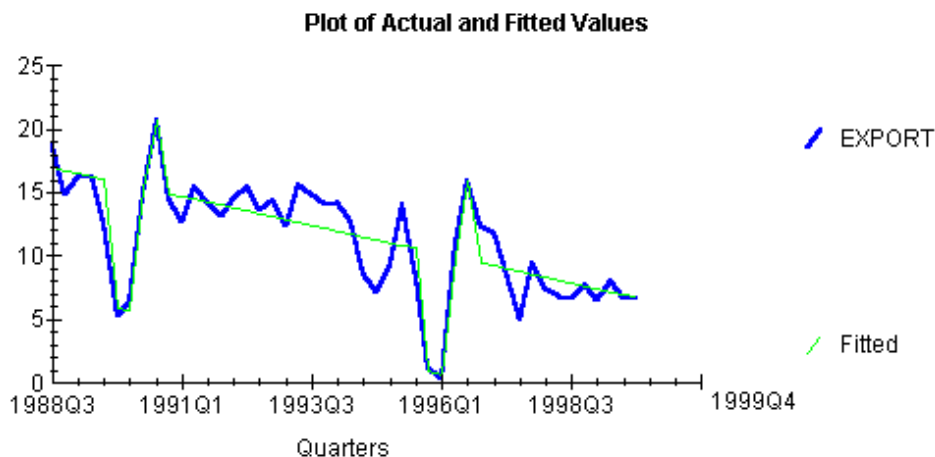
direct effect on export prices and profitability. Second, there have been the impacts of hurricane damage on the production and exports, as is shown in more detail in Section 7.2.

The decline in commodity earnings in the 1990s has been partially offset by some increase in other export categories, but especially by a substantial rise in NFS (Figure 7.2). From 1990 NFS exceeded banana earnings, marking a new phase of reduced sensitivity in total exports to hurricanes. The NFS, which includes tourism and international financial services, is a relatively opaque category of the external account and some of its behavior is difficult to explain. For example, there was a surge in NFS exports in 1979, perhaps suggesting that some of the relief activity was being funded as NFS payments. The import of both goods and NFS has been comparatively stable over the same period reflecting the slow growth in this extremely open economy in which imports have a high share of consumption and investment.

7.2 Storm Shocks and Banana Export Earnings

The full, immediate extent of the direct impacts on banana export earnings is partially obscured by the timing of hurricane shocks in the third or fourth quarter of the year, August-November, and almost immediate impact on bananas exports. The reduction in exports may also be increased by problems in shipping out the perishable crop. Thus in November 1999 a week's exports already in store were lost because of the disruption to shipping. Because of the capacity of producers to replant and recover production in 6 to 9 months, direct impacts are spread over the end of one and the beginning of the next calendar year. This pattern of rapid decline in exports and recovery is illustrated in Figure 7.3 for the effects of Hurricane Hugo and the triple shock in 1995. The dominant share of banana in exports accounts for the extent to which a hurricane impacting on agriculture but causing little structural damage, such as Hurricane Hugo, impacted severely on exports and the wider economy.

Figure 7.3 Banana export earnings (EC\$m) and disaster shocks, 1988-1998



Source: Table A.7.2

The relationship between banana export earnings and extreme storm shocks has been quantified employing regression analysis in a similar way to that already adopted in Chapter 4 and 5 and described in Annex B, introducing individual dummy variables to represent major disaster events. But in this case quarterly data on export earnings were available from 1988 to 1998, and, as Figure 7.3 shows, most of the short-term variability in export earnings around a downward trend is linked with the major storms in 1989 and 1995.

The downward trend is also associated with a decline in real EC\$ export prices and a related fall in grower profitability. This declining trend in real banana earnings since about 1989 has had implications too for the sensitivity of the trade account to disaster shocks. In 1995-96, despite the temporary loss of banana earnings, there was actually a small increase in total export earnings because of growth in DCP exports and resilient NFS earnings. This is an instructive example, showing how the nature of an economy's sensitivity to natural disaster shocks may change quickly. It implies that vulnerability and appropriate policy response need to be regularly re-assessed. Both regional and to some extent international arrangements for buffering the effects of natural disaster shocks have been geared to compensating for primary commodity export earnings - as with the complementary EC's STABEX for government or for producer revenue, in WINCROP (Box 5.2). There are no comparable easily accessible mechanisms for counteracting shocks in other sectors.

7.3 The Trade Balance and the Capital Account

Figure 7.4 shows both the current trade and the capital account balances. As would be expected, these tend to follow each other's pattern inversely: an increase in the trade deficit is associated with a positive movement in the capital account balance. However, the capital account has varied considerably over the period, particularly in hurricane years and for at least one succeeding year. These increases in capital inflow typically overcompensate for current account movements. Afterwards capital inflows decline to levels that are much closer to the trade account deficit (see Figure 7.5).

**Figure 7.4 Dominica - Real trade balance and capital accounts balance, 1977-1997
(constant 1990 prices)**

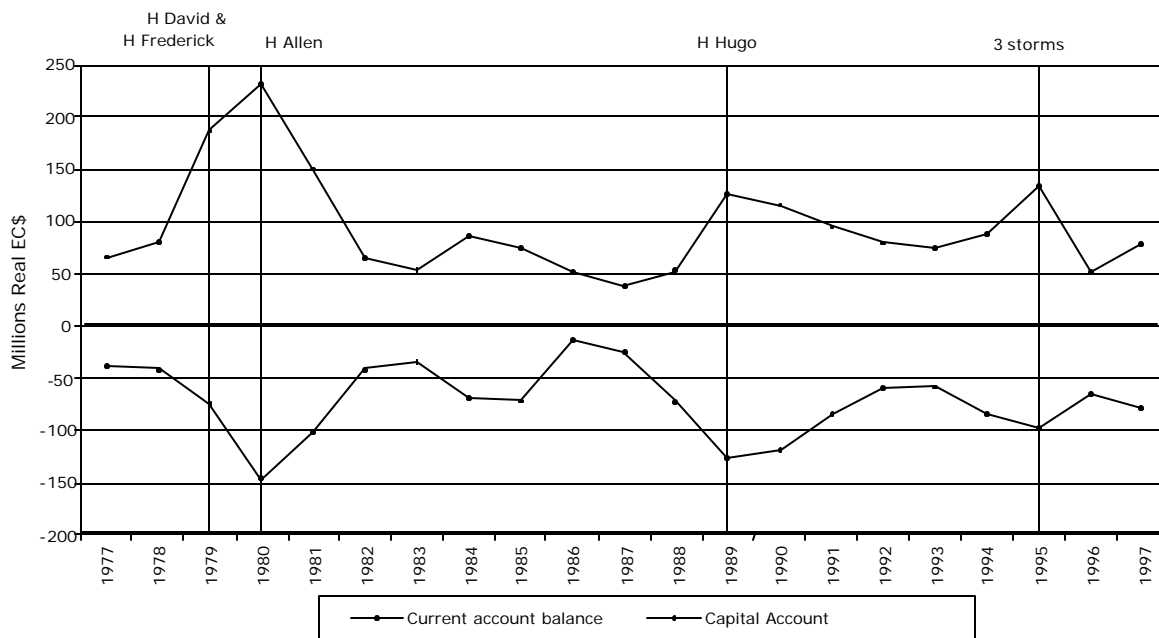
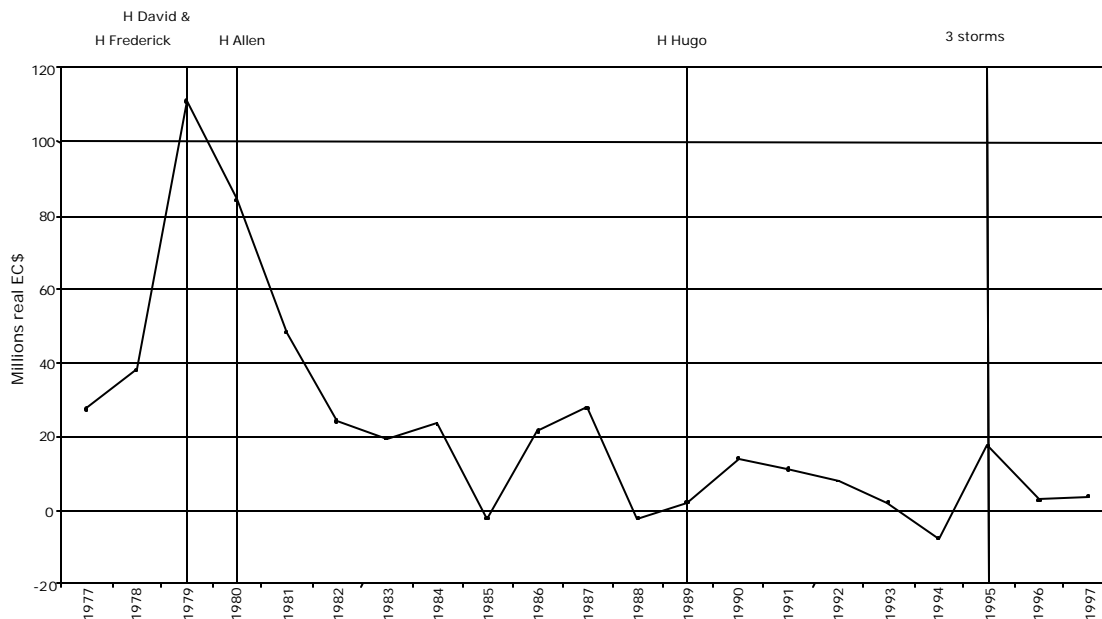


Figure 7.5 Dominica - Balance of payments, 1977-1997 (constant 1990 prices)



In earlier years the temporary increase in the capital account flows was principally due to official or public grants, comprising of budgetary grants, capital grants and relief import counterparts. Between 1978 and 1979, public grants rose by 300% to EC\$54m (in current prices). Most of the increase (66%) was channeled via the import relief component. Public grants also expanded in 1984, associated more with the structural adjustment agreement and channeled as capital grants. The next marked upward movement in the capital account coincided with Hurricane Hugo in 1989, to EC\$126m (in current prices) from EC\$52m in 1988. The account did not fall toward normal, balancing levels until 1992. Most of this effect manifested itself via increases in credit to the financial account (which doubled) and decreases in debits from this account. 'Other investment' categories and long-term public sector loans also contributed to the net increase. Again the capital account surplus declined toward more normal levels in 1993 and 1994. In 1995 three storms impacted Dominica and this was associated with a further rise in the capital account surplus including capital transfers (an increase of 100%) and direct investment (increase of 150%).

Economic assessments of the performance of the Dominican economy such as World Bank Economic Memoranda have typically concluded that performance in the external account is largely determined in the short term by banana export earnings and capital movements. The overwhelming importance of the former at least up to the mid 1990s is confirmed. The role of capital account movements is also confirmed. From the viewpoint of this study the most important issues appear to be overcompensating immediate reactions to disaster-related downward pressures on the trade account. In particular, there was considerable inflow of capital from 1979 and into the early 1980s that contributed to funding reconstruction investment. Many in Dominica's public and private sectors referred to this massive capital inflow as an opportunity that considerably counterbalanced the damage from Hurricane David. (The external assistance component of these capital account flows is considered further in Chapter 12).

Chapter 8.

Domestic Absorption

Disasters have potentially significant implications for levels of consumption and investment. The impact of a disaster on private consumption is determined by a number of factors, including the effects on levels of employment; the ability and willingness of households to dis-save; the availability of goods for sale; the extent of any insurance payouts; and the scale and nature of various relief efforts, and the extent to which they utilize domestic resources and create local job opportunities.

8.1 Investment Levels

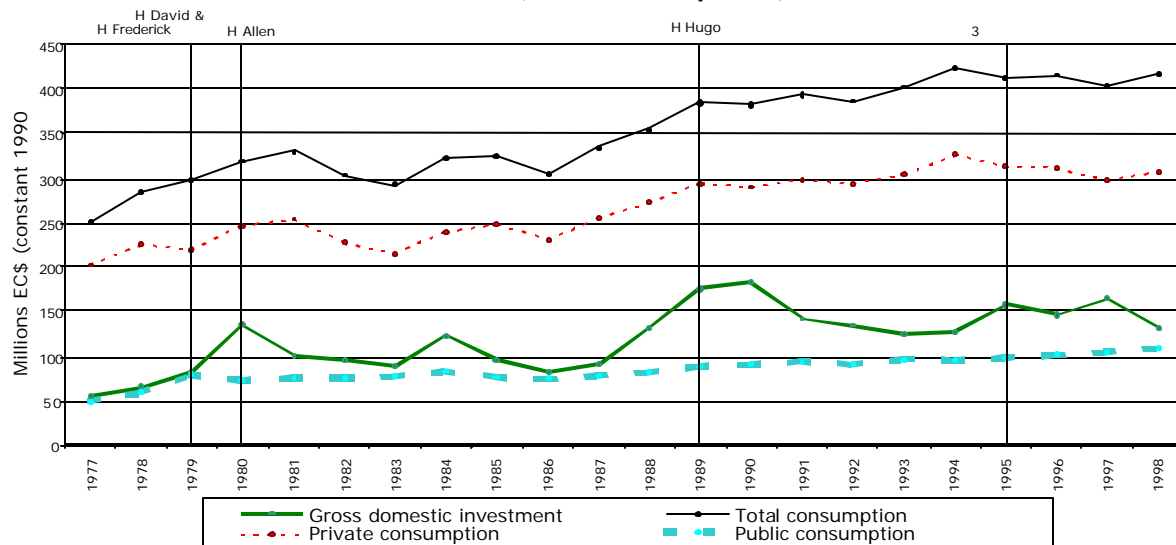
Sudden-impact disasters damage and destroy productive and non-productive assets and infrastructure. Overall rates of investment may rise as lost infrastructure is replaced, but only to the extent that investment resources are additional and do not involve the diversion of resources away from other potential areas of investment. The economic impact of this investment is then dependent on the ratio of non-productive to productive investment. However, disasters may also act as a deterrent to prospective new investors. The impact of disasters on public investment and consumption is explored in more depth below (Chapter 9).

The GoCD (2000) identifies the capital formation effort as critical to Dominica's medium-term growth prospects. It has actively and continually sought foreign private investment to supplement scarce domestic capital, facilitate technology transfer and provide the thrust of economic growth (World Bank, 1992). Various fiscal incentives are offered to promote private sector investment.

It is difficult to discern much evidence of the impact of natural disasters on total investment or consumption in Dominica, other than in the aftermath of Hurricane David in 1979 (Figure 8.1). Hurricane David resulted in a massive infusion of investment funds, initially primarily in the form of private investment and afterwards in the form of public investment. The scale of both losses and reconstruction funds created a significant opportunity to replace and update much of the island's infrastructure and commercial, productive capital, following years of inadequate maintenance and limited investment. Gross domestic investment increased by 24.9% year-on-year in real terms in 1979, with a further 65.2% increase the following year. However, although remaining significantly above the 1978 level, gross domestic investment fell again by 25.2% in 1981, with further marginal declines in 1982 and 1983. The fall off in private investment from 1981 onwards was apparently particularly pronounced, based on a comparison of data on gross domestic investment with that on central government capital expenditure (unfortunately only available on a July-June fiscal year basis) (see Chapter 9).⁵² Central government capital expenditure almost doubled in real terms between 1980/81 and 1984/85 to reach a figure of EC\$61.1m (at real 1990 prices). Total gross domestic investment averaged EC\$111.0m (at real 1990 prices) in 1984 and 1985. Thus, it would appear that private investment fell significantly once repairs were undertaken to existing capital, with the hurricane possibly having played a role in deterring new investment. Moreover, a significant part of the private investment that did occur may have been in the form of non-productive capital. Subsequent hurricanes have caused only partial dislocation and have not resulted in any comparable infusion of capital for reconstruction.

⁵² Data disaggregating between public and private investment are not readily available.

Figure 8.1 : Dominica - Domestic absorption by component, 1977-1998
(at real 1990 prices)



8.2 Consumption

Disaggregation between public and private consumption also suggests that the former to some extent compensated for a decline in the latter in 1979 (Figure 8.1) but that fluctuations in both consumption and investment in other years have largely reflected other factors. This observation is confirmed by regression analysis of total investment and government and private consumption against both the composite and individual disaster dummy series. The regressions indicate some increase in government consumption in 1979 and a decline the following year but even then the overall power of the fitted equation is weak.

Nevertheless, natural disasters may be one of a number of factors leading to high consumption volatility both in Dominica and the Caribbean more broadly. The World Bank (2000a) reports that although Dominica has one of the lowest levels of consumption volatility within the Caribbean region, the level is still high. Although the data suggest that the GoCD may be playing some role in reducing volatility through its pattern of public consumption, as already noted in the specific context of Hurricane David, standard deviation of private consumption over the period 1960-97 was estimated at 7.46% for private consumption and 5.51% for total consumption. The World Bank attributes the relatively high level of consumption volatility in the Caribbean region generally to the fact that, in the face of high vulnerability to external shocks (see Box 4.1), countries are not diversifying their risk optimally, despite having relatively well-developed financial systems. The World Bank concludes that 'much remains to be done to foster the developments of both financial and insurance markets' (p15), including through regional harmonization of the banking and insurance systems, deepening of government and corporate securities markets, pension reforms and more efficient transfer of catastrophic risks to the international market (see Chapter 9).

Chapter 9.

Financial Aspects

This chapter examines three ways in which natural disasters impact on the financial system and the ways in which private and public financial institutions cope with these pressures. It begins with the issue of vulnerability of credit and banking institutions to disaster shocks. It then looks at evidence of disasters resulting in inflationary pressures. Finally, it considers the effectiveness of formal risk spreading through insurance and other risk mechanisms.

9.1 Banking and Credit

Natural disasters can place considerable pressure on financial systems as deposits are drawn down and increased credit sought, both from the public and private sectors, to finance uninsured rehabilitation costs and compensate for disruptions in the flow of income. Repayment of existing loans can also be deferred and some loans even defaulted upon. In more extreme cases, such pressures can result in the collapse of part of the banking sector.⁵³ However, increased pressure on credit markets may be partly offset by reduced demand from other quarters, reflecting the generally recessionary nature of severe natural disasters. Both the banking system and capital markets more generally can also play a potentially important role in spreading risk.

There are four foreign-registered commercial, one locally-registered commercial and one locally-registered development banks currently in operation in Dominica.⁵⁴ In terms of both loans and advances and deposits and assets, the local National Commercial Bank (NCB), is the largest commercial bank. Dominica also has an extensive network of credit unions, the first of which was founded in 1951, and several other non-profit making organizations that are involved in microcredit and revolving loan activities (see Box 9.1)⁵⁵. Credit unions have experienced particularly rapid growth in the past few years. Membership has risen from 21,211 in 1978 to 61,709 by 1998, equivalent to 81% of the population. The smallest union has only 255 members whilst six have fewer than 1,000 members. However, the Roseau Credit Union now has 27,000 members and is one of the island's principal mortgage providers.

⁵³ For example, the on-going volcanic eruption in Montserrat, which began in mid-1995, resulted in the effective collapse of the country's only building society, the Montserrat Building Society (MBS). The MBS estimated that prior to 1995 it accounted for approximately 90% of housing mortgages on the island as well as a high proportion of personal savings. However, following an escalation of the crisis and the subsequent sudden cancellation of most insurance policies on the island in August 1997, mortgaged assets held by the MBS immediately assumed a zero value, putting the Society into substantial deficit. Although the MBS has remained open, following a temporary 3-week closure, until early 1998 depositors were only able to withdraw up to 35% of their savings, whilst the Society remained in deficit. Then the MBS announced that savers could withdraw a further 35% of their savings (Clay and others, 1999).

⁵⁴ Until 1981, the NCB was known as the National Commercial and Development Bank (NCDB), which in turn was founded in 1977. The NCDB was the parent bank of the AID Bank, which became autonomous in 1981.

⁵⁵ For example, the Hucksters Association was established in 1983, with a grant from the Inter-American Foundation to create a revolving loan program and assist hucksters in finding markets for their produce. Loans are guaranteed using a peer system, in which another huckster must co-sign and be responsible for repayment if the borrower does not honor the loan agreement.

Box 9.1: The National Development Foundation of Dominica

The NDFD, now Dominica's largest NGO, was founded in 1981 to assist the recovery of poorer segments of society following Hurricane David. The Foundation has focused primarily on support to micro-enterprises, initially providing loan guarantees to commercial banks against lending to businesses that would otherwise have been unable to secure loans. More recently, it has extended its operations to access funds directly for on-lending as well; and later again to provide technical support (principally in the form of business advisory services) and training. In the aftermath of hurricanes, external resources have also sometimes been channeled through the NDFD. For example, following the 1995 hurricanes the NDFD was contracted to manage an Inter-American Institute for Cooperation on Agriculture (IICA) revolving fund providing support to livestock farmers. In 1998, the most recent year for which data is available, the NDFD granted 273 new loans to the total value of EC\$1.8m. The average loan term is now 4 years.

As regards the composition of its lending portfolio, in 1998 services accounted for 26% of total new loans and retail and distributive trade for 18%. Home improvement loans accounted for 18% and retrofit loans for a further 2%. NDFD made its first housing loans under its retrofit program in 1994 (see above). The NDFD also provides some loans to the agricultural sector, totaling 8% of new lending in 1998. Such loans are focused on non-banana farmers as the Agricultural, Industrial and Development Bank (AIDB) and DBMC have historically met the loan requirements of banana growers and include some on-lending of STABEX funds. A very small proportion of NDFD's total lending portfolio is extended to the fishing industry, accounting for 3% of new lending in 1998.

Over time, the NDFD has become increasingly risk averse. Until 1994, its overall operations relied almost entirely on grant funds but since then, as grant funds have dried up, it has been forced to secure loan funding instead and has also accelerated its efforts to become financially self-sufficient. It was hoping to achieve 100% self-sufficiency by 1999 (NDFD, 1999). The shift in funding base has had implications for the NDFD's activities. In the past, it was able to undertake high risk lending. However, with the shift in funding base it has been forced to observe increasingly prudent lending practices and to reduce its level of unsecured risk.

In terms of the vulnerability of the NDFD's operations to natural hazards, loans are secured against collateral where possible, either in the form of property, equipment or a share in sale proceeds. The signature of a guarantor is accepted against loans to the very poor. The NDFD encourages the uptake of insurance on properties financed through NDFD loans but it is not a mandatory requirement. Lending to the fishing industry carries a particularly high risk of default and the NDFD will no longer make new loans during the hurricane season, despite the fact that fisheries loans are typically of 30 years duration. Instead, the Foundation prefers some lead time between the commencement of a new fisheries loan and the onset of the hurricane season, during which it can encourage the borrower to undertake appropriate preparedness measures (See.also Box 13.1).

In the aftermath of disasters, some loans are rescheduled and there is typically an increase in both arrears and demand for new loans. For example, overall arrears increased to around 19-20% in 1995, compared to a normal rate of around 15%. In the event of another hurricane on the scale of David, the NDFD considers that it would have to renegotiate the terms and conditions of agreements with NDFD's own creditors and seek grant assistance for on lending.

There is no national central bank. Instead, the ECCB acts as a currency board, conducts monetary policy for Dominica and all other members of the OECS and is the sole supervisor and regulator of commercial banks in the member territories (see Box 9.2).⁵⁶ By statute, the ECCB is also a lender of last resort although it has never been approached to perform this role.

Box 9.2: Disasters and the Eastern Caribbean Central Bank

The ECCB identifies natural disasters as one of a number of factors contributing to considerable volatility in its foreign reserve earnings. In the aftermath of major regional disasters there can be a substantial inflow of foreign exchange in the form of external post-disaster assistance and reinsurance payouts. However, over the succeeding year most of this inflow is spent on imported rehabilitation materials whilst export earnings are also reduced by the disaster, leading to a fall again in the ratio of external assets to demand liabilities. Data extending back to 1987 suggests that this pattern of upward and then downward movement in the ratio of external assets to demand liabilities has, indeed, been observed, although on a relatively modest scale (Figure 9.1).

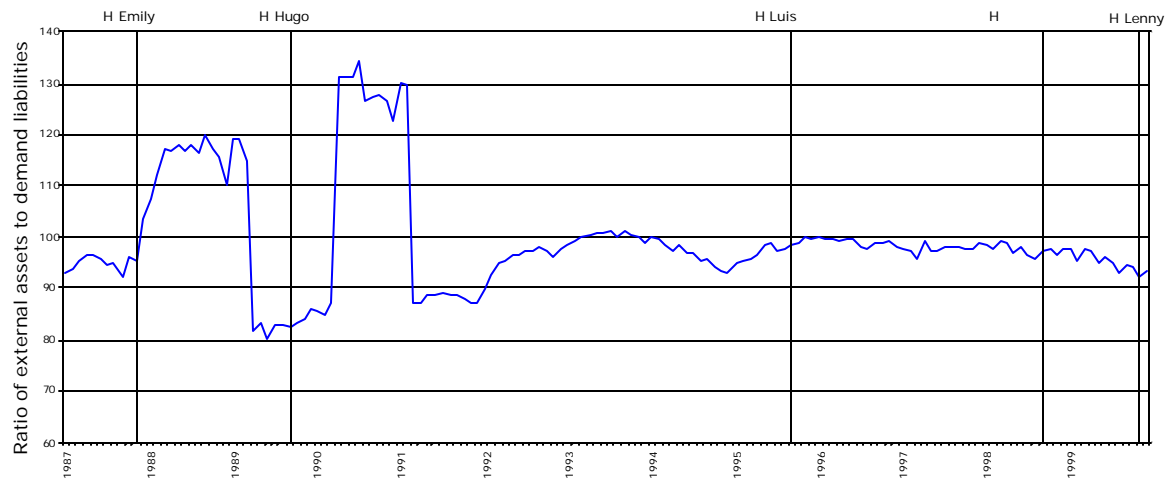
In part in order to take into account this potential volatility, whilst also ensuring that it meets its mandatory requirement to back at least 60% of its monetary liabilities with foreign currency assets, the ECCB has maintained a backing ratio of 90-100% since the early 1990s. Another factor – indeed, the major one – contributing to such a high ratio has been the limited draw down of credit lines available to member governments. The ECCB recognizes the considerable opportunity cost in holding such high levels of reserves abroad rather than investing them in income-generating activities within the ECCB. However, it considers that this practice provides an effective form of self insurance in view of the high cost of alternative commercial insurance.

On at least one occasion, the ECCB has explicitly taken more direct action to offset the impact of a disaster. Following the 1995 hurricanes and uncertainty about banana export prospects, the ECCB reduced its discount rates from 9% to 8% in August 1996 in order to help stimulate the regional economy, the first cut in interest rates since 199⁵⁷ (EIU, 1999). This reduction in part underlines difference in the potential impact of a disaster depending on the form of monetary regulation in place. In a national economy where a government has direct control over monetary instruments, a disaster can potentially contribute to an initial increase in the money supply as the government seeks to finance a possibly larger fiscal deficit and then to a subsequent tightening of monetary instruments to dampen further monetary growth. In contrast, a regional central bank or currency board is less likely to allow monetary policy to be influenced in this way by the circumstances of individual member states. There are possible parallels that might be explored between the behavior of the ECCB and the other major developing country regional currency arrangement, the West African CFA Franc zone.

The ECCB also operates a fiscal reserve account for on lending to member countries facing economic difficulties, including those caused by natural disasters. Contributions to the account are in part mandatory, with an amount automatically deducted from the profits owed to each member country. However, although the account has been in place for about six years it has never been drawn upon and the fund now totals around EC\$20m. This probably reflects the fact that any draw down would have to be re-paid, with terms and conditions to be determined on a case-by-case basis but probably including some interest payment.

⁵⁶ Other member countries are Anguilla, Antigua and Barbuda, Grenada, Montserrat, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.

⁵⁷ The minimum interest rate on savings deposits and the interbank rate were left unchanged.

Figure 9.1: ECCB - Ratio of external assets to demand liabilities, 1987-1999

Note: the sharp change in the ratio in April 1989 is due to a reclassification of demand liabilities.

Source: ECCB, various.

Broadly, available commercial banking data suggest that natural disasters have had relatively little overall impact on the banking and credit sector in Dominica, but that the sector's ability to spread and transfer risk is also limited. However, there are obvious difficulties in analyzing the impacts of natural hazards in isolation. Other factors have also contributed to sometime considerable inter-annual or even inter-quarterly fluctuations in money and credit markets. Analysis is also limited by data availability, with readily available public statistics only since 1980, while data on rates of default and deferred payment are not available at all. This section therefore provides only a brief account of historical evidence on the impact of natural disasters, suggesting that there are other confounding factors either obscuring or overwhelming any effects that disasters may have had on financial aggregates – credit assets and broad money supply. This analysis is complemented by a review of the vulnerability of individual banking and credit institutions on which there is more evidence.

Disasters and Financial Aggregates

The available data on commercial bank overdrafts by maturity indicate an increase in total short-term loans (up to one year) in both the hurricane years 1989 and 1995, although it should be noted that there have also been considerable fluctuations in levels of short-term lending between other years.⁵⁸ There is also some secondary evidence in official reports of increased GoCD borrowing from the domestic banking sector following various disasters including Hurricanes Allen (ECCB, *Quarterly Bulletins*, 1980) and Hugo (World Bank, 1992). The latter disaster in turn contributing to a tightening of credit markets as lending rates to the private sector increased by 1%. Domestic dis-saving more generally is also reported to have occurred as a direct consequence of the hurricanes in 1979 and 1980, with some dis-saving continuing into 1981 and 1982, although at much lower rates (ECCB, *Quarterly Bulletin*, 1984 (2(1))).

However, there is little more general discernible association between disasters and the composition of commercial bank lending by category of borrower, sectoral use or the total volume of lending. Similarly, there has been little apparent overall impact on the total level or pattern of distribution of commercial bank assets, or on interest rates.

An examination of net foreign assets suggests some possible disaster-related impacts. In both 1990 and 1996 – that is, in years following hurricanes – commercial bank foreign currency deposits fell, by 39.2% and 45.7% respectively.

⁵⁸ For example, total loans rose annually by over 20% in real terms in each of 1988, 1989 and 1990 whilst there was a parallel slow down in deposit growth, causing a marked fall in liquidity.

These movements could partly reflect deterioration in the external trade balance (see Chapter 7) and/or commercial bank draw down of foreign assets to meet refinancing needs.

Broader monetary impacts of disasters are not apparent from the data. There was a 36.6% real annual increase in money supply in 1978 with a further 43.1% rise in 1979, followed by a decline again by 22.8% in 1980. Quasi money fell by 2.4% in 1978, rose by 8.4% in 1979 and then declined by 5.6% in 1980. Some part of this increase may have reflected an increase in private sector demand deposits following receipt of insurance claim payments and also perhaps some disaster-related inflow of remittances. However, the fact that there were high levels of monetary growth in 1978 as well as in 1979 suggests that non-disaster related factors were also important. In 1989, money and quasi-money (M2) only increased by 4.2% in real terms year-on-year. In 1995, further substantial increases in money and quasi money occurred, but again possibly largely unrelated to the hurricanes that occurred in the same year, as a substantial part of the growth occurred in the first half of the year, prior to the occurrence of the hurricanes.

Disasters and Risks for Individual Banking Institutions

All those interviewed in banking institutions acknowledged the potential risk posed to their operations by natural hazards. However, each felt that their own institution was relatively well protected - and in the case of foreign commercial banks very well protected - despite the fact that commercial banks in the ECCB area do not carry any deposit insurance.

The two managers of commercial banks interviewed reported an increase in their institution's non-performing debt in the aftermath of hurricanes.⁵⁹ One also reported an increase in demand for loans from the tourism sector following the most recent hurricane, Lenny, in 1999. However, debt arrears are apparently often repaid at a later date whilst collateral is anyway secured against all types of loan. Default on loans on properties destroyed by a disaster is unlikely as commercial banks require insurance, including catastrophe cover, on all property and capital loans. Credit unions also require insurance coverage on property loans, including against catastrophes.

The foreign-owned commercial banks are in addition effectively protected by the fact that they have a wider geographical spread of risk, with individual branch banks part of a larger institution operating across a number of countries. The foreign-owned commercial banks manage their liquidity on a sub-regional basis, with one branch covering the reserve requirements of another (World Bank, 1998a). Moreover, they are typically more risk averse in their lending activities. For example, as a rule, foreign commercial banks will not extend loans to the agricultural sector because of the high risks associated with such lending.

However, a closer examination suggests that local bank and credit institutions may be potentially more vulnerable to severe natural disasters than they indicated, both by the nature of their lending portfolio and because their assets are less geographically diverse. They suffer from two major constraints which contribute to poor risk spreading practices and which the World Bank (1998a) suggests are faced by the financial system in the ECCB area more generally: inter-territory fragmentation and intra-territory fractionalization. This fragmentation reflects a combination of legal and regulatory obstacles and infrastructural and logistical factors, which result in domestic institutions that lack well developed portfolios. These institutions then have high operating costs and the risks associated with lack of diversification, and are unable to engage effectively in geographical risk spreading. Fractionalization has been caused by the proliferation of numerous operations and intermediaries within each island, particularly in the general insurance and credit union sector, and, again, has contributed to less diversified portfolio hedging against risks. Local banking institutions are also potentially more hazard vulnerable by the very nature of their lending operations, in part because they may feel obliged to take on higher risks.

Agricultural, Industrial and Development Bank

Dominica's development bank, the AIDB, has relatively few foreign assets, implying that its geographical dispersion of risk is certainly limited. The GoCD has a majority share in it, implying that the Bank feels that its overall position is

⁵⁹ ECLAC/ECCB (1998) also note that in Saint Kitts and Nevis ability to service loans was adversely affected by Hurricane Georges, although liquidity in the banking sector remained relatively buoyant.

nevertheless secure, but this arrangement ultimately has government budgetary implications in the event of a financial crisis.

In terms of the composition of its loan portfolio, in its capacity as the island's only development bank the AIDB is the principal source of agricultural loans, lending both to individuals and via cooperatives. It also targets small businesses and offers mortgages for lower-income families. Its loan portfolio therefore entails relatively high levels of risk. Its more favorable lending terms may also increase its risk exposure by involving longer repayment periods - as the World Bank (1998a) notes, increasing the probability that a disaster will occur within the period of loan repayment and thus adversely affecting ability to repay.

As with the commercial banks, the AIDB reports that in practice its operations have been affected by disasters principally in terms of increased re-scheduling of loans and higher rates of delinquency, particularly with regard to agricultural loans.⁶⁰ The Bank also reported a temporary decline in new agricultural lending after Hurricane Hugo, pending the recovery of the agricultural sector, suggesting that some farmers were largely able to rehabilitate their farms without incurring increased indebtedness, whilst others chose to reduce their activity. There was a similar pattern in 1995 (see Section 5.1.1).

Despite the fact that defaulted loans are often recovered a year or so later, the AIDB has become increasingly concerned about the risk of widespread default in the aftermath of a major disaster. It has therefore decided to aim to increase its non-agricultural operations, a decision which it has been able to implement relatively easily because it has coincided with reduced medium-term demand from the agricultural sector. In the aftermath of the 1995 hurricanes and windstorm, the AIDB also reduced new loan approvals in the tourism sector because of poor performance of the existing portfolio.

National Commercial Bank

Dominica's only local commercial bank, the NCB, also has a very limited geographical dispersion of risk. It is not involved in cross-border branch operations or inter-bank lending. Indeed, the NCB recognizes the importance of broader geographical coverage and has indicated its intention to strengthen internal networks and support mechanisms, such as syndicate lending, between indigenous banks in the region. The NCB's June 1999 Annual Report stated that the Bank's foreign reserve position was the highest in the OECS sub-region, implying some form of self insurance or risk minimizing strategy against domestic economic difficulties. In the aftermath of disasters, the Bank has also received inflows of external assistance for on lending to affected borrowers, again helping to maintain its level of capitalization.

In lending operations the NCB, like the AIDB, has effectively sought ways of protecting itself against increased risk exposure. It only makes very limited agricultural loans, equivalent to 3.8% of its total lending portfolio in 1998, and these have primarily been made through the DBMC, which effectively bears much of the risk in place of the NCB. Some of the NCB's other (non-agricultural) loans to small enterprises are also made through credit unions that on-lend the funds, again providing a layer of insulation against potential default.

Credit Unions

Credit unions are particularly vulnerable to potential problems arising from the high geographical concentration of their activities. Each credit union is an autonomous, financially separate community-based organization, operating on a non-profit basis within a very small area of the island. The credit unions offer various savings accounts, including cheque accounts, as well as loan facilities. Home loans, including mortgages which are offered by six of the credit unions, account for an average 95% of their total loan portfolio on average, with the remaining 5% extended to small businesses. Again, there is no hard evidence on the impact of natural disasters on credit union operations, in part

⁶⁰ The AIDB only began offering its first deposit accounts in 1997/98.

reflecting the more general weakness of data on their activities.⁶¹ Possible impacts are also obscured by their longer-term expansion, although the particularly high 39% real increase in new loans granted between 1979 and 1980 is noteworthy. However, although the Dominica Cooperative Credit Union League identified the WINCROP scheme (Box 5.1) as playing an important role in helping to sustain rural incomes in the aftermath of disasters, credit unions do face increased deferment of payment at such times. Meanwhile, their capacity to deal with any increase in demand for loans is limited, in part precisely because of higher deferment. To date, no credit unions have actually collapsed as a consequence of a disaster, but the possibility certainly exists. For example, it is not inconceivable that volcanic activity in the south of the island (see Box 13.2) could result in the withdrawal of insurance cover in the affected area and possibly also Roseau, as occurred in Montserrat in 1997 (see footnote 53). None of the six credit unions in the far south of Dominica offer mortgages. But the Roseau Credit Union does and so such a loss of insurance cover could therefore pose a threat to its financial viability.

Regional Risk Spreading

In recognition of the problems of inter-territory fragmentation and intra-territory fractionalization, there are some efforts underway to increase the overall level of integration of the banking system in the Caribbean, effectively enhancing its hazard risk-spreading role, although progress to date has been slow. At the OECS level, some investment has been begun in certain services such as common credit cards. Such efforts will facilitate risk sharing as banks in the region shift increasingly into syndicate lending. This risk sharing will also apply to natural hazards, as resources placed in potentially hazard-vulnerable investments could be provided by a number of lenders from a range of islands and banks. There has also been some discussion about the establishment of a jointly-owned lending subsidiary that could diversify across territories and fund loans that are too large for individual banks (World Bank, 1998a). The World Bank has also suggested that domestic financial institutions should be encouraged to acquire foreign financial assets: 'in the event of a natural catastrophe or severe economic downturn, the sale of foreign assets would balance an increase in imports, serving to stabilize the balance of payments... outweigh(ing) the risks of restricting investment to home markets'.

As indicated above, the banks and credit institutions are also taking certain steps to reduce levels of risk exposure as determined by the composition of their loan portfolios, particularly with regard to levels of agricultural lending (see Box 9.1). This does, however, raise an important question: could it become increasingly difficult to obtain agricultural loans in the future? If so, this could also have implications for post-disaster recovery, especially as banana production falls and thus the importance of the WINCROP scheme in supporting post-disaster recovery declines.

9.2 Inflation

Natural disasters might be expected to have a net temporary inflationary impact, potentially introducing a further element of economic uncertainty and compounding problems in re-establishing stability. Prices may rise as a consequence of supply shortages, reflecting damage to both goods and means of production and to transport and marketing infrastructure. Demand may also increase for certain items, such as building materials, depending on the nature of the disaster. Additional inflationary pressure could occur as governments resort to seignorage to help finance potential disaster-related budgetary difficulties. However, governments can also take certain measures to protect consumers against post-disaster, or more general, price hikes, at least partially offsetting inflationary pressures.

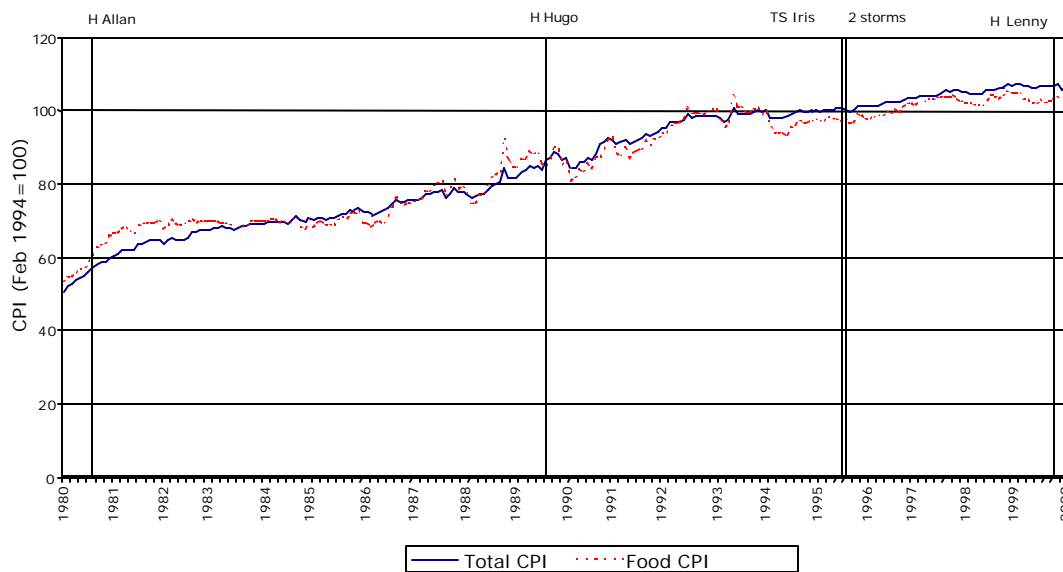
The rate of inflation has remained relatively low in Dominica over the past 20 years. Inflation, as measured in terms of the consumer price index (CPI), averaged 3.1% per annum between 1980 and 1999. Low average rates partly reflect the fact that the EC dollar has been tied at a constant rate of exchange to the US dollar since 1976. Limitations on the monetization of budgetary deficits by the ECCB have also effectively contained potential inflationary pressures. In addition, the price of certain items, including basic food items, has been administered, based on a pre-determined mark-up on landed price, although the items controlled have been gradually reduced over

⁶¹ Credit unions provide monthly and annual reports on their operations to the Dominica Cooperative Credit Union League. However, there is no legal requirement to do so, as credit union activities are not regulated. In consequence, there are a number of gaps in the data on credit union lending activities.

time. Instead, reflecting the openness of Dominica's economy, the rate of inflation has been primarily determined by movements in world market prices and rates of inflation in the USA, the country's main trading partner.

Natural disasters have also played some role in influencing price movements. However, in part as a consequence of deliberate government efforts, post-disaster price increases only seem to have occurred on a limited scale. The exception was in the aftermath of Hurricane David when temporary shortages of a wide range of commodities combined with other factors, including the 1979 oil price shock, contributed to more substantial price increases. The CPI increased 34.1% between December 1978 and December 1979 (Figure 9.1 and Table A.9.1). The food index alone, which has a weighting of 56.9% in the overall CPI, was reported to have increased by 45.4%, an indication that part of the rise in overall prices was probably due to Hurricane David rather than simply the oil price shock alone (ECCB, *Quarterly Bulletin*, 1980 (11(1)).⁶² There was a further increase of 21.3% in 1980. There has been nothing comparable before or since in the rate of consumer price inflation.

Figure 9.2: Dominica - Consumer price index: monthly index of all items and food, 1980-2000 (Feb 1994=100)



High inflation rates were again experienced in 1989, in part reflecting the impact of Hurricane Hugo on food production, as well as the removal of various taxes on wholesale trade and consumption (World Bank, 1992).⁶³ The overall CPI increased 8.2% between December 1988 and December 1989, with a 3.9% increase in food prices alone over the same period.

The GoCD (1995) also anticipated significant increases in the price of food for domestic consumption in the aftermath of the 1995 hurricanes, with forecast rises in the latter of 50 to 100%. It therefore took various steps to counter such increases, waiving import duty on chicken and mark-ups on flour and rice, encouraging farmers to plant short-term food crops and appealing for food aid. In consequence, the overall CPI actually rose by only 1.4% between

⁶² There may have been even higher temporary increases in the price of goods in the immediate aftermath of the hurricane. Unfortunately, however, monthly consumer price data is not available for the two months of September and October 1979.

⁶³ Consumption tax was removed from milk, cheese, dried and salted fish, smoked herring, flour, rice, sugar, natural yeast, baking powder, salt and medicines under the 1989/90 budget.

December 1994 and December 1995, with a 2.4% increase in food prices alone over the same period.

More generally, post-disaster inflation may also be partly constrained by the fact that Dominica imports much of its construction materials. In addition, Clause 5(2)(b) of Dominica's 1991 *Emergency Powers (Disaster) Act* also states that during a state of emergency maximum wholesale and retail prices can be fixed for items of food, clothing, water, fuel light and other 'necessities of life', although it is not clear whether this law has ever been applied.

9.3 Insurance and Other Financial Risk Transfer Mechanisms

The most commonplace form of financial risk transfer mechanism is that of a standard insurance policy. The cash payouts received in the aftermath of a disaster can play an important role in helping to facilitate the recovery process, both in terms of its pace and scope. If sufficiently competitive, the insurance sector can also act as an efficient mechanism for pricing risk, thus acting as a signaling device for the economy as a whole (Gilbert and Kreimer, 1999). Furthermore, insurance can be used as a mechanism for the enforcement of building and land use zoning codes by making the issue of policies conditional upon certain actions. Extensive use of the reinsurance market additionally offers a potentially important means of reducing the cost of reconstruction activities borne by the domestic economy and can help offset post-disaster current account deficits by generating a cash inflow.

Dominica has one locally registered insurance company, First Domestic Insurance, and, as of December 1998, 17 foreign registered companies. Basic property insurance policies cover all natural hazards, including windstorms and volcanic risk. However, there is a 2% deductible on claims relating specifically to natural disasters. Catastrophe insurance is mandatory for taking out a mortgage. Business interruption policies are also available, including against natural disasters. Catastrophe cover is not available on standard motor insurance policies, but can be purchased for an additional 1% of the value covered. Marine insurance is available but insurers reserve the right not to provide cover during the hurricane season, between 1st June and 31st October each year. A separate insurance scheme, WINCROP, exists for banana producers (see Box 5.1) but no other form of agricultural insurance is available. Foreign businesses are expected to secure insurance locally except under exceptional circumstances.

In comparison with many other developing countries, the insurance industry is relatively well developed, probably partly reflecting the level of risk posed by natural hazards, but not particularly high. Gross premium income totaled EC\$36.1m, equivalent to 6% of GDP in 1998, whilst gross premium on property insurance alone totaled EC\$11.13m or 1.9% of GDP.

However, the catastrophe insurance industry has played a relatively limited role in transferring or spreading natural hazard risk in Dominica. The GoCD (1995) notes that in the aftermath of the 1995 hurricanes and storms hotels were able to embark on rehabilitation fairly quickly because they were generally insured and were therefore expected to be open for business by the beginning of the tourist season in November. Yet although a high proportion of risk is reinsured overseas, over the period 1987-97 – that is, including the hurricane years of 1989 and 1995 – there was a net debit of EC\$25.0m on insurance services reported under the balance of payments. Gross reinsurance inflows after the 1989 and 1995 hurricanes specifically were relatively modest, with gross insurance credit of EC\$5.8m in 1989, EC\$10.1m in 1990, EC\$4.4m in 1995 and EC\$5.3m in 1996, compared to an annual average for the period 1987-97 overall of EC\$5.7m. Thus, post-disaster insurance payments would appear to be relatively modest. Limited claims in the aftermath of the 1995 hurricane were confirmed during an interview with one of the larger insurance companies operating in Dominica, which reported storm-related claims on less than 75 of its total of about 2,000 property insurance policies.

The problem of under-insurance in part reflects the high and volatile cost of insurance in the Caribbean region. The high volatility reflects the fact that some 80-85% of gross property insurance premiums in the region overall are transferred to reinsurers, with any fluctuations in reinsurance costs – be they caused by local, regional or global

factors - passed directly on to insurees.⁶⁴ Thus, there have been considerable inter-annual fluctuations in insurance premiums in the region, in some cases reflecting heavy losses in other parts of the world. An insurance industry informant provided the following history of premiums in the case of Dominica. Premiums had risen from around \$2-3 per \$1,000 cover in the 1970s to \$3-4 in the early 1980s (reflecting flood losses in the US rather than the impact of Hurricane David), about \$5 by 1988 and then \$8 by 1990 (again reflecting global factors, plus Hurricane Gilbert in 1988), declining to around \$6 by 1993 and then slowly edging up (following Hurricanes Marilyn and Luis in 1995) to around \$8 per \$1,000 covered in about 1997 or 1998, with a further \$2 rise to \$10 coming into effect as property policies were renewed in 2000. The latest rise reflects a tightening in world catastrophe reinsurance markets following a relatively active hurricane season in the Caribbean in 1999, as well as a number of disasters elsewhere. Others interviewed also reported a significant increase in premiums following Hurricane Andrew in 1992, which precipitated a change in reinsurer perceptions of the potential cost of hurricanes.⁶⁵ Rates only fell again from about 1995, following the creation of additional reinsurance capacity and the global development of capital market instruments, such as catastrophe bonds. A further major disaster in the Caribbean or a succession of global disasters could once again force a substantial increase in premiums.

Although no data are available on the scale of under-insurance in Dominica specifically, the World Bank (2000b) estimates that some 25-40% of dwelling stock in the Caribbean overall is uninsured, with the small and indigenous dwellings least insured. In contrast, almost all medium and large dwelling owners carry catastrophe insurance, but they may not be fully covered. In Dominica, for example, although mortgagees must carry insurance, as already noted, the level of insurance cover often remains based on the loan rather than the current market value of the property. Thus, as property prices have increased, only those householders with recent mortgages may be adequately insured. In the event of a disaster, insurance payments are further reduced by the application of an 'average clause', which assumes that policyholders carry self-insurance on the difference between the real estate and insured value of a property.⁶⁶

Take-up rates on business interruption policies are also very low - standing at perhaps only 5% in Dominica according to one insurance industry informant - with only the largest enterprises carrying this form of insurance. Meanwhile, certain hotels in Dominica are reportedly no longer insured after severe damage from successive hurricanes had resulted in a substantial increase in premiums.⁶⁷ The GoCD itself has some limited insurance on government buildings. Properties, including the government headquarters in Roseau, are insured by the Establishment Department to the total value of over EC\$20m. However, it is not clear whether any other public property is insured. Each government ministry is responsible for making its own decision with regard to insurance of buildings, other infrastructure and capital equipment falling under its jurisdiction but the extent of cover is almost certainly limited by budgetary constraints.⁶⁸

There are also concerns about the efficiency and underlying strength of the insurance industry in both Dominica and the Caribbean region more widely, relating to the proliferation of property and casualty insurance players in the

⁶⁴ Island-specific risk factors only seem to come into play where risks are perceived to be particularly high. For example, in Antigua, which has experienced four hurricanes during 1995-1999, rates as high as \$18 to \$20 per \$1,000 cover were being charged as of mid-2000.

⁶⁵ For the Eastern Caribbean generally, the World Bank (2000b) reports that average property rates increased from 40 per 1,000 cover in 1990 to 130 by 1994 (as a consequence of Hurricane Andrew in 1992) and then down to 70 by 1998.

⁶⁶ For example, if a house is valued at \$100,000 but insured for \$60,000, then in the event of a claim the insurer is only liable for 60% of the sum claimed.

⁶⁷ The World Bank (2000b) also reports that in recent years some larger and special risk categories in the Caribbean region more generally, such as power utilities, have not been able to obtain full, affordable insurance. In consequence some have voluntarily devised heavy high self-insurance deductibles, only seeking insurance for higher, less exposed levels of risk. Others have sought alternative solutions. For example, members of the Caribbean Hotel Association have created a risk management firm for their own exclusive use based on a PML profile of members' properties that indicated sufficient diversification of risks to allow a regional insurance company to survive a 1.3% probability of a major storm.

⁶⁸ The Dominican Port Authority (DPA) does not insure some of its assets because of difficulties in financing premium costs. Instead, it looks to government to make good part of storm damage costs (see Section 7.3).

Caribbean. This proliferation, in turn, has impeded effective capital market development and risk spreading functions, including the development of other financial risk transfer mechanisms (World Bank, 1998a). There is apparently strong competition for property insurance in the region, motivated by the desire to capture reinsurance commission revenues. However, the widespread competition for direct fees discourages primary domestic insurers from accumulating reserves, together with tax disincentives on the sector resulting in a high dividend paying industry, high dependence on foreign reinsurance and continued fractionalization.

The sharp rise in reinsurance premiums in recent years has led to higher commissions, attracting even more insurers and agents into the market. The World Bank (1998a: 20) states that 'the proliferation of small insurers is cause for concern regarding efficiency... but even more regarding safety. Are these small companies sufficiently capitalized for the 15% of the risk they retain? Are they sufficiently careful in choosing reinsurers that can be relied upon to pay up their 85% share? Regulation in this sector needs to be substantially strengthened...'. In order to help overcome these problems, the World Bank recommends that companies and household should be encouraged to establish financial reserves to supplement insurance and cover uninsurable losses; and governments to consider the establishment of reserve funds that could be drawn upon for infrastructure repairs. The OAS has similarly recommended both incentives and requirements for the creation of financial reserves. In reality, in the absence of any incentives, profits have traditionally been paid out instead in dividends (OAS, 1996a). The potential scope for building up reserves or surpluses has also been undermined by relatively high expense ratios of insurance companies, in turn again reflecting the relatively small size of companies and thus diseconomies of scale. The World Bank (1998a) suggests that an increase in competition that would lower the cost of insurance and a drastic reduction in the number of small companies operating would be desirable; and that tougher standards, including an ability to cover maximum probable losses consistent with international industry practice, are required for domestic companies to improve their safety, particularly given the stochastic nature of catastrophic events.

In Dominica, the government currently does not offer any tax incentives for the creation of catastrophe reserve funds. However, the Dominica insurance industry stands to gain from a 1998 Act of Parliament allowing Barbadian insurance companies to set aside up to 20% of their property portfolio profits against tax in a self-insurance fund. Barbadian companies hold a significant share of the Dominica market and profits eligible to be offset against tax include those made outside Barbados, as long as they form part of reported profits of the Barbadian company.⁶⁹ A proportion of these funds can also be invested overseas, ensuring some geographical spread of risk. Several major insurance companies have taken up this option, although smaller ones typically have not done so.

The ECCB has reviewed the regulatory framework of the insurance industry in the OECS and has drafted new insurance legislation aimed at providing disincentives to small players (by stipulating minimum levels of capitalization, reserves and so forth) and also encouraging amalgamation across countries (for example, by no longer requiring registration in every country an insurer operates just in one country in the region, so reducing licensing costs). The proposed legislation includes regulations on minimum levels of share capital required for registration. The legislation is now awaiting approval by each country in the region and, in Dominica, it was due to go before Parliament in 2000. Several regional and international organizations have also been exploring ways of reducing the volatility of premiums (Box 9.3).

⁶⁹ On average 75% of the OECS market overall is held by Trinidadian and Barbadian companies (World Bank, 2000b).

Box 9.3: Potential Regional Risk Management Arrangements

Various regional and international organizations have been exploring ways of reducing the volatility of insurance premiums in the Caribbean for a number of years. In particular, there has been some debate about the creation of some form of regional risk management tool. In the latest initiative, the World Bank is developing a proposal for the East Caribbean that favors some form of inter-country insurance pooling arrangement. The arrangement would aim to utilize reinsurance and risk financing resources more effectively by reaping economies of scale and improving capacity to accumulate and retain capital reserves. Thus, it would reduce the level and volatility of catastrophe insurance premiums, increase coverage and, it is intended, ultimately contribute to improved long-term development prospects. Another objective of the scheme would be to reduce physical hazard vulnerability through the improvement and enforcement of building code standards and land use/construction planning. In the earlier years of the pool, it is recognized that its full capitalization would require guarantee financing, a contingent line of credit for quick disbursement from a multilateral institution or, alternatively, a long-term bond issue in the capital markets. The World Bank has indicated that mechanisms could also be built into the scheme to facilitate the extension of some form of cover to poorer segments of the population and possibly to government-owned as well as private property.

There is strong governmental support in principle for the World Bank proposal in the region although the details, including its precise structure and how it would be financed, have yet to be determined. Governments in the region may be asked to provide a capital injection. Private sector contributions may also be sought. Individual insurance companies are more reserved in their enthusiasm to date. They feel it is not clear how the scheme would take into account the fact that different companies operate to different standards regarding the selection of reinsurers, inspection, underwriting of risk, etc. There is also some concern about the viability of the scheme given the high ratio of claims to premiums in the Caribbean region in recent years. The CDB/IADB (1996: 12), for example, notes that 'the pooling of risks for a group of disaster-prone mini-states is not likely to achieve much improvement in terms of damage and claim probabilities'.

Finally, there has been limited use of insurance as a mechanism for the enforcement of building and land use codes, despite calls for its use to this effect.⁷⁰ Within Dominica, a differential premium structure exists to some extent, with at least some companies offering a discount on policies for properties that have been strengthened against natural hazards. For example, since 1998-99 a \$2 per \$1,000 discount has been available at least from some companies on retrofitted, concrete-roofed properties while excess premiums are charged on beachfront properties.⁷¹ One insurance industry informant reported, however, that the availability of a lower premium does not, of itself, apparently encourage retrofitting.

More widespread discriminatory pricing practices, both in Dominica and the Caribbean more generally, are discouraged by low retention of risk combined with the reinsurance industry's blanket pricing policy. Wide geographic areas are placed in the same Probable Maximum Loss category, as the World Bank (2000b: 57-58) comments 'without regard for the topographical features and structure resistance distinctions propounded by regional and international experts'.⁷² Meanwhile, OAS (1996a) reports that individual insurance companies fear that significant premium discounts for their better-protected risks cannot be balanced by surcharging poorer risks. As such, insurance companies – with one notable exception (see Box 9.4) - typically follow the reinsurance lead, in effect doing little to promote hazard mitigation in the region. More widespread discriminatory premium pricing would require comprehensive hazard mapping as well as inspection to determine the vulnerability of individual properties.

⁷⁰ For example, the OAS (1996a) recommended that compliance with building codes should be required before insurance coverage can be provided. The World Bank (2000b) has also recommended the linkage of insurance regulation to building code compliance prior to the provision of insurance coverage or discounts based on vulnerability reduction measures.

⁷¹ In the past, levels of premium were also determined by proximity to fire hydrants but this practice was discontinued after fire-fighters responding to fire emergencies found that some fire hydrants contained no water.

⁷² Broadly, the northern zone (Antigua and Barbuda and Saint Kitts and Nevis) is considered the higher risk zone, the middle zone (Dominica, Saint Lucia and Barbados) medium risk and the southern zone (Saint Vincent and the Grenadines, Grenada and Trinidad and Tobago) the lowest risk, particularly with regard to hurricane activity (World Bank, 2000b). Some reinsurers also lump the south-eastern part of the United States together with the north Caribbean.

Box 9.4: United Insurance's Mitigation Program

One Caribbean based insurance company, United Insurance, has been actively promoting structural mitigation measures. The company first recognized the need for such measures in the early 1990s, as reinsurance costs began to escalate. The company introduced a formal mitigation program in 1997.

Under the program, premium discounts of up to 40% are available for retrofitted commercial properties, and 17-25% for retrofitted domestic properties. In order to qualify, commercial properties must be inspected by a structural engineer. An insurance company representative inspects domestic homes. In support of the program, United has also produced two sets of guidelines on upgrading existing and designing new buildings to achieve hurricane resistant construction. These guidelines, which conform with CUBiC standards and those specified in the draft OAS codes, have been made available not only to United's clients but to the insurance market more generally.

The program is offered in all islands in which United operates, including Dominica, but has been taken up particularly in Antigua, where a high frequency of hurricanes has been experienced in recent years. The program has already achieved impressive results. The average cost of claims on affected risks following Hurricane Jose in Antigua in 1999 was equivalent to 10% of the total sum insured, but to only 4.75% of the sum insured in the case of retrofitted projects. Some 7-8% of properties insured by United Insurance in Antigua are now covered under the mitigation program. Although the program was not intended as a marketing tool, in Antigua it has also generated new clients for the company.

United has considered making its mitigation program mandatory for all its insurees but, as the sole company offering such a scheme, concluded that, on balance, it would probably lose clients if it did so. Meanwhile, it feels that there is neither the political nor economic will to make the program mandatory for the insurance industry as a whole, although the OAS has tried to encourage United to spearhead a move to achieve a regional consensus in the industry.

Chapter 10.

Public Finance

This chapter analyzes the effects that natural disasters have on the public finances. It begins by providing the background of severe fiscal constraints. Next it looks at the evidence of impacts of severe storms on both revenue and expenditure. Next it considers the implications of findings that suggest the budget is apparently relatively insensitive to disaster shocks. Finally, there is an examination of the disaster related constraints on road development. The analysis is supported by a more detailed review of the budgetary impacts of major storms of 1979, 1989 and 1995 in Annex C.

10.1 Background

Fiscal policy is the major macroeconomic policy instrument at the disposal of the GoCD. As already indicated, the ECCB is responsible for monetary policy for the OECS and there are strict limitations on the ability of member governments to monetize public debt by borrowing from the ECCB, as fiduciary issue is limited by statute.

The GoCD faces particular challenges in achieving a balanced fiscal account, reflecting the great pressure on its limited resources. As the GoCD (2000: 1) states:-

'as a result of the size of the country, the intensity of the topography and the settlement patterns, a widely dispersed system of public services is required to meet the basic needs of the population like security, public health, education, recreation and community services. This results in increased pressures on the fiscal account as resources need to be allocated to maintain the provision of services which, in other cases, would not have been economically justifiable'.

The GoCD also faces an additional burden in the form of natural disasters. However, the GoCD has never tried to document the public finance implications of the island's hazard vulnerability, although it recognizes the potential usefulness of such an exercise.

In part reflecting high per capita costs in servicing its dispersed and small population, the central government has historically run only a marginal surplus, if at all, on its recurrent fiscal account (Table A.10.1). Moreover, external concessionary and grant inflows have financed a large proportion of public investment as well as some recurrent expenditure. For example, local duty accounted for only around 60% of total government revenue over the period 1978/79 to 1997/98 (Table A.10.2).⁷³

The strengthening and stabilization of the public finances has been a key stated objective of the GoCD since Independence and there have been continuous efforts to restructure the public finances, both via tighter controls on expenditure and efforts to increase revenue generation. Recurrent expenditure has been high, accounting for some 77% of total expenditure between 1979/80 and 1997/98. The public salaries and wages bill alone has typically accounted for over half of total recurrent central government expenditure. The GoCD also has faced increasing external indebtedness. Public debt servicing gradually increased, from 5.3% of recurrent expenditure in 1977/78 to 15.2% by 1995/96, with further growth in subsequent years.

⁷³ The GoCD uses the term 'local duty', rather than the more conventional 'domestic duty'; and 'local expenditure' rather than 'domestic expenditure'. This report follows GoCD practice.

10.2 Impact of Natural Disasters

In theory, natural disasters may have several potentially significant impacts on public finance. They can result in either additional expenditure or partial redeployment of planned expenditure, both to meet the costs of repair and rehabilitation of public property and to provide support to the victims of disasters. They can also cause a fall in domestic revenue, reflecting reduced economic activity. Although such losses may be partly offset by increased flows of official external assistance, they are unlikely to be entirely so. Publicly owned enterprises may also experience disaster-related losses, placing an additional burden on government resources.

In consequence, the government may face intensified budgetary pressures which it will be obliged to meet by increasing the money supply, running down foreign-exchange reserves or raising levels of domestic and/or external borrowing. These financing options, in turn, have potentially significant knock-on effects. The creation of base money is inflationary. Domestic borrowing exerts upward pressure on interest rates and can result in a credit squeeze. Foreign borrowing can result in an appreciation of the exchange rate, reducing the price of imports and increasing that of exports, and create future economic pressures via higher debt-servicing costs. Natural disasters can also trigger an increase in interest rates charged on external debt by increasing the risk premia associated with a country's assets. Another option, the run-down of foreign-exchange reserves is limited by the very size of those reserves and entails an appreciation in the exchange rate, with possible associated risks of capital flight and a balance-of-payments crisis (Fischer and Easterly, 1990).

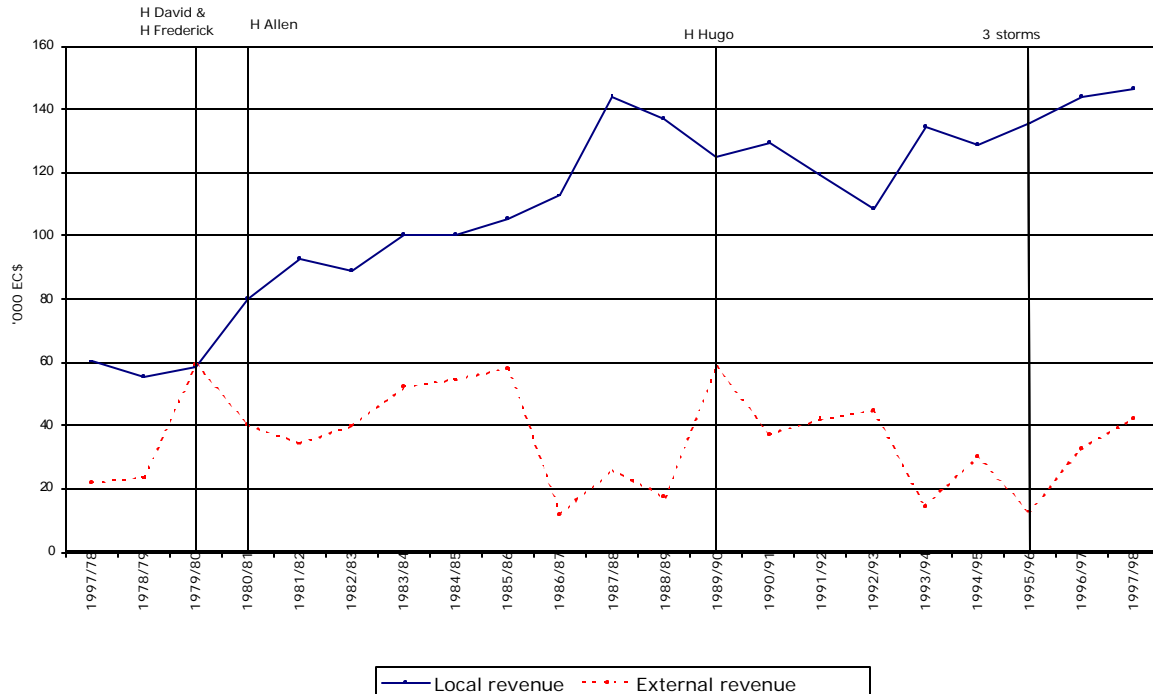
Disasters can also impose more permanent pressures on public finance to the extent that governments undertake disaster mitigation and preparedness measures, costs which governments in less disaster-prone countries do not have to bear.

In the case of Dominica, however, an inspection of aggregate budgetary statistics suggests that disasters have had little apparent impact on the public finances, except in the most severe events. Until the 1990s, public expenditure on disaster mitigation and preparedness also appears to have been relatively low, although, as discussed in further detail in Annex C, this may partly reflect problems in the way expenditure is categorized.

Partly in response to Hurricane David, but also because of civil service wage increases on an already inflationary situation, recurrent expenditure rose by 31.3% in real terms in 1979/80 and by 11.8% in 1980/81⁷⁴. In contrast, more recent hurricanes have had little discernible impact on total recurrent expenditure. Indeed, despite Hurricane Hugo, recurrent expenditure actually fell 2.7% in real terms year-on-year in 1989/90 (Figure 10.1). Instead, natural disasters have largely resulted in changes in the composition of recurrent expenditure due to ex post reallocations of resources, although the full extent cannot be easily gauged because such re-allocations have not been recorded. Some re-allocations have probably occurred between, as well as within, ministries, effectively facilitated by the fact that allocations to individual sections of government are not ring fenced for their specific use.

⁷⁴ As explained in further detail in Annex B, the finalization of the 1979/80 Budget allocations was significantly delayed and so took into account additional requirements arising as a consequence of Hurricane David.

Figure 10.1: Dominica - Central government local and external revenue, ('000 EC\$ at real 1990 prices)



It is even more difficult to measure the impact of natural disasters on the overall level of capital expenditure. Capital investment projects relating to post-disaster rehabilitation and reconstruction are typically not identified as such in annual budget statements, whilst post-disaster reconstruction can also be significantly delayed and prolonged. For example, a large part of the increase in capital expenditure that occurred between 1983/4-1985/6 – that is, up to seven years after Hurricane David - could be attributed to major road investment projects in part necessitated by the hurricane (see Annex A). There are further difficulties in relating all this expenditure to Hurricane David because much of the country's infrastructure was already in a poor condition due to years of inadequate maintenance and low investment (CDB, 1980). Thus, part of the increase in capital expenditure that occurred in the first half of the 1980s would have been required in any case. Finally, measurement difficulties are further complicated by the fact that reconstruction can also involve some upgrading of services.⁷⁵

However, it would be reasonable to conclude that disasters have displaced planned investment projects by creating more urgent needs. This observation is confirmed by GoCD (2000: 4) which states that 'the fiscal burden (of natural disasters) has been significant necessitating the diversion of scarce resources from programmed activities'. Moreover, even when additional external financing has been made available in the aftermath of a disaster, the GoCD has sometimes been unable to use these funds because it has been unable to meet associated local counterpart financing requirements – as, for example, in the aftermath of the 1995 storms (see Annex C.3).

As regards revenue, aggregate data on both local and total central government revenue on the recurrent budget again suggest that disasters have had relatively little impact, other than in generating additional external budgetary support in the aftermath of Hurricane David. The apparent insensitivity of local revenue to natural disasters, and

⁷⁵ There are also further problems in examining the relative allocation of the capital budget to individual government departments. This is because detailed sectoral data on actual capital expenditure, as reported in annual budget statements (relating to expenditure in the years immediately preceding that specific budget year), typically exceed total capital expenditure as subsequently reported, for example, in the 1999 Statistical Digest (GoCD, 1999a).

associated economic decline, is to some extent explained by coincidental, non-disaster related changes in the tax structure that have offset the impact of particular disasters (see Annex C). Local revenue has also been relatively insensitive to natural disasters because there is no direct taxation on agricultural production in Dominica, whilst export taxes have been a relatively unimportant source of revenue, accounting for well under 1% of total local revenue since 1979/80.⁷⁶

Meanwhile, as already noted on the capital expenditure side, the limited discernible impact of disasters on capital funding largely reflects the lagged responses by donors and extended nature of external assistance, which accounts for most public capital funding in Dominica. However, it is also worth remarking that in each of the years 1979/80, 1989/90 and 1995/96, the contribution of local duty to capital expenditure dropped significantly, presumably as available local resources were diverted into the recurrent budget to meet increased disaster-related costs.

There are five non-financial public sector enterprises in Dominica: the Dominica Banana Marketing Corporation, Dominica Export Import Agency, the Dominica Water and Sewerage Company, the Dominica Port Authority and the Dominica Broadcast Corporation. Information on their finances and central government subvention is not included in government statistics or budget estimates and further detailed investigations were beyond the scope of this study. Nevertheless, it is apparent that disasters have had a severe negative impact on several of the public enterprises (see Sections 6.3, 6.4 and 6.6). More generally, the World Bank (1985) reported that the consolidated current account of the non-financial public enterprises fell into deficit following Hurricane David and remained in the red until FY 1983/84. A deterioration in the DBMC's finances was again reported in FY 1989/90, a consequence of Hurricane Hugo and related rehabilitation expenditure (World Bank, 1992) and it was recently adversely affected in 1999 by Hurricane Lenny (DMBC, 2000).

10.3 Implications

The above analysis highlights the complexity in measuring the budgetary impacts of disasters. A review of data on total annual revenue and expenditure suggests that disasters have had little apparent impact, except in the case of the most extreme events. However, this apparent insensitivity to disaster shocks partly reflects the government's response of reallocating available budgetary resources in support of disaster relief and rehabilitation. The extent of ex post reallocations is exacerbated by the fact that the GoCD does not set aside any calamity reserves. Indeed, the practice of reallocating expenditure in this way is apparently an annual occurrence, as unanticipated expenditure on landslides and storms crowds out routine maintenance every year.

In reality, the hidden cost of disasters is substantial. Indeed, their budgetary implications have been so severe that they have been a contributory factor behind Dominica's adoption of a structural adjustment program in FY 1986/87 and, in the more immediate aftermath of Hurricane David, certain reforms under an IMF-supported program. There was further pressure for adjustment following the 1995 storms.

Disbursement of external post-disaster capital rehabilitation assistance have also been slow, effectively delaying recovery both because of continuing infrastructural problems and because the implied multiplier effects of major reconstruction efforts have not been felt. Delays in the receipt of external resources, in turn, have partly reflected local counterpart financing difficulties. Faced with increased disaster-related budgetary difficulties, the government has been even less able to meet local counterpart funding requirements, upon which the receipt of external aid may be conditional.

⁷⁶ The program agreed with the IMF in November 1981 sought to increase recurrent revenue, but nevertheless recognized that although farmers had not paid income tax since 1974, the state of the agricultural sector was such that it could not be expected to provide a direct contribution to revenue yet (GoCD, 1981). No subsequent agricultural tax has been introduced although a banana development levy was collected until 1992/93 (known until 1984/85 as an estate levy). This levy was based on the banana export price and paid directly by the DBMC. At least from 1977/78, it was not a particularly significant source of government revenue, accounting for 3.4% of local and 4.4% of total central government revenue at its peak in 1991/92. Nevertheless, it is worth noting that it was suspended in FY 1992/93, in part as a consequence of Hurricane Hugo.

In the longer term, disaster shocks have had an adverse impact on the very pace and nature of economic development in Dominica. In aiming to achieve one of its principal goals of economic diversification, the GoCD has placed particular emphasis on the provision of infrastructure to support growth in agriculture, manufacturing and tourism. However, the weak infrastructure base has been consistently identified as a critical constraint (e.g., GoCD, 1998 and 2000), limiting the country's ability to attract and sustain new productive investment. Part of this weakness relates to the continuing vulnerability of the internal transport and communication network to adverse weather systems, as illustrated below in the context of the road system (see Sections 6.4 and 10.4), necessitating additional expenditure to rehabilitate the roads in the aftermath of storms. The indirect fiscal impact of disasters has been an additional factor behind the island's weak infrastructural base, contributing to limited government saving and restricting the availability of counterpart financing. As the GoCD (1998: 24) states, 'the lack of counterpart financing has also led to the non-implementation or the deferral of important projects in the social sector, notably in housing, water and sewerage'.

It is essential that the budgetary impacts of disasters are measured more explicitly, in order to emphasize the importance of integrating hazard risk reduction concerns into medium- and long-term economic and financial planning. This will also contribute to a more rational response to disasters, including in the reallocation of public resources, in the identification of the most appropriate forms and levels of external assistance and in assessing the GoCD's ability to raise local counterpart funding. Moreover, disasters have effectively resulted in unplanned and unevaluated budgetary reallocations, in part relating to their timing relative to the financial year. Dominica's financial year begins in July, just at the start of the hurricane year. Thus, most immediate post-disaster expenditure falling under the recurrent budget is not anticipated. Subsequent budgetary reallocations can then force planned development off course and imply that short-term targets are not met.

Careful and detailed reviews of the fiscal implications of individual disasters, undertaken in their immediate aftermath, would also help make the reasons underlying any failure to reach planned targets more transparent – an ever more pertinent exercise in the face of declining aid resources and increasingly stringent donor conditionality. Explicit monitoring of annual expenditure on disaster and storm-related damage would also provide invaluable data for use in appraising potential projects, not only those explicitly labeled as disaster mitigation or preparedness but also others potentially including mitigation or preparedness components as part of broader projects or for which the level of quality of infrastructure invested in could play a role in determining hazard vulnerability.

Improved measurement of the financial impacts of disasters is particularly important as the GoCD again enters a period of increased budgetary constraints. As of 1998, discussions were being held with the EU for budgetary support and subsequently some STABEX funds have been used for this purpose. Rises in debt service commitments are also anticipated as additional commercial borrowing is expected to be required to meet statutory commitments on a timely basis. Increased debt repayment requirements are expected to curtail future new borrowing options, implying that the current account will have to meet an increased share of the capital expenditure program, which in turn is required to play a critical role in the overall restructuring process. The GoCD (2000) has identified three particular areas of government expenditure at risk in such an environment including the country's capacity to provide short-term responses to natural disasters.

10.4 Road Development and Disaster-Related Public Finance Constraints

The importance of infrastructure to economic and social development is widely recognized, reducing costs of goods and services and increasing access to markets and basic services. Internal transport in Dominica is entirely reliant on the road network. As of the mid-1990s, Dominica had a total 787 km of roads, of which 74% was paved, equivalent to a relatively high 8,041 km per million people. Although the volume of traffic is low on many roads, the network is essential for serving the island's scattered population, the two ports, airport (by road some 50 km from the capital, Roseau) and areas of agricultural production. Some 46% of the road network is estimated to be in good condition (CDB/IADB, 1996).

The road system has placed a constant strain on the public finances, in part because of the damage inflicted by natural disasters, as already documented in Chapter 6. There has been substantial capital investment in roads since the early 1980s, totaling almost EC\$223m (at constant 1990 prices) between 1979/80 and 1997/98, equivalent to 31% of total capital expenditure over the same period. However, investment requirements still remain considerable. Indeed, the GoCD (1998) stated that 'at 15.5% of the (most recent) Public Sector Investment Program (PSIP) allocation (\$31.6m), the investment in transportation infrastructure represents a very small portion of transportation investment needs'.

Annual expenditure on road maintenance has also been relatively high, averaging EC\$5.1m per annum (at constant 1990 prices), or 4.3% of total recurrent expenditure, between 1979/80 and 1997/98. As the CDB/IADB (1996: 60-61) comments, 'a major implication of small populations and fractured geography is the high per capita cost of maintaining most road networks in the Caribbean'. However, evidence suggests that additional maintenance tasks created as a consequence of hurricanes and storms have resulted in the reallocation of funds away from routine activities such as patching, culvert and ditch cleaning and cutting of roadside vegetation, compromising the ability of the road authority to maintain the overall road network to an acceptable standard and, in the long run, increasing the cost of future disasters.

For the purposes of this study, it has not been possible to estimate the proportion of total public recurrent expenditure on the road network that has been necessitated as a direct consequence of natural disasters. Indeed, the GoCD has made no effort to track such expenditure. However, during an interview for this study, it was suggested that perhaps 30% of the annual roads maintenance budget is spent repairing damage from slides and floods.

There are also difficulties in isolating the proportion of capital road expenditure that has been necessitated as a consequence of natural disasters. Nevertheless, available evidence on the estimated cost of post-disaster rehabilitation suggests that the figure must be substantial (see Section 6.5). For example, considerable damage was sustained as a consequence of Hurricanes David, Frederick and Allen in 1979 and 1980, exacerbated by years of inadequate maintenance and aged pavement and drainage systems. A subsequent GoCD Road Maintenance and Rehabilitation Programme for the period 1982-85 called for the rehabilitation of 227 km of main road and 14 bridges as well as the reconstruction of 43 km of feeder roads. This program was estimated at a total cost of US\$36m (EC\$97.2m) or 27% of the PSIP (World Bank, 1982), although even in the absence of the hurricanes some of this expenditure would have been required in view of the extended period of under investment in road maintenance. Meanwhile, rehabilitation and reconstruction costs following the 1995 hurricanes and storms were estimated at EC\$11.75m (GoCD, 1995). The road rehabilitation costs as a consequence of the impact of Hurricane Lenny, including strengthening of sea defenses to mitigate further damage, were estimated at EC\$110-125m (GoCD, 2000; Liautaud, 2000). The road network also suffers storm damage on a lesser scale on an annual basis. For example, unseasonable heavy rains over Easter 1980 were reported to have caused several million dollars' damage to the roads (GoCD, 1980).

Tight budgetary constraints, a scattered population and high hazard vulnerability create particular difficulties in defining appropriate road standards. According to the GoCD, it is relatively difficult to secure external funding for major road projects because in much of Dominica roads have low ERRs. In the same vein, cost-benefit analysis could suggest that low standards are appropriate in view of the volume of traffic. However, such analysis may fail to take into account the implications of road quality for maintenance costs and natural hazard vulnerability. Indeed, during this study, government officials cited an example of a recently completed road across the interior of the island that had already deteriorated significantly, because the quality of the road was determined on the basis of the projected volume of traffic rather than weather conditions.⁷⁷

⁷⁷ Concerns about the appropriate standard of roads were also raised in the context of a World Bank road maintenance and rehabilitation project approved for Dominica in 1982. This project was designed on a least-cost approach in order to rehabilitate, rather than upgrade, roads and thus to achieve considerable short-term gains in road conditions. The project included drainage improvements that, although not formally quantified, were estimated to have an economic return of over 50% by reducing requirements for emergency maintenance (World Bank, 1982). Nevertheless, during project implementation the GoCD raised

Post-disaster repairs are also typically undertaken on a least-cost basis, with roads simply patched up to re-establish access as quickly as possible. Once this task has been completed, the Ministry of Communications, Works and Housing reviews the funding available for further repairs but, in reality, no additional work is sometimes done. This, in effect, minimal basic maintenance approach again leaves roads more vulnerable to future storms. Thus, although already substantial, road maintenance expenditure may not be sufficiently high.

concerns that the project's overall least-cost approach would result in high future maintenance costs. The World Bank's project performance audit report also subsequently discussed the possibilities of relatively high future maintenance costs and further hazard-related damage, indicating some doubt that adequate government funding would be available for an appropriate level of maintenance in the future (World Bank, 1986). However, the same document concluded that the application of least-cost solutions to the rehabilitation efforts had been a sound decision under the circumstances, including the urgency of the task at hand and level of funding available.

Chapter 11.

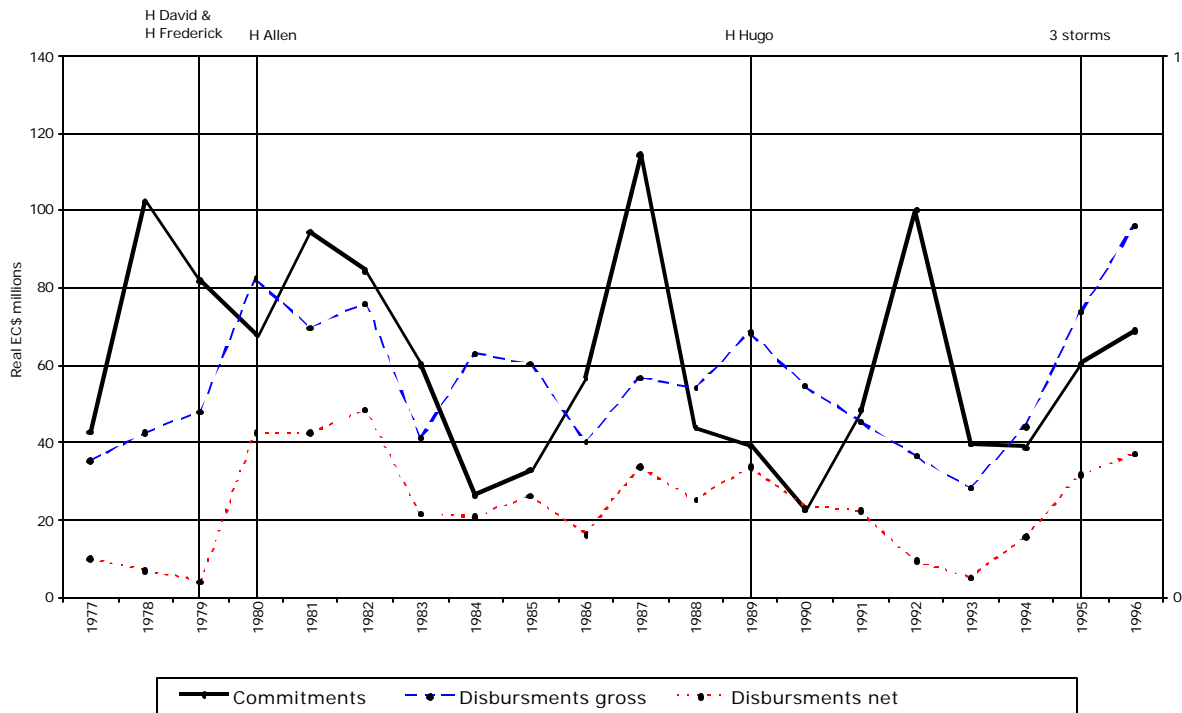
External Assistance and Macro Variability

External assistance accounts for a large proportion of the GoCD's public capital expenditure and also for intermittent recurrent budgetary support. As such, the impact of natural disasters on aid disbursements has already been touched upon in Chapter 10 of this report. However, it is also worth undertaking a separate examination of external assistance to consider the impact of disasters on aid commitments as well as disbursements; to explore the behavior of individual donors in more detail; and to investigate other factors determining aid flows and, where relevant, how these have interacted with disaster events. Disasters also impact negatively on the external sector through reduced export earnings and some temporary increase in imports, raising the additional issue of the extent to which external assistance has provided compensatory capital flows (see Chapter 7). To explore these issues a statistical analysis of aid flows over 20 years since 1979 was undertaken, using the OECD's Development Assistance Committee's (DAC) database. Neither GoCD official statistics nor documentation available during the visit offered a complementary source of information on official flows covering such an extended period. When examined, the data reported to the DAC on sectoral and other uses of aid were found to be incomplete and sometimes misleading. It was, therefore, decided not to proceed with a statistical analysis of the composition of aid flows.

Total development assistance as commitments and gross and net annual flows in real terms between 1977 and 1996 is shown in Figure 11.1.⁷⁸ There are no discernible trends in the level of total aid flows in real terms since Independence, but considerable short-term variability. There is also no discernible pattern in aid commitments that can be related to the major hurricanes shocks, the exception once again being Hurricane David. Gross and net disbursements, which are only loosely related to commitments with a 1 – 2 year lag, are also not closely associated with shocks that impact on the balance of payments and the budget, including natural disasters, total exports or banana export earnings. This result confirms the pattern indicated in Chapter 10 in relation to individual disasters – namely, that receipts of external disaster-related assistance are delayed, prolonged and to some extent may divert resources away from non-disaster related projects, together implying that natural disasters typically have little discernible impact on aggregate annual levels of aid disbursement.

Instead, the time pattern of total aid flows appears to reflect a sequence of 'policy' outcomes involving the small number of important donors, both individually and in concert. There was a cluster of aid commitments at around Independence in 1978, particularly by the departing colonial power, the UK. Canada and the European Commission (EC) also made substantial allocations. Following Hurricanes David and Allen, there were new commitments of relief and reconstruction assistance peaking in 1981, perhaps also in part stimulated by increasing political stability in the country. Rapid disbursement in support of the relief and reconstruction efforts, as well as slow disbursement of earlier commitments made in 1978 (this delay itself possibly due to the hurricanes) resulted between 1980 and 1982 in the highest sustained levels of disbursement before the late 1990s. A high level of net disbursement reflected the high proportion of grant assistance for relief and reconstruction and official debt written off by the UK.

⁷⁸ Aid flows are analyzed after being converted to real 1990 EC\$ using the DAC aid deflator.

Figure 11.1: Total aid flows to Dominica, 1977-1996 (million EC\$ at real 1990 prices)

The subsequent peaks in aid commitments in 1987 and 1992 were linked to structural adjustment agreements. Later disaster shocks are less obviously related to increased disbursements, although in 1989 and 1995 there were increased disbursements. When the relationship between changes in aid flows (both in terms of commitments and disbursements) and hurricane shocks is explored using regression analysis, this confirms only the clearly visible response to Hurricane David. There is also no statistically significant relationship between aid flows and fluctuations in exports or banana export prices, the main source of external shocks (see above Chapters 5 and 7).

Highly aggregated flows encompass quite diverse behavior at a donor agency level. A review of donor commitments and disbursements over a 20-year period suggests a variety of influences on donor actions. Initially the UK and the CDB were the main source of external assistance. From 1979 the EC, Canada and, to a lesser extent France and Japan, became important sources of support. The only reported direct US assistance was after Hurricane David, but USAID also channeled funds through the CDB (Section 6.4) and the OAS. The IMF provided support through both its Emergency Assistance arrangement and its Compensatory Financing Facility (CFF) in December 1979. Dominica again borrowed from the CFF, but only in 1992, in response to loss of export earnings resulting from Hurricane Hugo in 1989. The World Bank was not an important source of development lending. The involvement of individual UN agencies was modest because of Dominica's small claim and middle-income status. Individual donor and agency actions reflect the consequence of discrete development, usually capital investment, projects that are relatively lumpy in the case of this very small economy. In the late 1990s the EC emerged as an especially significant donor (Cox and Chapman, 1999), providing even budgetary support from ACP-Lome long-term development and STABEX funds in relation to the Barbados Programme of Action (Commonwealth Secretariat/World Bank, 2000). This support was extended in the context of declining export earnings from bananas, which is as much a result of a sustained decline in profitability as the effects of hurricane and drought shocks. In the Caribbean region donor agencies are typically organizing development co-operation through regional offices with responsibility for a relatively large number of countries. So a disaster may temporarily ensure greater attention to the management of aid to the affected countries.

This may contribute to accelerated disbursement of already committed aid as well as new actions. That could explain some evidence of increased disbursement after disaster shocks.

The main conclusion of this relatively superficial analysis is that neither aid commitments nor disbursements have been very responsive to the considerable short-term external account public expenditure pressures that resulting from external shocks and natural disasters. The important exception is the concerted response in the most extreme case, the catastrophic effects of Hurricane David, which became an international disaster in the full glare of media scrutiny.

Chapter 12.

Social Issues and Poverty

Issues of social vulnerability to natural hazards and their impacts at a community and household level are outside the scope of this study. Nevertheless, this is an extremely important area that we have found to be little researched, meriting further investigation. Such issues need to be better understood in order to formulate an appropriate disaster management strategy, including both mitigation and preparedness and the strengthening of broader social policy to make it more sensitive to problems of vulnerability and poverty caused or exacerbated by natural disasters.

This chapter draws attention to areas that should be explored in further depth. Attention is also drawn to more specific issues that have been highlighted in the course of our investigations.

12.1 Demography and Human Capital

Hurricane David resulted in the exodus of almost 20,000 people, equivalent to about a quarter of the pre-Hurricane (1978) population (Chapter 1). This outflow included many school-aged children. There was also anecdotal evidence of skill shortages as many of those with marketable skills migrated to other islands. The government subsequently encouraged the return of farm workers from North America, with the largest numbers returning between 1981 and 1989, during the period of rehabilitation and subsequent banana boom (GoCD, 1999a, Table 28). However, twenty years later the population had still not recovered to its 1978 level.

12.2 Education

Successive hurricanes have caused physical damage to school buildings, but their full effects on education have not been documented.

The effect of Hurricane David was also apparently felt in terms of its impact on the school population. Data on enrolment in primary schools indicate a 12.8% drop, equivalent to 2,682 pupils, between academic years 1978/79 and 1979/80, with a further 9.8% fall the following year, apparently reflecting post-David related out-migration of families with primary-aged children. The primary school population temporarily increased again in 1981/82, to 91% of its 1978/79 level, but has since entered a period of long-term decline. The high school population, although equivalent to only 11.5% of the primary school population in 1978/79, was more resilient, increasing marginally in 1979/80 and again in 1980/81 and 1981/82.

12.3 Healthcare

Successive hurricanes have caused physical damage to hospital buildings. This impact is captured to some extent by the 35% decline in hospital beds from 240 in 1978 to 156 in 1980, presumably as a direct consequence of Hurricane David.

At least in recent history, there have been relatively few deaths as a consequence of natural disasters in Dominica. A reported 42 people were killed as a consequence of Hurricane David and around 3,000 treated for injuries. However, there have only been two subsequent deaths associated with hurricanes (one in 1995 and one in 1999).

There is no statistical or other evidence of any major increase in disease related mortality or morbidity in the aftermath of recent disasters. There was an outbreak of bacillary dysentery in the aftermath of Hurricane David,

which peaked in the second and third month after the storm. It was thought that this may have been associated with the destruction and slow repair of latrines and a reported increase in the disease-carrying insect population. Diarrhea cases occurred in 7.3% of surveyed households. However, a survey undertaken eight months after Hurricane David found that health problems were 'relatively unimportant' (Lechat and others, 1981: 1). In fact, the number of deaths from most reported causes declined in 1979-80, probably due to the mass movement of people off-island.

12.4 Rural Livelihoods and Informal Labor Markets

Several highly vulnerable sectors of the economy are important in the livelihoods of poorer households. Banana growing involves a relatively large number of extremely small marginal producers and a small number of dominant larger scale farms. The latter would benefit disproportionately from the WINCROP insurance scheme, which pays out on about 20% of estimated damage, covering a substantial part of production costs (Box 5.2). They can also lay-off labor to reduce costs. Bananas have also apparently provided a way for many poorer households to re-establish a post-hurricane source of income.

Some evidence of the impact of hurricanes on informal labor markets is indicated by their effects on hucksters. Hucksters (also known as higglers or traders) form an important part of the informal labor market in Dominica, mainly trading in agricultural products with surrounding islands. They are primarily women, often wives of small farmers, from poor rural households and in some cases heads of single parent families. Huckstering can be quite profitable. Some individuals make between EC\$200 and EC\$4,000 (US\$74 – US\$1,480) per week, equivalent to around 40% of the value of their produce (World Bank, 1996).

Huckstering is highly vulnerable to natural hazards both via potential disruptions caused to agricultural production (which also have an adverse impact on local market vendors) and damage to transportation, shipping and storage facilities. There is no insurance currently available for huckster consignments. Even the issue of a storm warning, whether for Dominica or neighboring countries, can temporarily disrupt trade. Moreover, vulnerability is not limited to storms alone. For example, the Layou-Carholm landslides also had an adverse impact, initially forcing some hucksters to use an alternate transport route, so increasing transport costs, and forcing them to endure longer waiting times at the port, again increasing costs. Hucksters also face potential loss of markets in the event of any disruption to their operations, as they operate in a highly complex environment.

Fisheries is another extremely vulnerable sector (Box 12.1). This was most recently shown in the effects of Hurricane Lenny. The assessed damage to boats, gear and sheds and disruption to fishing marketing was considerable. However, at the time of the field visit for this study, seven months after Lenny, nothing had apparently been done to recompense and rehabilitate affected households.

The use of forestry resources, including for hunting, is also still important to rural groups, including some of the poorest such as the Carib community, and should be considered in a social and poverty analysis.

Box 12.1: Fisheries – a vulnerable livelihood

The fishermen are probably the producer group most vulnerable to natural hazards. Approximately 3,000 people are economically engaged in the fishing industry. About 1,200 are considered full-time fishermen. It is almost impossible to relocate boats and gear when a hurricane threatens. Many are forced to leave boats and engines at sea. Fish sheds are especially vulnerable since the majority are simple shacks of timber and galvanized metal sheeting, without concrete footings or hurricane-resistant reinforcement.

Fishermen typically operate pirogues that are less than 20 ft long and 8 ft wide, often powered by a single outboard engine. Many fishermen do not consistently use life vests nor do they routinely own communications equipment such as radios.

They are often the first group whose income is reduced by hurricanes. A Storm Warning and Small Craft Advisory may be in effect for many days before a hurricane affects Dominica. The lack of on-shore electricity and refrigeration after a hurricane sometimes dramatically reduces the demand for fresh fish. The beach erosion that frequently accompanies hurricanes also creates access problems for those fishermen whose boats survive the storm.

Vulnerability is exacerbated because fishing is typically a family activity. Fishing households often seek to supplement their income by producing crops or raising livestock, activities which are also vulnerable to storms. Thus, a hurricane can easily reduce or temporarily eliminate all sources of income for a fishing family.

Fishermen often equip themselves with boats and engines through loans. A typical level of investment is EC\$60,000. This may be lost entirely in a hurricane, but the debt must still be repaid. It is rare for them to be able to obtain insurance on fishing assets. Even if insurance is theoretically available, because of the high cost of premiums linked to high risks, it may be out of reach for most fishermen.

12.5 Housing

The social distribution of housing losses is another aspect of differential vulnerability. The poorest, in their choice of both material and building standards, are less likely to adhere to building codes for storm resistance. But there may also be urban–rural differences. Much of the construction in Roseau and other West coast settlements has been relatively recent. At least before Hurricane David many of these houses were less storm resistant than traditionally constructed older houses. So possibly this was why much of the destruction of housing in 1979 occurred in urban areas rather than rural localities, such as the Carib Reserve.

Various studies have also highlighted the appropriate provision of support for low cost housing as one of the least satisfactory aspects of post-disaster response. For example, a review of a variety of initiatives for low cost housing provision and innovations in housing after Hurricane David found that projects were unable to provide support to housing that was sufficiently low cost so as to be accessible for the poorest. The only successful surveyed scheme provided finance for self-build housing (Coit, 1988).

12.6 Anti-Poverty Strategies and Natural Disasters

At the household level, poverty is, as the above examples suggest, the single most important factor determining hazard vulnerability, in part reflecting location of housing, choice of building materials and primary source of income generation and lack of access to risk spreading financial mechanisms. Disasters, in turn, can play a significant role in reinforcing poverty.

Tackling hazard vulnerability should therefore form an important part of any poverty reduction strategy in Dominica, given the island's proneness to natural hazards combined with its relatively high level of poverty. Some 28% of the

population was estimated as living at or below the poverty line in 1995 (Bonnerjea and Weir, 1995)⁷⁹. The incidence of poverty is particularly high amongst the indigenous Carib community (World Bank, 1996). There is also a high incidence of unemployment in parishes where banana production has been the major source of income (GoCD, 2000).

The links between natural hazard vulnerability and poverty are only now being accepted as raising an important issue for the development agenda. Thus, a 1996 World Bank overview report on poverty in the Caribbean region did not pay attention to natural hazard vulnerability reduction in either reviewing the coverage and effectiveness of poverty alleviation efforts and coping mechanisms or in identifying key areas for strengthening such efforts. This was despite the fact that the same report did acknowledge the vulnerability of countries in the region to natural disasters, specifically commented on the vulnerability of small farmers and indirectly noted the role of natural disasters as a factor causing poverty.⁸⁰ More positively, a more recent report (Bonnick, 2000) does outline a poverty reduction agenda for the Caribbean that include mitigating the impact of disasters on the poor. More generally, the World Development Report 2000/01 (World Bank, 2000d) also clearly recognizes that natural disasters are a source of transient hardship and distress and a factor contributing to persistent poverty.

The development of strategies for hazard vulnerability reduction in Dominica will require careful investigation into the links with poverty. Although poverty is reported to have increased in recent years, due to the decline in the banana sector in particular, there is limited available information on either the extent or nature of poverty in the country or on how it relates to hazard vulnerability (GoCD, 2000). The GoCD has already identified the need for further investigation into the nature of poverty in Dominica .

More specifically relating to disaster management, the undertaking of post-disaster social assessments would be most valuable in highlighting needs. For example, Hurricane Lenny is known to have caused some temporary loss of employment in the hotel trade but it is not clear whether or not those laid off were able to secure alternative forms of income generation. Similarly, fisheries, which is an important element in the livelihood of one of the poorer social groups, was also seriously impacted by Hurricane Lenny (see Box 12.1).

⁷⁹ The survey on which this figure is based was undertaken prior to Hurricanes Luis and Marilyn.

⁸⁰ The report stated that 'Poverty has increased in countries that have had low or negative growth rates for protracted periods such as Guyana, Haiti, Jamaica, Suriname and Trinidad and Tobago. The low growth is attributed in part to external shocks, such as adverse changes in a country's terms of trade, changes in global demand for a country's exports, changes in the global interest rate on a country's external debt, and hurricanes, and in part to inadequate domestic policy responses, including sharp increases in external borrowing and expansionary monetary and fiscal policies.' (World Bank, 1996: ix).

Chapter 13.

Disaster Management

There have been many statements of commitment to strengthening capacity and arrangements for disaster management in the Caribbean region particularly in the wake of earlier major disasters such as Hurricane Hugo in 1989 and more recently Hurricanes Georges and Mitch in 1998. This commitment is reflected in regional initiatives such as the USAID-OAS Caribbean Disaster Management Project between 1995 and 1999 that provided many useful inputs into this study and the new UNDP/USAID/CDERA Comprehensive Disaster Management Project. Regional institutions such as CDB, CDERA, which was established by CARICOM in 1991, and the ECCB consulted in the course of the study also provide further evidence of that growing commitment. Funding agencies such as the World Bank, the EC and DFID are also seeking to support improved disaster management in the region.⁸¹ Although the primary focus of this study is economic and financial, it was felt that the report would be incomplete without discussing briefly three disaster management issues which came up repeatedly in the course of the team's visit to Dominica and regional institutions in June 2000 and which concern:

- Institutional arrangements and the lack of an overall strategy for disaster reduction in Dominica;
- Information on hazard risks and public and private sector choices in risk management;
- Effective building and planning regulation for reducing disaster risks.

13.1 Institutional Arrangements for Disaster Management

The contrast between the near chaotic situation following Hurricane David in 1979, as described by many of those who were affected and then involved in relief and rehabilitation, and the current state of preparedness is a measure of the considerable progress that has been made in disaster management. Dominica has institutional arrangements and plans for disaster preparedness. These broadly reflect the evolution of disaster management thinking and practice within the region, influenced by experience in several hurricanes, and the training and technical cooperation provided at a regional level by CDERA, PAHO and other agency initiatives.

Disaster preparedness is organized within the Ministry of Communications, Works and Housing (MCWH). That arrangement brings most of the public sector's disaster mitigation and rehabilitation expenditure and preparedness under one ministry. However, this gives the role for national coordination to a line ministry and that may not enable disaster management policy issues to receive sufficiently high priority in overall economic planning and budgetary policy or the activities of other ministries. For example, seven months later, in June 2000, the government had still not prepared an overall assessment of the effects of Hurricane Lenny or a rehabilitation plan. Nor is it clear where responsibility lies for establishing needs and priorities and then ensuring that social assistance or support for rehabilitation is provided to affected groups.

The national Office of Disaster Management (ODM) is currently a small unit within the MCWH, headed by an Assistant National Disaster Coordinator, who carries out most responsibilities, as there is no National Disaster Coordinator, apart from the Permanent Secretary, MCWH. The unit is probably insufficiently staffed, as reflected in the implementation of the World Bank's disaster preparedness project. The considerable scope for strengthening the ODM is implied in the proposals for equipment and human resources in the various components of the project (See box 13.1).

⁸¹ For example the World Bank approved in 1998 a program to support rehabilitation and disaster preparedness in the OECS countries (see Box 13.1) and is seeking to develop insurance mechanisms for risk spreading (World Bank, 2000b). The EC has established a Disaster Preparedness (DIPECHO) program, based in the Dominican Republic and covering the region (CRED, 1997). DFID is currently reviewing ways to support strengthening of capacity and arrangements in both the independent Commonwealth Caribbean countries (Davis and Michael, forthcoming) and UK Caribbean Overseas Territories.

Box 13.1 World Bank OECS Emergency Recovery and Disaster Management Program

In 1998 the World Bank approved the first phase of US\$23.79m of a three phase program of US\$54.89m, combining IBRD and IDA credits in favor of the five members of the OECS, Dominica, Grenada, St Kitts-Nevis, St Lucia and St Vincent & the Grenadines (World Bank, 1998c). The Dominica component of Phase 1, with approximately equal IBRD and IDA contributions of US\$2.5m each of total projected costs of 6.03m covers:

- | | |
|--|---------|
| 1. Physical prevention and mitigation measures, including a section of sea defense works, river control and flood damage reduction, road protection and shelters | \$4.12m |
| 2. Strengthening emergency preparedness and response through the National Office of Disaster Management, the Meteorological Office and community based disaster management | \$1.22m |
| 3. Institutional strengthening | \$0.17m |

The project usefully contributes to the whole range of ways in which disaster management can be strengthened - to physical investment in mitigation, hardware, information systems and training. However, the project has been slow to implement, with both borrower and lender attributing delays to a range of institutional problems that have been identified by the joint Task Force of the Commonwealth Secretariat and the World Bank (2000) as characteristic of small state donor relationships. The Bank and other agencies are giving separate support to segments of the sea defenses program, in this case to the most southerly section between Soufrière and Scotts Head, which accords with the Bank's priority for poverty reduction in use of IDA funds (See Section 6.5). This project and other segments have to be separately designed and tendered according to Bank and other donor such as CDB and DFID procedures. Such an approach leads to overstretch for the GoCD's limited management capacity in the civil works area. The other sub-components involve officials without previous familiarity with Bank procedures for project management. An example of the delay is the island-wide emergency communications system under the preparedness subcomponent which was not in place for the beginning in July of the 2000 hurricane season. Slow progress is attributed to procedures and lack of management capacity on both sides dedicated to the project. Possible ways in which these problems could be addressed are suggested in Chapter 14.

Dominica has a *National Disaster Plan* and multi-hazard plans updated in the last five years (GoCD, 1996a). In addition, following the volcanic alert in September 1998 a volcanic emergency preparedness plan was quickly drafted with support from CDERA, funded by DFID and drawing on experience in Montserrat (GoCD, 1999b). These plans, described in Box 14.2, suggest that disaster management policy has recently begun to recognize the need to include measures to sustain livelihoods and reduce economic impacts, but has not proceeded very far in giving concrete form to this thinking.

The *National Disaster Plan*, which was issued in 1996, is a substantial and detailed document, which is basically concerned with disaster preparedness. It outlines the duties and responsibilities of various government, civil and private organizations such that the country will be in a constant state of preparedness, that necessary precautions can be taken after warning of an imminent hazard, that immediate relief efforts are effective and that post-disaster restoration of essential services is as rapid as possible. In contrast, the Plan largely overlooks responsibilities with regard to long-term hazard mitigation and prevention, despite the foreword stating that 'the effects of Hurricane David could have been mitigated and that recovery would have been faster and more orderly if we had all been prepared' (GoCD, 1996b: 2). According to the Plan, each Government agency is also responsible for drawing up its own internal disaster manual but it is not clear to what extent this has actually been done. It also focuses on immediate and shorter term, primarily humanitarian, requirements.

The Plan provides little guidance on measures to address the economic impacts of disasters and promote economic recovery after the event. The few notable exceptions where aspects of mitigation are addressed relate to the need for

hurricane proofing of buildings (p37) and for the protection of beaches and dive areas against pollution, including dispersed oil (pD1).

The Department of Local Government and Community Development and the Government Information Service are also tasked with arranging dissemination of information on disaster prevention, but the scope and nature of this material is not indicated.

Contained within the *National Disaster Plan*, is the volcanic evacuation plan, which includes amongst its objectives the development of the capability to enhance the effectiveness of mechanisms for the mitigation of the impact of geological disasters generated by volcanic activity but, again, there is no further indication of any specific measures that could be taken towards this end. The more recent *Volcanic Contingency Plan* (GoCD, 1999b) issued following seismic swarms in the latter part of 1998 again primarily focuses on preparedness, including contingency arrangements for evacuation of the population at risk. The eleven objectives of the plan include to 'reduce the potential loss of personal effects' and to 'assist the population to re-establish personal independence' (p7) in the event of an eruption. Importantly, this plan recognizes that economic impacts should be minimized and livelihoods sustained, but gives very limited consideration as to how this should be done. The Ministry of Agriculture is assigned responsibility for developing a sectoral plan for the relocation and care of livestock in the hazard areas and for assisting relocated people in continuing agricultural related activities. There is, however, no mention of measures to protect non-capital assets (e.g. fishing equipment) that are important for sustaining livelihoods. The Plan also recognizes the adverse impact that an evacuation could have on the private sector and indicates that assistance has been offered to private sector organizations to develop plans specific to their requirements. It anticipates that 'these plans will focus attention on distribution services and the establishment of linkages with local and international agencies for the provision of emergency supplies' (p19).

Damage assessments

According to the 1996 *National Disaster Plan*, individual government departments are responsible for undertaking post-disaster damage assessments of impacts on sectors and sub-sectors within their jurisdiction. The Ministry of Finance is responsible for collecting and collating damage statistics and producing an overall assessment.

In practice, although sectoral damage assessments are undertaken, with individual departments producing reports relating to their particular areas of responsibility, an overall damage assessment report is not usually produced. Donors interested in supporting a particular aspect of relief or reconstruction then approach the relevant ministry. Moreover, the Ministry of Finance's has not produced any assessment of the overall macro-economic impacts of a disaster, instead it has simply integrated sectoral reports into an overview document without any further analysis. There is also no systematic collation and archiving of sectoral and overall damage assessments for future reference.

A notable exception was a report prepared following the three storms in 1995 by a task force composed of both public and private sector representatives under the coordination of the Ministry of Finance. This report included some analysis of the broader impact of the disasters on factors such as the level of unemployment, inflation, public sector finances, the balance of payments, and the commercial banking sector as well as on infrastructure and assets and productive sectors. However, it was prepared in October 1995, only a month after Hurricane Marilyn and was apparently not revised as the precise nature and scale of the impact of the disasters clarified. An overall assessment was produced following the 3 storms in 1995 with the assistance of the three major lending agencies (GoCD, 1995). Nothing comparable was produced after Hurricane Lenny in 1999 (See Annex Section A.4).

Risk assessment appears to be still in the early stages of development. Volcanic and seismic monitoring are considered more fully in section 13.2. The various CDMP project components draw attention to issues of vulnerability in the island's infrastructure (See Chapter 6) and also the failure in project design to make full use of the scientific information that is available, for example on landslide hazard (OAS, 1996b). Land use planning and building approval are not the responsibility of MCWH but of the Physical Planning Division within the Ministry of Agriculture, Environment and Planning (see below Section 13.3).

There appears to be relatively good inter-agency community organization and good NGO cooperation. Overall, there seems to be a good awareness of disaster issues, but that generalized concern and commitment has not been translated in to a coherent, overall strategy for disaster reduction. There is an annual cycle of preparedness linked to the hurricane season. But when disaster struck, as in November 1999, the organizational arrangements within government and the level of political support has not ensured that there was follow-through in key areas – a comprehensive, robust assessment of damage and social impacts; preparation and implementation of appropriate social assistance and rehabilitation measures for affected groups such as fishing households; and the preparation of a comprehensive rehabilitation plan including mitigation measures that had been shown to be necessary. The latter would also require extensive consultation with local stake-holders such as the private sector and NGOs, and then cooperation with regional bodies and potential funding agencies.

The damage done by Hurricane Lenny drew attention again to the weaknesses of the island's sea defenses and limited progress made in implementing the sea defenses upgrading plan drawn up in 1990 (Mouchel, 1991) and revised in 1997 (Mouchel, 1997). Apart from the problem of funding, there appear to be have institutional problems impeding progress.

Experience in Dominica after Hurricane David and more recently in the region during and after hurricanes in 1998 and 1999 (Michael, 2000) and also the Montserrat volcanic emergency (Clay and others, 1999) suggests that a high-level inter-departmental task force would contribute to more effective disaster management both in a crisis and in planning for disaster reduction.

13.2 Natural Hazard Assessment and Monitoring

The environmental assessment of natural hazards poses particular difficulties for smaller developing countries. Hazard assessment and monitoring are naturally public goods. The economies of scale in organizing scientific research and monitoring necessitate regional or international arrangements which can be combined with a focus at country level or a few key areas such as forestry where a multi-purpose capacity can be maintained. Concerns about exposure of an increasingly large capital stock resulting from economic development and of higher level risks from climatic change both highlight the need for increasing expenditure on hazard assessment and monitoring.

There are also institutional issues to be addressed in ensuring adequate support for monitoring. Scientific hazard monitoring and information dissemination have been organized in the Caribbean at a regional level in ways that reflect colonial history. For example, for seismic-volcanic monitoring, Dominica contributes to and relies on the Seismic Research Unit (SRU), based in Trinidad.⁸² The islands of Martinique and Guadeloupe, between which Dominica is sandwiched, are part of the French national monitoring system, and are not part of the same seismic network. The US territories rely upon the US Geological Service. CDERA, which supports disaster preparedness and disseminates information is an organization confined to the former UK colonies and remaining UK Overseas Territories. The OAS, which supports disaster mitigation and loss reduction, does not include European overseas territories.

The SRU had successfully monitored volcanic alerts in the 1970s and 1980s and initiated risk assessment and risk mapping (Wadge, 1985). However, when a new volcanic alert began in September 1998, the monitoring arrangements were found to have been not properly maintained (SRU, 1998). Two of the four seismographs on Dominica were out of action. The monitoring network had to be refurbished as well as enhanced to provide the appropriate level of seismic monitoring. Through CDERA, the UK provided both equipment and technical assistance, suggesting that the SRU network was insufficiently funded to enable it to provide enhanced crisis monitoring without additional external support.

⁸² The SRU is an autonomous entity within the University of the West Indies, St Augustine Campus, Trinidad. It receives its core funding from Trinidad and Tobago, 20% from Barbados and 30% from 6 other countries, Antigua, Dominica, Montserrat, St Lucia, St Vincent, and St Kitts. Additional funds are obtained from specific contracts such as that to provide seismic monitoring for Netherlands Overseas Territories (Clay and others, 1999).

The 1998-99 alert and the way it was handled (Box 13.2) raise the difficult but important issue of how scientific information should be disseminated to the wider public to ensure that both public and private sector institutions make rational decisions on natural hazard risk:

- What forms of information is it appropriate to make available to various stakeholder groups?
- How can scientific information be disseminated in an easily understandable form?
- How should scientific information be used and with what implications, bearing in mind that it will be probabilistic and so difficult to take into account?
- What role should scientists play in informing the general public and other stake-holders directly about natural hazard risk and uncertainty?

Box 13.2: Public Information And Hazard Risk : The 1998-1999 Volcanic Alert

The current practice in Dominica and other eastern Caribbean states is for the SRU monitoring seismic and volcanic hazards to report to government as their client. The government then decides when and in what form information should be made available to the general public or specific stakeholder groups. Concerns that influence decisions include minimizing risks to life and property and avoiding unnecessary damage to domestic and international investor confidence.

From September 1998 to April 1999 Dominica experienced a series of seismic swarms in the south of the island that could be precursory to an eruption and earth tremors were widely felt by the population. Little information was made available to the general public other than that contained in a GoCD *Volcanic Contingency Plan* (GoCD, 1999b) prepared in response to the crisis and an initial scientific assessment conducted by SRU (1998). There were preparedness exercises for a possible evacuation which could involve 11,500 persons in the event of an eruption in the Morne Pays Plat area (Area 1 in Map 2). However, the public have not been provided with further explanatory risk assessments, and risk-zoning maps, such as those in the Contingency Plan, have not been made widely available.

There has been considerable uncertainty about the precise nature and level of risk posed, how the crisis might evolve and appropriate responses. This resulted in a confused range of reactions. For example, some insurance companies apparently temporarily stopped taking on new business in the southern part of the island whilst a few did not renew existing (annual) policies. However, others continued to provide cover, in part reflecting concerns about their credibility and reputation. Some foreign-owned commercial banks were also reported to have suspended new lending operations temporarily in the immediately endangered area, but others were happy to step into the breach and seize any opportunity – even though temporarily reduced by the crisis - for increased business. The National Commercial Bank, in particular, took the view that as a local bank it was expected to take higher risks than foreign commercial banks. The National Development Foundation (see Box 9.1) also continued lending activities in the south, taking the view that should commercial banking operations halt, then it should continue its own operations, but endeavor to do this by securing grant assistance for on-lending. All banks have now resumed new lending operations conditional on insurance coverage remaining available.

The Dominica Association of Industry and Commerce (DAIC) and the DHTA took the initiative in requesting a briefing by SRU and then in drawing the attention of their members to the possible consequences of relocation from Roseau and the south of the island, or of the loss of facilities in the event of an eruption. The DAIC also issued a circular encouraging members to ensure that accounts were in order, titles and other valuable documents in an accessible, safe place and so forth. However, in acting thus, the DAIC was accused by the GoCD of overreacting and causing unnecessary concern. In the absence of the regular dissemination of updated information on volcanic risk, there was by mid 2000 a sense outside of government that the crisis had probably passed.

Following independence for many Caribbean states, wider regional arrangements for scientific research on strengthening disaster management are emerging under the auspices of OAS, in practice supported with international and US financial and human resources. These projects have played a role in enhancing scientific hazard assessment and monitoring. For example, concerns about sea level rise within the Caribbean Sea and the

absence of reliable benchmarks have highlighted the past lack of sea level and wave monitoring within the region. Dominica itself had no capacity to undertake such monitoring independently. Consequently only qualitative assessments of the coastal sea conditions associated with the impact of individual storms up to Hurricane Lenny are available. To provide benchmarks for determining the effects of climate change, the OAS has launched a regional program for sea level monitoring supported by the Global Environment Facility (GEF).⁸³

Hurricane David in particular gave impetus to environmental monitoring to provide the data for understanding the ecological effects of natural hazards on Dominica's forests and fauna. These investigations also depended substantially on external funding and human resources and that has posed problems of sustainability and ensuring that longer term ecological effects are monitored.

13.3 Building and Planning Regulation and Mitigation

Various estimates have been made of the cost of vulnerability reduction measures in the Caribbean and their expected return, highlighting the low costs of mitigation and thus the potentially considerable financial benefits of hazard proofing. For instance, the World Bank (2000b) reports that regional civil engineering experts have estimated that spending 1% of a structure's value on vulnerability reduction measures can reduce probable maximum loss from hurricanes by, on average, a third. As a further example, a CDMP study (Wason, 1998) of four infrastructure projects in the Caribbean that had failed due to the impact of natural disasters found that the additional costs required to mitigate the damage suffered by the four projects varied from less than 1% to under 12% of the original project cost. Similarly, OAS (1996a) cites a Barbados civil engineer who reported in 1995 that, after five years of involvement in designing and implementing structural vulnerability reduction measures (including retrofitting), he considered that many buildings could be made virtually invulnerable to Category 3 hurricanes at a cost equivalent to only 1-2 years' insurance premiums.

However, despite various initiatives to establish one, there is currently no formal Building Code in Dominica. During the 1980s, the GoCD received technical support from the Commonwealth Fund for Technical Cooperation to assist in the development of a building code (CCA, 1991), but no such code was apparently produced. At a regional level, a Caribbean Unified Building Code (CUBiC), which was drawn up with support from USAID and CARICOM and finalized in 1985, was also developed with the intention that it would be adopted by Caribbean governments (Poncelet, 1997). The Code was, indeed, subsequently developed into useable codes in several nations, but typically without any effective enforcement practices (World Bank, 2000b), and not in Dominica. A more recent model building code drawn up with Habitat and CDMP support, and intended for application by all OECS states is awaiting approval by the Dominica Parliament.

In the absence of any formal building codes, the GoCD's Physical Planning Division - which has responsibility for land use change and development and for the enforcement of building codes - reviews plans for individual buildings, including with regard to their strength against hurricanes.⁸⁴ However, it was suggested during the course of this study that site supervision from the Planning Division could be improved as, although the building profession receives basic training, shortcuts are often taken to reduce costs.

Land use planning is also weak, with detailed physical plans apparently only having been prepared for selected urban and industrial areas, whilst a countrywide land use plan is not available. Moreover, according to CCA (1991), the Physical Planning Division has only limited control over broader planning and regulatory aspects of major development projects and programs and is not necessarily consulted about their location, including with regard to environmental and land suitability issues. Similarly, detailed hazard risk mapping of the island has not been undertaken.

⁸³ Monitoring units have been installed, one in each participating country. Such a project raises problems of sustainability, so trust funds of US\$50,000 has been agreed for the maintenance of each unit. In light of damage suffered by some units during Hurricane Lenny, further expenditure will also be required to improve storm resistance (information derived from www.cpacc.org).

⁸⁴ Some foreign-owned commercial buildings are built to standards specified by the owner company concerned.

Complete data are not available on the extent of vulnerability of the island's infrastructure to tropical storms. However, the CDMP has completed a probable maximum loss (PML) study of hurricane vulnerability in three islands including Dominica, covering airports and runways, electricity generation, utility and high voltage poles, health service buildings, public buildings, schools and colleges, ports and wharves, main road networks, waste management sites and refuse collection (OAS, 1999). The PML, defined as an estimate of the monetary loss expressed as a percentage of total value experienced by a collection of structures, their contents and equipment, when subjected to a maximum credible event, was estimated at 64% for a hurricane event of 119 mph, based on a mean return period of 50 years and a 90% prediction limit, suggesting significant vulnerability.⁸⁵ Further evidence of high structural vulnerability is provided by the 1991 census, which found that some 22% of the island's housing stock was sub-standard, needing replacement; and 72% not in good condition (CCA, 1991). The ODM (GoCD, 1999b) also reports that the typical construction method in use implies that the majority of houses in Dominica are not resistant to earthquakes. Meanwhile, OAS (1996a) reports that small builders and contractors in the Caribbean construct much of the housing, with little attention to or awareness of appropriate standards for structures and materials. Suite (1996: 266-267) additionally states that 'as in defiance, new houses in the region continue to be built without adequate fastening of roofs to walls. The present engineering practice, with respect to dwellings, has not demonstrated much benefit from the collective but unfortunate experience of the region'. The World Bank (2000b: 45) attributes limited progress on retrofitting in the Caribbean generally primarily to 'lack of incentives and concerted leadership in the promotion of benefit features and practices'.⁸⁶ In the case of Dominica, limited availability of flat land also forces developments into coastal areas and hillsides, again increasing hazard vulnerability of buildings.

⁸⁵ This figure was much higher than those estimated for two other island states that were also examined as part of the same study, Saint Lucia and Saint Kitts and Nevis.

⁸⁶ In the context of Saint Kitts and Nevis, ECLAC/ECCB (1998) reports that the lack of quality control and monitoring in the construction industry was very evident in terms of the number of walls that 'just disintegrated' as a consequence of the high winds experienced during Hurricane Georges, reflecting poor reinforcement and low quality of bricks.

Chapter 14.

Conclusions and Policy Implications

This study has demonstrated how many aspects of the Dominica economy, with perhaps the notable exception of offshore financial services, are vulnerable to tropical storms and hurricanes. It has been relatively easy to highlight their impact on short-term, annual fluctuations in macroeconomic and agricultural performance, particularly the devastating impact of Hurricane David. However, it has been far more challenging to assess their impact on longer-term growth and their implications for sustainable development. Such effects would be felt, most fundamentally, via their impact on the pace of capital accumulation, in turn tied to opportunity costs in terms of the use of both public and private investment resources and savings.

In analysing the economic and financial impacts of disasters in Dominica, five key issues have emerged, which are discussed in further detail below:

- ❑ the changing nature and uncertainties of natural hazards;
- ❑ the dynamic nature of the economy's hazard vulnerability;
- ❑ the emphasis which has been placed on rapid post-disaster recovery rather than longer-term vulnerability reduction;
- ❑ the tensions associated with decision making in a capital-scarce economy and the related importance of comprehensive economic and financial analysis; and
- ❑ inadequacies relating to hazard risk information and broader disaster management.

Many of the findings of the case study are intuitive, even obvious. However, this is the first time that the evidence for Dominica has been brought together, analysed and used to draw policy implications. Such detailed analysis is also of wider importance in testing widespread assertions about the economy-wide significance of natural disasters in hazard-prone countries across the world and the problems they pose for long-term development.

A wider purpose of the whole study is to explore the usefulness of economic analysis in informing disaster management policy. Therefore these conclusions also review what has been learnt in this country study. The method of investigation adopted has been primarily empirical. The available evidence on natural hazards and their impacts has been examined through a series of complementary, sometimes highly disaggregated, analyses. Different forms of analysis have been used in an eclectic way – as the available evidence permits – involving visual inspection of time series statistics sometimes combined with more formal regression analysis to quantify apparent relationships. This has been complemented by a separate review of individual natural disasters, based on available written documentation and qualitative evidence from interviews with some of those directly involved at the time, including several still in positions of responsibility in government and civil society in Dominica. An important consideration in this approach has been only to do what can be replicated relatively easily in another developing country.

What conclusions are to be derived from this extended and perhaps sometimes repetitious series of investigations at economy wide, sectoral and sub-sectoral levels? What kind of 'model' is emerging of the way in which natural disasters impact on a small Caribbean island economy? Do findings reconfirm existing approaches to managing and reducing natural hazard vulnerability or are there possible 'gaps'? Does such a detailed investigation help to refine or redefine our appreciation of the ways in which economic analysis can better contribute to understanding and reducing the negative effects of natural hazards?

14.1 Natural Hazard Risks And Uncertainty

Perceptions of natural hazard risk depend in part on recent experience. New experience combined with incomplete, but changing, objective information about complicated processes in determining and expressing levels of risk, imply

that reported levels of hazard risk are constantly being adjusted. Thus there is considerable uncertainty relating even to underlying natural hazard risks, both in Dominica and elsewhere.

Tropical storms and hurricanes are the most common natural hazard in the Caribbean, causing enormous physical damage and socio-economic disruption. Considerable progress has been made in the formal assessment of risks – from historical data and through increasingly sophisticated modeling. The ‘normal’ model presupposes that physical damage is expected to be a function of the *intensity* of the storm and its *proximity* to the at-risk place or island. These relationships are also expected to be non-linear, as is implicit in the storm and hurricane categories – for example, this is illustrated by contrasting the effects of Tropical Storm Debbie or Iris with Hurricane Category 1 Marilyn and Category 4 David (Table A2.1). However, as the most recent extreme event that affected Dominica, Hurricane Lenny, shows, these underlying assumptions about storms and their likely physical impacts may need to be re-examined. Dominica and neighboring Guadeloupe and Martinique suffered coastal damage equivalent to what might have been expected from a close encounter with a Category 4 hurricane as this ‘unprecedented’ storm tracked west to east, some 150 miles to the north of Dominica (Map 3). Yet such a storm was too distant to be included in the hurricane frequency statistical analysis reported in Annex A.3 and created difficulties for meteorologists in predicting from their models how Lenny would develop and in providing hazard warnings. The variable timing of occurrence of a storm creates additional uncertainty. For example, the lateness of Lenny may have implied that its impact on the tourist industry was more severe, allowing little time to rehabilitate facilities before the main winter season began.

Landslides introduce additional uncertainties that physical development planning should take into account. A small economy has no redundancy in its lifeline infrastructure. Thus, if even a small section is damaged as a consequence of a landslide, it can have island-wide implications. There are considerable pressures to develop the apparently most financially attractive locations of the island without due regard to natural hazards and also to minimize initial investment costs. The Layou River landslide (Map 2) was not anticipated, but fortunately it affected an area in which damage to infrastructure, housing and commercial assets was limited. How should landslide risk assessments be built into physical planning approvals?

The recent *volcanic alert* and similar episodes over the past 30 years have shown how difficult it is to assign probabilities within a typical physical planning horizon of 25-30 years to the likelihood of perhaps a 100 or even a 400 year eruption event, such as those that have occurred since 1971 in St Vincent, Guadeloupe and Montserrat. Should Dominica’s government adopt a “precautionary principle” of avoiding public sector and discouraging private sector development in that area of the island where scientists might assign a significant risk of an eruption within the next 100 years? Such a policy could imply no substantial development of public infrastructure and utilities beyond those for distribution to consumers and discourage some forms of private development in Area 1, the region of the island identified in the 1999 preparedness plan (Map 2) as currently thought to be the highest risk zone.

The risk of a severe or even catastrophic *earthquake* is probably very small, but this is currently another area of uncertainty and there is a lack of public information. The more precise assessment of seismic hazard risk is likely to have implications for building codes and construction practices for private and public buildings and other key infrastructure.

Finally, *climatic change* is a further complicating factor that is widely thought to be altering the whole distribution of risks associated with meteorological and sea-related hazards.

14.2 Dynamic Nature of Vulnerability

This study has highlighted the dynamic nature of hazard vulnerability, relating both to changing levels of development and capital investment in the island and also to the structure and composition of economic activity. As indicated above, in the longer term scientific research suggests that climatic change may also increase the underlying level of hazard risks themselves, with further implications for the scale and nature of vulnerability.

In the past, as a colonial plantation cum subsistence economy, the impact of disasters was heavily dependent on the vulnerability of the prevailing export crop and the associated structure of production and marketing. In the first half of the twentieth century, limes were the dominant crop. Limes are relatively insensitive to high winds, and were grown on plantations owned by UK-based companies who were able to absorb intermittent losses and associated recovery costs from operations within a particular country. This effectively acted as a geographical risk-spreading mechanism. Meanwhile, small-scale farmers produced much of the island's food as 'ground provisions'. From the 1950s, banana production under smallholder cultivation progressively displaced plantation agriculture, increasing the overall hazard vulnerability of the agricultural sector. Bananas are highly sensitive to wind damage and smallholders were also less able to bear heavy losses, implying increased vulnerability in both the type and the structure of production.

Hurricane David demonstrated that vulnerability, but also increased the share of bananas in total agricultural output, as banana cultivation offered a fast, low-investment means of restoring agricultural livelihoods in an assured export market. The compulsory WINCROP banana crop insurance scheme, introduced in 1987-88, also provided partial financial protection. The rapid recovery in export production and earnings after Hurricane Hugo in 1989 demonstrated the resilience of the banana economy.

In the 1990s, banana production declined with falling real prices and the loss of guaranteed preferential access to the European market, again changing the economy's hazard vulnerability. To some extent, the fall in banana production was a positive development, reducing the potential scale of agricultural losses in the event of a disaster. However, a more diversified agricultural sector will also be less secure because the WINCROP scheme only covers bananas and other crops lack an assured domestic or export market. Thus, a future disaster could be associated with a higher rate of default on agricultural loans, increased demand for credit and slower post-disaster recovery.

The economy's hazard vulnerability has also changed over the past two decades because of a shift in its broader composition, accelerated by the WTO process. Agriculture's share of GDP halved to only 19% between 1977 and 1997, while manufacturing, tourism and financial services became increasingly significant. These latter sectors are less sensitive to all except a catastrophic event, such as Hurricane David, implying a reduction in the island's broader economic vulnerability. If the country's recent expansion into international financial services proves successful then a further decline in broad economic vulnerability can be anticipated in the future.

Development of the island's key infrastructure and the road system provides another example of changing long-term hazard vulnerability, in this case linked to Dominica's level of development rather than structure and composition of economic activity. Until the 1950s, sea transport was the primary form of intra-island movement, implying rapid recovery of the transport network in the aftermath of a storm, assuming that boats suffered little damage. The more recent emergence of road transport as the major form of transport, coupled with the fact that Dominica has a mountainous terrain, forcing much of the road network along the coastline, has effectively exacerbated the impact of storms, both in terms of direct and indirect effects. The scale of physical damage to the transport network is now potentially far more severe and the pace of recovery much slower, with knock-on implications for the movement of goods and people. Increasing vulnerability of this nature can have extreme consequences in a country such as Dominica, with limited capital resources relative to demand and thus a tendency to select least-cost solutions, a vulnerability first exposed by Hurricane David. The subsequent slow and uneven progress towards the effective protection of roads and the rest of the island's key infrastructure is shown by the coastal damage caused by Hurricane Lenny (see below).

The changing character of hazard vulnerability of the Dominica economy over time was sharply captured by the fact that a number of those interviewed during the course of this study stated that the impact of Hurricane David was in part so severe because the island had not experienced a hurricane for 40 years and thus that everyone was caught unaware. Yet, whilst Dominica had not experienced a Category 4 hurricane since 1930, meteorological records show that there had, in fact, been a number of less severe storms (Annex A.2-A.3). Instead, it would appear that the changing nature of, and apparent rise in, the island's hazard vulnerability had not fully impinged on perceptions of risk. Similarly, periods of drought have been increasingly reported in the first months of the year – that is, in the dry

season. This phenomenon probably reflects both wider and more intensive banana cultivation, rather than long-term changes in rainfall.

There is apparently a widespread perception after several disastrous hurricanes, and even disaster elsewhere (e.g. Montserrat), that there is increasing hazard risk. However, that increase in risk is often seen as the consequence of exogenous forces, climatic change or geophysical processes – that is, factors which cannot be controlled or influenced. In reality, as this study has highlighted, the level and nature of hazard vulnerability is also critical. Moreover, a particular level or form of hazard vulnerability is not inevitable. Some sectors and sub-sectors are more hazard vulnerable than others whilst measures can be taken to reduce structural vulnerability. The latter may imply an increase in initial investment costs but can prove cost-effective in the longer term. Thus, detailed and comprehensive medium - and long-term economic and financial analysis and planning should take into account hazard risks. This could reduce substantially the Dominica economy's hazard vulnerability and thus contribute to sustainable growth.

14.3 Economic Policy Choices in Disaster Management

Mitigation versus rapid recovery

In the immediate aftermath of a disaster, there are some inevitable choices for both government and the private sector that need to be made between the pursuit of rapid recovery and a reduction in longer-term hazard vulnerability. In Dominica, effectively by default, the emphasis has been placed more on rapid recovery because the political impetus and associated financial incentives for change have been insufficiently strong. Two examples illustrate this.

First, Dominica's agricultural sector is currently unable to satisfy the relatively assured domestic demand for copra from the island's largest manufacturer, DCP. Coconuts are also relatively insensitive to hurricanes and moisture stress. But it can take four to six years for a new tree to produce commercially whilst newly planted bananas can bear fruit in as little as six months. Thus, in the aftermath of hurricanes, farmers have opted to replant bananas and even switch into bananas, rather than to cultivate less hazard-prone coconut trees.

As a second example, a high proportion of temporary housing sited without planning approval and repairs undertaken in the immediate aftermath of hurricanes has become semi-permanent, in part due to funding constraints. Such practices potentially imply deterioration in the housing stock and increased vulnerability to future hazards.

The opportunities presented during periods of post-disaster rehabilitation to reduce longer-term hazard vulnerability need to be grasped. This is an issue that the government, the people and the donor community should address.

Decision-making in a capital-scarce economy

The study has highlighted the tension caused by the wide range of demands made on public finance, including for funding to reduce physical vulnerability to disasters (in the form of both initial capital investment and maintenance resources). For example, Hurricane Lenny in 1999 exposed the inadequacies of sea defenses and the considerable vulnerability of the road network and other infrastructure along the coast, 20 years after Hurricane David also inflicted severe damage and almost a decade after the first comprehensive sea defense protection plan was completed (Mouchel, 1991). Such tensions are particularly acute in small economies such as Dominica's, with relatively high per capita infrastructure needs, in turn due to diseconomies of small scale and the island's relatively scattered population, combined with a difficult and mountainous terrain. Moreover, the problem has been exacerbated by a lack of long-term planning, quite apart from the incorporation of hazard risk information into this process.

The study points to the need for improved information on the budgetary impact of disasters in order both to facilitate cost-effective allocation of resources and also to emphasize the importance of integrating hazard risk reduction concerns into medium - and long-term economic and financial planning. Improved information on the impact of disasters on individual

investments is also required to facilitate the adoption of appropriate mitigation measures in the design of new projects. Such information would be of benefit to donors as well, who finance a substantial part of public investment in Dominica.

The GoCD (2000) identifies two issues of particular relevance in seeking to establish sustainable growth and alignment with the liberalized global market: first, the strengthening of macroeconomic fundamentals, particularly the structure of the fiscal and external accounts, and, second, the need to expedite the establishment of the infrastructure required to support the expansion of private investment. Such goals are unlikely to be attained without improved hazard risk management. However, an integrated approach to national development planning, including between economic and physical planning operations, has also been announced as one of the government's medium-term objectives. This offers an important opportunity to incorporate natural disaster risk reduction into future planning.

Dominica currently has no comprehensive strategy for hazard vulnerability reduction. The damage done by Hurricane Lenny drew attention again to the weaknesses of the island's sea defenses and limited progress made in implementing the sea defenses upgrading plan drawn up in 1990 and revised in 1997 (Mouchel, 1997). Apart from the obvious problem of funding, there appear to be have institutional problems impeding progress. Experience in Dominica after Hurricane David and more recently in the region, during and after hurricanes in 1998 and 1999 (Michael, 2000) and also the Montserrat volcanic emergency (Clay and others, 1999) suggests that a high-level inter-departmental task force would contribute to more effective disaster management both in a crisis and in planning for disaster reduction.

There has been little analysis of the nature of vulnerability of the island's economy, at least in part reflecting a perception that although Dominica is highly hazard prone, there is little that can be done to reduce its vulnerability. The country has yet even to approve a building code, whilst land use is not based on detailed risk mapping. Moreover, the potential power of insurance as a mechanism for promoting reduced infrastructure vulnerability has yet to be harnessed.

14.4 Natural Hazard Information and Risk Management

Inevitably, perceptions of risk play a major role in determining economic actions. Perceptions, in turn, shift in an environment of changing vulnerability, as already noted. It is critically important to ensure that perceptions of risk closely approximate levels of objective risk. In Dominica, there has been some recent evidence of increased risk aversion, as displayed, for example, by certain banking institutions. However, the levels and forms of hazard risk information available have been inappropriate, hindering both financial service providers and other actors from taking appropriate risk-averting decisions. A case in point is volcanic risk (Box 14.2).

The World Bank's (1998c) disaster management project and previous projects have included a risk-mapping component. However, as of mid-2000, there appeared to have been little progress in implementation, at least in Dominica. The attitude of aid agencies towards risk mapping also varies widely, with some dismissing landslide risk mapping as an 'academic preoccupation.'

Two issues that urgently need to be addressed are how to ensure sufficient investment in hazard risk mapping, monitoring, assessment and dissemination and to ensure that the information is provided in an easily understood and usable form. Ensuring such investment is particularly difficult in a small island economy, due to related economies of scale and because hazard monitoring and assessment are public goods. These issues require sustainable regional solutions, in turn posing questions relating to funding, human resources and political commitment to co-operation.

The Task Force of the Commonwealth Secretariat/World Bank (2000) on small states draws attention to the role of good quality and widely disseminated public information in providing a more rational basis for business decisions. Information and consultation on its implications is necessary to ensure that civil society, embracing both commercial and non-profit voluntary organizations, plays its part in the evolution of public policy on natural hazards.

14.5 Economic Analysis of Natural Disasters

The cumulative implication of the economy-wide and sectoral analyses undertaken in this study is that Dominica's economy is highly sensitive in the short term to natural disaster shocks. The short-term impacts of these shocks are visible in national income statistics, trade, physical measures of production and social sector indicators. The value of more formal analysis has been to quantify the effects of the most extreme events and to show that some of the possible effects cannot be detected.

The use of regression analysis is relatively straightforward but highly context specific. The variables introduced to "quantify" the effects of natural disaster shocks - hurricane event dummies and producer prices for bananas - provide a significant level of explanation. However, when, as a test of specificity, the same variables were included in an analysis of the performance of the economy of St Lucia, the other large Windward island banana producer, hardly any of the variability in growth rates of the economy or agricultural sector was explained. However, it would be relatively simple to undertake a similar analysis for other eastern Caribbean economies incorporating a more appropriate set of explanatory variables.

Some of the effects of shocks are probably lost in economic assessments by confining the analysis to annual national income statistics that are readily available for almost all countries. This study also found that far better fit equations were obtained using quarterly rather than annual data.

The study has not attempted to estimate the longer-term impact of disaster shocks and related uncertainty on economic performance. Such figures could be very useful in impelling governments and donors into action. However, they would, at best be very rough approximates.

Estimates of long-term impacts could be derived in a variety of ways but each has its drawbacks. First, a simple auto-regressive model of annual rates of growth could be developed, incorporating disaster dummies as an explanatory variable and then using the model to calculate long-term rate of growth that would have been achieved under a no disaster scenario (that is, setting the dummy variables to 0). Such an exercise was undertaken in an earlier study of Fiji (Benson, 1997a), suggesting that in the absence of a succession of natural disasters Fiji could have doubled its average annual real growth rate, achieving an average of 4.8%, rather than 2.4%, per annum. However, precisely because it was so crude, the model may exaggerate the growth effects of disaster reduction.

Others have explored the long-term impact of disasters by modeling economic growth as a function of the rate of growth of the capital stock and then considering the implications of disaster-related capital losses (e.g., MacKellar and others, 1999). However, such models presuppose that the principal disaster-related losses occur to productive infrastructure. In reality, in the case of Dominica the relative proportion of fixed capital stock in total losses can vary significantly between disasters while non-capital losses also have potential long term implications. Non-capital losses would also need to be taken into account, pointing the direction towards general equilibrium (CGE) modeling.

CGE modeling, in turn, again entails certain difficulties, this time relating precisely to the shift away from simplistic assumptions to an attempt to emulate an economy more fully. The complexity of impact of a disaster, often affecting virtually every aspect of the economy in the case of small nations, creates difficulties in designing appropriate general equilibrium models with valid underlying behavioral assumptions. There are additional difficulties relating to the relatively rapid structural changes which small open economies such as Dominica's commonly experience and which would also need to be taken into account in any model.

14.6 Wider Implications for Small State Economies⁸⁷

“The Caribbean will be expected to successfully carry out over a period of ten years a process of liberalisation which has taken the advanced economies over fifty years to master.” (Owen Arthur, Prime Minister of Barbados, quoted in Commonwealth Secretariat/World Bank, 2000)

This study has shown just how quickly the vulnerability of an economy can alter in a small economy. The sources of change are structural, occurring within the economy that is being driven by exogenous forcing mechanisms – technological development, (most uncertain) climatic change and the WTO process. The latter source of change underlines the conclusion of this study that there is nothing inevitable about the extent of vulnerability or that it will simply decline as a consequence of economic development. What then are the likely areas in which there would be substantial value added from improved disaster management, leading to the promotion of sustainable development of Dominica and other small island states?

Vulnerability indicators

Work undertaken by the Commonwealth Secretariat and others has done much to identify subgroups of smaller highly vulnerable states (Commonwealth Secretariat/World Bank, 2000). Various indices have been developed based on a (sometimes weighted) range of components capturing different aspects of vulnerability, including that relating to natural hazards/disasters (see Box 4.1). However, as this study and our earlier research shows, the various groups of small states according to this form of categorization are themselves characterized by considerable diversity. First, their economies are typically dominated by a few activities, reflecting the theory of comparative advantage. Second, much depends on issues of governance and the effects of very specific historical developments – contrast Dominica, Fiji and Montserrat.

Vulnerability indicators themselves are based on statistics over relatively short periods of time. Yet country circumstances change very quickly, implying that the specifics of vulnerability are highly dynamic. Thus, frequently revised data are required if the indicators are intended to reflect the dynamics of the economy. Practically, this lapse of time means that the indicators are insufficiently sensitive to changes and important subtleties of the situation.

In the specific case of natural hazard or disaster related measures of vulnerability, the way vulnerability has been measured has varied between studies, basically reflecting poor data on the impacts of disasters as well as the complexity of factors determining hazard vulnerability. The results indicate the sensitivity of the relative ranking of countries to the indicator chosen and the period of time over which data are taken to calibrate the indicator.

In conclusion, whilst vulnerability indices may be useful for certain purposes, the results should be treated as very approximate and not used in isolation to determine allocations of mitigation resources or the extent of need for improved disaster management.

Disaster mitigation

In considering appropriate forms of disaster mitigation, it is important to look at the physiography of a small state which underlies the economy and society. Such factors differentiate volcanic, mountainous and wet Dominica and Montserrat from Antigua or Fiji in terms of infrastructure at risk to hurricanes or landslides. Predominant forms of economic activity – bananas, coconuts, sugar, tourism and so forth - have also been influenced by historical legacies whilst certain more recent events have also made a heavy footprint. The dynamics of the economy must be considered. The analyses undertaken in this study reconfirm the substantial value added in disaster mitigation investment. More specifically, areas of investment that will generate high social returns and help facilitate long-term sustainable development by buffering medium-term growth from the effects of disaster shocks should be pursued. The facilitation of appropriate investments by the private sector is a particular challenge. However, a first step in this direction could be achieved by encouraging and supporting the

⁸⁷ The authors draw in this section on their earlier investigations of two other small island economies, Fiji and Montserrat (Benson, 1997a; Clay and others, 1999).

private sector in enhancing their hazard risk awareness and adopting appropriate risk management tools, both structural and non-structural.

Stable macro-economy

A current extremely difficult issue facing many small states is the adjustment to the WTO regime, with the loss of preferential access to EU markets, in particular, and advantages under the Multi-Fibre Agreement. The recent task force report by the Commonwealth Secretariat and World Bank (2000: para 74) makes the argument that, since it is unknown in a general sense or even more specifically at a country level what new activities are likely to succeed, investing in the quality and robustness of lifeline and social infrastructure makes sense as a financial strategy. The rapidity of this enforced process of adjustment is illustrated by the recent sharp decline in Dominica banana exports, and hazard events show how disruption to economic activity, as in 1995 and 1999, and uncertainty, as in the 1998-9 volcanic alert, carry the additional risk of undermining this process.

Financial risk spreading mechanisms

The insurance industry is relatively well developed in the Caribbean but the role of catastrophe insurance in spreading and reducing risk could be enhanced significantly. The cost of insurance is high and volatile, resulting in significant under-insurance. There has been little use of insurance as a tool for promoting hazard mitigation. Moreover, there are fundamental concerns about the efficiency and underlying strength of the insurance industry, relating to the proliferation of property and casualty insurance players in the Caribbean. Insurance legislation drafted by the ECCB aimed at strengthening the industry should be approved by member country legislative bodies as a matter of urgency.

Uptake of business interruption cover as well as property insurance has been low. Businesses have often made inefficient choices in arranging cover in part because of the limited information available to them and lack of competition as well as high costs. Business community organizations could play a potentially beneficial role in this regard, by acting as a conduit for the dissemination of information and providing training in risk spreading techniques.

The only form of agricultural insurance has been provided by WINCROP, covering bananas (see Box 6.1). This scheme has been relatively successful in transferring risks from growers to the insurance market. This is because (inter alia):

- there is a well defined client group of growers for export through the DBMC;
- premiums are easy to collect at low cost, via automatic deductions from DBMC payments to growers;
- damage assessment is relatively simple and reliable – a visual sample survey of plants combined with average sales over the past 3 years;
- the scheme is not too ambitious, providing cover of around 20% of damage; and
- the organization, a company owned by marketing boards, makes reinsurance easier.

The scheme has several of the advantages of earlier dedicated export commodity reserve schemes without the disadvantages of inter-year storage or intervention in markets. Even so it is vulnerable to draw down of reserves because risk is not sufficiently spread – including only four islands that can all be affected in one or two years, as in 1994-95. Moreover, something similar is needed for the highly vulnerable agricultural small-scale natural resource sector groups, such as fisheries, vegetable, fruit and ground provision growers and hucksters. Indeed, this need is becoming increasingly urgent with the declining importance of bananas. However, some of the conditions for success are difficult to replicate.

The Small States Task Force is also critical of the role of international and bilateral agencies. There are many agencies working in parallel in the Caribbean region, and they too encounter problems of coherence and overstretch in their relationships with several small states. The establishment of an Eastern Caribbean donor group in Barbados, including the UN agencies and bilateral donors, is therefore potentially an important development. It can bring more coherence to support for post-disaster relief and rehabilitation and to planning for disaster reduction. Within such a grouping, possible ways of supporting the strengthening of disaster management in a small state like Dominica include:

- ❑ joint donor support for a disaster mitigation program with substantial capital costs instead of parallel projectized funding minimizing duplication of arrangements that increase recipient/lender transaction costs;
- ❑ government and donors agreeing a lead donor agency for support and supervision of a project reducing overstretch in contributing agency personnel working with several small states;
- ❑ supporting regional solutions whenever possible on a sustained medium - and longer-term rather than short-term basis, delegating responsibility to a lead agency in the region and where appropriate a lead contractor, again minimizing transaction costs and providing continuity in support; and
- ❑ exploring ways within existing procedures that minimize micro-management of small project components at a country level.

Annex A.

Natural Hazards and Natural Disasters: Definitions, Chronology, Storm Frequency and Reported Impacts of Recent Disasters on Dominica

This annex provides more detailed information on natural hazards as background to the discussion of these issues in the Main Report, especially Chapters 2, 3, 4, 7 and 14. The definitions of natural hazards employed in the report are explained in Section A.1. Sections A.2 and A.3 bring together complementary sources of evidence on the incidence of major tropical storms and hurricanes from historical written sources covering the period since 1763 and meteorological statistical evidence for the period 1886-1996 from the US National Center for Atmospheric Research. The findings of these two approaches are consistent and provide an extremely useful basis for assessing the probabilities of extreme storms and their likely associated characteristics. The impacts of the most serious natural disasters affecting Dominica since independence in 1978 as reported in immediate post-disaster assessments are summarized in Section A.4. Attention is drawn to some of the inconsistencies in assessments and in particular the incomplete assessment for Hurricane Lenny.

A.1 Definitions: Natural Hazards, Disasters, Risks and Vulnerability

In considering natural hazards in Dominica, it is useful to briefly clarify the related and inter-connected terms of natural hazards, disaster, risk and vulnerability used in this study. These terms are modified from United Nations definitions to focus on economic dimensions of hazards and their consequences (UNDP, 1992).

Natural Hazard - A rare or extreme event in the natural environment that adversely affects human life, physical or human capital or activity to the extent of causing disaster.

Disaster – A serious disruption of the functioning of a society, causing widespread human, material, or environmental losses. These may exceed the ability of the affected society to cope, using only its own resources.

Risks - The expected number of lives lost, persons injured, damage to capital stock and disruption of economic activity due to a particular natural hazard and these expected losses are consequently the product of a specific risk and the elements (lives, etc.) at risk.

Uncertainty- A situation in which there are insufficient data to estimate 'risk' in terms of mathematical probability.

Vulnerability – The degree of loss to a given element at risk, or set of such elements, resulting from the occurrence of a natural phenomenon of a given magnitude. For capital stock this is expressed on a percentage scale from zero (no damage) to one (total loss). In the case of activities then the effect is in terms of a reduction below expected levels in the period of impact or afterwards. *Resilience* provides a complementary concept of how quickly the level of activity recovers to either pre-disaster or expected trend level.

Natural Hazards generally arise from sources that may be described according to the forcing mechanisms, which are meteorological-climatic or geological. Major meteorological hazards include Tropical Storms and Hurricanes as categorized in the Saffir/Simpson Scale (Table A3.1). Hydrological hazards, which include floods, and, on coasts, storm surges, are likely to result from extreme meteorological conditions, and drought from abnormally low precipitation. Geological hazards include earthquakes, volcanic activity and landslides. Tsunamis are a product of a geological event. Natural phenomena tend to interact such that the hazards and their effects represent a complex interplay of forces. For example, a hurricane has very strong winds but also produces intense, high rainfall that can give rise to floods and landslides. It may produce huge waves and a storm surge that can lead to coastal flooding.

A.2 Hurricane impacts on Dominica, 1764-1999: a chronology and historical note⁸⁸

There is much informal speculation about the frequency of hurricanes that have impacted severely on human activity on Dominica. For example, Hurricane David is sometimes referred to as a one in a hundred year event, or an even more rare occurrence, whereas the historical data summarized below suggest that it is approximately a one in fifty year event. In the design and assessment of infrastructure investments, the expected frequency of specific levels of extreme conditions such as windspeeds and wave height is also critical to the determination of appropriate levels of mitigation (Chapter 7). It is appropriate, therefore, to look at the historical record and attempt to construct a chronology of severe storms, and what this suggests for the frequency and pattern of these events.

A history of storms is presented in this annex in two ways. In this section a historical approach is adopted drawing on available published and unpublished sources. This approach is an elaboration of that contained in Honychurch's history of Dominica (1995). Second, Section A.3 reproduces the results of statistical analysis, HURSTAT, showing the incidence and frequency of tropical storms which have passed sufficiently close to Dominica to have had tropical storm or hurricane category effects. This analysis uses data from the US National Center for Atmospheric Research and was originally published in the CDMP Wave Hazard Assessment Study by Wagenseil and Watson (1996). The findings of these two approaches are consistent and provide an extremely useful basis for assessing the probabilities of extreme storms and their likely associated characteristics.

A visual analysis of the list also provides valuable evidence on the issue of the formation of expectations and apparently changing subjective assessments of risk within the island society. The long period without a major event between 1930 and 1979 is frequently commented upon as a reason for lack of preparedness in the late 1970s. There is apparent marked bunching of severe events in three periods – from the mid 1760s to 1780 (6 years out of 16), from 1813 to 1834 (8 years out of 21), and from 1876 to 1893 (5 years out of 17). These periods are reported officially as periods of economic difficulty, depressed agriculture and trade. The third of these periods provided the impetus to successful official efforts to establish commercial insurance by the Administrator, Hesketh Bell, between 1900 and 1905. In between these periods of more intensive hurricane impacts there were lengthy periods in which there were few storms, and suggestions of a more relaxed attitude to mitigation measures, most recently after 1930. For example, the practice of protective windbreaks, common on estates was given up from the 1950s. With the expansion of banana cultivation and break up of larger holdings, windbreaks were cut down and not actively replanted (Lennox Honychurch, personal communication). There were also probably lower design standards in much of the more recent urban construction in Roseau and other West coast settlements, so that the destruction of housing in these areas by Hurricane David was apparently more widespread than in traditionally constructed older buildings in some rural localities such as the Carib Reserve. We are possibly in a fourth period of relatively more frequent storms affecting Dominica, but this may be more apparent than real, because of wider communications, combined with the increased awareness of hurricane hazard since 1979.

The historical record is also useful in showing that some of the more unusual phenomena of the period since Hurricane David are not unprecedented. The sequence of three storms in 1995 – Iris, Luis and Marilyn – is paralleled by the reported three storms of August 1787. 'In August all the buildings (including the barracks and hospital) on Morne Bruce, the shipping and some houses in Roseau were destroyed by three gales of wind on the 3rd, 23rd and 29th' (Lockhart, 1879).

During the great storm of 1834 Dominica was in the eye of the storm for several hours on the night of 20-21 September, according to the testimony of the physician, Dr John Imray, which notes also the destruction of the forests. The damage and disruption to estate production and trade in all quarters of the island offers another striking parallel to the experience of Hurricanes David and Frederick in 1979. The great hurricane of 1834 followed within one month of emancipation and Hurricane David occurred within a year of Independence, both coming in periods of social turmoil that amplified problems of relief and recovery. The full measure of the severity of the 1834 storm is provided by the detailed official assessment report from the Governor, setting out the case for temporary relaxation of import duties and granting of relief to the island. The assessment covering destruction to fixed and moveable property and loss of crop production is conceptually similar to those still conventionally made up to the present. 'The annexed return contains a general statement of the losses in the several parishes, and in the town of Roseau, distinguished under the several heads of Loan and Grant, the former amounting to the sum of 90,418 pounds 16s sterling; the latter to the sum of 32,104 pounds 2s sterling' (Report of Governor, Murray McGregor, 18 February, 1835). These were agreed on 1 June 1835 and confirmed by Royal Acts on 3 July and 31 August 1835, probably too late to be fully effective.

⁸⁸

The invaluable advice of Dr Lennox Honychurch in preparing this note and chronology is gratefully acknowledged.

Table A.2.1 Chronology of Hurricanes Affecting Dominica 1764-1999

Year	Leeward Islands Almanack, 1879	CIMH	Other notes/names of TS or Hurricane
1764	X		
1766 October		X	
1769 July 26		X	
1772 August 30	X	X	
1776 September 6	X	X	
1780 October 9	X	X	
1787 August 3, 23,29	X	X	3 storms
1792 August 1		X	
1806	X		
1813 July 22	X		
1815	X		
1817 October 21	X		
1818	X		
1819	X		
1820 September 26	X		
1826	X		
1834 September 20-21	X	X	Most extreme, David-like
1876		X	
1883		X	
1889		X	
1891		X	
1893		X	
1916 August 28		X	
1928 August 30		X	
1930		X	
1955 September		X	Janet
1979 August 29, Sept 1			David, Frederick
1980 August 4			Allen
1984			Klaus
1989 August 17			Hugo
1994 September 9-10			Debbie
1995 Aug 25, Sept 5, 18			3 storms: Iris, Luis, Marilyn
1999 Nov 17-19			Lenny

Source: Lockhart, 1879; CIMH; NOAA and ECCB Quarterly Bulletins

A.3 History of Storms on Dominica: HURSTAT (adapted from Wagenseil and Watson, 1996)

As of 1996, the US National Center for Atmospheric Research had 110 years of reliable, standardized weather data for the region. The HURSTAT program, developed by Charles Watson in conjunction with CDMP, extracted statistics from this data base for storms affecting Dominica, using the latitude and longitude of a point near the center of the west side of the island.

The storms are sorted by category of intensity, according to the Saffir/ Simpson hurricane scale. HURSTAT gives the storm category according to the pressure and wind strength at the longitude and latitude chosen. Many of these historical storms had higher intensities at their centers, but the centers did not pass over the chosen location, and HURSTAT compensates for that.

The numbers in the tables need to be used with caution. For instance, Table A.3.3 indicates that there would be an average or mean interval of nearly three years (2.9 years) between years in which there have been storms. But this Table also shows that the actual interval has ranged from one to twelve years. In order to relate these statistics to personal experience, it is useful to remember that Hurricane Marilyn of 1995 was a strong Category 1, and that Hurricane David of 1979 was a strong Category 4 hurricane.

Hurricane Lenny, also a Category 4 storm, was unprecedented in moving from west to east across the northern Caribbean (Map 3). Passing 150 miles to the north it caused largely coastal damage to Dominica and neighboring Guadeloupe and Martinique, but only modest wind damage. So far the assessment of hurricane risk, as reflected in HURSTAT and these tables, is based on the assumption that the severity of impact will be a function of the intensity of the storm and its proximity to the island. Lenny type events will require a re-assessment of risks to coastal infrastructure and facilities.

Personal experience offers only limited help in assessing the risk of severe storms, however. Table A.3.3 shows that there was one interval when Dominica did not experience a hurricane strength storm for twenty years. People who grew up during that calm period may have felt complacent about hurricanes, based on their experience, but they were wrong to do so.

Table A.3.1 Saffir / Simpson Hurricane Scale

Category	Pressure (millibars)	Winds (km/hr)	Storm Surge (meters)	Damage
0 Tropical storm	> = 995	61 - 119	0.5 - 1.2	Some
1 Hurricane	980 - 995	120 - 153	1.2 - 1.5	Minimal
2 "	965 - 979	154 - 177	1.6 - 2.4	Moderate
3 "	945 - 964	178 - 209	2.5 - 3.6	Extensive
4 "	920 - 944	210 - 250	3.7 - 5.4	Extreme
5 "	< 920	> 250	> 5.4	Catastrophic

Table A.3.2. General Tropical Storm and Hurricane Statistics for Dominica, at Lat 15.5, Lon 61.4, from 1886 to 1996

Number of storms	61
Years with storms	45
Years with multiple storms	13
Years with multiple hurricanes	1
Category 0, tropical storms	40
Category 1, hurricanes	13
Category 2 "	3
Category 3 "	3
Category 4 "	2
Category 5 "	0

Table A.3.3. Interval Analysis for Tropical Storms and Hurricanes at Lat 15.5, Lon 61.4, from 1886 to 1996

Category of storm or above	TS	C1	C2	C3
Intervals Found (number)	35	17	7	4
Average Interval (years)	2.9	5.8	13.6	23.8
Maximum Interval (years)	12	20	34	70
Minimum Interval (years)	1	1	2	2

A.4 Important Natural Disasters and Reported Impacts, 1978-1999

The most important natural disasters affecting Dominica since 1960 are reported below. Typically there were assessments of damage and other effects soon after the event. The estimates in these various assessments have been synthesized and presented in summary form. Information on damage to the fixed capital stock of infrastructure and buildings has also been used to provide the estimates of rehabilitation costs presented in Chapter 7. Some of the inconsistencies in assessments are also noted.

A.4.1 Hurricane David –August 29, 1979

Prior to 1979 Dominica had not been devastated by a hurricane for several decades. Hurricane David has been described as the most devastating hurricane in more than 150 years and is regarded as one of the most powerful hurricanes to have affected the Eastern Caribbean up to that time. It achieved at least a category 4 status with winds in excess of 130mph (180km/hr) (Map 3).

Dominica took the full brunt of the onslaught of the hurricane, which can be described as the single most destructive disaster in the island's recorded history, in terms of its impact on the fixed capital stock and natural resources sectors. The direct effects lasted approximately 12 hours, but the impact was to be felt for many years afterwards. There is general agreement that Dominica was not well prepared for this hurricane either politically or operationally. The island had achieved political independence only one year before and was in the throes of a political crisis that had seen the installation of an Interim Government.

Socio-economic impact

- 42 persons killed.
- 75,000 persons made homeless.
- 95% of buildings damaged or destroyed.
- 66% of the population initially left without food, water or electricity.
- 12% of houses completely destroyed – i.e., 2,000 units.
- 50% of houses severely damaged – i.e., 8,000 units.
- 3,000 persons treated for injuries.
- Almost all schools damaged or destroyed.
- The total estimated damage to fixed capital was over EC\$ 53.8m.
- Massive social dislocation including emigration

Agriculture, forestry and fisheries impact

- Entire banana crop damaged or destroyed.
- Entire citrus crop affected.
- Damage to other crops estimated at EC\$ 6.6m.
- Overall damage to the agricultural sector estimated at EC\$ 33m.
- More than 75% of forests damaged or destroyed.
- 40% of forest wood volume lost, about 5 million trees damaged or destroyed
- There were extensive landslides but the area affected was not quantified, many hundreds were observed.
- Extensive damage to agricultural and forestry feeder roads.
- Significant localized erosion as more than 50 mm (20 inches) of rain accompanied the hurricane.
- 472 or 75% of fishing boats destroyed.
- A further 157 of the remaining 25% lost engines.
- Damage was exacerbated one week later with hurricane Frederick. Twelve inches of rainfall at Melville Hall on September 4, 1979 resulted in flooding.
- There was extensive coastal erosion that was largely unassessed and unquantified. Frederick did not produce direct wind damage but disrupted relief activities after David and led to the loss through flood damage of some relief supplies in storage .

A.4.2 Hurricane Hugo – September 17, 1989

Hurricane Hugo also reached category 4 status in the eastern Caribbean. The islands of Antigua, Barbuda, St. Kitts and Montserrat were devastated. Dominica did not receive a direct hit but the hurricane had a serious impact.

Socio-economic impact

- Damage estimates to capital stock were put at EC\$20m.
- Government savings were reduced by EC\$11m as emergency response activities were undertaken.
- Tourist arrivals fell by 27% in the next year, 1990.

Agriculture, forestry and fisheries impact

- Damage to the sector overall estimated at EC\$ 49m. This included EC\$ 48m direct damage and a further EC\$ 1m in agricultural infrastructure.
- Agricultural output in general declined by 18%
- Banana output, at record levels in 1988 of 79,000 tonnes, fell to 58,000 tonnes in 1989.
- Banana exports fell by 30%.

A.4.3 Three Storms: Iris, Luis and Marilyn - 1995

Three storms affected the Eastern Caribbean in rapid succession – Tropical Storm Iris on August 27, Hurricane Marilyn on September 5 and Hurricane Luis on September 18 both of Category 1 strength. Since the three events occurred within 3

weeks, it is almost impossible to separate the effects of each on any of the affected countries. Most of the available literature describes the effects of these storms together. Dominica was not as severely impacted as Antigua, Barbuda, Montserrat, St. Kitts and Nevis, however the economic impact and the effects on the natural resource sectors were significant.

Socio-economic impact

- One person killed.
- A projected economic growth rate of 4.5% converted into a decline of 2%.
- Discernible rise in food prices.
- CDB initially suggested a national rehabilitation estimate of EC\$ 174m.

Agriculture, forestry and fisheries impact

- Crops affected severely: 98% of bananas, 90% of plantains, 85% of vegetables, 71% of citrus trees, 55% of tree crops in general, 50% of root crops, and 33% of coconut trees.
- Banana losses valued at EC\$ 64m.
- Root crop losses valued at EC\$ 14.5m.
- Reduction in export revenues by EC\$ 72m.
- There was a 25% decline in crop production and 20% decline in agricultural output.
- Forestry was damaged but no accurate estimates available – estimate of EC\$ 8.8m suggested by some authorities
- Hurricane Luis alone destroyed 10 fishing boats and set back completion of the Roseau Fisheries Complex by six months at an additional cost of EC\$ 2m.
- Fishery landing sites, boat houses, boats and engines lost, to an estimated value of EC\$ 3.5m.
- The total damage to the agricultural sector was estimated at EC\$ 192m. An agricultural rehabilitation program of EC\$ 88m was proposed.

A.4.4 Hurricane Lenny – November 18-19, 1999

This very unusual eastward-tracking and late-season storm developed in the Caribbean Sea in mid-November reaching strong Category 4 by November 17-19 when it stalled within the Leeward Islands in the Anguilla-St Maarten area (Map 3). It caused high seas and storm damage on western coastal areas of Dominica that are commonly less vulnerable, being on the leeward side of the island. As it was not expected to cause high winds in the Windward Islands, there was no hurricane warning in Dominica. Consequently, Hurricane Lenny caught many unawares with minimal opportunities to protect vulnerable property, such as fishing boats and equipment and hotels exposed to the West. There were, however, high sea alerts on the Internet and at least one hotel owner took mitigation action by moving vessels to the lee of St Lucia. The hurricane warning system appears not to have been geared to anticipating and indicating consequences of such an unusual event, being focused primarily on wind speed based measures of hazard. In the absence of wave monitoring, the sea surge, wave height and swell can only be inferred from observer reports.

The hurricane caused considerable structural and equipment damage on the western side of the island. There were also some limited reported agricultural losses reflected in the loss in storage of one week's banana exports by DBMC of EC\$730,000 and WINCROP payouts.⁸⁹

The Ministry of Communications, Works and Housing (GoCD, 1999d)) damage assessment focuses on roads and associated infrastructure on the West Coast and associated service infrastructure (Map 2). Much of the damage was to previously 'inadequately' protected or unprotected structures. Most badly affected were road connections from Soufrière to Scott's Head, which were interrupted, along with power lines and telecommunications.

⁸⁹ There were 1560 claims; 1474 payments with a total value of EC\$1.106m, with an average payout of EC\$750 (Table 6.1.3).

The MCWH assessed cost of repair restoration to roads and sea defense works was EC\$3.4m and building damage EC\$7.8m. In addition the MCWH estimated the cost of permanent works to protect road infrastructure as EC\$109.6m. This estimate is closely related to the sea defense strategy capital investment of EC\$96.1m in the 1997 Review of Capital Defence strategy (Mouchel, 1997). The costs of rehabilitation, including mitigation measures, was re-estimated as EC\$125m. (Liataud, 2000).

By June 2000 no overall assessment of the direct damage caused by Hurricane Lenny had been undertaken comparable to that, for example, made by the government with CDB/IADB assistance following Hurricanes Luis and Marilyn in 1995 (GoCD, 1995). Other reported direct damage was as follows. WINCROP's payout of EC\$1.1m implies total producer losses in the 1999-2000 season of around EC\$5.5m (Table A 6.1.3). The Ministry of Agriculture estimated total losses in the rest of the crop sector as EC\$3.9m, including EC\$1.8m for plantains and EC\$0.9m for 'ground provisions' or root crops. The absence of very high winds or heavy rain associated with Hurricane Lenny makes this 'provisional' assessment appear somewhat high. In fact, the Ministry's assessment had already been adjusted downwards from an implausible initial EC\$18.6m for the non-banana sector (GoCD, 1999e). Independent observers pointed to the potentially sensitive situation in late 1999 prior to the General Election as a possible factor influencing assessments for the rural sector.

Other assessments of direct losses or costs included:	<u>EC\$ million</u>
DOWASCO (water and sewage)	0.34
DOMLEC (electricity)	0.15
Port Authority	1.3
Fisheries	
Roseau complex	3.4
Other private sites and equipment	1.4
Hoteliers	0.67 ⁹⁰
Residential Property	2.73
DCP	2.8

There are also various estimates of other damage and indirect costs. For example, the Ministry of Agriculture estimated potential damage to coral reefs and seagrass beds on the basis of beach level assessments as EC\$2.2m. The estimated cost of business disruption in terms of unemployment in the fishery sector was EC\$0.5m (GoCD, 1999c). As for damage to residential property provisional estimates were of 174 affected households, including 602 people, whilst 69 houses were destroyed and 104 reported damaged. The largest number affected was in Loubiere, south of Roseau (GoCD, 1999d). Private sector informants indicated substantial losses in terms of business disruption, especially in the tourism related sector, and temporarily higher transport costs.

A.4.5 Other Hurricane Events

Hurricanes Frederick and Allen are noted in Dominica's history not for the scale of destruction but for the timing of their impact (Table A.2.1). Hurricane Frederick occurred *only one week after* Hurricane David in 1979. It brought prolonged torrential rainfall and exacerbated the damage done to the natural resources sector by Hurricane David. Quantification was almost impossible. Hurricane Allen, which severely affected St Lucia, hit Dominica a glancing blow on August 4 1980. It disrupted and interrupted the recovery and rehabilitation efforts that were underway from Hurricane David the year before (Walsh, 1982).

Tropical Storm Debbie generated winds of about 40 mph. over Dominica on September 9 and 10 in 1994. The winds were accompanied by persistent rains. This storm followed an extended dry period that many local people regarded as a drought. At the time, approximately 5,000 acres were under banana cultivation, of which 2,800 were affected by the storm. 143 acres of plantains, 355 acres of root crops and 355 acres equivalent of tree crops were also damaged. Losses in banana production were initially estimated at EC\$25m, but this is not confirmed by WINCROP payouts (Table A.6.1.3). Losses in fisheries and non-banana agriculture amounted to EC\$5m. The forestry and environmental losses were not quantified.

A.4.6 The Layou Valley Landslide

The Layou-Carholm Landslides represent a complex series of landslides that achieved climactic proportions in 1997 and remain a hazard today (Map 2). The Layou River is one of the largest watersheds in Dominica and drains about 10% of the land.

⁹⁰ The hoteliers estimated themselves that total losses including business disruption might amount to around EC\$5.0m.

Landslides were common in the area, with specific reports occurring between 1987 and 1997. There is an eyewitness account of a slide following Hurricane Hugo in 1989 and also following Hurricanes Iris, Luis and Marilyn in 1995. There was a major change to the pattern of small landslides. Dramatic slumping occurred between November 18 and 25, 1997. Two major slides blocked the river and created a natural dam. The dam was breached on November 21 with mudflows reaching the sea accompanied by extensive flooding of the lower river valley. A wall of material estimated at 50 feet high was washed downstream. An estimated 300 million gallons of water had collected behind the natural dam wall, at a depth of 60 feet and $\frac{3}{4}$ of a mile in extent. The riverbed rose dramatically in its lower reaches. This elevation was estimated at 30 feet at the location of the swing bridge. The river had dried up between November 18-20 1997 and then flooded on November 21. Further landslides occurred on November 25, 1997 and October 8 and 11, 1998 with subsequent dam breaks being significant events.

A monitoring program by the Forestry Department was introduced and remains in place because of the continuing hazard of flooding of the valley that is traversed by a main road connecting northern west coast villages with Roseau (GoCD, 1997b; James, undated; Rodgers and others, 1997).

Socio-economic impact

- Temporary evacuation of 600 residents.
- Loss of an access road to banana producing areas.
- Closure of Layou Valley Hotel.
- Loss of Swing Bridge
- Loss of income through fisheries and tourism related sales.
- Severe disruption of traffic

Agriculture, forestry and fisheries impact

- Loss of approximately 40 acres of land.
- Loss of natural vegetation.
- Loss of bananas and tree crops especially citrus and cocoa.
- Destruction of cocoa drying shed and banana boxing plant.
- Siltation of river and build up of sediment offshore.
- Pot fishery has been destroyed in the area.
- Fish sales have fallen away dramatically.
- Fishermen have been dislocated many must now use other landing sites.
- Reefs located two miles offshore are covered with mud.
- Aquatic life in the river was obliterated.
- Loss of streamside vegetation.

Annex B.

Regression Analysis Methodology

This Annex describes the methodology employed in undertaking more formal regression analysis of the impact of storms on certain aspects of the Dominica economy. Regression analysis was undertaken in four key areas: broad economic performance (as defined by GDP), banana sector activity, tourism and external aid flows.

The results of the analysis are discussed in relevant sections of the main report. A more detailed account of the regression analysis, including tables of results, is available upon request from the authors.

B.1 Storm Dummy Series

For the purposes of the analysis, the impact of the storms was captured using a dummy series. Two types of dummy variable were tested, with a variant of the second type used in the analysis of quarterly banana production :-

i) *a weighted composite series* – a dummy series assuming a positive value for storm years and 0 for non-storm years reflecting the record of storms since 1976 (Table A.2.1). The weights were constructed partially on the basis of data on WINCROP insurance payments during 1988-99 (Table A.6.1.3). The full dummy series was as follows:

1976 – 0	1988 – 0
1977 – 0	1989 – 5
1978 – 0	1990 – 0
1979 – 7	1991 – 0
1980 – 1	1992 – 0
1981 – 0	1993 – 0
1982 – 0	1994 – 1
1983 – 0	1995 – 5
1984 – 1	1996 – 0
1985 – 0	1997 – 0
1986 – 0	1998 – 0
1987 – 0	1999 – 1

ii) *a series of discrete independent dummy series* – a separate dummy series for each storm year (see Annex A), assuming a value of 1 for the year of impact and 0 for all other years.

B.2 Gross Domestic Product

The impact of hurricanes on annual GDP, agricultural GDP and non-agricultural GDP was explored. Initially, simple models were developed, regressing the various components of GDP (in real EC\$ terms) against a constant and the composite and independent dummy series. Regressions were undertaken in both linear and logarithmic form, whilst the explanatory power of the dummy series lagged one period were also tested. Initial regression runs with the independent dummy series indicated that some of the hurricane events had had very little impact on the Dominica economy and so subsequent analysis included only three discrete dummy variables - for 1979, 1989 and 1995.

Several other explanatory variables were also tested to control for their effect on GDP: government consumption, private consumption, total investment⁹¹ and the average banana unit price.

⁹¹ Disaggregated investment data was not available.

To further tighten the econometric methods, regressions were re-run based on rates of growth of all the non-dummy variables. Growth rates were computed in two ways: firstly, as $(\text{var}-\text{var}(t-1))/\text{var}(-1)$ and then as $\log(\text{var})-\log(\text{var}(-1))$.

B.3 Banana Production and Export Earnings

A variety of techniques were used to determine – separately - the role of natural disasters, banana producer prices on banana production and export earnings. The analysis was based on quarterly data reported by the ECCB over the period 1988Q3 to 1999Q4.

Simple ordinary least squares (OLS) techniques were used to explore the impact of the 1989 and 1995 storms on banana production (expressed in volume terms) and also export earnings in real 1990 prices. Discrete dummy variables were tested, assuming a value of 1 for the quarter in which the relevant storm struck and 0 for other quarters. An additional dummy series was included to control for seasonality.

B.4 Tourism

Analysis was undertaken to assess the impact of storms on annual visitor arrivals, expressed in terms of the rate of growth of numbers of visitors, over the period 1976 to 1998. Analysis was undertaken on data disaggregated by type of visitor - stopover, cruise and excursion – as well as on total number of visitors. Visitor expenditure was also assessed but the results were found to be inconsistent.

Again, both the composite and discrete storm dummy variables were tested. In the latter case, a general to specific approach was adopted, such that the least significant variables were removed one at a time in a stepwise fashion. All equations were run on a constant and the dummies. The explanatory power of the storm dummies lagged one period were also tested.

B.5 External Assistance

It had originally been hoped to undertake an in-depth analysis of aid flows to Dominica. However, inconsistencies in the data arose that were insurmountable, and so a more simplified approach was adopted.

The impact of hurricane events on annual aid flows was analyzed using a variety of OLS methods and dummy series. Both composite and independent dummy series were run as explanatory variables against commitments and gross and net disbursements. The dummies were lagged for up to 2 periods. As before, general to specific methods were adopted. In later stages of the analysis, the effects of total value of exports and banana market value were also controlled for (separately).

Annex C

Public Finance

This annex considers the impact of Hurricane David, Hurricane Hugo and the 1995 storms on Dominica's public finances in more detail. As already noted, overall data on public expenditure and revenue suggest that disasters have little impact on this aspect of the economy. However, this apparent insensitivity reflects post-disaster reallocation of resources, rather than a sharp increase in public expenditure, combined with protracted – rather than rapid - reconstruction investment over a number of years.

A careful examination of the budgetary impact of individual disaster events is important because, by providing a more accurate assessment of their full public cost, it emphasizes the importance of integrating hazard risk reduction concerns into medium- and long-term economic and financial planning. It also helps facilitate a more rational response to natural hazard risk and disasters, both in allocating public resources and external assistance and in determining appropriate standards for Dominica's infrastructure.

This annex also includes an examination of the level of public investment in hazard mitigation and preparedness, noting particularly the difficulties in measuring this form of expenditure in Dominica – a problem also observed elsewhere.

C.1 Hurricane David

In the immediate run up to Independence, the GoCD already faced considerable budgetary difficulties and was operating a process of monthly cash budgeting in an attempt to contain expenditure. The GoCD was also receiving considerable budgetary support from the British Government, totaling an average 24.1% of total recurrent revenue in 1977/78 and 1978/79. The 1978/79 *Budget Address* noted how the persistent liquidity problems had made it 'virtually impossible to put into effect long term programs for budgetary expenditures, and made it extremely difficult to implement development projects without interruptions and delays' (GoCD, 1978: 6).

Although a draft budget for 1979/80 was drawn up before the end of fiscal year 1978/79, internal problems following Independence in November 1978 led to the dissolution of the country's parliament and the establishment of a provisional government in June 1979. The new government set about revising the draft budget. It had almost completed its task when Hurricane David struck, causing estimated damage of EC\$64.3m (US\$23.8m) (see Annex A). In terms of damage to public assets alone, an initial reconstruction mission undertaken in October 1979 estimated the cost of repairs to public buildings at US\$500,000; to hospitals and health centers at US\$630,000; to school buildings and equipment at US\$3.6m; to roads at US\$3m; and to the power system at US\$4m (UNDRO, 1980). In recognition of the severe budgetary implications of the disaster, a second 'comprehensive and detailed review involving every attempt to cut back upon expenditure and a detailed recasting of the anticipated revenue picture' was therefore undertaken (GoCD, 1979: 2), with the final draft Budget Statement eventually introduced on December 10, 1979.

The first draft budget drawn up by the new administration had indicated total expenditure of EC\$35.7m, including EC\$18m for the remuneration of civil servants. Various tax adjustments were expected to increase revenues over the previous year, together with UK budgetary support of EC\$2m resulting in a balanced recurrent budget. In comparison, the final 1979/80 budget, as announced in December 1979, detailed estimated recurrent expenditure of EC\$37.8m, only 5.9% higher than the original figure. Of this, EC\$16m was earmarked for the remuneration of civil servants implying a 23% increase in recurrent expenditure on other items. The estimate for budgetary support remained at EC\$2m. Revenues were now expected to be 32% lower than in 1978/79, in part reflecting an anticipated fall in employment as well as a one-year waiver on duties on a wide range of building materials in order to help facilitate the rehabilitation process. Meanwhile, a previously planned change in the nature of taxation on gasoline, which was expected to lead to a rise in tax on the product, and an intended doubling of the monthly allowance for destitute people were also deferred (GoCD, 1979).

In the event, total recurrent expenditure increased by 31% in real terms between 1978/79 and 1979/80 to EC\$51.9m – that is, to a level 37% higher than had been estimated. However, this rise in part reflected an addendum to the 1979/80 budget that was introduced in January 1980 following industrial action by public servants. Under this addendum, public sector wage increases were announced bringing planned total recurrent expenditure up to EC\$45.2. Public sector salaries accounted for 61% of this

new total. To counteract the wage-push inflationary spiral that the GoCD anticipated as a consequence of this increase, the pauper allowance was also doubled.

Thus, total actual recurrent expenditure exceeded the final planned figure by only 14.9%. However, non-wage related expenditure alone was 59%, or EC\$10.4m, higher (based on actual expenditure of EC\$23.9m on wages and salaries, as reported by the World Bank (1985)). Nevertheless, it is difficult to identify any recurrent expenditure specifically made in response to Hurricane David other than a small amount expended through a special recurrent budget line, entitled Hurricane David Relief, which was created in 1979/80 to provide support to the disaster victims. This budget line received an initial allocation of EC\$2m, with a small supplementary allocation in 1980/81. Actual expenditure totaled an estimated EC\$2.2m over the two years, equivalent to only 1.9% of total recurrent expenditure over the same period, almost half of which was spent on supplies and materials. However, available evidence suggests a considerable increase in expenditure under certain existing budget lines. For example, the budgetary allocation for casual labor in the Plant Propagation Division of the Ministry of Agriculture, Lands, Fisheries and Marketing was 76% higher than in 1978/79, reflecting the fact that it was 'a vital key to the rehabilitation program in the agricultural sector' (GoCD, 1979: 28). Similarly, the cost of casual labor for the maintenance of roads and bridges alone increased from EC\$0.74m in 1978/79 to EC\$1.88m in 1979/80. However, the cost of supplies and materials under the same budget subhead fell 34%, to only EC\$0.26m. Subsidies were also paid to Statutory Boards whose finances had been seriously adversely affected by the dislocation caused by Hurricane David although, unfortunately, detailed information on the amounts involved are not readily available.

Capital expenditure had been set at EC\$27.1m in the final 1979/80 budget, compared to actual nominal capital expenditure of EC\$1.6m in 1978/79. Despite this substantial year-on-year increase, further rises were expected in subsequent years. As the 1979/80 Budget noted, 'much of the reconstruction work will be reflected in subsequent budgets spread over the next five years... as we have had to rethink our priorities and redesign projects that were already in the pipeline to take account of the new post David situation' (GoCD, 1979: 38). For example, capital estimates for the Ministry of Communications, Works and Tourism were much lower than in previous years due to the fact that many new projects were still being designed and therefore that accurate costings were not yet possible, although they were expected to be substantial. Indeed, as it turned out, actual capital expenditure was very low across the board, totaling only EC\$10.3m.

Although, as already indicated (see Chapter 11), it is not possible to identify precisely which items of capital expenditure related to post-disaster rehabilitation, a large proportion of the total estimated capital budget was allocated to the agricultural sector, with particular emphasis placed on emergency food production, rehabilitation of banana cultivation, early restoration of facilities for boxing fruit and rehabilitation of plant propagation facilities for replanting of tree crops. In the event, this sector received 57% of total capital expenditure for the year. Other clearly disaster-related activities included a pilot logging and sawmill project, aimed at salvaging fallen timber for use in housing reconstruction, and a building materials pilot project.

The increase in recurrent expenditure was partly met through additional external support, including STABEX transfers. Overseas grants in support of recurrent expenditure totaled EC\$26.8m, EC\$24.8m higher than had been expected. Indeed, some 82% of total external grants and loans received in 1979/80 were in the form of budgetary assistance. Additional uncosted material aid was also reported to have been received in the form of goods and services (GoCD, 1980). Meanwhile, local revenue was 84% higher than expected, in part reflecting the announced re-introduction of duty on building materials and a number of other tax changes in January 1980 to meet additional costs relating to the public sector wage increases that were announced at the same time.

External grants and loans received in support of the capital sector in FY 1979/80 were much lower than originally expected, totaling only EC\$4.7m compared to original estimates of EC\$28.2m. The precise factors underlying such low flows of assistance are not clear but they presumably reflected difficulties in determining priorities and designing and processing aid projects under chaotic circumstances, as created both by the hurricane and extreme political difficulties.

The Government Budget for the following fiscal year was introduced just ten days after Hurricane Allen and, as such, revenue projections were again expected to require 'considerable readjustment' although these adjustments had yet to be made (GoCD, 1980: 4). Although the Budget included no changes in taxation, it had been anticipated that there would be a substantial increase in local revenue as the economy began to recover from Hurricane David. Instead, following Hurricane Allen it was now expected that local revenue would have to be reduced by an estimated EC\$10.6m, leaving an EC\$28.6m deficit on the recurrent budget. Various steps were identified to help reduce this deficit, including that payment of arrears to civil servants would be delayed and that indiscriminate granting of tax and duty concessions would cease immediately. STABEX compensation of EC\$10-11m was also anticipated as a consequence of the hurricanes.

In the event, local revenue totaled EC\$47.8m, only 4.8% or EC\$2.4m lower than had been initially anticipated. Local revenue was boosted, in particular, by substantial increases in personal income tax and consumption duty revenues as, despite Hurricane Allen, economic performance improved (see Section 4.1). Recurrent expenditure totaled EC\$62.6m, 11.8% higher in real terms than in the previous financial year, although expenditure was partly contained through strict controls. This implied an overall improvement in Dominica's recurrent fiscal budget, but still left an EC\$14.8m deficit, in part financed by an EC\$9.5m draw down under an IMF Program. In view of Dominica's serious budgetary difficulties, to which Hurricane David had been a major contributing factor, the GoCD had agreed a three-year program of assistance with the IMF in November 1980. Various expenditure targets were set under the program, both on overall spending and spending within particular sectors. However, the agreement also recognized that increased expenditure was required in certain areas, such as road maintenance.

Meanwhile, external capital revenue totaled EC\$36.1m during FY 1980/81, compared to an original estimate of EC\$71.4m. This shortfall was in part attributed to unusually heavy rainfall, which caused severe additional damage to the road network and hampered 'work in the field' (GoCD, 1981: 5). Financing for some projects was also not forthcoming, particularly for road infrastructure and health.

As already indicated, the budgetary implications of Hurricane David and years of poor public infrastructure maintenance continued to be felt for a number of years as rehabilitation and reconstruction projects, including some major road projects, were gradually implemented. Annual capital expenditure was, on average, 61% higher in real terms in each of the years 1981/82-1985/86 than in 1980/81. Heavy rains experienced as a consequence of a further hurricane, Klaus, in 1984 also probably played a role in prolonging road reconstruction. These capital projects were met almost entirely through external grants and loans. Indeed, in large part because of Hurricane David, Dominica experienced a relatively rapid increase in its outstanding external debt, rising from US\$15.2m at the end of 1979 to US\$42.7m by the end of 1984, including obligations of US\$10.5m to the IMF (World Bank, 1985).

C.2 Hurricane Hugo

In the 1989/90 budget estimates presented in mid-1989, the GoCD had envisaged total recurrent expenditure of EC\$108.9m over the forthcoming fiscal year. A current account surplus of EC\$22.6m was also forecast, which would be put towards the PSIP.

The subsequent occurrence of Hurricane Hugo in September 1989 contributed to only a marginal 2.1% rise in recurrent expenditure as compared to the original GoCD estimate, suggesting that there must have been considerable reallocation of resources within the recurrent account. Despite an improvement in efficiency of the tax system, local tax revenue was also EC\$11.9m or 8.8% lower than had been expected, reflecting poor economic performance (see Section 4.1), unfavorable exchange rate movements and the suspension of the banana development levy. The latter measure was implemented to alleviate pressure on the agricultural sector, in turn caused both by the hurricane and low EC\$ banana prices, and alone resulted in a EC\$3.8m loss in estimated revenue, as earnings from this source fell from a projected EC\$4.5m to only EC\$0.7m. The overall recurrent account surplus for the year was reduced to EC\$11.8m from EC\$17.5m in the previous fiscal year.

Meanwhile, overall flows of external grant and loan assistance totaled EC\$57.6m, including unanticipated hurricane relief of EC\$7.6m, compared to the original figure of EC\$27.5m contained in the 1989/90 estimates (GoCD, 1989).

Total public sector savings fell from EC\$44.4m in 1988 to EC\$25m at the end of 1989, in most part reflecting a draw down of DBMC reserves to assist banana farmers. Central government savings alone fell from EC\$19.1m to EC\$6.1m over the same period, again in part reflecting the temporary use of local funds to compensate farmers for losses sustained as a result of Hurricane Hugo in anticipation of subsequent STABEX transfers, and in part reflecting the suspension of the banana development levy.

In relative terms, current expenditure remained unchanged in 1989/90 at about 25% of GDP. However, capital expenditure rose by some 5 percentage points to 19% of GDP, in part reflecting activities under two non-disaster related domestically financed port projects, which were completed the following year. The weakened fiscal position led to increased domestic borrowing and, in turn, to a tightening of credit markets, as the lending rate to the private sector was increased by 1% (World Bank, 1992). In FY 1990/91 there was a further decline in the current account surplus to 1.5% of GDP as certain tax reductions were introduced, in part apparently to alleviate the impact of Hugo, and a 21% retroactive civil service pay increase was implemented.⁹²

⁹² Tax relief measures included a reduction in the corporation tax from 35 to 30%; tax exemption for interest income, hotel bar and restaurant sales and for distributed profits in the form of bonds; reduction of the hotel occupancy rate from 10 to

The banana development levy was reinstated in 1990/91, contributing 4.4% of total local revenue and 1.8% in 1991/92. However, Hurricane Hugo was a significant underlying factor leading to a further suspension of the levy in 1992/93, in order to relieve pressure on the agricultural sector and to allow the DBMC to manage its cash flow, following a deterioration in the sterling-US dollar exchange rate and a subsequent fall in banana export earnings (GoCD, 1994).⁹³ In restructuring of the corporation's debt, the GoCD eventually wiped off the arrears on the levy owed by the DBMC and the levy was never reinstated, although annual Budget estimates continued to assume some revenue from this source until FY 1996/97.

C.3 The 1995 Storms

In the 1995/96 Budget Address presented in mid-1995, the GoCD had indicated total recurrent expenditure of EC\$182.3m and central government capital expenditure of EC\$104.0m over the forthcoming fiscal year. It was anticipated that the latter would be partly met through external grants totaling EC\$38.6m and concessional loans totaling EC\$28.8m with an additional EC\$8m raised through a capital review, leaving an EC\$28.6m financing gap.

In the event, total recurrent expenditure was 8.1% lower than planned whilst capital expenditure totaled only EC\$23.9m – equivalent to a mere 23% of the GoCD's original estimate and 57.8% lower (in real terms) than the previous year - in part as a direct consequence of the 1995 hurricanes. The following year, capital expenditure remained low, at only 8.0% above the FY 1994/95 figure despite considerable post-disaster rehabilitation needs (see Annex A). The GoCD attributed low expenditure on the capital account 'to delays in the implementation of projects arising from the non-satisfaction of conditions precedent for disbursement of funds from lending agencies coupled with the utilization of government's counterpart funds for Capital Projects in order to satisfy emergency rehabilitation requirements, following the passage of hurricanes Luis and Marilyn' (GoCD, 1996b: 5). In other words, the storms themselves were in part responsible for low capital expenditure, rather than generating immediate additional external investment resources to fund rehabilitation.

Local revenue receipts were 5.1% or EC\$9.1m lower than expected in FY 1995/96, again in part a consequence of the storms. Import duty on chicken was suspended from October 1995 to March 1996 in order to provide some relief to citizens in the immediate post-hurricane period. For the third year running, no revenue was also collected under the banana development levy.

In part as a consequence of the impact of the 1995 storms, the GoCD began discussions with the IMF in 1996 about a possible package of reforms, although no agreement was ever reached. The GoCD decided to enter into such discussions in view of its continuing fiscal and balance of payments difficulties, in part disaster related; growing awareness on the part of the GoCD that access to external assistance could become increasingly difficult if it did not take action to correct fiscal imbalances or thus to meet its loan obligations on schedule; and donor pressures for reform. Meanwhile, the 1996/97 budget was austere, reflecting both the fact that revenues would be limited by the economic downturn following the 1995 storms and continued donor pressures to implement structural adjustment. Nevertheless, the GoCD was reported to be unable to achieve its target of fiscal savings of 2.5% of GDP by FY 1996/97 due to economic difficulties relating both to changes in the banana industry and the continuing effects of the 1995 storm devastation (GoCD, 1998).

C.4 Mitigation and Preparedness

The GoCD has also invested some public resources in disaster mitigation and preparedness. However, it is not possible to estimate the full cost of such measures because some – for example, the hurricane proofing of public buildings – are not reported separately or even at all. Indeed, the only capital investment mitigation measures that the GoCD has undertaken which can be more easily quantified are those relating to sea defense and volcanic monitoring and hazard mapping. The latter totaled EC\$0.6m (at real 1990 prices) between the late 1980s and early 1990s.

Sea defense works have been conducted under a number of budgetary heads, including not only the Ministry of Communications, Works and Housing but also the Ministry of Tourism, Ports and Employment (under headings of airport and harbor). There was some limited capital investment in sea defense in the 1970s but, according to a review of annual government budget statements, no further expenditure was undertaken until the 1990s. Some EC\$0.8m (at real 1990 prices) was then spent

5%; introduction of a 10% investment credit; and revision of the capital allowance in order to shorten the period over which assets could be written off (World Bank, 1992).

⁹³ Formally, the GoCD introduced a reduced rate but in practice did not even enforce collection of the levy at this reduced rate.

on a government-financed sea defense project between 1992/93 and 1998/99. Additional expenditure was undertaken as part of an EC\$15.6m British-funded bay front development project for Roseau; and under an EC\$1.3m airport sea defense project. A significant further increase in spending was anticipated under the 1999/2000 Budget, together with some road rehabilitation costs totaling over EC\$22m, in part as work on CDB and World Bank sea defense and wave tidal protection projects was begun.

In the past, the recurrent budget also included an allocation under the Ministry of Communications, Works and Housing (General Maintenance Services) for sea walls and river damage repairs and control. However, although EC\$5,000 was consistently allocated for sea wall maintenance over the period 1975/76-1978/79 and again from 1981/82-1984/85, no actual expenditure was ever made and the budget sub-head was subsequently dropped. Similarly, an allocation of EC\$15,000 was made for river damage repairs and controls under the 1976/77-1978/79 budgets and again in 1980/81 but no expenditure was actually undertaken. Subsequently, between 1982/83 and 1988/89, a total EC\$44,299 (at real 1990 prices) was spent under this budget line but there have been no more recent allocations specifically earmarked for river damage repairs and control.

As regards preparedness, small levels of capital expenditure have been intermittently made on supplies and materials. Some recurrent resources have also been allocated to preparedness, including via the GoCD's contribution to the regional organization CDERA and, since it was created in 1995/96, the GoCD Office of Disaster Management (ODM). However, budgetary allocations remain small with, for example, only EC\$145,639 approved for the ODM under the 1999/2000 budget.

Annex D

Statistical Tables

Table A.4.1: Dominica GDP by economic activity at factor cost, 1977-

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Agriculture	83.1	92.4	62.9	61.6	75.3	77.0	77.7	82.5	79.1	91.9	95.4	101.4	86.6
Crops	80.5	91.0	59.5	50.7	62.0	64.2	64.2	68.7	63.7	76.2	79.3	84.9	70.1
Livestock	2.2	2.2	2.5	3.1	4.1	4.5	4.8	4.6	5.5	5.8	5.9	6.0	6.1
Forestry	1.4	1.4	1.6	1.6	2.5	2.5	2.5	2.6	2.6	2.6	2.6	2.6	2.7
Fishing	4.4	4.5	2.2	6.2	6.3	5.8	5.9	6.6	7.3	7.4	7.6	7.9	7.7
Mining &	2.4	2.5	1.7	1.7	1.7	1.9	1.8	2.1	2.1	2.0	2.3	2.9	3.0
Manufacturing	8.6	11.9	9.9	12.6	14.8	17.4	17.8	17.6	19.9	20.7	22.0	24.2	25.7
Electricity &	6.3	6.7	5.8	5.8	6.3	6.4	6.9	7.1	7.6	8.0	8.6	9.2	9.9
Construction	11.8	11.8	14.5	25.9	22.0	19.1	18.0	20.7	18.5	15.6	17.6	22.9	24.2
Wholesale & Retail	20.5	24.2	16.8	23.9	25.2	25.2	24.7	25.0	27.3	30.0	33.4	36.1	39.5
Hotels and	3.5	4.0	3.0	2.7	2.6	2.9	3.3	3.8	3.7	4.2	4.6	5.3	5.5
Transport	16.6	17.7	16.1	17.0	14.3	16.3	22.0	22.9	24.7	27.4	29.0	31.7	31.9
Road	10.1	10.5	10.3	10.6	8.0	9.6	13.7	14.1	16.2	17.9	18.2	19.7	19.2
Sea	5.1	6.0	3.6	4.9	6.0	6.0	6.6	7.0	6.7	7.7	8.7	9.3	9.7
Air Transport	1.6	1.9	1.5	1.4	1.4	1.5	1.6	1.8	1.7	1.8	2.0	2.7	3.0
Communication	4.4	5.1	5.2	5.6	7.0	7.9	10.1	10.9	12.1	13.5	18.6	20.5	23.2
Banks &	18.8	23.3	25.7	27.8	28.4	28.6	28.7	29.5	31.0	32.0	33.6	36.4	38.8
Real Estate &	9.9	10.1	7.7	11.2	11.4	11.5	11.8	11.9	12.0	12.1	12.4	12.7	13.1
Government	43.6	49.8	52.4	54.5	56.7	58.4	59.3	60.5	62.0	62.6	64.2	66.1	66.9
Other	2.8	2.8	2.5	2.8	2.9	3.1	3.1	3.2	3.2	3.3	3.4	3.6	3.8
Less Imputed Service	10.7	13.3	14.6	14.1	14.4	14.6	14.6	15.3	16.0	16.5	17.3	21.2	24.3
Total	223.0	250.8	208.2	242.4	257.9	264.1	270.6	282.3	287.1	306.7	327.6	351.7	347.8
<i>Growth rate</i>		12.4	-17.0	16.4	6.4	2.4	2.5	4.3	1.7	6.8	6.8	7.4	-1.1

Source : Dominica Central Statistical Office

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Table A.4.1: Dominica GDP by economic activity at factor cost, 1977-1999 (constant

	199	199	199	199	199	199	199	199	199	199
Agricult	92.	92.	93.	94.	90.	83.	87.	86.	85.	85.
Crop	77.	76.	78.	77.	73.	65.	69.	68.	66.	66.
Livesto	6.	6.	6.	6.	6.	6.	7.	7.	7.	7.
Forest	2.	2.	3.	3.	3.	3.	3.	3.	3.	3.
Fishin	5.	5.	5.	6.	7.	7.	7.	8.	8.	8.
Mining &	3.	2.	2.	3.	3.	3.	3.	3.	3.	3.
Manufactu	26.	27.	29.	30.	27.	27.	29.	30.	36.	31.
Electricity &	11.	11.	13.	12.	13.	14.	15.	16.	18.	19.
Construct	28.	28.	28.	29.	32.	36.	35.	35.	34.	35.
Wholesale & Retail	41.	42.	43.	44.	49.	50.	52.	54.	55.	57.
Hotels and	7.	8.	9.	10.	11.	11.	11.	11.	11.	11.
Transp	36.	34.	36.	38.	39.	40.	43.	43.	44.	46.
Road	19.	20.	21.	21.	22.	23.	24.	24.	24.	24.
Sea	12.	10.	11.	13.	13.	14.	15.	14.	16.	18.
Air	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
Communicat	23.	28.	31.	31.	32.	38.	39.	44.	45.	45.
Banks &	41.	48.	47.	47.	49.	53.	52.	50.	53.	56.
Real Estate &	13.	13.	13.	14.	14.	14.	14.	14.	15.	15.
Government	69.	70.	70.	71.	72.	71.	72.	74.	77.	78.
Other	3.	4.	4.	4.	4.	5.	5.	5.	5.	5.
Less Imputed	28.	36.	36.	36.	36.	41.	40.	39.	40.	43.
Tota	369.	377.	388.	395.	403.	410.	422.	431.	446.	447.
<i>Growth rate</i>	6.	2.	2.	1.	2.	1.	3.	2.	3.	0.

Source : Dominica Central Statistical

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Table A.4.2: Logarithmic regression results: factors explaining variation in rates of growth of GDP, agricultural GDP and non-agricultural GDP, 1978-98

		<i>GDP</i>		<i>Agricultural GDP</i>		<i>Non-agricultural GDP</i>	
		Simple specification	More complex specification	Simple specification	More complex specification	Simple specification	More complex specification
<i>Constant</i>		0.036	0.043	0.029	0.046	0.041	0.039
Composite storm dummy series	Current	NA	NA	NA	-0.040 (-7.077)	NA	NA
	Lagged	NA	NA	NA	0.021 (3.542)	NA	NA
1979 storm dummy	Current	-0.216 (-7.532)	-0.214 (-36.008)	-0.419 (-6.072)	NA	-0.121 (-4.380)	-0.116 (-10.254)
	Lagged	0.114 (3.975)	0.131 (17.267)	Insignificant	NA	0.180 (6.525)	0.125 (8.968)
1989 storm dummy	Current	Insignificant	-0.061 (-14.075)	-1.890 (-2.74)	NA	Insignificant	Insignificant
	Lagged	Insignificant	0.029 (7.498)	Insignificant	NA	Insignificant	Insignificant
1995 storm dummy	Current	Insignificant	-0.053 (-12.803)	Insignificant	NA	Insignificant	Insignificant
	Lagged	Insignificant	0.013 (2.946)	Insignificant	NA	Insignificant	Insignificant
Banana price/dt	Current	NA	0.069 (6.689)	NA	Insignificant	NA	0.106 (4.168)
	Lagged	NA	0.098 (9.244)	NA	Insignificant	NA	Insignificant
Investment	Current	NA	0.061 (12.070)	NA	0.120 (2.173)	NA	0.043 (3.256)
	Lagged	NA	Insignificant	NA	Insignificant	NA	Insignificant
Private consumption	Current	NA	Insignificant	NA	Insignificant	NA	0.174 (3.793)
	Lagged	NA	0.144 (9.970)	NA	Insignificant	NA	Insignificant
Government consumption	Current	NA	Insignificant	NA	Insignificant	NA	Insignificant
	Lagged	NA	-0.178 (-6.999)	NA	-0.943 (-5.645)	NA	Insignificant
Adjusted R2		0.78	0.99	0.66	0.87	0.75	0.96
Durbin-Watson Statistic		1.67	2.15	2.19	1.87	1.13	2.24
Diagonistics		Failed at 5% on only	No problem detected	No problem detected	No problem detected	Failed at 5% on only	No problem detected

Note: Results reported under 'simple' specification relate to those taking only the storm dummy variables as independent variables, with only the best fit result reported (i.e., either using the independent or composite dummy series.) Results reported under 'more complex specification' relate to best-fit specifications taking additional independent variables into account.

t-statistics are indicated in parentheses.

Table A 5.1.1: Agricultural commodity production and fish landed in Dominica, 1961- 1998 (tonnes)

Year	Bananas	Coconuts	Roots and Tubers	Citrus	Fish Landed
1961	29211	10000	15950	16700	500
1962	28667	9000	16160	15800	600
1963	28597	10600	16770	14850	600
1964	42545	8000	17030	16000	600
1965	49756	10600	17400	18150	500
1966	48840	12700	17800	16194	500
1967	48470	11000	18150	16250	500
1968	55884	11200	18450	16550	600
1969	60000	11500	18830	16580	600
1970	44000	12300	19250	16800	500
1971	39000	12700	19800	16830	600
1972	38000	12000	20250	17050	700
1973	28000	17200	20760	17180	800
1974	36000	15800	21270	17300	900
1975	36694	17100	21813	18739	1001
1976	40362	17000	23170	24111	1024
1977	36358	18000	24660	23710	1047
1978	48386	18500	26730	21785	1070
1979	24398	18000	25099	14955	642
1980	15120	7000	26941	16244	1445
1981	35252	6290	27346	17143	1514
1982	35423	11000	27416	17926	1545
1983	38013	17000	27043	13679	800
1984	41177	16200	27685	14079	700
1985	42656	16200	24636	17357	640
1986	62741	13800	27870	18957	644
1987	67725	14000	25167	29592	500
1988	76872	15500	27571	32822	500
1989	58259	15500	29705	28586	500
1990	66706	11300	32517	21370	448
1991	66679	13250	24604	19013	552
1992	61449	13567	22468	22206	711
1993	64149	15130	24949	16434	794
1994	52000	14000	23700	17300	882
1995	40500	13300	23479	16022	838
1996	47397	13300	25772	27315	840
1997	41700	12200	26232	30335	850
1998	30000	11000	26100	29900	NA

Source: FAO Agristat

Notes: NA Not available

Table A5.1.2: Dominica: Production and Prices of 10 Major Crops in 1977, 1987 and 1997*										
a Value of Production as a Percentage of the Total Value of Assessed Products										
	<i>Banana</i>	<i>Coconut</i>	<i>Cabbage</i>	<i>Cucumber</i>	<i>Dasheen</i>	<i>Grapefruit</i>	<i>Lime</i>	<i>Orange</i>	<i>Tannias</i>	<i>Yam</i>
1977	27.6	5.6	2.0	4.6	17.9	6.6	8.8	3.2	14.5	9.2
1987	39.2	10.6	4.3	1.9	10.2	5.0	5.8	3.0	10.4	9.5
1997	27.3	20.3	2.8	1.9	10.5	3.5	2.4	4.2	8.1	19.0
b Relative Price/MT Index (Base=Banana Price/MT Index in that year)										
	<i>Banana</i>	<i>Coconut</i>	<i>Cabbage</i>	<i>Cucumber</i>	<i>Dasheen</i>	<i>Grapefruit</i>	<i>Lime</i>	<i>Orange</i>	<i>Tannias</i>	<i>Yam</i>
1977	100.0	100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1987	100.0	59.1	271.9	66.5	99.8	57.6	150.5	87.7	114.1	103.5
1997	100.0	108.4	171.2	78.1	94.2	64.8	276.8	146.4	133.0	143.7
c Agricultural Production Index (Base=1997)										
	<i>Banana</i>	<i>Coconut</i>	<i>Cabbage</i>	<i>Cucumber</i>	<i>Dasheen</i>	<i>Grapefruit</i>	<i>Lime</i>	<i>Orange</i>	<i>Tannias</i>	<i>Yam</i>
1977	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1987	193.0	77.8	107.3	85.5	77.8	180.2	59.4	147.1	85.5	135.7
1997	124.9	74.5	104.8	67.6	78.9	104.3	12.2	113.9	53.0	182.1
d Agricultural Production Index Relative to Banana Production (Base=banana production in reference year)										
	<i>Banana</i>	<i>Coconut</i>	<i>Cabbage</i>	<i>Cucumber</i>	<i>Dasheen</i>	<i>Grapefruit</i>	<i>Lime</i>	<i>Orange</i>	<i>Tannias</i>	<i>Yam</i>
1977	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1987	100.0	40.3	55.6	44.3	40.3	93.3	30.8	76.2	44.3	70.3
1997	100.0	59.7	83.9	54.2	63.2	83.5	9.8	91.2	42.5	145.8

Source: GoCD (1999) and FAO Agrostat

Notes: All data used in the computation of tables 5.1.2a to d, was derived from GoCD statistics, with the exception of coconut production volumes (FAO estimate for 1987) and coconut producer prices (FAO estimates used for 1977 and 1987). This was deemed necessary due to data anomalies in the coconut data field.

* The top 10 agricultural commodities selected by greatest productive value over period versus total agricultural productive value.

Table A.5.1.3; WINCROP Insurance claims in Dominica

	Reported growers	Active growers	Holdings	Claims	Total payment (EC\$'000)
1987				219	238
1988				1,283	528
1989				6,730	7,905
1990	7,833		10,751	999	450
1991	8,858		11,327	1,056	690
1992	9,318		11,702	1,225	637
1993	9,537	5,779	12,198	728	643
1994	9,446	6,763	12,272	1,489	1,777
1995	9,580	6,218	12,482	7,022	8,224
1996	9,611	5,471	12,435	194	106
1997	9,761	4,793	12,596	201	108
1998	7,895	3,133	12,796	1,016	556
1999	3,038 *	3,038 *		1,474	1,106

Source: WINCROP

* Growers being re-registered during 1999

Table A.9.1: Dominica consumer price index - year-end monthly (Dec)

	<i>Index (Feb 1994 = 100)</i>		<i>Year-on-year % increase</i>	
	All CPI	Food CPI	All CPI	Food CPI
197	29.			
197	31.		5.7	
197	33.		8.5	
197	36.		9.5	
197	49.		34.	
198	60.	65.	21.	
198	65.	70.	8.1	6.5
198	67.	70.	4.1	0.0
198	69.	70.	2.7	-
198	70.	70.	2.0	0.7
198	73.	72.	3.5	3.1
198	75.	75.	3.0	3.3
198	77.	78.	2.9	5.2
198	81.	86.	5.2	9.3
198	88.	89.	8.2	3.9
199	92.	92.	4.6	3.2
199	94.	92.	2.0	0.4
199	98.	100.	4.4	7.8
199	100.	100.	1.7	0.7
199	100.	96.	-	-
199	101.	99.	1.4	2.4
199	103.	101.	2.0	2.7
199	105.	103.	2.3	1.5
199	107.	105.	1.4	2.0
199	107.	103.	0.0	-

Source: GoCD, various.

Table A.10.1: Dominica - Recurrent and capital central government revenue and expenditure, 1977/78-1999/2000 (at constant 1990 EC\$'000)

	Recurrent budget					Capital budget				
	Revenue				Expenditure	Revenue				Expenditure
	Local duty	Revenue grants from overseas	Loans	Total	Total	Local duty	Revenue grants from overseas	Loans	Total	Total expenditure
1977/197	59,935	17,746	-	77,682	87,212	52	3,554	478	4,084	1,180
1978/197	55,046	18,759	-	73,805	71,397	90	4,456	188	4,734	3,474
1979/198	58,288	48,396	2,213	108,89	93,770	35	8,210	205	8,450	18,613
1980/198	80,149	4,032	-	84,181	104,87	42	28,325	7,780	36,147	31,087
1981/198	93,022	3,683	-	96,705	105,14	98	16,439	13,919	30,357	41,588
1982/198	88,876	1,497	-	90,373	101,79	792	14,967	22,686	38,445	32,409
1983/198	100,14	-	-	100,14	105,21	288	37,479	14,860	52,627	55,601
1984/198	100,03	-	-	100,03	103,58	70	40,661	13,834	54,565	61,078
1985/198	105,25	-	-	105,25	104,27	85	49,485	8,601	58,171	60,874
1986/198	110,27	-	-	110,27	104,80	2,408	5,618	6,403	14,429	16,162
1987/198	123,66	-	-	123,66	114,76	20,334	8,949	17,110	46,394	35,577
1988/198	128,64	-	-	128,64	109,96	8,377	7,074	10,220	25,671	38,318
1989/199	124,71	-	-	124,71	112,89	374	20,095	38,330	58,799	82,038
1990/199	128,46	-	-	128,46	130,25	1,292	11,780	24,720	37,792	54,720
1991/199	131,32	-	-	131,32	128,21	2,365	8,300	19,276	29,941	32,436
1992/199	130,65	-	-	130,65	132,18	5,530	13,298	3,614	22,442	23,719
1993/199	133,12	-	-	133,12	139,42	1,088	8,562	5,922	15,57	22,90
1994/199	-	-	-	128,56	136,19	5,319	4,572	20,18	30,07	30,59
1995/199	-	-	-	135,29	132,53	881	6,228	5,587	12,69	18,94
1996/199	-	-	-	144,00	156,43	19,17	4,277	9,027	32,47	24,13
1997/199	-	-	-	146,30	161,66	12,16	4,783	25,22	42,17	32,18

Source: GoCD, 1999

Table A.10.2: Dominica - Central government revenue by principal types, 1977/78-1997/98 (at constant 1990 EC\$'000)

	Export duty	Income tax		Consumption		Banana development levy	Other local revenue	Total local revenue	External revenue	Total revenue
		Personal	Corporate	Licences	duty					
1977/1	10,1	62	13,5	2,76	1,17	15,1	97	16,4	60,0	81,7
1978/1	8,66	76	9,17	2,42	1,33	13,9	0	18,8	55,1	78,5
1979/1	7,03	18	12,3	2,39	1,11	18,8	1,16	15,1	59,4	117,3
1980/1	11,0	16	19,7	4,87	1,58	29,4	14	13,1	80,2	120,3
1981/1	13,6	32	22,6	3,42	1,84	30,8	16	20,0	93,0	127,0
1982/1	11,5	31	22,8	2,67	1,98	28,7	12	20,6	89,0	128,8
1983/1	14,6	32	22,9	3,95	2,19	32,3	15	23,7	100,5	152,7
1984/1	13,5	27	23,8	6,18	2,68	40,9	20	12,4	100,3	154,6
1985/1	13,3	30	22,8	9,25	2,83	45,5	18	11,0	105,3	163,4
1986/1	12,7	0	18,8	9,13	3,50	55,4	5	12,9	112,6	124,7
1987/1	15,8	0	17,2	15,1	4,19	55,0	4,86	31,6	148,8	170,0
1988/1	19,7	0	16,4	9,62	4,52	49,4	3,26	33,9	140,2	154,3
1989/1	20,3	0	14,1	14,9	4,54	46,0	66	24,3	125,7	183,5
1990/1	20,3	0	13,7	13,2	4,62	44,4	4,16	28,5	133,2	166,2
1991/1	19,8	0	13,4	16,6	4,33	40,7	5,55	18,8	124,9	161,2
1992/1	19,5	0	14,8	14,2	6,00	41,8	2,02	9,86	110,4	153,1
1993/1	17,8	0	13,8	14,3	5,74	41,4	0	40,9	134,2	148,6
1994/1	16,1	0	17,3	11,5	4,72	39,5	0	39,2	128,5	158,6
1995/1	15,5	38	15,6	18,3	5,11	42,2	0	38,2	135,2	147,9
1996/1	16,4	23	17,9	17,1	5,56	41,5	0	45,3	144,0	176,4
1997/1	18,4	23	18,6	18,2	7,03	43,0	0	40,8	146,3	188,4

Source : GoCD, 1999.

Annex E

List of Persons met by members of team during visits to Dominica, Barbados and St Kitts, June 3 27, 2000*

Government of Commonwealth of Dominica

Hon. Ambrose V. George, Minister of Finance
 Hon. Charles Savarin, Minister for Tourism and External Trade
 Hon. Atherton Martin, Minister for Agriculture, Environment and Planning
 Mr. Ambrose Sylvester, Financial Secretary, Ministry of Finance
 Dr. Joseph Bannis, Permanent Secretary Planning, Environment and Agriculture;
 Mr. Samuel Carrette, Permanent Secretary, Communications & Works
 Mr. Joseph Peltier, Director of Agriculture
 Mrs. Prima Burton, Chief Statistical Officer
 Mr. Colin Bully, Agricultural Diversification Office
 Mr. David Corriette, Insurance Regulator
 Mr. Raphael Francis, Physical Planning Dept
 Mr. Arlington James, Forestry Dept
 Mrs. Joan James, Establishment Dept.
 Mr. Andrew Magloire, Fisheries Officer, Fisheries Development Division
 Mr. Greg Rabess, Government Information Service
 Ms Matilda Royer, Chief Welfare Officer
 Mr. Cecil Shillingford, Coordinator, Office of National Disaster Management
 Mr. Algernon Simon, Chief Technical Officer, Dept of Works, Min. of Communications and Works

Other persons in Dominica

Mr. Michael Astaphen, Dominica Chamber of Commerce and Industry
 Mr. Benoit Bardouille, Accountant, Dominica Port Authority
 Mr. Ackroyd Birmingham, Manager, Dominica Co-operative Credit Union League
 Mr. V. John Charles, Chairman, WIBDECO
 Mr. Edward Charles, EH Charles
 Mrs. Patricia Charles, General Manager, Agricultural, Industrial and Development Bank
 Mr. Julius Corbett, General Manager and Director, National Commercial Bank
 Mr. Vincent Elwin General Manager, Dominica Port Authority
 Mr. Francisco Esprit, Director, SPAT
 Mr. Ettinoff, National Development Foundation of Dominica
 Mr. Kerwin Ferreira, Manager, Windward Island Crop Insurance (1988) Ltd(Wincrop)
 Mrs. Hernica Ferreira, Company Secretary/Accountant, WINCROP
 Dr. Lennox Honychurch, archaeologist and historian
 Mr. Cecil Joseph, Ex Sec, Dominica Hucksters' Association
 Mr. Aliic Lazaar, formerly Financial Secretary, GcoD
 Ms. Lucilla Lewis, Manager, International Business Unit
 Mrs. Eileen Morraine, Managing Director, Royal Bank of Canada
 Mr. Pemberton, Managing Director, Dominica Coconut Products
 Mr. Derek Perryman, DIVE Dominica
 Ms. Cheryl Rolle, Life of Barbados
 Mr. Gregoire Thomas, Head/MSSD, Dominica Export Import Agency (DEXIA)
 Mr. Robert Tonge, Managing Director, First Domestic Insurance Company

Barbados

Mr. N. Amerally and others, Caribbean Development Bank
 Ms. Audrey Mullins, Deputy Coordinator, CDERA

Mr. Ian Carrington, Insurance Regulator (Barbados)
Mr. David Alleyne, Overseas Manager, United Insurance, Barbados
Mr. Dave Blackman, Managing Director, United Insurance, Barbados
Mr. Alister Campbell, Director General, Insurance Association of the Caribbean
Mr. David Deane, Managing Director, Barbados Fire and Commercial Insurance, Barbados

St Kitts Nevis

Dr. Wendell Samuel, Research Director, Eastern Caribbean Central Bank
Dr. Garth Nicholls, Senior Economist
Ms. Miriam Blanchard, Economist
Ms. Gale Archibald, Statistician

* This is inevitably an incomplete list of those met by appointment during the visits by Charlotte Benson, Edward Clay and Franklyn Michael.

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