

The Last Straw

Integrating Natural
Disaster Mitigation
with Environmental
Management

Maarten van Aalst
Ian Burton



The World Bank

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The Last Straw

Integrating Natural Disaster Mitigation with Environmental Management

(with examples from Dominica, the Dominican Republic and St. Lucia)

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The World Bank



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Acronyms

CARICOM	Caribbean Community	OECS	Organization of Eastern Caribbean States
CAS	Country Assistance Strategy	OECS-NRMU	OECS Natural Resources Management Unit
CCCC	Caribbean Climate Change Center	OFDA	Office of Foreign Disaster Assistance, USA
CDB	Caribbean Development Bank	PAHO	Pan American Health Organization
CDERA	Caribbean Disaster Emergency Response Agency	PGDM	Post-Georges Disaster Mitigation Project
CERA	Central Emergency Relief Organization	UN	United Nations
CGCED	Caribbean Group for Cooperation in Economic Development	UNDP	United Nations Development Programme
CIDA	Canadian International Development Agency	UNEP	United Nations Environment Programme
CIFEG	International Center for Training and Exchanges in the Geosciences	UNFCCC	United Nations Framework Convention on Climate Change
CIMH	Caribbean Institute for Meteorology and Hydrology	USAID	United States Agency for International Development
CPACC	Caribbean Planning for Adaptation to Climate Change	USGS	United States Geological Survey
CRED	Center for Research on the Epidemiology of Disasters	UWI	University of the West Indies
DFID	Department for International Development, UK		
DMF	Disaster Management Facility, World Bank		
DIPECHO	Disaster Preparedness – European Community Humanitarian Office		
DBMC	Dominica Banana Marketing Corporation		
ECHO	European Community Humanitarian Office		
ECLAC	United Nations Economic Commission for Latin America and the Caribbean		
EIA	Environmental Impact Assessment		
EU	European Union		
FAO	United Nations Food and Agriculture Organization		
IFRC	International Federation of Red Cross and Red Crescent Societies		
GCM	General Circulation Model		
GDP	Gross Domestic Product		
GNP	Gross National Product		
GEF	Global Environment Facility		
IBRD	International Bank for Reconstruction and Development (World Bank)		
IDA	International Development Association (World Bank)		
IDB	Inter-American Development Bank		
ISDR	International Strategy for Disaster Reduction		
IPCC	International Panel on Climate Change		
ISDR	International Strategy for Disaster Reduction		
LIL	Learning and Innovation Loan		
MACC	Mainstreaming Adaptation to Climate Change		
NEAP	National Environmental Action Plan		
NGO	Non governmental organization		
OAS	Organization of American States		

Table of Contents

Executive Summary	vi
1. Introduction.....	1
2. Scope of the Linkages	2
3. Country Studies	4
3.1. Introduction and Caveat.....	4
3.2. Country Backgrounds	5
3.3. Natural Hazards	5
3.4. The Effect of Environmental Degradation on Natural Hazard Risk	7
3.5. Attention to the Linkages	10
3.6. Implementing Hazard Mitigation and Environmental Protection	12
3.7. Addressing the Challenges.....	14
4. Theoretical Considerations and Practical Dilemmas	17
4.1. A Broader Perspective	17
4.2. A Simple Question.....	17
4.3. Growing Risk Factors.....	18
4.4. Misdiagnosis and Misunderstanding	20
4.5. Who Decides? Who Acts?	22
4.6. The Fragmentary Application of Knowledge	23
4.7. Practical Consequences	23
5. Conclusions.....	25
5.1. The Diagnosis.....	25
5.2. Improved Risk Management.....	26
5.3. Recommendations/Next Steps.....	27
Annexes	
A. Dominica.....	30
A.1. General Background and Geography.....	30
A.2. Natural Hazards	31
A.3. The Effect of Environmental Degradation on Natural Hazard Risk	32
A.4. Disaster Mitigation and Environmental Management.....	32
A.5. World Bank Involvement.....	32
B. Dominican Republic.....	35
B.1. General Background and Geography.....	35
B.2. Natural Hazards.....	36
B.3. The Effect of Environmental Degradation on Natural Hazard Risk	37
B.4. Disaster Mitigation and Environmental Management.....	37
B.5. World Bank Involvement.....	38
C. St. Lucia.....	43
C.1. General Background and Geography.....	43
C.2. Natural Hazards.....	44

C.3. The Effect of Environmental Degradation on Natural Hazard Risk.....	44
C.4. Disaster Mitigation and Environmental Management.....	45
C.5. World Bank Involvement.....	47
D. Regional and International Institutions and Initiatives	50
D.1. Overview	50
D.2. Regional Institutions.....	50
D.3. Regional Projects and Programs.....	51
D.4. International Organizations and Donors.....	52
Sources	
i) List of contacts.....	55
ii) Printed reports, books, and articles.....	56
iii) Internet resources.....	59
Figures	
3.1. The Caribbean Region, with from left to right the Dominican Republic, Dominica, and St. Lucia	4
4.1. The three-way interrelationship between poverty, natural hazards, and the degradation of natural resources and the environment.....	19
A.1. Map of Dominica.....	30
B.1. Map of the Dominican Republic	34
C.1. Map of St. Lucia	42
Tables	
3.1. Existing hazard maps in Dominica, the Dominican Republic, and St. Lucia.	14
A.1. Major disasters in Dominica.....	31
A.2. World Bank projects in Dominica.....	33
B.1. Major disasters in the Dominican Republic	36
B.2. World Bank projects in the Dominican Republic.....	39
C.1. Major disasters in St. Lucia.....	44
C.2. World Bank projects in St. Lucia.....	48
Boxes	
3.1. Natural hazards affecting Dominica, the Dominican Republic, and St. Lucia.....	6

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Executive Summary

This paper examines the ways in which natural resources management and environmental degradation affect natural hazard risk, and makes a preliminary assessment of the importance of such linkages and the extent of their incorporation into disaster mitigation strategies and activities. Our analysis is based upon case studies in three countries in the Caribbean: Dominica, the Dominican Republic and St. Lucia, which are all highly vulnerable to natural hazards.

In these three countries, (and we infer in most other countries), detailed comprehensive analyses of these linkages do not exist. Such detailed analyses are also beyond the scope of this paper, which is a desk study without benefit of direct on site field surveys or experience. Nevertheless, we have found strong circumstantial evidence from documents and interviews to support the conclusion that natural resources and environmental management can have a significant influence on natural hazard risks. For instance, the degradation of mangroves, reefs and natural beaches affects storm surge and wave risk, and deforestation and unsustainable agricultural practices on mountain slopes lead to increases in flood and landslide risk, locally and downstream. These linkages are often recognized in the disaster management literature, but they have not been incorporated in appropriate strategies and activities.

While lack of attention and capacity by the governments to set and enforce both hazard mitigation and environmental standards are part of the problem, we suggest that there are two important root causes that help to explain it. First, in many cases, short-term economic interests prevail above long-term sustainability, often despite existing knowledge and regulations. Second, in other cases, poverty leaves people no other option than to use the natural resource base in an unsustainable way. The subsequent degradation of the natural environment may threaten environmental assets like biodiversity, but also harm the very natural resources that the poor depend on, and moreover increase the risk of natural hazards. The hazard event itself, which could have been relatively harmless had natural protection still been in place, can become the last straw that breaks the camel's back, hurting both human development and natural ecosystems.

The neglect of natural resources and environmental management is symptomatic of a more general deficiency of disaster management, which will have to be addressed if the rising losses are to be curtailed and eventually reversed. This entails the recognitions that disasters are not rare Acts of God, but that instead, they are embedded in everyday human decisions and actions. This idea is not itself new to disaster specialists, but its effective realization remains a hope unfulfilled. Attempts to mitigate natural hazard risks should recognize that these hazards are an integral component of the challenges of development and environment. A more integrated approach is needed at all levels: from the global environmental conventions to regional cooperation among countries; within national governments, and by local villages and small communities.

In our three case study countries, the capacity of the national government is a major bottleneck for effective disaster reduction- as well as environmental management. A consolidation of activities of various national agencies, as well as creating some new or stronger regional or sub-regional capacity would help to address this problem. However, we suggest that the biggest opportunities may exist at the local and community level. Detailed knowledge about the nature of the linkages between natural hazards and natural resources management can only be acquired by combining technical expertise and information, such as hazard maps, with local practices, knowledge and experience. Local communities should be empowered to identify and address the issues and play their own more effective role in the vicious cycle of poverty, environmental degradation, and natural hazards.

Introduction

Rising disaster losses all over the world beg a simple question. Why in an age of advancing science, expanding wealth and more powerful technology do disasters continue to occur and get worse? A great deal has been written on this topic in the past decade, but the trend remains. Several factors in the rising losses have been clearly identified, and received ample attention in efforts to address this alarming trend. Other possible factors however, have featured much less prominently, both in the disaster literature and in the design and implementation of risk reduction strategies. In particular, the relationship of hazard losses to natural resource and environmental management has been at best of peripheral interest to most. While the degradation of the natural environment has often been mentioned as a natural hazard risk factor, policy implications of that observation have rarely been considered outside of the sustainable development community, which itself does not focus primarily on disaster risk reduction. Quite recently, this gap is receiving increasing attention, for instance in the debates towards the World Summit on Sustainable Development (ISDR, 2002), or in the 2001 State of the World Report (Worldwatch Institute, 2001). However, the literature lacks detailed explorations of this topic, and concrete policy implications remain unexplored. This paper aims to address this gap, and begins an exploration of the role of natural resources and environmental management in natural hazard risk. If that factor is indeed significant and neglected, we may be missing opportunities for mitigating those risks.

While we believe our broad observations to be true for much of the world, specific observations about this topic can only be made in a particular geographical context. Thus, while we draw from examples across the globe, our main focus is on one region. In particular, we will examine three countries in the Caribbean region: Dominica, the Dominican Republic, and St. Lucia. Despite their differences, these countries all exhibit some typical characteristics for the Caribbean region: a very high exposure to a wide array of natural hazards and enormous disaster losses in recent decades, but also a strong dependence on the natural resource base, for agriculture, fisheries, and particularly tourism

This regional focus also relates to the practical role of this piece in a joint project of the World Bank Disaster Management Facility and Latin American and Caribbean Region. Rather than being just an academic exploration, this paper is the starting point for further development of policy and practice in this area. In terms of policy, the issues raised here will be taken up at the 2002 meeting of the Caribbean Group for Cooperation in Economic Development (CGCED)¹. In terms of practice, we suggests a couple of pilot projects, which can serve as case studies for the linkages identified and the ways to better incorporate them into development policy in general, and specifically in natural hazard risk reduction.²

A generic perspective on the scope of the linkages between natural resources and environmental management and natural hazard risk is presented in Chapter 2. In Chapter 3, we explore this topic in some more detail in three countries in the Caribbean. In Chapter 4, we put the observations from our case study in a broader perspective, and bring the linkages between natural hazard risk and the management of the natural environment into the general context of disaster management. This brings us back to our simple initial question, and allows us to draw some more general conclusions.

¹ This paper also served as background to a strategy paper for this meeting, being prepared by the World Bank with substantial inputs from the OAS.

² Together, these elements (this assignment, the background work for the CGCED and the case studies) form a project conducted under the umbrella of the Bank-Netherlands Partnership Program (BNPP) related to forestry and biodiversity, aiming to establish the linkages between environmental degradation and disaster impacts, and developing action plans for environmental management and natural disaster reduction.

Chapter 2.

Scope of the Linkages

This chapter provides a summary account of what is known about the linkages between natural hazards and the natural environment. The scope of this paper limits us to a general description rather than a detailed technical investigation. In reality, the interactions between the geological, atmospheric, biological, and human systems are highly complicated, and highly location-dependent (for a more detailed general discussion of the interactions between the natural environment and hazard risk, see e.g. OAS, 1991b, in particular chapter 3).

For the purpose of discussion, we make a distinction between the hazard phenomena and the systems that they impinge upon. We classify extreme anomalies in precipitation, temperature or wind as atmospheric hazards, and earthquakes and volcanic eruptions as geologic hazards. Events like landslides however, are in fact a combination of local topography and meteorological or geological phenomena. In the case of floods and droughts, it becomes even more obvious that the local geography, including orography, soil, and vegetation, is an integral part of the hazard. And while storm hazard could be defined simply in terms of the height or energy of waves approaching the coast (a function of meteorological and tidal conditions), our main concerns relate only to what actually hits settlements and resources that humans directly depend on. If coral reefs and mangroves in front of the coast absorb most of the wave energy, the hazard is diminished. From that perspective, the separation of hazard and local environment simply does not hold. Moreover, the hazard itself is no longer an Act of God, but is directly influenced by our management of the natural environment.

If we want to remain strict about separating the hazards from the system they impinge upon, the local environment gets a slightly different role. From that perspective, some aspects of the natural environment become protective structures, shielding us from the actual hazards (e.g. OAS, 1997). For instance, mangroves and reefs are alternatives to seawalls, and vegetation on hillsides is an alternative for floodwater channels or higher design standards downstream. While this perspective does again demonstrate the value that must be attached to the natural environment for disaster mitigation, it can also be deceptive. Seawalls, flood channels and bridges can be rebuilt (at a cost) with different design standards whenever we change our perspective on the nature of the hazard and the level of protection that we want to accomplish. Many natural protective structures however, are less replaceable, and once lost recovery to their initial condition may be impossible within any human time frame. Once a steep hill has been deforested and the soil eroded, the original landscape cannot be reconstructed by human agency. Similarly, coral reefs only recover from damage on timescales of decades or centuries.

Whichever perspective one prefers however, it is clear that the local environment is an important element in determining hazard risks, and that we can influence our level of risk by our management of that environment. The picture only becomes complete when we recognize that meteorological and geological extremes are also hazards to our natural resources and the environment: floods, winds and landslides make no distinction between human and natural structures. Tropical storms cause landslides and accelerated erosion, which reduce agricultural productivity. Water quality and quantity downstream are affected by damage to the vegetation in the catchment area. Destruction of mangroves affects fishing activities. In fact, it can be argued that the deterioration of natural resources due to hazard impacts has significant and long-term negative effects on economic growth, which should be addressed as direct effects (Vermeiren, 1989). However, the precondition of the natural environment makes a big difference in its vulnerability to natural hazards. Forests that have been partly cleared are more susceptible to wind damage. Coastal ecosystems that are already under stress due to poor wastewater disposal or explosives fishing may get the final blow from a passing hurricane and be lost forever, or recover much more slowly than if they had been in good

health. Other examples abound. In fact, there even is a positive feedback cycle, since previous impacts may increase the vulnerability of natural systems to future hazards. Smaller and more frequent hazards can thus also set the stage for bigger ones, for instance when smaller floods and landslides have left a large catchment area much more exposed and vulnerable to larger floods. Background changes in climatic conditions due to the anthropogenic greenhouse effect pose yet additional stresses on many natural systems, again decreasing their ability to withstand and recover from extreme conditions.

Another cyclical aspect is brought into the discussion when we consider the relationship between poverty, environmental degradation, and natural hazard risk. Unsustainable natural resources management practices, like deforestation and agriculture on marginal land, or destruction of mangrove forests for firewood collection, are often induced, or at least exacerbated, by poverty. These practices directly affect the natural environment (for instance threatening biodiversity), and may hurt the very resource base that these poor people are depending on. Moreover, the degradation is creating an additional hazard risk. The hazard event itself, which could have been relatively harmless had the degradation not taken place, then becomes the last straw on the camel's back. The degraded natural systems have less resilience to the impacts, the poor lose the little assets they had, and both human and natural systems are left poorer, as well as more vulnerable to future hazards. Such cycles again demonstrate that sustainable development requires a holistic view, of which natural hazard risk concerns are an essential part.

In order to incorporate these dimensions into general hazard risk reduction, one needs a good understanding of the role of the local environment in natural hazard risk, and the way human activities are affecting it. In the case of inland flood risk for instance, one can look at the upper watershed area, examine the meteorology, topology, geology and natural vegetation, land use and agricultural practices, as well as the socio-economic realities behind them. In some cases, this will just reinforce existing concerns (for example in the case of slash-and-burn agriculture, which is unsustainable from an economic point of view, destroys biodiversity, but may also, through erosion of steep hillsides, contribute to flood risk). Incorporating natural hazard concerns can in fact boost some projects that would be beneficial for other reasons, but did not get attention, or had too little economic benefits. Protecting the rainforest in an upper watershed area that feeds a hydropower plant and an irrigation system may become more feasible when the mitigative effect of the forests on downstream sedimentation, landslides and floods are taken into account. In fact, such considerations can be used to design a system where benefits of changing practices are appropriately distributed, thus changing incentive structures, for the benefit of all involved.

In some other cases, natural hazard concerns may even shift priorities and lead to changing practices. For instance, forestry projects aimed at providing firewood to prevent the local population from slashing vulnerable rainforests would normally be planned in an area closest to the community using the firewood, where forest productivity is highest and harvesting easiest. Given natural hazards concerns however, one could decide to target the reforestation efforts at deforested hills that contribute to flood risk. While the productivity of the forest may be a bit lower, and the level of effort required to collect the firewood a bit higher, the lower flood risk may well justify such a shift.

In the next chapter, we will assess whether the type of linkages that we just identified do indeed play a significant role in their natural hazard risk, and whether these countries are taking such linkages into account in their activities and strategies to reduce natural hazard risk.

Chapter 3.

Country Studies

3.1 Introduction and Caveat

To assess the importance of the linkages between natural hazard risk and natural resources management and environmental degradation in the Caribbean, we examined three countries: Dominica, the Dominican Republic, and St. Lucia. While comprehensive analyses are lacking, what evidence there is suggests strongly that there has been an increase in natural hazard risks due to environmental degradation. This factor could be substantial, but without more information it is not possible to even come close to quantifying it. Instead, this chapter provides some initial insights into the importance of the linkages, as well as the extent to which they are taken into account in disaster management and natural resources and environmental management. While it draws from literature on, and experience in, these three particular countries, it is not a comprehensive description of those issues in any of them. Some more factual information is provided in the country-by-country annexes, but more detailed and/or comprehensive conclusions and recommendations would require more in-depth and location-dependent analyses, which were not possible in the context of this report³.

Figure 3.1: The Caribbean Region, with from left to right the Dominican Republic, Dominica, and St. Lucia



³ The next stages of the project to which this paper is the exploratory first phase should provide more in-depth information and experience.

3.2 Country Backgrounds

Two of our case study countries, Dominica and St. Lucia, are small islands in the Eastern Caribbean, with 80 thousand and 150 thousand inhabitants, respectively. Both are English-speaking, both are members of the OECS and CARICOM, and they share the Eastern Caribbean currency unit of the ECCB. Both also suffer many of the difficulties of most small island states, including high cost of economic and social infrastructure, small internal markets, and fragile ecosystems. Nevertheless, health indicators are very good, and poverty is estimated to be limited to about 10% of the population. A particular challenge for both countries has been the decline of the banana trade after the loss of preferential trading arrangements with the EU (in 1993). At that time, bananas were their main crop and export product, employing over 30% of the population. The drop in prices, in combination with the loss of employment on the large farms, has caused an increase of poverty among the rural population. More and more people are producing bananas at small, steep plots at low productivity.

There are also substantial differences, even between the two OECS countries. Dominica is rough and mountainous, and still retains a large portion of tropical rainforest. It has few beaches and no international airport, and thus relatively little tourism (although it is trying to position itself as an eco-tourism destination). St. Lucia is also mountainous, but much more densely populated (about 250 per km² relative to 100 per km²), and has a much larger tourist industry, partly because of its extensive white sand beaches. It has been one of the most active countries in the Eastern Caribbean when it comes to disaster management and mitigation. Its more sound fiscal policy has made it more resilient to economic shocks than Dominica, which currently has a public sector deficit of 10% of GDP.

The Dominican Republic is very different from the two Eastern Caribbean countries. Its area is 100 times larger than Dominica's, and 50 times that of St. Lucia. With 8.5 million inhabitants, its population density (174 km⁻²) lies exactly in between the other two countries. The Dominican Republic is Spanish speaking, and shares the large island of Hispaniola with Haiti. The geography is widely varied, but mostly dominated by rugged highlands and mountains, interspersed with fertile valleys. There is a long coastline, with extensive coral reefs. The country suffers from widespread poverty, particularly in inland rural areas, and a highly unequal distribution of wealth.

3.3 Natural Hazards

Natural hazards are widely recognized as one of the main challenges to sustainable development in the Caribbean. Just like many other countries in this region, the Dominican Republic, Dominica and St. Lucia all have a very high exposure to a whole range of hazards, including hurricanes and tropical storms, storm surges, inland flooding, and landslides, as well as volcanic and seismic activity, and a risk of tsunamis (see Box 3.1 for a brief overview). A quick glance at recent experiences (see tables A.1, B.1, and C.1 in the annexes) shows that the frequency and severity of these hazards has exerted a relatively high human and financial toll. For instance, Hurricane Georges (1998) affected more than half the population of the Dominican Republic, caused 288 casualties, and resulted in direct costs of about 2.2 billion dollars (or 14% of GDP), and tropical storm Debbie (St. Lucia, 1994) cost St. Lucia \$79 million in direct damages (18% of GDP). Such disasters can be expected to occur with a high probability (on average this works out to something in the order of at least one major disaster per decade). Floods and landslides may hit a smaller area, but are so frequent that they account for very large damages. For instance, in Dominica, at least 2% of the total land area has been affected by landslides (DeGraff et al., 1998). Unfortunately, no credible quantitative estimates exist for their total cost.

Box 3.1: Natural hazards affecting Dominica, the Dominican Republic, and St. Lucia. For a more extensive discussion of these hazards, see (OAS, 1997).

Hurricanes and tropical storms

All three case study countries are subject to frequent hurricanes and tropical storms, with severe consequences. These hazards exhibit themselves in several ways. Direct damage due to heavy winds affects human systems and agriculture, as well as mangroves and inland forests. Inland, the heavy rainfall leads to flooding and landslides. And at the coast, storm surges hit both human and natural systems.

Inland floods and landslides

Due to the rugged mountainous terrain in all these three countries, fairly regular variations in rainfall can already trigger floods and landslides. In Dominica, landslides are estimated to have affected at least two percent of the total land area, and large ones, like the 1997 Layou River landslide, have caused enormous devastation. Although Dominica does have the highest rainfall of the three, floods and landslides are also common hazards in the Dominican Republic and St. Lucia.

Droughts and wildfires

Occasional droughts and wildfires occur particularly in the Dominican Republic. The wildfires are often started by uncontrolled slash-and-burn deforestation.

Storm surges and tsunamis

The Caribbean's annual hurricanes and tropical storms are usually accompanied by strong wave action, triggered by the meteorological circumstances. Tsunamis, traveling waves triggered by earthquakes and volcanic eruptions (sometimes underwater, possibly at a considerable distance), are also acute hazards for all three countries.

Seismic and volcanic hazards

Dominica features geysers and hot springs, clear indicators of the risk of volcanic activity. Limited volcanic and earthquake risk also affects St. Lucia, while the Dominican Republic has extensive seismic activity, with associated landslide risks.

Over the past decades, natural hazard risk in these countries has increased, and there has been a dramatic upsurge in losses due to tropical storms and hurricanes (e.g. OAS, 1991b, St. Lucia 1994). There is not one culprit, nor one quick and easy remedy for this rising risk.

Climate change may already have contributed to a rise in frequency in adverse meteorological phenomena⁴. Further risk increases, particularly due to sea level rise, can certainly be expected for the coming decades. The International Panel on Climate Change (IPCC) concludes in its latest assessment that "Populations that inhabit small islands and/or low-lying coastal areas are at particular risk of severe social and economic effects from sea-level rise and storm surges" (IPCC, 2001c). While current climate models (GCMs) cannot confidently predict the exact effects of global climate change on the climate of our three case study countries, some indications can already be given. Rising sea levels, as already mentioned, are the most robust projection. Other, less certain climate changes may include a general reduction in rainfall, but also more variability in rainfall and more rainfall extremes. Finally, there may be increases in the intensity of tropical cyclones. From a natural hazards perspective, almost all hydrometeorological hazards could be going up, including coastal and inland floods, landslides, but also droughts and forest fires. More in general,

⁴ For a more extensive discussion of past and projected global climate changes, see also section 4.3.

such changes would affect many parts of the economy and ecology of these countries, including issues like coastal and inland erosion, declining freshwater supplies, damage to inland and coastal ecosystems (including coral reefs), health impacts, and adverse effects on agriculture and fisheries.

But regardless of whatever changes may occur in the climate, these countries' risks are rising for several other reasons. General economic development simply means that more assets are at stake, and concurrently, population growth has led to larger settlements in vulnerable areas. These factors are now well recognized, and have been the target of extensive efforts in disaster management in these countries. National disaster management offices have been created or strengthened, and much attention has been paid to improving emergency preparedness, building codes, and location and design of infrastructure and settlements, particularly in urban areas. While the capacity and perhaps the political will to implement and enforce the desired standards remains limited, these issues are clearly receiving the attention of both national policy-makers, international financing agencies and donors. However, this attention has certainly not solved all the problems at hand. Implementation has proven to be difficult, particularly because of the limited capacity of the national government agencies responsible for disaster management. Enforcement of building codes and land zoning remains problematic.

3.4 The Effect of Environmental Degradation on Natural Hazard Risk

Another factor that increases natural hazard risks in these countries' has received far less attention: the continuous degradation of the natural environment. This lack of attention is apparent from a canvas of the literature: no detailed on site analysis has been made of the extent and importance of the linkages between environmental degradation and natural hazard risks in any of these countries. Nevertheless, we did find strong circumstantial evidence that land degradation, unsustainable agricultural practices, and poor coastal zone management have contributed substantially to their natural hazard risks. Perhaps the fact that they have been regarded as secondary causes has helped to discourage more serious attention. Hence, we found that so far, only limited efforts have been made to identify and address these linkages.

Inland degradation: floods, landslides, droughts, and forest fires

Inland, deforestation (often due to slash-and-burn by poor farmers with no legal title to the land) and unsustainable agricultural practices, particularly in mountainous upper watershed areas, have contributed substantially to flood and landslide risks. In the Dominican Republic, the forest cover has been reduced from about 80% in 1900 to about 33% in 1995 (forestry figures all from FAO), and what remains is still being removed at the rate of 1.6% per year. In St. Lucia, only 8% of the land is still covered by forests, and deforestation still continues. In a hazard assessment in the context of a World Bank watershed management project after tropical storm Debbie, the OAS concluded that Debbie's impacts were certainly aggravated by deforestation and unsustainable agricultural processes, leading to sheet erosion. In Dominica, deforestation is also a concern, but compared to St. Lucia and the Dominican Republic, much of the original forest cover remains (60% of the land is still covered by forests), presumably because Dominica has a much lower population density, and the rough mountains have attracted fewer farmers. Nevertheless, a study in Dominica even mentions that all over the Caribbean, "most landslides cannot be regarded as natural events", given that they are essentially brought about by inappropriate farming practices (Consulting Engineers Partnership, 1998).

In the past, deforestation and land degradation by uncontrolled cattle grazing have been a problem, particularly in the Dominican Republic. Charcoal and firewood production is another cause for deforestation. However, the main driving force behind deforestation and land degradation in all three countries is uncontrolled settlement of poor farmers on steep mountain slopes. In many cases, they practice slash-and-burn agriculture, and cultivate the land only for a short time before soil exhaustion, loss of soil structure, and soil erosion cause them to abandon the plot and move on. The consequences of deforestation are often aggravated by unsustainable agricultural practices, particularly the production of bananas on steep hillsides.

Consequently, the stability of the soil and the ability of the soil and the vegetation to retain water are substantially reduced, and thus the risk of flashfloods, landslides, and possibly droughts increased.

These same unsustainable natural resources management practices contribute to the risk of forest fires, which occur on a regular basis, particularly in the Dominican Republic. Deforestation and erosion can create droughts and dryer vegetation, and the actual start of the fire is often created by slash- and burn agriculture. It has been shown in a World Bank project in Brazil that helping farmers to do slash- and burn in a more controlled fashion can be an effective means of preventing large uncontrolled forest fires (World Bank, 1998, 2000, and 2001a).

Coastal degradation

Coastal ecosystems are also under pressure, again to a variable extent depending on the country and the location. Mangrove forests have been cleared for firewood or development. Coral reefs have been destroyed or damaged by development at or nearby sensitive sites (often for tourism), explosives fisheries, coral mining for construction, and poor waste and wastewater management. Sedimentation flowing into the sea from rivers with degraded watersheds adds another burden on the reefs, thus connecting inland and coastal degradation. In addition, changes have taken place in natural beaches, often due to sand mining for the construction industry or due to nearby construction of ports or seawalls. This degradation is a serious threat to some of the most valuable natural resources of these countries (particularly beaches, coral reefs and tropical fish are crucial for their tourism industries), but also affects the ability of these natural systems to absorb wave energy of storm surges hitting the coast. There are several examples in the Caribbean where degraded natural protective structures had to be replaced by physical works (CPACC, component 7), showing that there are direct costs involved in the degradation of natural resources. No economic analyses of these examples appear to have been made. Clearly, the replacement cost approach only gives you the minimum value of the lost resources, which may have had a much larger value than that replacement cost. Moreover, even if we only look at their protective function, if degradation takes place and no replacements are made, the costs of the larger hazard damage may be even greater. Such costs are rarely attributed to the degradation itself.

The impact of natural hazards on the degraded environment itself

Both inland and on the coast, an additional linkage between human activities, environmental degradation, and natural hazards relates to the impacts of the hazards on the natural systems themselves. For instance, hurricanes damage forested areas, and also hurt coastal and marine ecosystems. In general, natural ecosystems are quite resilient to disasters, but the recovery timescale of the natural systems often remains unrecognized. For instance, mangrove forests may take six months or longer to recover from severe salt blast damage during a hurricane (St. Lucia, 1996). Before that time is over, suggestions often arise to "reclaim" the apparently dead forests. Similarly, the recovery of the mangroves may be threatened by relaxed waste disposal standards in the aftermath of a disaster (idem). In addition, degraded ecosystems are often less resilient than healthy ones. For instance, fragmented forest cover with cleared areas in between is more vulnerable to wind damage. The vulnerability caused by the degradation may then lead to hazard impacts which further degrade the environment, thus adding a cyclical dimension to the problem of environmental degradation (as mentioned in Chapter 2).

Attention to disaster-related patterns of environmental degradation from other perspectives

All these patterns of environmental degradation (deforestation, erosion, loss of coastal ecosystems) have been recognized as a major threat to the sustainable development of the countries examined in this study, and thus relatively well documented, albeit mostly for other reasons than their effects on hazard risk. For instance, loss of rainforest and coral reefs has raised biodiversity concerns, and has also been raised in the context of tourism revenues. Soil degradation is a recognized problem in agriculture and rural development, and has also affected downstream activities, such as hydropower generation. Coastal degradation clearly

affects fisheries and again, most importantly, tourism, one of these countries' prime sources of income. As mentioned above, environmental degradation has received much less attention as a natural hazard risk factor. Possibly because natural disasters are experienced as sudden Acts of God, the slow, creeping processes that may influence them are often overlooked. Consequently, the effect of the natural environment on hazard risk has not been well documented.

An economic perspective

Nevertheless, the importance of this linkage, even from a purely economic point of view, can be illustrated by a few examples. A retrospective economic analysis of bridge designs in St. Lucia was made after tropical storm Debbie (OAS, 1998), to reevaluate design standards after the extensive flood damage. Several factors played into the damage, including lack of maintenance, but one of those was that the occurrence frequency of a certain flood level had increased substantially over the life span of a particular bridge (which was built in the seventies) because of degradation of the upper watershed area. Such patterns of environmental degradation thus clearly affect economic investments, and ought to be taken very seriously. Theoretically, there are two management options: preventing the degradation, or taking it into account in infrastructure design, with all associated costs. In some cases, investments in the protection or (where feasible) rehabilitation of the natural environment may be the cheapest and most sustainable protection of a certain piece of infrastructure. However, it must be done in a timely fashion, usually in advance of construction, otherwise it may be too late. In the Dominican Republic, a study of the five principal hydropower dams in the country showed that unexpected sedimentation, caused by land use changes in the upper watershed combined with natural hazard impacts, had reduced their average expectation of productive life from 50 to 20 years unless substantial mitigative action was taken to remove some of the sediment. Estimated costs run into tens of million of dollars (World Bank, 1993). This sedimentation is a symptom of the same processes that also increase flood and landslide risk. In fact, the erosion responsible for the sediment behind the dam results not only from slow incremental processes, but can also be produced by sudden if small landslides and floods. Investments in reforestation in the upper watershed area could have lengthened the lifetime of the hydropower plants, and may well be the only way to keep such plants viable (a larger dam design substantially raises investments costs, and thus decreases the internal rate of return).

Examples like this demonstrate that the effects of environmental degradation on natural hazards do make a difference in these countries, and may have caused a considerable increase in their national natural hazard risk over the past decades. On a smaller scale, the relationship between natural hazard impacts and environmental degradation is likely to be even stronger. For instance, small-scale floods and landslides (which occur very frequently in these three countries, but are not recorded in the national statistics) first damage and then destroy the banana crops and settlements of the people closest to the degraded hillsides, and contribute to the further degradation of their livelihoods. The natural hazards themselves may then become part of the cycle that leads poor farmers to move on to clear a new piece of rainforest. In that manner, environmental degradation, natural hazards, and poverty are part of a continuous circular feedback process (see Figure 2.1), which occurs in all three countries. We have found no detailed analyses of these local-scale linkages between poverty, environmental degradation, and natural hazards. Due to the small scale of many of the events, and the limited economic importance of the assets and production at stake, such patterns receive less attention from the national or international media and policy-makers. However, a poverty assessment in St. Lucia (Kairi Consultants, n.d.) does notice that the indiscriminate cultivation of hillsides, related to the decline in the banana industry, has resulted in severe erosion, thus creating a major problem for sustainable development. Given such interrelationships with poverty, we note that more in general, "protection by distraction" is an interesting option for protecting the natural environment and thus for mitigating natural hazard risk. Creating other forms of livelihood may be one of the best ways to stop land degradation. For instance, jobs in the tourist industry remove people from the land and thus protect biodiversity, the soil and trees. Nevertheless, such generic statements about the benefits of general economic development must not distract us from the fact that there may be opportunities to improve policy

and practice in both disaster risk management and natural resource and environmental management policies.

3.5 Attention to the Linkages

The conclusion that environmental degradation may have contributed substantially to natural hazard risk in these countries raises the question to which extent these linkages are reflected in policy, planning, and practice. The answer is not encouraging: they are mostly neglected.

Incorporation of natural resources and environmental management components in disaster management

First, let us examine to what extent the linkages are reflected in disaster management projects⁵. Unfortunately, we found that little attention is paid to them; only in a few cases are the linkages even mentioned.

One of those examples is the St. Lucia Disaster Mitigation Plan, which was prepared in 1996 and reflects the high priority given to disaster mitigation by the government of St. Lucia. In this document, the rise in flood risk is attributed partly to a lack of maintenance of, and respect for, the natural gutters and flood plains, and the loss of natural vegetation. In addition, increasing hurricane risks are linked to population movements toward hillsides and high slopes, involving the removal of stabilizing vegetation. While it is encouraging that the linkages are being recognized, the document appears to have had little influence on actual efforts in disaster management, and also remains in draft form.

Most disaster management efforts were started in the wake of a disaster, and focus mostly on relief and rehabilitation. For instance, World Bank post-disaster projects in the seventies and eighties focused mostly on reconstruction, in particular infrastructure rehabilitation. The Dominica Road Maintenance and Rehabilitation Project (1982-88), the Dominican Republic Second and Third Road Maintenance and Reconstruction Projects (1979-85 and 1986-93), Emergency Road Reconstruction Project (1979-82), and Urgent Import Requirements for Hurricane Reconstruction Loan (1979-80) all address consequences of disasters, but have no components to prevent future ones. This pattern is typical for a large class of World Bank disaster projects from that period (Gilbert and Kreimer, 1999).

More recent projects often contain some elements aimed at disaster mitigation. However, while they may sometimes recognize the effect of environmental degradation on natural hazard risk, they usually take other angles to actually address the hazard risks, such as building codes, infrastructure design, and attention to the location of human settlements. This is, for instance, reflected in the activities undertaken in the context of the Caribbean Disaster Management Project (CDMP), one of the most comprehensive disaster mitigation projects in the Caribbean region to date. The most recent disaster management projects by the World Bank and other donors do mention some of the linkages, but have only a few concrete activities addressing them. For instance, the post-Georges project in the Dominican Republic, implemented by the World Bank and the IDB, contains some elements to address environmental and water management issues, including reforestation. The World Bank OECS Emergency Recovery and Disaster Management Project has some interesting opportunities for such activities linked to environmental degradation, including attention for community-based disaster mitigation and institutional strengthening. However, implementation has been difficult, and the project's main focus remains on more traditional risk factors (including physical protection works and attention for the institutional capacity to address issues like the location of settlements, infrastructure vulnerability, building codes, and disaster preparedness).

⁵ We examined all World Bank disaster related projects in this area, as well as selected activities by the country governments and by other organizations (for details, see the Annexes).

We also note, by the way, that the regional initiatives in disaster management, such as the Caribbean Disaster Emergency Response Agency CDERA, have so far paid little operational attention to the role of natural resources and environmental degradation. A new set of regional initiatives focuses particularly on climate change: Caribbean Planning for Adaptation to Climate Change (CPACC), and its follow-up project Mainstreaming Adaptation to Climate Change (MACC). Because of their broader climate change focus, these initiatives take a wider perspective than only disaster mitigation. Nevertheless, several components may be helpful to get a better handle on the linkages between natural hazards and the natural environment, for instance a coastal valuation project, and efforts to mainstream climate change concerns into both private and public planning and activities.

Incorporation of natural hazard risk concerns in natural resources and environmental management

Second, we examine the extent to which natural hazard risk concerns have been taken into account in the area of natural resources and environmental management⁶. We conclude that, although the situation may currently be improving, the linkages have, again, not received much attention. For instance, World Bank irrigation projects from the seventies and eighties, like the Nizao Irrigation project and the Yaque del Norte Irrigation Projects in the Dominican Republic, dealt with vulnerable watersheds and were initiated partly to rehabilitate irrigation infrastructure damaged by natural hazard events. They notice that erosion and downstream sedimentation due to deforestation and unsustainable agricultural practices in the watershed area are becoming a problem, but do not explicitly link that to natural hazard risk management, and do not even attempt to address the underlying problems.

Nevertheless, there have also been a number of environmental or agricultural projects that did not explicitly aim to reduce natural hazard risk, but that have certainly addressed related issues. In particular, much attention has been given to the interactions between poverty and land-use/agricultural practices. For instance, there have been a number of projects that address the suite of problems surrounding slash-and-burn agriculture. USAID's Natural Resource Investment Fund Project (FIRENA) was a very successful pilot project to stimulate soil conservation and reforestation. Landless farmers had been laid off by landowners in the lower areas suitable for agriculture, and were moving into the mountains, slashing the rainforest to create a little piece of agricultural land on steep hillsides (an ongoing phenomenon). The project addressed this issue by boosting productivity in the lower areas (amongst others by irrigation systems), thus allowing the landowners to rehire some people. At the same time, these landowners had to sacrifice some of their land. That land was then given, in small plots, to the landless farmers who had moved into the mountains, provided that they helped to reforest the areas they left behind. Such approaches, in this case addressing the underlying problems of agricultural productivity and land ownership, can also have great benefits for natural hazard risk reduction. Another early good practice example in this area is the OAS' Mabouya Valley Integrated Land Development Project in St. Lucia (OAS, 1991), which addressed rural land and watershed degradation and poverty by national and local measures, including legislative changes, better land planning and registration, but also microcredits, redistribution of unused or underused suitable land, and sustainable development of marginal land.

In recent years, two World Bank projects, in the Dominican Republic and in St. Lucia, have taken a more holistic approach to watershed management than the earlier Nizao and Yaque del Norte examples. In the Dominican Republic, the current Irrigated Land and Watershed Management Project (US\$28 million, 1995-2003) has multiple aims. Natural hazard risk reduction is not explicitly among them, but the holistic approach certainly contributes to their mitigation. The project aims to improve small-farmer income in a few selected sites, but also tests and develops methodologies for efficient water management and production support services, and for sustainable and environmentally sound watershed management. It contains some structural components, like developing irrigation systems, but also addresses underlying problems, like deforestation and inappropriate use of mountain slopes, partly by involving local communities and rewarding

⁶ As in the previous subsection, we examined most World Bank projects in this area, as well as selected activities by the country governments and by other organizations (for details, see the Annexes).

good practices with help to implement them, such as seeds or planting materials, and fertilizers. Duplicating such efforts, and focusing them at hazard-prone areas, may offer great opportunities to address natural hazard risk, environmental degradation, and rural poverty.

In St. Lucia, an Integrated Watershed Management Project was initiated in 1994 in response to the damage after floods and landslides related to tropical storm Debbie. Apart from structural rehabilitation, it also supported the formulation of a Watershed Management Plan, which would serve as the basis for more integrated and sustainable development of key watersheds, and helped to strengthen the Government's capacity in environmental management and flood preparedness. Study components included hazard maps, river and bioengineering studies, geotechnical/landslide and agronomy trials, together with community participation. It was confirmed that land use and agricultural practices added to the risk of floods and landslides. The project ended successfully in 1998, although the Project Completion Report notes that the Watershed Management Plan was a bit heavy on study results, and a bit thin on practical strategy. Participatory components involving local communities were very successful.

Another World Bank project in the Dominican Republic (a so-called Learning and Innovation Loan of US\$ 3 million, 1998-2002) is aimed at National Environmental Policy Reform. While it, again, does not explicitly address natural hazard vulnerability, many of its objectives, such as curbing deforestation and degradation of watersheds and coastal zones, perfectly match hazard mitigation concerns. It would be interesting to consider whether project components might change when hazard mitigation concerns would have been added explicitly to the project objectives. Yet another project, the Wastewater Disposal in Tourism Centers Project (2000-), addresses the degradation of coastal ecosystems by improving wastewater disposal practices. Natural hazard concerns were not explicitly considered.

A growing awareness of natural hazard risk concerns in the area of natural resources and environmental management is reflected in recent World Bank Country Assistance Strategies. The 1995 Country Assistance Strategy for the OECS countries (CAS) mentions that "damage from storms is made worse because of poor land use practices. The increased use of hillsides by marginal banana farmers and the felling of trees on steep grades is causing greater vulnerability to flooding and landslides. Thus, effective environmental planning will be crucial to limiting the future impacts of storms." To what extent this reflects a growing awareness inside the country, or by the environmental experts in the World Bank or its consultant remains guesswork. Anyhow, disaster management is listed as one of the three key priorities in the area of environment, and projects are planned to restructure the banana industry and stop hillside farming to reduce soil erosion and improve watershed management. Similarly, the linkages between degradation of the natural environment, natural hazards, and poverty in rural areas, are recognized in the 1999 CAS for the Dominican Republic. Further work towards the development of a comprehensive rural development program is proposed to address these issues in a holistic manner.

We thus conclude that in the area of natural resources and environmental management the attention to the linkages is limited, but growing. The underlying problems that cause the rising risk are being addressed in a few projects, which could be considered good practice examples. These should be replicated on a wider scale. However, we note that the linkages themselves are not very explicit in the project objectives of design, only circumstantially addressed. Hence, greater awareness, and good information about the nature and the causes of the hazard risk could help to focus these efforts even better.

3.6 Implementing Hazard Mitigation and Environmental Protection

We thus find that there are many important linkages between natural resources and environmental management and hazard risks, and that attention for them has remained limited. While we feel very strongly that these issues do deserve more attention, more attention by itself certainly does not guarantee an improvement in disaster mitigation. In fact, attention may not be the bottleneck at all. It is obvious from the start that we are dealing with a complicated management problem. While the linkages between them may

have been neglected, it is clear that both disaster mitigation and environmental degradation have been recognized as serious issues for these countries. Nevertheless, despite all the attention and efforts, hazard risks keep rising, and environmental degradation continues. Let us examine why.

Most disaster management efforts in the three countries have been initiated in response to large-scale disasters, mainly hurricanes. In the past, that has led to an exclusive focus on relief and rehabilitation. Over time, attention for emergency preparedness has grown, including things like shelters and evacuation plans, and sometimes early warning systems. On top of that, disaster prevention and mitigation are increasingly being recognized as important aspects of disaster management. Clearly, there are some differences between the three case study countries. St. Lucia has made disaster mitigation a national priority, while Dominica has paid relatively little attention to it. Nevertheless, we see that all three of them have started at least some disaster mitigation initiatives, including efforts to improve infrastructure design standards and building codes, use hazard maps in land use planning, and discourage settlements in vulnerable areas. However, the experience is that such efforts face great difficulties and have not yet had the results that could theoretically have been expected.

The first reason is probably that the underlying patterns that create the vulnerability are difficult to manage. It appears that the priority given to long-term disaster prevention is low compared to the perceived and certainly short-term benefits of neglecting them. In some cases, poor people simply cannot afford better standards, move into dangerous areas because they have little choice, or are unwilling to allocate some of their very scarce resources to some more security. This may lead to uncontrolled settlement in vulnerable urban areas, and on steep mountain slopes where deforestation and land degradation contribute to increasing risks. On the other hand, problems can also arise from organized development, when short-term economic interests often override disaster mitigation concerns. Particularly in the case of tourism investments on the coast, investors are often willing to cut corners, sometimes simply betting that they will recover their initial investment before the next disaster strikes. Particularly in the context of the tourism industry, it has been suggested that a different approach is needed, also from the national government, to ensure that tourism benefits are used to ensure the sustainability of the natural resources, and no false incentives (like tax holidays for the tourism industry) exist that unsustainable exploitation with short-term objectives (see e.g. CGCED, 2000).

The second reason is that there is a lack of capacity and coordination at the national level, particularly in the face of the virulent underlying patterns that we just described. How do you stop poor people that have little alternative but to move into the forests? Dominica's national report to the UNCCD explicitly recognized that "it is clear that the problems of land degradation and their solutions transcend the institutional and financial capacity of traditional institutions, agencies, and stakeholders." And how often do you find the political will to enforce the standards in the face of large potential external investments, perceived to be beneficial for the economy? In the case of new settlements or infrastructure location and design, Environmental Impact Assessments could be a useful instrument, but in practice (no matter whether one is concerned about biodiversity or natural hazard risk), they often have little effect, partly because they are usually undertaken too late in the design process. Even perfect enforcement of standards at the design stage can be insufficient, particularly in the case of large infrastructure, where poor maintenance may well recreate a high level of vulnerability even when the design was up to all standards (OAS, 1998). The national disaster management units that would have to ensure that such issues are addressed are relatively small, and not well integrated into the whole array of government activities that affect, or are affected by, natural hazard risk. Disaster mitigation activities funded by external donors have often been linked to post-disaster reconstruction projects, and thus been subject to the same short timeframes for design and implementation that are required for rapid reconstruction. Thus, most disaster mitigation activities have remained modest and rather focused, for example on early warning systems, infrastructure design, and building codes. Little success has been achieved in the integration of these, and other concerns, into all activities of the government, or actually all economic activity.

For some functions needed for effective natural hazard risk reduction and disaster mitigation, it is doubtful that these countries, in particular Dominica and St. Lucia, should pursue self-reliance. A country like Dominica, with 80,000 inhabitants, cannot be expected to run its own state-of-the-art Meteorological Office, or have in-country expertise to make detailed hazard risk assessments. Regional cooperation can be an important way to overcome scale problems for effective disaster mitigation. There is no need for all of the Caribbean countries to create their own building codes or Environmental Impact Assessment standards, and they would all benefit from having one state-of-the-art early warning system, with one good meteorological facility. Similarly, there can be great benefits in sharing information and experiences, and joined training. With these ideas in mind, many regional institutions have been set up, such as CDERA. The existing initiatives have not all been equally successful, but we applaud the overall direction of regional cooperation to develop better technical expertise and share experiences. It should be noted however, that sub-regional cooperations might work best. Dominica and St. Lucia would certainly fall into one cluster, but the Dominican Republic (which due to its size faces fewer scale-problems anyway) might be better off pooling its capacity with other Spanish-speaking countries.

For many aspects of disaster management however, regional institutions and their services cannot be the solution. Their guidance and expertise must be integrated into national activities to become really effective, and only the extent to which this is done well determines their pay-off. For instance, even when excellent hazard maps exist (many have been produced, for instance, in the context of the CDMP, see Table 3.1), they are seldom used by other agencies than the national disaster management office. And in fact, even if such maps are used in land zoning policy, or if advanced meteorological or seismic information is used to create better building codes, these standards remain poorly enforced, probably for the reasons outlined above.

Table 3.1: Existing hazard maps in Dominica, the Dominican Republic, and St. Lucia. Information provided by participants at the 1999 CDMP Hazard Mapping and Vulnerability Assessment Workshop.

Country	Seismic	Landslide	Flood	Storm Surge	Volcanic	Other
Dominica	Incomplete	Yes	Incomplete	Yes	Incomplete	-
Dominican Rep.	Fault lines	-	Flood plains	Susceptibility zones	-	Wind
St. Lucia	-	Yes	Yes	-	-	-

Environmental management in these countries faces similar problems as the ones just described for disaster mitigation. Again, it is often a clash between short-term needs and interests, and long-term sustainability. It is well known that slash-and-burn practices are not sustainable, even in the relatively short term, yet they continue to the present day. Current and future tourism, one of the most important sources of income in the Caribbean, almost entirely depends upon the natural beauty and biodiversity of the coastal and inland ecosystems of these islands. Nevertheless, environmental degradation continues, often even due to the pressures exerted by development of tourism facilities, but with very short economic perspectives in mind. And similar to the concerns of disaster mitigation, enforcement of environmental regulations remains poor, and environmental considerations remain a small add-on rather than an integral aspect of planning and design decisions.

3.7 Addressing the Challenges

We have shown that environmental degradation is a factor in the rising hazard risk in these countries. We also found that this link has not received the attention it requires to achieve sustainable development. Natural hazard concerns are seldom incorporated in planning decisions regarding natural resources and environmental management, and externalities of such decisions with respect to natural hazard risks are rarely taken into account. Hence, this area offers new opportunities to address the rising risks. The relatively

low national capacity of disaster management agencies is an additional argument to encourage integration of natural hazard concerns into other areas of the government. Given the interactions between natural hazard risk and the natural environment, that should primarily be the case with ministries responsible for land use planning, agriculture, and water management. Some of the information that is available in the disaster community, such as hazard maps, could be of great use to many other sectors, and gets its greatest value when it is coupled to information on land use and environmental degradation. It can then be used for prioritization of hotspots to address the linkages, or for planning purposes in related activities (including for instance hydropower generation). Natural hazard risk reduction is then naturally integrated into many other activities. In order to do so, more knowledge is needed about the nature of the interactions and their importance, also from an economic point of view. In addition, experience needs to be built of how to do such assessments, and how to identify the best ways to address the linkages.

That brings us to another issue: implementation. Awareness raising, integration of concerns, and generation of insight and experience are certainly needed. However, the previous section showed that knowledge and awareness alone will likely not be suffice, since the lack of capacity to implement the desired changes and enforce even the best designed standards will remain an impediment. Lack of capacity is one of the core concerns of World Bank disaster management activities in the OECS region, and an institutional assessment of national and regional capacity to address these issues is currently underway. We mentioned before that some capacities might need to be created at the (sub-) regional level. Effective donor coordination will be needed to ensure that the existing capacity is put to use and investments result in real changes, rather than being wasted in a number of parallel efforts with varying objectives, resulting in high transaction costs and fewer results. Beyond these remarks, we will not address the general aspects of the capacity question. Instead, we ask the question whether additional approaches exist to integrate natural hazards concerns into natural resources and environmental management (and vice-versa).

From that perspective, we note that because of their very nature, the linkages between environmental degradation and natural hazard risk may need to be identified, and best be addressed, at the local level. In the area of disaster mitigation, relatively little attention has been paid to the role of the local communities that are most directly affected by the hazards, and are often most directly involved in the management of the natural resources that affect hazard risk. By involving them more closely in the management of these linkages, disaster mitigation can draw from their knowledge and experience about the local circumstances. Moreover, their involvement ensures that the underlying problems, like poverty driving people onto steep mountain hills, become an integral part of the problem, and can thus be taken into account in the design of a solution (for instance, property rights are often ill-suited to provide the right incentives for poor farmers to invest in more sustainable agricultural production).

As noted above, in the area of sustainable natural resources management, there has been more experience with community-based work, and the experiences suggest that this is a most worthwhile approach. In many cases, a natural hazard risk reduction perspective can be an additional motivation for such an approach. In addition, adding a natural hazard perspective can help target such projects at the areas where they will have most benefits, to ensure that communities are aware of such aspects and, where necessary, are provided with appropriate technical support so that natural hazard concerns can be optimally integrated in the activities undertaken. In some cases, ensuring that all the costs and benefits of changing natural resources management practices with respect to natural hazard mitigation are taken into account can help to optimize the incentive structure and thus also contribute to the feasibility of some environmental concerns that are addressed concurrently.

In order to design projects or project components, it is crucial to take the exact local circumstances into account. First, one must understand the local linkages between natural hazards, the natural environment, and human activities. Local people's experience of the hazards will offer great insights, and should be integrated with more generic technical information, as well as hazard maps and land use and geological information for the region. Second, one must find out to what extent local communities and NGOs are aware of the linkages between the natural hazards and their use of the natural resources, and if so, what stands in

the way of addressing them. If appropriate, activities should be planned by the local communities or NGOs. Coordination with the government (and if necessary external experts or international donors) should ensure that optimal information is available and that, where necessary, incentive structures are appropriate (which may require legislative changes, or financial support). That coordination requires explicit attention, since some support structures are crucial to make these projects a success. In the past, many successful community level disaster mitigation and preparedness projects have been implemented by international organizations with substantial experience in that area (such as PAHO, IFRC, OAS), thus hiding national weaknesses in coordinating such activities (CRED/CIFEG, 1997). Particularly in St Lucia and Dominica, the local level of government is non-existent or very much neglected.

Chapter 4.

Theoretical Considerations and Practical Dilemmas

4.1 A Broader Perspective

In the previous chapter, an examination of three case study countries in the Caribbean showed (i) that natural resources management and environmental degradation have contributed to natural hazard risks, (ii) that this linkage has been largely neglected in disaster mitigation, and (iii) that disaster mitigation and environmental concerns face similar management problems, both related to the limited national capacity (or priority) to address unsustainable development that is driven by either poverty or short-term economic interests.

In this chapter, we will take a broader perspective, and show that the neglect of the linkages between natural hazard risk and our management of the natural environment is not just an isolated issue in a few selected countries, but that, instead, it stems from more general deficiencies in policy and management. That perspective allows us to broaden some of our conclusions, and extract a few recommendations that may be more widely applicable.

4.2 A Simple Question

On cursory examination the relationship between natural resources management and natural hazards and disasters may not seem particularly vital. The fact that human settlements are sometimes devastated by violent natural forces seems far from the everyday business of the management of natural resources such as land and soils, forests and ecosystems, rivers, lakes, and coasts. So if we want to understand this complex matter of the relationship between natural resources management and natural disasters, it might be well to begin with a simple and fundamental question. *Why do natural hazards and disasters exist at all?*

The simple and rather unrevealing answer usually given is that they are an inevitable feature of life on a planet with a constantly changing (variable) environment. Wherever human beings have lived they have necessarily encountered losses in the course of their use of the earth and its resources. Hazards are just the reverse side of the coin of the multiple benefits that are extracted from nature when people seek to make a livelihood, be it from hunting and gathering or agriculture, or from the most advanced forms of commercial enterprise. The rewards of catching and eating fish from the ocean are obtained at the risk of being caught in a storm that could mean loss of life. The benefits of planting crops and producing food cannot be divorced from the fact that all the labor may be in vain if the crop shrivels and dies in a drought, or if it is consumed by insects before it can be harvested. Even the New York Stock Exchange is periodically disrupted by blizzards, and an automobile assembly plant in South Carolina had to close down when the "just-in-time" delivery of parts from Japan failed to arrive as a result of the Kobe earthquake.

In the context of this simple answer, the pervasiveness of disaster losses may suggest that hazards and their consequences are inevitable. On the other hand, if we probe a little deeper the answer becomes less obvious. Why is it that in an age of great scientific knowledge and unprecedented technological virtuosity, losses are increasing rapidly? And why is it that some people, and some places, and some activities seem to experience much heavier and repeated losses than others? Could it be that scientific understanding and technological know-how are insufficient? This surely can be dismissed as an explanation. No doubt even more scientific knowledge would permit better forecasts to be made and more timely warnings to be issued. But these skills have improved considerably in recent decades while losses have continued to rise. Could improved technology permit the construction of safer and more resistant buildings that will not be swept

away in the floodwaters or collapse in the earthquake? Perhaps so, but here again, big strides in building design and materials have been made while losses continue to rise. Perhaps it could be that natural hazards now strike in unexpected places where they have not been known to occur before? The evidence strongly suggests otherwise. In addition to generations of accumulated experience, the magnitude and frequency, and spatial distribution of hazard events has been studied and plotted as never before, and few countries or areas are without some hazard risk maps, many of them of high quality. Certainly more could be done to ensure that high hazard zones are identified, and that people are made aware of the risks, but when the disasters occur it is rarely because the possibility had not been identified, with some sense of the level of probability. Then perhaps it is that the knowledge and technology are not being used, or not being used effectively, or are not available to some people. But how could this be when disaster management and preparedness programs have been in existence now for decades at both national and international levels? The United Nations even designated the decade of the 1990s as the International Decade for Natural Disaster Reduction. At the end of the Decade many meetings had been held; many plans formulated and assessed, but while the Decade contributed to focusing attention on the issue of natural hazards, losses were higher than ever, and show no sign of diminishing in the future. These disappointing results can hardly be due to lack of attention. Not only have governments and international agencies been alerted and engaged, but the world's media have also drawn attention to the problem with frequent and dramatic stories of death and destruction from all corners of the globe. It is true that knowledge and technology are not equally distributed or available, and no doubt more can be done to ensure access. But the remaining deficiencies can probably be attributed to the ineffective use of knowledge more than to its total neglect or unavailability.

Our opening question of why natural hazards and disasters exist now seems less simple. An examination of the considerable volume of literature leads us to a more complex diagnosis. This diagnosis has four main elements. First is the rate at which some of the causal processes or risk factors are increasing. The second concerns some historical misdiagnoses that have resulted in the misapplication of knowledge. The third factor is the "who decides?" question, and the fourth and final factor, which leads most directly to the subject of natural resources and environmental management, is the fragmented application of knowledge.

4.3 Growing Risk Factors

Our critique of science and technology, and its application through disaster management and preparedness programs is not meant to suggest that all these efforts have been worthless. Without doubt, much has been achieved. However, the efforts have to be set against the growth of the problem. Rapid population growth means that space has to be found for more people, and more human settlements and the infrastructure that serves them. If the growth of these risk factors were spread over the surface of the earth in random fashion some increased exposure to natural hazards would inevitably occur. But if knowledge of the hazards was used effectively to guide location decisions, such growth might be proportionately less than the growth of population and wealth. Regrettably the evidence proves otherwise. While in developed countries the growth in losses from natural hazards has remained an approximately constant proportion of national wealth, in developing countries it is increasing sharply. We conclude that *the growth in risk factors (population and development) is on a larger scale and is occurring more rapidly than the capacity of national and international programs designed to deal with the problem.* Since population growth is most rapid in developing countries it is not surprising that this is where the growth in losses is proportionately greater.

From the perspective of growing risk factors the natural hazards problem is not very different from the current scourge of the AIDS pandemic. Both preventive and treatment measures exist but are not applied at sufficient scale. In part this is a matter of cost and political will. Governments have simply not allocated enough funds or priority to the problem. It is also a manifestation of poverty and inequity. Governments and individuals in many developing countries are faced with a multitude of needs and priorities that cannot be adequately funded with their own resources. The richer nations have provided assistance of many kinds, but this is also not on a sufficient scale to adequately address the growth of the problem.

In the case of natural hazards, the growth of the risk factors has many dimensions. Population growth has already been mentioned. The evidence also suggests that many developing countries have not made the best use of available knowledge and assistance. Despite the science and technical knowledge available, human settlements continue to expand in high hazard areas. More people are living in areas subject to flood; on steep and unstable hill and mountain slopes subject to landslides; in coastal areas exposed to high winds, tropical cyclones, and storm surges; in lands with low and unreliable rainfall, and in earthquake and volcanic regions. Part of the reason may be lack of awareness on the part of uneducated or uninformed people, but more often such locational decisions are driven by poverty, and lack of better or affordable alternatives. Similarly the failure to employ better construction techniques and materials is often a function of poverty. Parenthetically it should also be stated here and now that it is the same poverty that also drives people to the destruction of natural resources and ecosystems, and so further contributes to the problem, so that there is a three-way interaction (see figure 2.1).

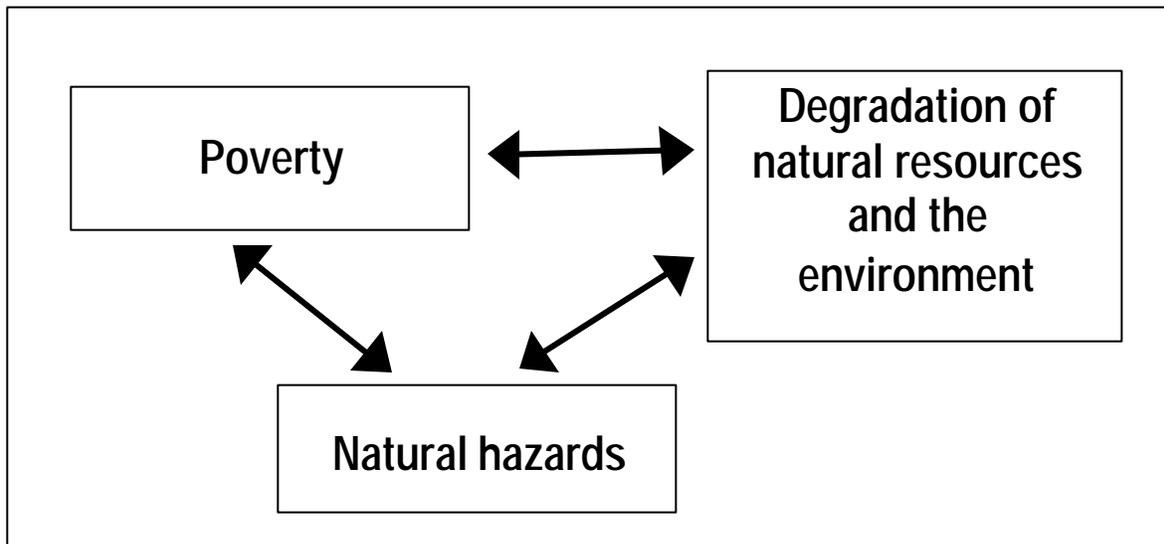


Figure 4.1: The three-way interrelationship between poverty, natural hazards, and the degradation of natural resources and the environment.

Another reason for concern on the side of the risk factors is climate change. In fact, climate change is already happening. The Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2001c) observes that the 1990s was the warmest decade, and 1998 the warmest year, in the instrumental record. Surface temperatures, but also the number of extremes in terms of temperature and precipitation (either droughts or floods) have already increased. Moreover, the IPCC also concludes that "observed changes in regional climate have affected many physical and biological systems, and there are preliminary indications that social and economic systems have been affected" (IPCC, 2001c). Sea level is rising, the duration of the ice cover of rivers and lakes is decreasing, El Nino events have been more frequent, persistent and intense during the last 20-30 years compared to the previous 100 years, plant and animal ranges have shifted, breeding flowering and migration times have changes for many species, coral bleaching has intensified, etc. etc. For the coming decades, the IPCC concludes that larger changes are underway. Depending on emissions scenarios, and given remaining uncertainties in climate models, global mean temperatures are projected to rise by 1.4-5.8 degrees Celsius until 2100 and sea level by 0.09 to 0.88 meters. Depending on the region of the world, average precipitation is likely to see either increases or decreases of typically 5-20%. These changes in average temperature and precipitation will likely be accompanied by an increase of extreme events. While some of the changes may actually be beneficial to some sectors in some regions, the IPCC concludes that "when considered by region, adverse effects are projected to predominate for much of the world, particularly in the tropics and subtropics", and moreover, that "the impacts of climate change will fall disproportionately upon developing countries, and the poor

persons within all countries, and thereby exacerbate inequities in health status and access to adequate food, clean water, and other resources" (IPCC, 2001c).

Hence, while the rise in hazard risk and disaster losses up to now probably must be attributed to other causes than the onset of climatic changes, climate change certainly adds an additional dimension to the challenges in the coming decades. Since climate change is projected to disproportionately affect developing countries, and in those countries the poorest people, it will not just increase the physical risk factors, but also aggravate the patterns just identified. In particular, multiple stresses on the natural environment (from unsustainable development and climatic changes) will threaten livelihoods and aggravate natural hazards, particularly in developing countries.

Despite these difficulties and deficiencies much has in fact been achieved. Without the advances in science and technology, and without the major efforts that have been marshaled to apply the knowledge we have, the situation would undoubtedly be much worse. But the rise in risk factors relative to the resources applied to deal with them is not the only problem. Governments could have done more to guide settlements away from hazard zones and ensure higher standards of construction. The fact that less is done than could be done also stems in part from some historical misdiagnoses and misunderstandings of the hazards problem.

4.4 Misdiagnosis and Misunderstanding

Paradoxically the growth of scientific and public interest in natural hazards, and the related media coverage, may have helped to exacerbate the problem. The focus of attention on the most extreme events has strengthened two misunderstandings. The first is that in any given place the recurrence of the event is unlikely in the near term. Secondly the magnitude of the consequences encourages the fatalistic notion that the disaster is an "Act of God" against which human efforts can do little. Consequently, when disaster strikes there can be a tendency to forget that smaller and less extreme events do occur more frequently. Since the event is perceived as rare there is less incentive for precautionary measures. Governments, private investors, and even the people placed at risk can more readily be persuaded that the next event is a long time off. There probably are other factors at work, such as the avoidance or evasion of responsibility. Both political leaders and private investors may be tempted to believe that they will out of office and divested of their financial liability before the next disaster strikes. There are also more noble motivations involved. When scientific and technical experts report their understanding of event magnitude and frequency, the risks may quite reasonably be discounted on the grounds that immediate and short-term benefits or savings are to be preferred even at the risk of longer-term losses. It is a matter of time preference. When faced with immediate privations, their alleviation can easily take priority over more farsighted precautions. These considerations can apply not only before a disaster occurs. After the event there is often strong motivation to get back to normal as soon as possible. The psychological shock of a disaster can best be counteracted by rapid restoration and rehabilitation of the community. The need to return to business as usual also motivates rapid reconstruction even if it means replacing buildings and infrastructure in the same place and of a quality that is no better, and sometimes worse than before. This can amount to the creation of the next disaster as it were by design (Miletti, 1999). But at least business disruption is reduced; crops can be brought to market, and the life of the community can recover.

While these views of disasters as rare events that require a "quick fix" are not in themselves always necessarily mistaken, they have served to strengthen a misallocation of funds. International assistance to disaster stricken countries and communities has concentrated heavily on the disaster and its immediate aftermath. Emergency food; medical supplies, field hospitals, water supply and disposal equipment and temporary housing are often flown in very rapidly by friendly governments and private humanitarian agencies, attracting much public attention. What is less noticed is that when the immediate crisis is over, the help goes away, and the affected people and their governments are left to begin the serious process of long-term recovery as best they can. Under such circumstances governments sometimes turn to international lending agencies and borrow money to finance reconstruction as before without change in

location or design. Because the reasons for such decisions are understandable does not make them more justified.

It should also be noted that many aspects of natural resources management typically do not fit the short time frame of the traditional post-disaster operations. Moreover, while the most visible hazard impacts, such as the hurricanes that wreak national havoc, attract most attention, this interaction is also thoroughly related to the whole spectrum of hazards, including many more frequent hazards that are smaller on a national scale, but certainly matter at a local scale (e.g. landslides).

To act differently requires a fundamental change in perception or perspective. It is the recognition that *disasters are not just rare events, but that they are woven into the fabric and decisions of everyday life* (Hewitt, 1998). While this notion by itself is not entirely new, it has only now been widely adopted and disseminated, which led to talk of a "new paradigm" of disaster management and response: short-term humanitarian actions, and planning for disaster preparedness is being supplemented with a new policy often referred to as disaster mitigation, or risk management. The arrival of the notion of disaster mitigation into the lexicon and mentality of the specialists and the policymakers is almost certainly having some good results. These include greater attention to the location of human settlements, and growing attention to structural designs.

In practice, the new paradigm is not yet paying off as could be expected. Partly, that may be because the shift is still taking place, and attention to issues like the ones mentioned may still be growing. However, there are other reasons why natural hazard mitigation is not yet achieving what could be expected.

Even if the driving force of poverty could be rapidly reduced, experience in developed countries shows that damages can continue to rise even as wealth replaces poverty, and as more choices become available. High losses from hurricanes in the south east of the United States are now seen to result at least in part from higher levels of risk taking among the affluent. Expansion of coastal settlements now occurs more as a result of the search for amenity values and the attractions of sun, sand and sea, than from the necessity to make a living. Short-sightedness and lack of responsibility still play a role but now these matter less because wealth is greater; insurance is often available and affordable, and even where this extra security does not apply, the wealthier society can and usually does provide compensation, even to those who knowingly accept the risks of hazardous locations. To trade poverty driven losses for wealth-driven losses would be an improvement for developing countries. Unfortunately what seems to be happening, especially in some island nations in the Caribbean and elsewhere, is that both processes are now found side by side. Tourism expands in an unsustainable fashion in prime coastal areas to accommodate the wealthy tourists, while poverty still limits the choices of the local residents. In many cases, such economic patterns can threaten long-term risk mitigation. In the Caribbean, tourist hotels and other facilities are often constructed by offshore interests who can recover their investments in a few short years, while leaving the island governments to cope with the longer term consequences. In fact, there may be perverse incentives in place, stimulating such behavior rather than discouraging it. For reasons like this the effective implementation of the disaster mitigation philosophy is not likely to happen rapidly.

Even such slow progress would be more acceptable if the risk factors were not themselves continuing to grow rapidly. It is not surprising therefore that some policy makers and many concerned organizations continue to ask what more is to be done, and whether aspects of the problem have been neglected in the diagnosis. Which leads directly to the concern about the linkages between natural resources management and natural hazards, which was demonstrated in Chapter 2.

Undoubtedly natural resources management has been a neglected, if not altogether hidden link in the system. One reason why this link has been ignored is that land use planning and construction standards have been seen as the major directions in which progress in disaster mitigation can be made. The received wisdom is that improvements in natural resources management may add a little to the overall strategy, but as a marginal increment rather than a fundamental change. This is a conclusion that we now have reason to

challenge. We argue that the correction or improvement of the current mismanagement of natural resources might contribute substantially to the reduction of vulnerability to natural hazards and the associated disasters.

4.5 Who Decides? Who Acts?

Before turning to the question of the fragmentary application of knowledge, it is well to consider how the available knowledge has been created and used and especially by whom. Some insight into this question can be gained by reflecting on the ideas recently advanced about natural hazards and disasters. Initially, the International Decade for Natural Disaster Reduction was guided by the belief that the heavy and growing toll of losses could be significantly reduced by the advancement and dissemination of the scientific understanding of the natural processes involved and their application to forecasts and warnings. Halfway through the Decade, at a conference in Yokohama, the community of government representatives and scientists involved in the Decade moved away from that focus, and instead adopted the newly formulated paradigm of disaster mitigation. This in turn owed much to the efforts of FEMA, the US Government's Federal Emergency Management Agency. Examination of the Agency's record by academic scholars and under Congressional Review in the 1970s and 1980s had revealed that successful emergency response served as a palliative approach at best. At worst the work of the Agency together with other Federal Disaster Relief and rehabilitation programs, including some Federally sponsored insurance, may have made matters worse, by encouraging a false sense of security and thus promoting more risk taking behavior. What is significant about this narrative is that both the original focus of the Decade, and the original disaster management efforts by FEMA are characterized by a "top down" approach. State and local governments, citizens and community organizations have largely played the role of demanding and willing recipients of largesse and technical guidance from the senior level of government. If this has been true in the United States, where local democracy and local autonomy are well-entrenched and thriving traditions, how much more is it likely to be the case in developing countries?

The evidence suggests that developing country governments have been encouraged to think of themselves as relatively powerless victims in the face of the violent forces of nature; the pattern of global inequalities, and the prevalence of poverty in their own populations. This psychology of "victimhood" has been reinforced by the well-intentioned interventions of other governments, international intergovernmental organizations and a plethora of non-governmental humanitarian agencies. These groups are in the habit of descending upon disaster sites with abundant fanfare and help. But as noted before, their presence generally fails to outlast the media attention by more than a few days or weeks, and the affected communities are quickly left to their own devices. The message to be taken from this analysis is not that humanitarian efforts should be reduced. On the contrary, they should be further expanded both in volume, and especially in time. Such help needs to be more sustained if it is to be of long-term value. However, our main concern relates to the top-down approaches that are often chosen. The important point is the disconnection between the external helpers and those to whom their help is directed. At the local and community level the victims of disaster are not only disconnected from their international helpers, but also often from their own national governments.

To answer our simple question of why natural hazards and disasters keep occurring, and in particular in examining the relationship between natural resources management and natural hazards and disasters, we also have reason therefore to ask about the roles and responsibilities of decision makers and actors at different levels. *The appropriate allocation of the power to act between levels of authority from individual to global is an essential element in the search for a more comprehensive approach to natural hazard risk reduction.*

4.6 The Fragmentary Application of Knowledge

The history of the scientific and policy debates about natural hazards and disasters over the past few decades has been the story of the steady widening of the frame of reference and portfolio of response. In the heyday of dam construction from the 1930s to the 1960s (1970s and 1980s in some places), it was believed that structural engineering measures could be deployed to control floods. Engineers, scientists and technologists entertained hubristic notions of the taming and control of nature. When engineering measures alone were found to be insufficient and in some cases counterproductive, the portfolio was expanded to include greater emphasis on forecasts and warnings. At this stage of the debate it was sometimes asserted that earthquakes would eventually be forecast with such accuracy that mass evacuations could be justified. More recently as we have seen, emphasis has shifted to the mitigation of disasters by land use planning and structural design. These advances in thinking have been additive. They have not replaced earlier approaches but have been introduced as supplements. So it is with the growing concern for the role of natural resources management and natural disasters. The new diagnosis being advanced, and we provide evidence in later sections, is that degradation of natural resources and neglect of good management practices is adding to the risks of natural disasters. We agree with that diagnosis, and argue for it at some length. At the same time we must ask if it is not just one more piece of the jigsaw, and possibly rather small and unimportant piece at that.

We have persuaded ourselves that natural resources management is important for natural hazard risk reduction, at least in some places and for some hazards, and also that it is more than just another piece of the disaster management jigsaw. We argue that the improvement in management of soils, forests, coastal zones, and other natural systems cannot be treated as another distinct domain or area of expertise that can be partitioned off and dealt with separately in the way that this can be done with hazard forecasting and warning, or land use planning and structural design. Even more than in those areas, risk reduction must be integrated in day-to-day management. In fact, this integrated management must go beyond the simple natural resources perspective. Improvements in natural resources management are of some importance in their own right, but they even gain in importance if we follow where the logic dictates and include not just natural resources in the narrow sense of the term, but also the total environment. Natural hazard risk reduction then becomes an overarching concern that must be integrated in a wide array of concerns and activities, from hydropower generation to biodiversity conservation, and from agriculture to wetlands management.

If this perspective is adopted then a holistic view of natural hazards and disasters becomes imperative. They are no longer a thing apart, for which science, scholarship, and policy can be developed and advanced in a compartmentalized way. Hazards become part of the everyday fabric of life and environment.

The simple question to which we offered a simple answer can now be seen in a more complete light. It is true that hazards arise from the human pursuit of what is useful, beneficial, and enjoyable in nature and the environment. When disasters are seen as part of this process the prospects for progress will improve.

4.7 Practical Consequences

Some technical linkages between natural hazards and the natural environment were discussed in Chapter 2, and applied in the country studies of Chapter 3. We saw that little knowledge exists, and more work is needed to map out all the technical linkages, and particularly to assess their importance, for instance in an economic way. However, we also saw in the country studies that a general knowledge and awareness of the nature of these linkages is not enough, and that a possibly even more important task is to understand how practical measures can best be identified and implemented, in what ways, and by whom? In most areas of natural disaster management, but also in natural resources management and biodiversity protection, identifying the desired changes is one thing, understanding the underlying difficulties in addressing them even more difficult, and implementing the solutions the toughest nut to crack.

Even in the context of the country studies in Chapter 3, our answers were at best partial and tentative. In fact, we even argue that a study like this can *by definition* not provide such answers, and that by design, those affected by the hazards and managing the natural resources must be part of the formulation (and implementation) of the solutions. That brings us back to some of our previous findings. *Natural hazard risks are rising*, despite our advances in knowledge and technology, mainly because of population growth and development in hazardous areas. Better *management of the natural resources, and the natural environment in a broader sense, is a neglected aspect of disaster mitigation*. The degradation of the natural environment may well be contributing to rising risks, and better management could certainly be part of a solution. However, we do not propose yet another set of separate disaster management activities. Instead, *natural hazard concerns should be integrated in general development management*. Such an integration of concerns is lacking at many levels. Virtually all national governments are organized in a number of rather independent departments, which operate without much interaction. Most NGOs specialize in a few topics. And even the international community tends to be organized thematically, with specialized agencies that do not have much interaction, and a number of international conventions that may overlap, but do not interact. We argue that this approach is ineffective, and may sometimes even be counterproductive.

The question is then how to integrate risk reduction into general development, keeping two things in mind. First, the fact that other areas of disaster mitigation, such as building codes, have not yet had the success that could be expected on theoretical grounds, primarily due to difficulties in implementation (both formulation and enforcement). Second, that similar problems also occur in relation to environmental and natural resources management, where short-term gains often override long-term sustainability. While disaster mitigation adds yet another argument to address some of these concerns, the difficulties in implementation are likely to remain the same. That brings us to the final point from our previous analysis, namely that *the appropriate allocation of the power to act between levels of authority from individual to global is an essential element in the search for a more comprehensive approach to natural hazard risk reduction*. We have come to believe that the misallocation of the power and the means to make decisions is the greatest remaining obstacle to the reduction of natural disasters. How natural resources and environment are managed and mismanaged is a key point of access to the processes that can lead to the eventual removal of this obstacle. In the context of natural resources management, it has been recognized (e.g. World Bank, 2001) that communities should drive natural resources management changes, and that, in light of the site-specificity of such problems and the need to consider the incentives of local stakeholders and empower them to take action, community driven development holds substantial promise as an approach to implement programs (an important caveat here is that when off-site benefits are considerable, external transfers may be necessary to complement local management).

This community focus has an additional aspect. Natural hazards are not restricted to national disasters like hurricanes. Much more frequent events may be too small to be registered in the national statistics, but continuously cause enormous devastation at the level of the local communities that are affected by them. These communities are often well aware of these risks, but have no choice other than to confront them, and are kept victim in the cycle of poverty, vulnerability, and environmental degradation that we described above. Appropriate information, but particularly also better incentive structures and real empowerment of those communities can help them to contribute to the solution to these problems. A more holistic approach to disaster management can then become an important building block in a sustainable development strategy for many vulnerable communities *and* vulnerable natural environments.

Chapter 5.

Conclusions

We began this paper with the simple question of why natural hazards and disasters exist at all. A case study in three Caribbean countries gave us some initial insights. An exploration of these findings in the light of recent developments in disaster management then brought us towards a broader conception of natural hazard mitigation, with the conclusions that follow.

5.1 The Diagnosis

- 1) The role of natural resource and environmental management has been relatively neglected in natural hazard mitigation. This issue deserves more attention, and not just for the sake of completeness. Significant opportunities exist to reduce natural hazard risk, but moreover, the absence in disaster mitigation activities is symbolic of the fragmentary view of disasters. We argue (as many have before us) that this fragmentary view must be discarded, not just in theory but especially also in practice.
- 2) The conventional view of disasters as rare events is wrong. It is misleading and results in the selection of the wrong priorities and the wrong balance in the choice of response options. Instead, disasters are inseparable from their causes, and their causes are embedded into the fabric of everyday life, including the everyday decisions and actions that result in the neglect or mismanagement of natural resources and environment.
- 3) From that perspective, natural hazards and disasters are both a symptom and a cause of inadequate natural resource and environmental management. Disasters cause direct damage to natural resources and environment, and indirect damage by increasing poverty, which in itself leads to the overexploitation (unsustainable use practices) of natural resources and environment. These in turn add to the vulnerability of both natural and human systems, which increases disaster losses.
- 4) These patterns are reflected our three case study countries, Dominica, the Dominican Republic, and St. Lucia. We found that in those countries
 - a) Environmental degradation has contributed to an increase in natural hazard risk.
 - b) The two main areas of interaction are
 - At the coast, degradation and destruction of natural protective structures that reduce wave impacts, including mangrove forests, coral reefs, and natural beaches.
 - Inland, deforestation and unsustainable agricultural practices, particularly at steep mountain slopes, affect erosion, flood risk and landslides (processes which downstream also affect the natural protective structures at the coast).
 - c) While there are several examples of large damage due to these patterns of degradation, this factor in increasing hazard risk has been mostly neglected in disaster management efforts. Neither comprehensive analyses nor detailed local studies have been made to assess the importance of these linkages, their relationship to development, and possible ways to address them.
 - d) Degradation of these two areas is not just of concern because of natural hazard risk increases. The natural resource base is crucial for these countries, in terms of agriculture and livelihoods, but

particularly for its tourist industry, which heavily relies on these countries' natural beauty and biodiversity.

- e) More sustainable natural resources and environmental management (from an biodiversity, natural resources, or natural hazard risk perspective), faces two main obstacles (very similar to the ones that stand in the way of "regular" disaster mitigation like effective implementation of building codes): poverty, driving people toward the unsustainable and risky options (partly due to the incentive structures), and short-term economic interests. The capacity of the national governments is insufficient to effectively tackle either natural hazard risks or environmental degradation in the face of these underlying challenges.
 - f) Some encouraging initiatives have been undertaken, which indicate an interest in more integrated approaches, and attention to the local context and the role of local communities. While still relatively limited in scale and scope, they illustrate the range of new opportunities that arise from a new perspective, and can serve as best practice examples for further work in these areas.
- 5) The relative importance of the various factors and forces in the vicious cycle of environmental degradation, poverty, and natural hazards, has not been carefully assessed. It is in any case difficult and dangerous to generalize about both their nature and solutions, which can only be assessed in the full local context, including the geography and hazard history, as well as the awareness, knowledge and concerns of the local communities, and the national and regional imbedding. More knowledge is needed about how to assess and address the linkages in those local contexts, as well as detailed case-studies, including economic analyses, of the importance of the linkages.

5.2 Improved Risk Management

- 6) Given this diagnosis, attempts to mitigate natural hazard risks should recognize that these hazards are an integral component of the challenges of development and environment, not just a matter of emergency aid and humanitarian assistance. Nor is the currently popular focus on building and infrastructure design and land use planning by itself sufficient. This perspective brings poverty, empowerment, and the allocation of public and private functions and responsibilities into focus as core aspects of disaster management.
- 7) The need for a more integrated approach of disasters should be reflected at all levels of activity, in local communities, and at the national, supranational/regional, and global levels.
- 8) At the global level, disaster concerns should be integrated with other global environment and development issues including climate change, desertification and land degradation, and biodiversity conservation.
- 9) At the national level, we found that in our three case study countries, the limited capacity of national governments has been a key bottleneck in addressing both disaster mitigation and environmental degradation (particularly given the pressures of poverty and short-term economic interests). Consolidation of capacity and responsibilities among government agencies may be required, but some tasks (such as meteorological services, or the development of building codes) might also be better managed on a (sub-)regional basis, especially in the case of small island states.
- 10) Improvements in natural resource and environmental management on the other hand, amongst others to reflect natural hazards concerns, usually require more local and community stakeholder involvement. Local communities should not be passive recipients or victims, but partners with a real voice, and thus some power. Local knowledge and concerns should be a key aspect of efforts to address these issues, and the decision-making and incentive structures should reflect a large degree of local ownership and

responsibility. Such approaches have been explored on a small scale in our three case study countries, and provide some first best-practice examples for further work.

- 11) At all levels, an integrated approach may have two implications. First, promoting the things that we already do that we know make good sense from all perspectives (poverty alleviation, economic development, natural hazard risk, sustainable natural resources management, biodiversity conservation, etc.). Second, finding out where trade-offs may come into play (e.g. foregoing short-term benefits for long-term sustainability in the case of investments in forestry in high- instead of low-risk areas or decisions not to develop certain forested or coastal areas). In the latter case, one must make sure that all aspects, including information about natural hazard risks (e.g. hazard maps), are taken into account when such decisions are being made, and ensure that all those involved are able to contribute to and benefit from the changes.

5.3 Recommendations/Next Steps

Clearly, this study is only a first exploration of a very rich topic. We have limited ourselves mainly to one region, and even there to only three countries. In those three countries, we were restricted to a deskstudy, drawing from project documents, literature, and interviews. As pointed out in the introduction, this paper is only the first step in a larger project by the World Bank Disaster Management Facility and Latin America and Caribbean Region, which will have two further components.

The first component is a background paper for the CGCED meeting in June 2002. Using, among others, input from this paper, the OAS has prepared best practice matrices with risk reduction measures, and will draw a comparison to current practices in a number of Caribbean countries. This will feed into a background document which will be the starting point for discussions among the Heads of State of the Caribbean countries about how best to integrate disaster risk reduction strategies into policy and practice, in all sectors of their economies.

A second follow-up to this paper are a few small-scale pilot-studies. As we noted above, one of the main constraints for better disaster risk reduction in the Caribbean is the limited capacity of the national governments to tackle the very difficult pressures of poverty and short-term economic interests on sustainable development. We believe that there may be room for improvement of the regional capacity, particularly for more technically oriented aspects of natural hazard risk management. However, based upon our three case studies, we conclude that the most promising angle for improving the sustainable management of the natural resource base, including its effects on natural hazard, is to make better use of the community level. In this paper, we cannot prescribe any concrete activities on that level, mainly because the best approaches are too situation dependent, having to take into account both the local geography and the interests and concerns of the local population and their ways of dealing with them. Answering those questions for specific circumstances will be the goal of the case studies that we propose here, and which will be the second follow-up activity.

These goals of these small pilot studies is to explore ways of bringing natural hazard and natural resources management issues together, at the local community level, with strong stakeholder involvement, including local communities and island governments. Based on land use and natural hazard information, one could identify a few "hotspots" where the linkages between natural hazard and environmental degradation can be expected to be important. At those locations, one could do on-the-ground examinations of (i) the actual importance of the linkages between natural resources and environmental management and natural hazards at a particular location (including, wherever possible, some economic quantifications), (ii) the awareness of and knowledge about these linkages in the local communities (including individuals as well as the public and the private sector), and (iii) the ways to address some of these issues as integral aspects of development and environment concerns, with strong involvement from the local community. Attention must be paid to the incentive structure, and to possible trade-offs between short- and long-term benefits. In an implementation

phase, support from development agencies or bilateral donors could help to shift some of those benefits (preferably not by putting in non-sustainable, e.g. monetary, incentives, but by supporting new development opportunities, such as a shift to higher-yield, more hazard resistant crops, that pay off on the short, as well as the long term).

The local-level examinations of the importance of these linkages, and possible response options, could form an excellent basis for further discussions with national agencies involved in disaster mitigation and natural resources management, in the region and around the world. In such discussions, this information could help to build awareness of the linkages, stimulate cooperation between various government agencies, and stimulate the governments to take on a supporting and coordinating role for many more local-level activities.

Annexes.

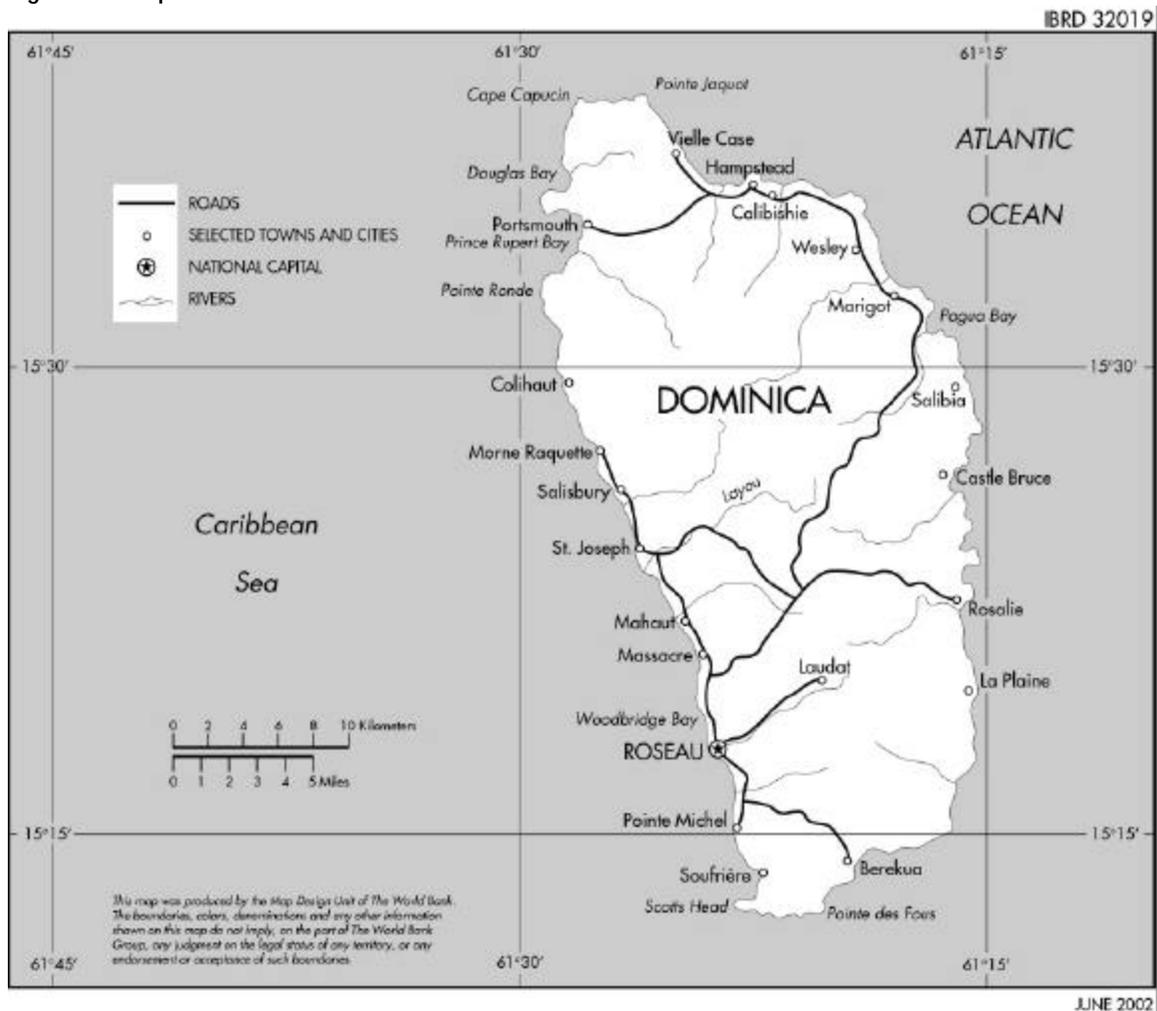
The following four annexes contain some more detailed information about the three case study countries, World Bank strategies and projects in those countries, and an overview of some regional and international initiatives and organizations.

Given the scope of this study, these annexes, while more detailed than the main text, do not pretend to be comprehensive. At the country level, a real understanding of the interactions of development, environment, and natural hazards requires more detailed examinations. More statistical and analytical information about the countries can be found in many of the internet sources listed at the end of this report. The institutional descriptions of national and international activities is also only cursory; a more comprehensive institutional review of national and regional activities in disaster management is currently being prepared by another consultant for the World Bank OECS country team.

Annex A

Dominica

Figure A.1: Map of Dominica



A.1 General Background and Geography

Dominica consists of a 754-km² island in the eastern Caribbean. The island is of volcanic origin and consists of rugged, heavily forested, mountainous terrain. 60% of Dominica's terrain consists of slopes of over 30%, and is characterized by numerous swift non-navigable rivers in narrow, incised valleys. The rainfall is very high, and varies from 1800 mm per year on the western coast to 7500 mm in the mountainous interior. The abundance of water sustains dense and diverse tropical vegetation.

Dominica has just over 70,000 people (97 per sq km) and a per capita GNP of \$3150. In 1996, about 30% of the population was estimated to live below the poverty line. Agriculture, while in decline, still accounts for over 20% of GDP, 25% of exports, and at least 30% of labor (in fact, taking account of self-provisioning or small-scale market-oriented production, the actual proportion of the population directly depending on agriculture may actually be about half). Bananas were the primary crop, and accounted for a large share of

Dominica's economic growth in the 1980s. Hence, adverse changes in the EU banana-trading regime (liberalization) caused considerable problems in this sector. Little irrigation is used.

Tourism is relatively limited (but still important) due to the rugged coastline, the relative lack of white sand beaches, and the fact that there is no international airport. (Dominica is trying to position itself as an eco-tourism destination). 50% of Dominica's electricity is generated by hydropower; about half of the roads are paved. There are no metallic minerals or hydrocarbons. Fishery potential is not yet much exploited.

Its extensive remaining forest cover (60%) sets Dominica apart from St. Lucia and the Dominican Republic (where many more of the forests have already been removed). Economically, the forestry sector is insignificant, particularly since economic exploitation of forests is now severely restricted. However, it has been noted that the role of forests with respect to environmental damage and vulnerability makes them far more important than economic figures would suggest. In addition, the forests still play a large role in the livelihood of some of the poorest rural groups.

A.2 Natural Hazards

Dominica is highly disaster-prone (one index for disaster proneness puts it in second place, after only Vanuatu (Briguglio, 1995). The main disasters from the recent past are displayed in Table A.1.

The most prominent disasters to affect Dominica are tropical storms and hurricanes, which can be expected during the late summer months. They cause damage through floods, storm surges and strong winds. In addition, Dominica's high rainfall results in frequent localized flooding and recurrent landslides.

Estimates are that at least 2% of the total land area has been affected by landslides (DeGraff et al., 1989), the most notable one being the huge Layou River landslide in 1997.

Dominica's volcanic activity is apparent from the occurrence of geysers and hot springs. Although no recent incidents have occurred, the risk of volcanic activity remains fairly high, and most recently led to an alert in 1998-99. There is a related risk of earthquakes (which has not manifested itself in recent times). Less prominent potential hazards include droughts, bush fires, and tsunamis.

Table A.1: Major disasters in Dominica.

Source: EM-DAT: the OFDA/CRED International Disaster Database.

Year	Event	Casualties	People affected	Damage (US\$)
1930	Hurricane San Zenon	2,000		
1963	Hurricane Edith			2,600,000
1966	Hurricane Inez			
1970	Tropical cyclone			
1979	Hurricanes David and Frederick	40	72,100	44,650,000
1980	Hurricane Allen			
1984	Hurricane Klaus	2	10,000	2,000,000
1989	Hurricane Hugo	0	710	20,000,000
1995	Hurricane Luis	1	3,001	3,428,000

A.3 The Effect of Environmental Degradation on Natural Hazard Risk

We found very little documentation on the interaction of environmental degradation and natural hazard risk in Dominica. However, the conversion of Dominica's forests, and unsustainable agricultural practices at the mountain slopes (including preferences for bananas, instead of, for example, coconuts), must be contributing to hazard risks, particularly given the high levels of rainfall and the existing risk of landslides and floods. The primary threat to Dominica's forests is the pressure of expanding agriculture and the production of charcoal, posts, and firewood. In addition, with expanding agriculture there has been an increased eutrophication of fragile ecosystems (mangroves, sea grass, wetlands), which may also contribute to rising vulnerability to particularly storm surges.

Dominica's first report to the UNCCD mentions a number of land degradation patterns, including slash and burn practices to clear land for banana farming, the clearing of steep slopes without soil stabilization measures, coral reef degradation, river siltation, and decreased average flow in the major rivers.

A.4 Disaster Mitigation and Environmental Management

Dominica currently has no comprehensive strategy for hazard vulnerability reduction. Disaster vulnerability is particularly high since even simple infrastructure mitigation is extremely insufficient. There has been substantial but uneven progress in reducing hazard risk in infrastructure and buildings.

The level of hazard risk information available in Dominica is unsatisfactory. Hazard monitoring, assessment, mapping, and dissemination activities are urgently needed. At the time of the CDMP, hazard maps existed for storm surges and landslides, but were incomplete or missing for seismic, flood- and volcanic risks. In many cases, the existing information is not used (even in the case of large infrastructure investments, such as hydropower facilities, which were hit by several landslides over their lifetime (OAS, n.d.).

Some maps can be found at the website of the Dominica Banana Marketing Corporation, and the powerful effects of combining various types of knowledge by layering maps is demonstrated clearly.

In 2000, Dominica prepared a first report on its efforts in the context of the UN convention on desertification (UNCCD). In this document, the government itself mentions "it is clear that the problems of land degradation and their solutions transcend the institutional and financial capacity of traditional institutions, agencies and stakeholders." It therefore proposes a review of existing legislation and capacity, and the revitalization of the Sustainable Development Council to advise the government on strategic environmental management and sustainable development issues. It suggests that financial support, e.g. from GEF, is needed to ensure that planned activities, including land use mapping and a mass education program can be implemented.

A.5 World Bank Involvement

Country Assistance Strategy

St. Lucia and Dominica are included in the CAS for the OECS countries (prepared in 1995). This CAS recognizes the extreme vulnerability of these countries' economic performance to natural disasters. But it also focuses quite explicitly on the role of the natural environment in the vulnerability to natural hazards. For instance, it literally mentions (albeit in a box, not in the main text): "Damage from storms is made worse because of poor land use practices. The increased use of hillsides by marginal banana farmers and the felling of trees on steep grades are causing greater vulnerability to flooding and landslides. Thus, effective environmental planning will be crucial to limiting the future impacts of storms."

The section on environment also mentions these issues, as well as the risk to beaches and reefs of construction and tourism activities. It is mentioned that implementing capacity of –often recently instituted–

national environmental management units remains low, but that the OECS countries have a large and active NGO community involved in environmental issues.

For Dominica and St. Lucia, one of the major priorities for the CAS period is the restructuring of the banana industry, by broadening the economic base, raising productivity, creating the right incentive structures, and providing a safety net for displaced farmers. While addressing some of the prime poverty concerns in these countries, it would also reduce soil erosion and create opportunities for improved watershed management, thus offering excellent opportunities for co-benefits in terms of natural hazard risk reduction.

Disaster prevention and mitigation are also mentioned, alongside watershed management and waste management, as key elements of another priority issue: safeguarding the (fragile) environments of the OECS countries. It thus appears that there is great interest in and support for the development of practical steps to integrate environmental and natural resources management with natural hazard concerns, as suggested in this paper.

Finally, it should be noted that several activities in this area are coordinated with other donors and implementing agencies, notably the EU, CDB, IDB, UNDP, GEF, OAS, and a number of bilaterals. In some areas, joint programs are undertaken, in many others, close coordination is envisaged. Bank priorities could thus end up in projects to be implemented by others, and the other way around.

In St. Lucia, a watershed development project addressed some of the issues related to the effect of environmental planning on natural hazard risk. No such initiatives exist in Dominica.

Specifically for Dominica, the CAS mentions that the fiscal policies (more than 10% overruns in public expenditure) prevent a regular lending program. The Bank would however, be willing to be involved in a transition program.

Projects

Table A.2: World Bank projects in Dominica

Project name	Status June 01	Board date	Closing data	IBRD (M\$)	IDA (M\$)	Project total (M\$)
Dominica Emergency Recovery & Disaster Management	Active	Jun-09	Jan-02	0	0	6
Basic Education Reform Project	Active	Dec-95	Jun-01	3.07	3.07	7.9
Structural Adjustment Credit Project	Closed	Jun-87	Jun-92	0	3	0
Power Project	Closed	Mar-87	Dec-95	0	3	0
Road Maintenance and Rehabilitation Project	Closed	Apr-82	Jun-88	0	5	0

In 1979-80, Dominica suffered 3 hurricanes (David, Frederick and Allen) within a 12-month period. Partly in response to the damage done by these events, the Bank provided a USD 5 million credit for a Road Maintenance and Rehabilitation Project. No generic disaster prevention, nor attention to natural resources management issues, is included.

The current World Bank OECS Emergency Recovery and Disaster Management Program does contain a host of mitigation measures. The planned Dominica component consists of a variety of physical prevention and mitigation measures, strengthening national office of disaster preparedness, an early warning system, a component, for community based disaster management (focusing mostly on preparedness, but also

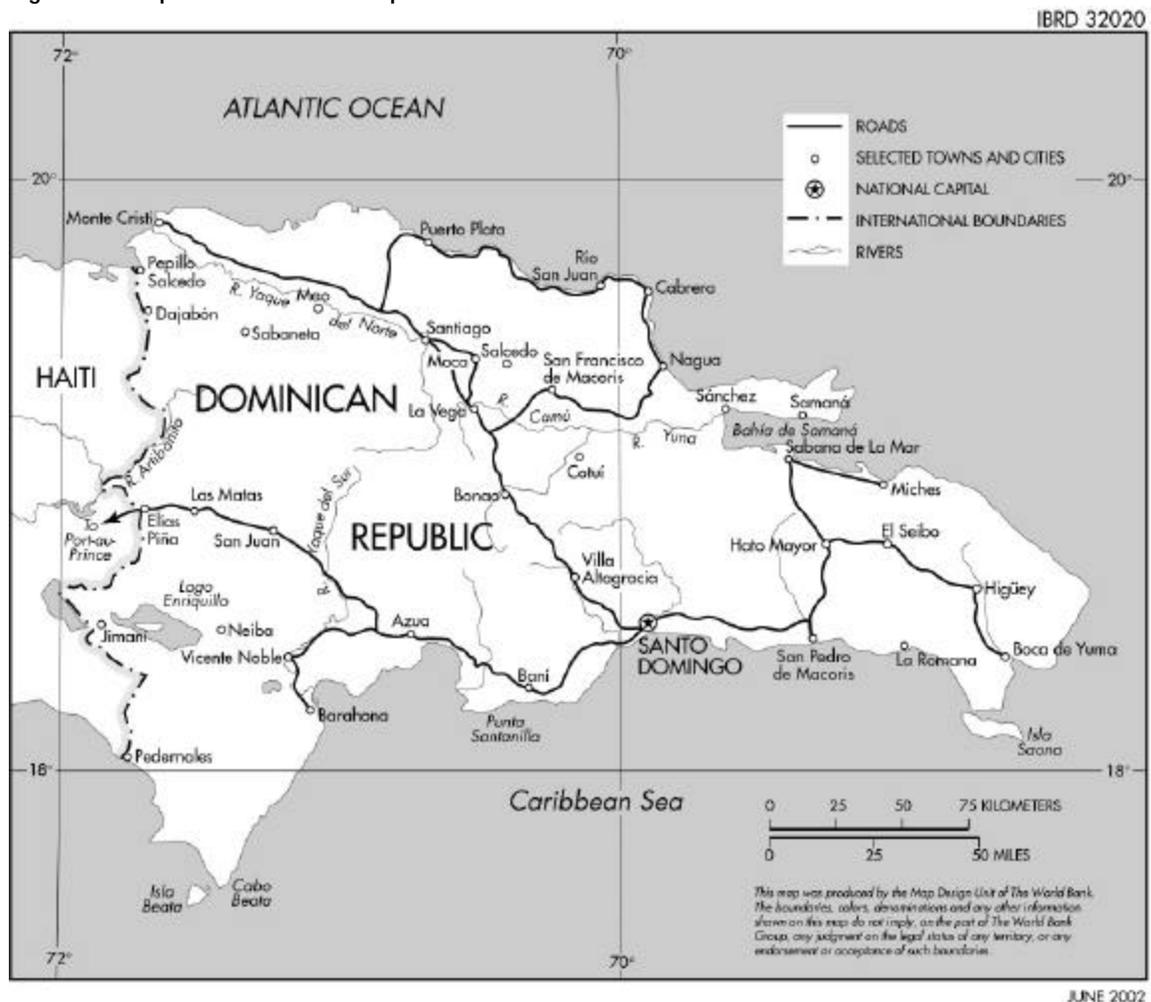
containing some community level mitigation activities, including education, local drainage and culvert work, and hazard mapping and assessment of mitigation measures to reduce loss of life and property in the next hazard event), and institutional strengthening to develop and use hazard analyses and vulnerability maps, building codes, and assessments of the vulnerability of public buildings.*

Progress so far is rather unsatisfactory, and the last components have not at all been addressed yet. A vulnerability reduction fund for community level activities is being implemented, but slower than expected.

Annex B

Dominican Republic

Figure B.1: Map of the Dominican Republic



B.1 General Background and Geography

The Dominican Republic shares the island of Hispaniola with Haiti. It is dominated by rugged highlands and mountains, interspersed with fertile valleys. It has a wide variety of microclimates and ecosystems, and the most abundant biodiversity in the Caribbean. There is a long coastline, with extensive coral reefs, supporting a booming tourist industry.

The Dominican Republic has a population of about 8.5 million people (174 per square km); GNP per capita is \$1910 (1999). 36% of the population lives in rural areas. About 11 % of GDP is earned in agriculture, which employs 17% of the population, and makes use of fairly extensive irrigation systems. About 20% of the country is so dry that irrigation is absolutely necessary for crop production. Another 15% is considered an intermediate zone where supplemental irrigation can make agriculture much more productive, but is not essential. The remaining 65% of the country is basically a wet zone, but most of it is mountainous and

unsuitable for intensive agriculture. The forest cover has been reduced from about 80% in 1900 to about 33% in 1995, and what remains is still being removed at the rate of 1.6% per year. The country has some mineral reserves; more than a quarter of electricity is generated by hydropower, and about one third of the roads is paved.

B. 2 Natural Hazards

The Dominican Republic is very disaster-prone. It lies in the middle of the hurricane belt, and is subject to severe storms. The country also suffers from torrential rains, flooding and landslides, and frequent droughts and forest fires. In addition, there is seismic activity, leading to earthquakes and an associated additional landslide risk. The main disasters from the past decades are displayed in Table B.1.

Table B.1: Major disasters in the Dominican Republic.

Source: EM-DAT: the OFDA/CRED International Disaster Database.

Year	Event	Casualties	People affected	Damage (US\$)
1930	Hurricane San Zenon	4,500	20,000	15,000,000
1946	Earthquake	73		
1963	Hurricane Flora	400		60,000,000
1964	Hurricane Cleo	7		1,000,000
1965	Forest Fire			1,000,000
1966	Hurricane Inez	74	12,942	10,000,000
1968	Drought		240,000	5,000,000
1979	Flood	32	1,000	
1979	Hurricanes David and Frederick	1,400	1,554,000	150,000,000
1980	Hurricane Allen	7		47,000,000
1981	Torrential rains and floods	20	150,000	
1983	Forest Fire			
1986	Storm, heavy rains	12	2,000	
1987	Hurricane Emily	3		23,700,000
1988	Flood		1,191,150	
1989	Hurricane Hugo			
1991	Heavy rains and floods	10		
1993	Flood	18		
1993	Heavy rains	12	22,000	
1995	Torrential rains and floods	9	2,000	
1995	Two tornadoes	2	330	
1996	Hurricane Hortense	23	15,000	
1996	Floods, tropical storm Marco	3	1,000	
1998	Hurricane Georges	288	4,515,238	2,193,400,000

The enormous impact of some of these disasters is illustrated by Hurricane Georges, which hit the Dominican Republic in 1998. It affected more than half the population, caused 288 casualties, and resulted in direct damages of the order of about 14 % of GDP. In 1979, Hurricanes David and Frederick caused devastation on a similar scale.

B.3 The Effect of Environmental Degradation on Natural Hazard Risk

Environmental degradation is a major development problem in the Dominican Republic. The major issues include deforestation, soil erosion, watershed degradation, and coastal zone degradation, as well as urban environment degradation and solid waste and water pollution.

Deforestation has a number of causes. Historically, forest clearing for cattle ranching was an important factor. In the lowlands and some other areas that are easily accessible from the big urban areas, forests are being cut down unsustainably for charcoal production. Flood and landslide risk are mostly influenced by a third category, which is most important up in the mountains. Because of declining employment opportunities due to declining agricultural outputs in the productive rural lands, landless poor are driven towards environmentally fragile mountain areas. In these areas, property rights over lands and trees remain unclear, creating open access to resources. Slash and burn agriculture leads to an unsustainable pattern of deforestation and overexploitation, accompanied by increased forest fires, and flood risk due to watershed degradation.

Studies of the on-farm cost of the effect of erosion on crop yield have indicated that soil conservation measures like diversion ditches and live barriers would have an internal rate of return of about 17% (in the circumstances of that study), too little to be attractive to the local farmers (Hernandez 1992, in Dominican Republic Environment report). Off-farm benefits may change that picture, since maintenance costs of irrigation are probably lower.

A study of the five principal hydropower dams in the country shows that unexpected sedimentation has reduced their average life to 20 years, while 50 years were planned, with costs of tens of million of dollars (Nelson 1990, in Dominican Republic Environment Report). Water resources are being threatened, and biodiversity is being lost. Last but certainly not least, inland floods are on the rise, causing damage along the rivers, and constant flood-risk in low-lying areas.

In addition, offshore systems are under threat. Changes in water runoff, often accompanied by waste and pollution from human systems, and sediment flowing into the sea damage mangroves, coral reefs, and coastal fish. Mangrove forests at the southern coast have been mostly destroyed, and those that remain are under considerable pressure. On the northern coast, tourism development, settlements, rice growing and salt production threaten the mangroves there, which are still relatively intact. In all these cases, environmental degradation causes irreversible damage to tourism and fisheries, and may lead to additional storm surge risk. We found no detailed assessments of the latter effect.

B.4 Disaster Mitigation and Environmental Management

There is an excellent World Bank report on Dominica's environmental problems. Among (many) other things, it notes that:

- The National Institute for Hydraulic Resources (INDRHI) builds and manages millions of dollars worth of dams and irrigation systems, but pays very little attention to watershed management, even though the cost of planting trees would be negligible relative to the total investment for a hydropower station.
- Public sector agencies are the worst offenders of forestry legislation.
- In general, better agricultural management is needed, including revision of policies that encourage forest clearing, and limiting open access to trees and forestry lands.

- There have been very positive experiences with donor-financed community-based watershed management projects, which provided incentives for subsistence farmers to conserve the environment and, at the same time, increase productivity. Other donor-financed activities have aimed at modernizing the forestry regulations, and establish protected areas.

One such project is USAID's Natural Resource Investment Fund Project (FIRENA), which was a very successful pilot project to stimulate soil conservation and reforestation. Landless farmers had been laid off by landowners in the lower areas suitable for agriculture, and were moving into the mountains, slashing the rainforest to create a little piece of agricultural land on steep hillsides (an ongoing phenomenon). The project addressed this issue by boosting productivity in the lower areas (amongst others by irrigation systems), thus allowing the landowners to rehire some people. At the same time, these landowners had to sacrifice some of their land. That land was then given, in small plots, to the landless farmers who had moved into the mountains, provided that they helped to reforest the areas they left behind. Such approaches, in this case addressing the underlying problems of agricultural productivity and land ownership, can also have great benefits for natural hazard risk reduction.

CDMP activities in the Caribbean included a huge community preparedness program, with over 600 communities hosting a workshop, and over 18000 community leaders having learned to recognize and address disaster risk. It also contained a large public information and training component (See CDMP progress bulletin on activities in the Dominican Republic). The CDMP worked with a local NGO, the DDMC (Dominican Disaster Mitigation Committee), made up of representatives of NGOs and private sector companies, which promotes disaster preparedness and mitigation activities in five areas: coordination and communication, community education, community initiative, and training.

B.5 World Bank Involvement

Country Assistance Strategy

The most recent CAS for the Dominican Republic dates from 1999. It notes that the rapid economic growth has not had equal benefits for all parts of the population. The worst poverty appears to occur in rural areas, particularly toward the border with Haiti. General measures might not reach those areas of worst poverty, which would require targeted attention. Local knowledge of the incidence, patterns, and causes of poverty could help to enhance the efficiency and effectiveness of required targeted interventions. A Poverty Assessment, currently underway, might shed some more light on the nature of these problems. It is noted already that core environmental problems, mainly water pollution, solid waste and natural disasters, do disproportionately affect the poor, and thus require priority attention.

The CAS notes that extensive deforestation, soil erosion, and watershed degradation threaten the agricultural sector and the welfare of the rural population, amongst others by exacerbating vulnerability to natural hazards. The best approach to alleviate these problems would be a comprehensive rural development program, addressing (i) infrastructure and social service provision (ii) land tenure issues (iii) access to credit, and (iv) natural disaster vulnerability and mitigation. Many other environmental problems are related to tourism, either because rapid tourism development harms the environment, or because environmental degradation threatens short- and long-term attractiveness of certain areas, and eventually the whole country, for tourists.

Projects

The World Bank has been actively involved in the Dominican Republic. A list of projects is presented in Box B.2.

Table B.2: World Bank projects in the Dominican Republic

Project name	Status June '01	Board date	Closing data	IBRD (M\$)	IDA (M\$)	Total (M\$)
Global Distance Learning Network Project	Active	Sep-00	Oct-05	3.43	0	3.43
Wastewater Disposal in Tourism Centers Project	Active	Apr-00	Jun-03	5	0	5
CDF Consensus Building on National Dev. Priorities	Active	Aug-99	N/A	0	0	0.4
Telecommunications Regulatory Reform Project	Active	Jul-99	Jun-04	12.3	0	21.7
Hurricane Georges Emergency Recovery Project	Active	Dec-98	Jan-02	111.1	0	125.2
DR: SOCIAL POLICY	Closed	Oct-98	N/A	0	0	0
National Environmental Policy Reform Project	Active	Mar-98	Dec-01	3	0	3.7
Provincial Health Services Project	Active	Jan-98	Jun-04	30	0	42
DR COMMUNICATIONS	Closed	Jun-97	Jul-99	0	0	0
National Highway Project	Active	Dec-96	Dec-01	75	0	122.5
Strengthening Inst. Capacity, Central Bank/Finance Secr.	Closed	Apr-96	Apr-98	0	0	0
Basic Education Development (02) Project	Active	Nov-95	Jun-03	37	0	100
Irrigated Land and Watershed Management Project	Active	May-95	Dec-03	28	0	43.3
Admin. Reform, Min. of Public Health/Social Assistance	Active	Feb-93	N/A	0	0	0
Primary Education Development Project	Closed	Jun-91	Jun-98	15	0	17
Road Rehabilitation and Maintenance Project (05)	Closed	Jun-91	Dec-98	79	0	111
Industrial Free Zone Development Project	Closed	Mar-89	Dec-96	30	0	0
Power Sector Rehabilitation and Distribution Project	Closed	Jun-88	N/A	105	0	0
Road Maintenance and Reconstruction Project (03)	Closed	Jul-85	Dec-93	35.8	0	0
Vocational Training - Education Project (04)	Closed	May-85	N/A	5.8	0	0
Itabo Coal Terminal and Power Engineering Project	Closed	Dec-83	Jun-86	3.8	0	0
Santo Domingo Municipality Technical Assistance Project	Closed	May-83	N/A	7.1	0	0
Sites and Services Project	Closed	Mar-82	N/A	25.4	0	0
Cocoa and Coffee Development Project	Closed	Jun-81	Jun-89	24	0	0
Emergency Road Reconstruction Project	Closed	Dec-79	Jun-83	25	0	0
Road Maintenance and Reconstruction Project (02)	Closed	Dec-79	N/A	35	0	0
Urgent Import Requirements for Hurricane Reconstr.	Closed	Dec-79	N/A	25	0	0
Sugar Rehabilitation Project	Closed	Sep-79	Jun-91	35	0	0
Tourism Project (02)	Closed	May-79	Dec-87	25	0	0
Nizao Irrigation Project	Closed	Jan-79	Dec-87	27	0	0
Population and Family Health Project	Closed	Sep-76	Dec-81	5	0	0
Road Maintenance and Reconstruction Project	Closed	Jul-76	Jun-80	5	0	0
Education Project (02)	Closed	Apr-75	Jun-83	8	0	0

Puerto Plata Tourism Project	Closed	Oct-74	Dec-82	21	0	0
Yaque del Norte Irrigation Project	Closed	Jan-73	Jun-81	0	13	0
Livestock Development Project	Closed	Apr-71	Jun-77	0	5	0
Education Project	Closed	Nov-70	Dec-77	0	4	0
Nickel Project – Falconbridge	Closed	Dec-69	N/A	25	0	0
Solid Waste Management in Tourism Centers Project	Pipeline	N/A	N/A	5	0	5
Power Market Development Project	Pipeline	N/A	N/A	90.6	50	149.6

Since the seventies, several World Bank post-disaster projects have been implemented in the Dominican Republic. The first ones, like the Second and Third Road Maintenance and Reconstruction project (1979-85 and 1986-93) and an Emergency Road Reconstruction Project (1979-82), were mostly aimed at infrastructure rehabilitation and maintenance, with little attention to disaster mitigation. These projects were only marginally successful. Linked to the same hurricanes, the Urgent Import Requirements for Hurricane Reconstruction Loan (1979-80) only provided financing for extra imports after hurricane, without disaster mitigation objectives.

Fortunately, recent efforts are more comprehensive. A project currently ongoing in the area of disaster management is the Hurricane Georges Emergency Recovery Project. This project, for a total amount of USD 111.11 million, was conceived in response to Hurricane Georges, which struck the Dominican Republic in September 1998 and caused 288 casualties and widespread damage (estimated at US\$ 1.3 billion, or 8% of GDP). Apart from emergency reconstruction activities, the project contains a US\$ 7.1 million disaster prevention component, which is implemented in conjunction with the IDB. The Bank's main responsibility in this context is vulnerability reduction for infrastructure, public buildings and critical facilities. As part of the IDB component of the disaster management project (financed with a US\$ 105 million dollar loan from IDB and 12 million from the government), a national disaster management plan will be developed, and attention is paid to land planning issues, environmental management (including reforestation and eco-tourism development), and water management (partly by capacity building in the water resources agency and the Met Office).

The national disaster management plan, which is currently under preparation, mentions the environmental issues underlying natural hazard risk, including general environmental degradation, deforestation and soil erosion. Population growth and poverty increase these problems, and it is the poor on marginal lands who are most vulnerable. The plan also indicates ways to address vulnerability due to environmental degradation, including land use planning, environmental management and rehabilitation, and diversification of agriculture, as well as institutional capacity building for these tasks. Implementation is not yet underway.

Beyond disaster management projects, there have been a number of other Bank projects that could affect the linkages between natural resources and environmental management and natural hazard risk reduction. Again, the projects from the seventies and eighties did little to address the problems that we observed, but more recently, a number of interesting initiatives have been undertaken that, while not addressing natural hazard risk explicitly, can be regarded as good practice examples in terms of their holistic approaches and attention for community involvement.

In the seventies and eighties, the World Bank invested heavily in irrigation and agriculture development. The Nizao Irrigation Project (\$ 27 million 1979-1984), was intended to reconstruct a 2 km stretch of a canal that was damaged by hurricanes, and to rehabilitate irrigation systems, supplemented by some on-farm development, and supporting infrastructure. The project document remarks that "The area in farms rose from 2.23 million ha in 1960 to 2.74 million ha. in 1971. Three-quarters of the increase in agricultural output for that period is attributable to the expansion of agricultural areas and one-quarter to productivity increases.

The possibilities for increasing lands in farms further however, are extremely limited in the Dominican Republic. Expanding irrigation and improving drainage and flood control in some of the coastal areas could result in small additions of agricultural land at reasonable cost, but, if the over-cultivation of marginal land and consequent erosion problems in mountain areas are not stopped, total agricultural land in the Dominican Republic could well decrease in the future. The scarcity of new agricultural land has important implications for rural development in the country, and land productivity will have to be increased in per capita food supplies are to be maintained. The best possibility for increasing productivity lies in the good lands that can be cultivated intensively, some of which are now underutilized".

It was agreed with the government that the soil conservation program in the Nizao catchment basin would be continued as a means to reduce accumulation of sediments in the Valdesia reservoir. Illegal deforestation in remote mountainous areas was at that time already contributing to erosion and sediment loads in streams and rivers. Project life is about 50 years; is it doubtful that developments in the meantime would not have increased these problems. This risk was not mentioned.

The Yaque del Norte Irrigation Project (\$13 million, 1973-79) was a similar project, which mainly aimed to increase agricultural production by providing a modern irrigation and drainage system, complemented by agrarian reform and technical assistance. This project turned out inefficient, with too little physical progress, and no increase in productivity or production in the project area. When the project was started, deforestation in the upper areas was becoming a problem, and the government was starting to address it. This issue does not come up again in the Project Completion Report, and does not seem to have received much attention in the course of the project.

The Irrigated Land and Watershed Management project (US\$28 million, 1995-2003) is an example of interesting new approaches. It aims to improve small-farmer income in a few selected areas, and to test and develop new methodologies, for nationwide replication, for efficient water management and production support services, the operation and maintenance of irrigation systems, and for sustainable and environmentally sound watershed management. The project takes a holistic approach to the problems facing a particular watershed; instead of just developing structural irrigation systems, it also addresses underlying watershed management problems, deforestation and inappropriate use of mountain slopes. The project currently does not explicitly address natural hazard risk reduction, but it is likely that it has substantial side benefits in this area. One of its components is a program where village communities that have a greed on a village management plan fro community lands and will adopt the recommended treatments will get community grants (administered by a strong local NGO) to finance seeds or planting materials and fertilizer packages. Other components include institutional development, agricultural development, including adaptive research, transfer of technology and extension to ensure that full benefits of irrigation will be reaped, and studies of technical and policy issues (including issues like land and water rights, water tariffs, and cost recovery).

Other interesting initiatives are underway in the context of a National Environmental Policy Reform Project (financed by a LIL, a flexible Learning and Innovation Loan). This project currently does not deal with natural hazard risk reduction explicitly, but many of its components address shared underlying problems. In particular, the projects aims to improve natural resources and environmental management, prepare a National Environmental Action Plan, and promote decentralization. It is recognized that issues like deforestation, water resource management and coastal zone degradation severely undermine the country's social and economic development, that there is insufficient knowledge on the degree, location, and causes of major environmental problems, that the current institutional and legal framework is fragmented and inadequate, that competition between environmental management agencies frustrates coherent reform, and that there is no consensus on priorities or solutions. The goal of this project is to ensure that the environment can be managed in such a way that it contributes to, rather than impedes, social and economic development. It has three main components: support for policy and institutional reform, capacity building, and a number of pilot activities to test the approaches envisaged. While the thrust of this project seems right

on the mark, it would miss a great opportunity by not considering natural hazard risk concerns, which could easily be integrated into the management framework if appropriate expertise and information are available.

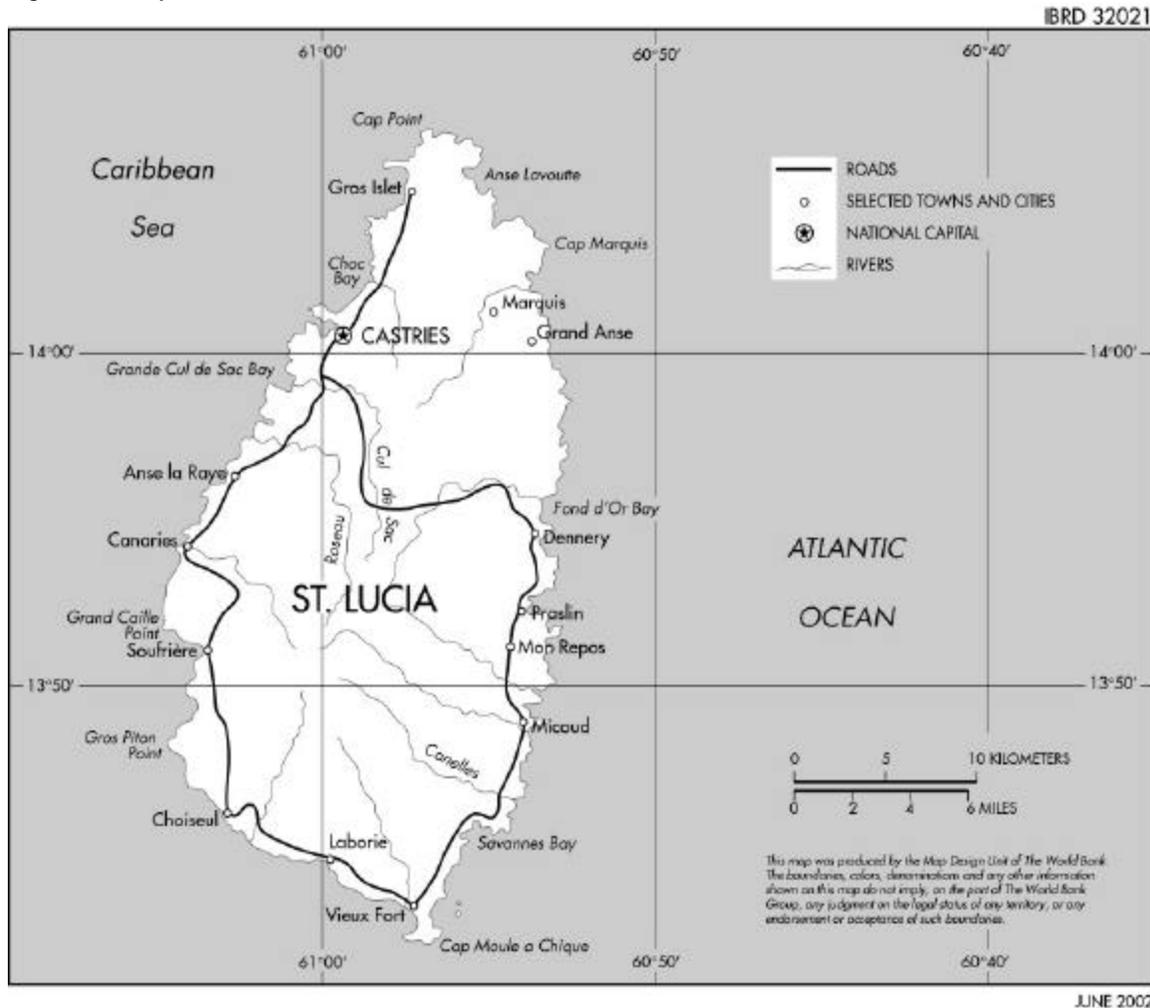
Another LIL is the Wastewater Disposal in Tourism Centers Project (initiated in 2000), which aims to find innovative ways for environmentally sound wastewater disposal, with involvement from the private sector. This will limit a number of direct environmental issues, but also address some of the short- and long-term risk to coastal ecosystems. While the latter may well help to prevent degradation of natural protective systems at the coast, this was not an explicit objective of the project.

Finally, we could mention that two studies on environmental impacts of projects, one on wastewater disposal, one on potable water supply and sanitation in tourist centers, do not refer very much to disaster mitigation. Since the projects occur at the coast and in the low-lying areas, this is not the location where mitigation can be done. However, a reduction in flood risk could have helped to reduce some of the problems related to these areas, and reforestation in the upper watershed could have been considered. The wastewater project mentions effects on marine structures; in the end that would have some effect on disasters, but that is not discussed.

Annex C

St. Lucia

Figure C.1: Map of St. Lucia



C.1 General Background and Geography

St. Lucia consists of one (620 km²) island in the eastern Caribbean. The terrain is mostly mountainous, of volcanic origin, with some broad, fertile valleys, forests, and white sand beaches. Over half the island has slopes greater than 20 degrees, and more than 70% has slopes over 10 degrees. It is faced with deforestation (still at 1.6 % per year, with only 8% of the original forest remaining) and soil erosion, particularly in the northern region. In addition, St. Lucia has lost up to 40% of its wetlands due to reclamation and physical land transformation. There has also been a dramatic reduction of beach areas due to sand mining for the construction industry.

The climate is tropical, but moderated by northeast trade winds. There are a dry and a wet season.

St. Lucia has a population of about 150,000 (about 250 per km²) and a GNP of about 3660 per capita. According to a poverty assessment for the CDB (Kairi Consultants, n.d.), about 25 % of the individuals live in poverty. 62% of the population lives in rural areas, where poverty is most pronounced.

Agriculture accounts for around 10 % of GDP and 40 % of the labor market, but is in decline, mainly because of a negative trend in banana trade (due to changes in EU import preference regime and increased competition from Latin American countries). There is hardly any irrigated land. A shift is taking place towards tourism and construction, diverse manufacturing, and the start of an offshore financial sector. St. Lucia has no hydropower and very few paved roads.

C.2 Natural Hazards

Natural hazards in St. Lucia include hurricanes and coastal storms, with impacts through floods, storm surges and strong winds. Inland floods result from heavy rains in relation to the steep topography, non-porous rock base, and thin clayey soils. In addition, there is some earthquake and (very limited) volcanic risk, as well as landslides, droughts and occasional wildfires. Tsunamis, induced by seismic events elsewhere (e.g. Mt Pele in Martinique, Soufriere in St Vincent, and the submarine Kick-em-Jenny in Grenada) could also occur.

Table C.2 presents an overview of St. Lucia's main disasters in the recent past. The main events were hurricanes, notably Allen, in 1980, and Debbie in 1994 (the latter with an estimated direct cost of \$79 million, or 18% of GDP).

Table C.1: Major disasters in St. Lucia.

Source: EM-DAT: the OFDA/CRED International Disaster Database

Year	Event	Casualties	People affected	Damage (US\$)
1960	Hurricane Abby			
1963	Hurricane Edith	10		3,465,000
1967	Tropical Storm Beulah			3,000,000
1980	Hurricane Allen	9	80,000	87,990,000
1983	Gale force winds		3,000	1,290,000
1986	Tropical Storm Danielle			
1987	Hurricane Emily			
1988	Hurricane Gilbert	45		1,000,000,000
1994	Tropical Storm Debby		750	
1996	Heavy rainfall and landslides		175	

C.3 The Effect of Environmental Degradation on Natural Hazard Risk

According to St. Lucia's National Hazard Mitigation Plan (1996) floods are increasing. One category are floods in urban areas, due to the increase in impermeable surfaces, the lack of an adequate storm water drainage system, and appropriate garbage disposal that blocks drains. Urban development has also altered or eliminated many of the older drainage ditches. Outside of heavily urbanized areas, the increase in flooding is attributed to the lack of maintenance of, and respect for, the natural guts and flood plains, and the

loss of natural vegetation. In addition, the report mentions the increasing hurricane risk due to population movements toward hillsides and high slopes, involving the removal of stabilizing vegetation.

After Debbie, the Bank financed a watershed rehabilitation project in St. Lucia. Within that project, the OAS did a hazard assessment. The impacts were certainly aggravated by deforestation and unsustainable agricultural processes, leading to sheet erosion. Consultant who did the work is Cassandra Rogers at University of the West Indies in Trinidad.

A poverty assessment for the CDB (Kairi Consultants, n.d.) notices that indiscriminate cultivation of hillsides, and as a result, severe erosion, were a major problem for sustainable environmental management in poor communities. The decline in earnings from the banana industry contributed heavily to poverty.

C.4 Disaster Mitigation and Environmental Management

In the World Bank's 1998 Caribbean Economic Overview (prepared under the auspices of the CGCED, Caribbean Group for Cooperation in Economic Development), it is mentioned that one of the main policy issues facing St. Lucia is

"Environmental Management. Development of ecotourism requires increased efforts to conserve the environment. Investments in sewage facilities, waste management, water treatment, and coastal zone protection, which are assigned the highest priority, need to be continued."

Relative to other OECS countries, St. Lucia's capacity for disaster mitigation is relatively high, partly due to the high priority that the national government has given to the issue. There is an extensive national disaster management plan, with a separate component on disaster mitigation. The latter component was only available in draft form, from 1996. While it is a very thoughtful and comprehensive document, it is unclear what happened with it since then.

At the time of the CDMP, hazard maps existed only for flood- and landslide risk, not for storm surges or other hazards.

In the 1998 Caribbean Economic Overview (prepared by the World Bank under the auspices of the CGCED, Caribbean Group for Cooperation in Economic Development), it is mentioned that one of the main policy issues facing St. Lucia is that " Environmental protection efforts need to be consolidated and expanded, especially to address the issues of deforestation and waste management".

In the World Bank's 1998 Caribbean Economic Overview (prepared under the auspices of the CGCED, Caribbean Group for Cooperation in Economic Development), it is mentioned that one of the main policy issues facing St. Lucia is

"Environmental Management. Increasing reliance on tourism will require increased efforts to conserve the environment. The importance of land use management, including slope stabilization, river training, and disaster prevention, are critical given frequent hurricanes."

A CDB poverty assessment (Kairi Consultants, n.d.) makes a number of recommendations to fight poverty. Some are at the national level, including reorganization of the tax regime, improvement of the social-safety net and improvements in the social and physical infrastructure. But the assessment also recommends the development and implementation of mechanisms for the empowerment of communities, including help for community organizations and the revitalization of a system of local government.

St. Lucia has a national hazard mitigation strategy, which explicitly aims to address all of the population: "hurricane damage to the marine and coastal community is not a phenomenon which only affects a few rich boaters who are covered by private insurance; the fishing community of St. Lucia have their livelihood affected and as such may suffer even more. It is a general pattern of hazards with significant impacts on all aspects of the marine community." It offers, amongst others, a very comprehensive assessment of natural

hazard risks, an overview of disaster legislation, and a rather thorough overview of steps to be taken to minimize disaster risk in the future. It mentions the co-benefits of certain disaster mitigation activities on conservation of the natural environment, and mentions the natural protective role of reefs, wetlands and mangroves, and the risk of over-exploitation of certain natural resources (including sand for construction, or fishing on reefs). This angle is not pursued to a very large extent. Recommendations include:

- New development should at least not increase vulnerability.
- ODP, together with the Ministry of Planning, should identify measures for hazard mitigation relating to surface and groundwater resources.
- The ODP, Ministry of Planning, Ministry of Agriculture, and Ministry of Finance should study construction and development permitting activities (coastal zone, earth change, occupancy, etc.) to determine if consolidation and streamlining of the permitting process can be combined with improved mitigation incentives. By highlighting accountability, it should be possible to combine efficiency with improved protection of vital public interests (this includes amongst others density management, including bonuses for clustering in new developments, enforcing or setbacks or buffer zones, protection of natural mitigation features)
- The Ministry of Planning should build its capacity to incorporate new hazard mapping and improved understanding of dynamic hazard processes into Coastal Zone permitting and other major permit programs.
- Cumulative hazards mapping is a priority concern for NEMO (National Emergency Management Organization). These cumulative hazards would include issues ranging from geologic studies for landslide potential, land use/sedimentation rates, to long-term impacts on coasts resulting from the deterioration of fringing reefs.

The plan should be implemented on a day-to-day basis by all government agencies, not just the Office of Disaster Preparedness (which has the primary responsibility for mitigation activities). In addition, other organizations should be involved as well, including the private sectors and NGOs (see list in appendix D).

The Mabouya Valley Integrated Land Development Project (see OAS, 1991), prepared and implemented by the OAS in the early 1980s identified and addressed a number of the concerns mentioned here. As in all of St. Lucia, and many areas of the Caribbean, the underlying cause of many rural problems was (and is) an acute scarcity of arable land, compounded by very concentrated ownership of the best lands (the project notes that according to an agricultural census in 1973/74, 92.7 percent of all farmers controlled only 24 percent of the land, and at the opposite end, about 50 percent of the cultivable land is controlled by only 0.17% of the farmers). The majority of the rural population is thus left to small plots on suitable hillsides, with the known consequences of soil erosion and watershed degradation. The problems are even more difficult because of unclear land titles, excessive fragmentation of already small land parcels, and a sizable proportion of landless farmers and squatters, and thus encroachment of forest reserves. At a national level, the OAS proposed fiscal measures to encourage better land use, financial instruments to provide access to credit to small farmers, and better regulation of land development and land registration. At a local level, interventions included consolidation of small holdings to reduce land scarcity as a constraint to small farmers, redistribution of unused or under-used land, and expansion of the rural frontier, bringing marginal lands in production in a sustainable manner, with innovative technology. These interventions were tested in a pilot project in the Mabouya Valley, applied in a nationwide land registration and tilling programme, and in the larger Mabouya Valley Development Project (MVDP). By the end of 1990, significant progress had been made in their implementation, and the project was considered an interesting and successful case study, which could be replicated in other areas in St. Lucia, the Caribbean, and other countries with similar regional development needs. While some follow-up was still ongoing in St. Lucia in the early 1990s, it is unclear to which extent these efforts have been replicated, particularly outside St. Lucia. The Mabouya Valley project still provides an excellent model for linking national and community level action, and addressing natural hazard concerns with an integrated approach to natural resources management and rural development.

The Government of St. Lucia has initiated the Northwest Coastal Conservation Project (NCCP). Its objective is to develop an integrated planning and management plan that will address current environmental and

development pressures along the coast, but also the long-term sustainability of the natural, cultural and economic coastal resources. We have not examined the project documents and do not know to what extent it explicitly addresses the linkages to natural hazards, and to what extent the development of the plan also results in concrete actions to protect mangroves and reefs.

C.5 World Bank Involvement

Country Assistance Strategy

St. Lucia shares its World Bank Country Assistance Strategy with the other OECS countries; it is discussed in section A.5 in the annex on Dominica.

Projects

Table C.2: World Bank projects in St. Lucia

Project name	Status June 01	Board date	Closing data	IBRD (M\$)	IDA (M\$)	Project total (M\$)
Poverty Reduction Fund Project	Active	Jul-99	Dec-02	1.5	1.5	5.3
St. Lucia Emergency Recovery & Disaster Management	Active	Dec-98	Jan-02	0	0	7.65
Watershed and Environmental Management Project	Closed	Jul-95	Dec-97	2.6	2.7	7.1
Basic Education Reform Project	Closed	Jan-95	Dec-00	3.36	3.3	12.8
Water Supply Project	Closed	Mar-90	Mar-97	2.5	5.2	0
Coastal/Wetland Ecosystem Conserv./Sustainable Livelihoods	Pipeline	N/A	N/A	0	0	3
Technical Assistance Water Sector Reform Project	Pipeline	N/A	N/A	1.3	1.3	8.36
Coastal/Wetland Ecosystem Conserv./Sustainable Alternatives	Closed	N/A	N/A	0	0	1

The St. Lucia component of the World Bank OECS Emergency Recovery and Disaster Management Program consists of physical prevention and mitigation works, strengthening of the office of disaster preparedness with planning, communications, and disaster equipment, strengthening the early warning system, including support for the Met Service and a local flood warning system, a community based disaster management component, providing assistance to local disaster committees, mostly for disaster preparedness, and institution building related to vulnerability reduction of public buildings, hazard analysis/vulnerability mapping, and building codes. Implementation so far is slow, but satisfactory.

From the report "A Sectoral Environmental Analysis of for the Water and Sewerage Sector of St. Lucia." "the negative environmental impacts of physical development in St. Lucia have themselves impacted negatively on WASCO's ability to provide a cheap and efficient water supply to its costumers. Therefore, it is essential that projects in the sector do not contribute to the pollution overload on St. Lucia's environment. Furthermore, the suggestion is made that there be a structure approach to community participation in Environmental Management (already proposed in St. Lucia's new Environmental Legislation). With reference to the physical planning process in the water sector, it is suggested that the EIAs for such planning include, amongst others, disaster management components, including attention to preparedness, mitigation and response. No particular attention is paid to NRM measures. It does mention however, that measures must be taken to protect the catchment area for water resources, and the quantities of water to be abstracted to be carefully managed. It mentions the use of hazard maps in planning of water structures, and the need for public consultation to find out where previous landslides, flooding and other potential disasters have taken place, and that debris from the building site may not be blocking drains and other water courses. It also mentions that mining activities should ensure that the land is rehabilitated, including its vegetative cover.

It also mentions that the Bank's Watershed and Environmental Management Project contained a comprehensive review of environmental related legislation and institutions, paying particular attention to those related to watershed management, which made recommendations for institutional rationalization and strengthening, the strengthening of the environmental legislative framework, and the further involvement of community based organizations in environmental management. According to the sectoral analysis, little if any of those recommendations has been implemented.

A Sectoral Environmental Analysis for the Water and Sewerage Sector of St. Lucia mentions the need to follow guidelines for disaster management established by the national disaster management offices. Little

reference is made to the role of the natural environment in this respect, and the possible role of the water management sector in optimizing natural hazard mitigation. However, deforestation is mentioned as the cause for high turbidity of raw water at river intakes during high rainfall, and lower flows during periods of low rainfall, making it more difficult to meet consumer demands for drinking water.

The report also mentions that "In 1995, as part of the Watershed and Environmental Management Project (WEMP), financed by the World Bank and DFID, after the passage of tropical storm Debbie consultant, financed by DFID, were engaged to prepare a strategy for the sustainable management of St. Lucia's 37 watersheds. Under that assignment, the consultants performed, inter alia, a comprehensive review of environmental related legislation and institutions, paying particular attention to those related to watershed management. In addition, a flood hazard mapping exercise was undertaken. Recommendations included institutional rationalization and strengthening, strengthening of the environmental legislative framework, and more involvement of community based organizations in environmental management. According to the Sectoral Environmental Analysis for the Water and Sewerage Sector (Nicholson Institute, n.d.) little if any of these recommendations has been implemented.

Annex D

Regional and International Institutions and Initiatives

D.1 Overview

Given the small size of many of the Caribbean nations, there have been many initiatives and institutions at the regional level. A full review of all regional activities, and their successes and failures is beyond the scope of this paper. Instead, we have made a cursory exploration of some of the most relevant initiatives, and in particular, identified any components related to the management of the linkages between natural hazards and the natural environment (for further information, we refer to these organizations' websites, listed at the back of this paper).

The small English-speaking island states of Dominica and St. Lucia are members of both the Organization of Eastern Caribbean States (OECS), and of the Caribbean Community (CARICOM). From that angle, they participate in a number of institutions and initiatives, including CDERA, CPACC, and MACC.

The Dominican Republic is of course much larger, and Spanish speaking. Therefore, it has different needs and networks than the small eastern Caribbean islands, and does not participate in many of the institutions and initiatives they are involved in. Nevertheless, there are some overlapping initiatives that cover both the Dominican Republic and the Eastern Caribbean, most notably the Caribbean Disaster Management Project (CDMP) of the Organization of American States.

Based on the information that we found in this casual overview, we conclude that many initiatives have been undertaken and initiatives exist. They have certainly provided added value, and this angle could be explored more. At the same time, additional institutions and initiatives must be planned in such a way that they really have added value over existing ones, address their shortcomings, and/or be integrated with them. In addition, they must fit the interests, capacities, and activities of the national governments. An institutional review to provide some insights into how this could best be done is currently underway in the context of preparations for a World Bank Caribbean disaster management strategy.

D.2 Regional Institutions

CCCC

As an outcome of CPACC and a part of MACC (see below), a regional Caribbean Climate Change Center is planned. This center, which is not yet operational, should provide the national governments with the knowledge and capacity to effectively plan for changes related to global climate change.

CDERA

The Caribbean Disaster Emergency Response Agency (CDERA) is the main agency with a regional disaster mandate. It is an intergovernmental regional disaster management organization established in 1991 by the Caribbean Community (CARICOM), thus including Dominica and St. Lucia, but not the Dominican Republic. Its headquarters are in Barbados.

CDERA's main function is to make, upon request, an immediate and coordinated response to any disastrous event affecting any of its members. It also deals with information dissemination, mitigation of disaster impacts, establishing and maintaining adequate disaster response capability among its members, and mobilizing and coordinating disaster relief from governmental and non-governmental organizations.

In reality, CDERA does not have the means to fulfill all these functions effectively, and seems to have lost some support from its member countries.

While it may not entirely fulfill the role of regional disaster management agency, CDERA has been involved in many partnerships for projects and studies in this area, amongst other with UNDP, FAO, PAHO, the EU, USAID, DFID, and various other governments, notably Japan. Together with DIPECHO (see below), CDERA is running a disaster preparedness program. UNDP and USAID are supporting CDERA to establish an effective framework for comprehensive disaster management (CDM) in the region. As part of this exercise, a regional comprehensive disaster management strategy will be developed, in which disaster mitigation is fully integrated into development planning processes, involving both public and private sector, non-governmental and service organizations, urban and rural communities, and the general population living in disaster-prone areas. The intention is that the separate governments will also be implementing those principles in their own disaster mitigation efforts. Aside from the USAID/UNDP support, substantial human resources will be put into this initiative by CDERA itself and the governments.

The linkages between natural hazards and the natural environment have not received prime attention in CDERA's activities, but its information does mention them. In conjunction with FAO, CDERA has worked on hurricane disaster preparedness and impact mitigation strategies related to agriculture, forestry and fisheries, including a review of information management in those sectors, sectoral hurricane preparedness and mitigation action plans, and public education and awareness.

CIMH

The Caribbean Institute for Meteorology and Hydrology, located in Barbados, is the regional training and research organization for meteorology and hydrology, to improve the region's meteorological and hydrological services and raise awareness about their benefits. Its primary functions are training, research, contracting and consultancy, a service for upkeep, repair and calibration of meteorological instruments, advice to participating governments, and data collection, analysis, and publication. While potentially important for disaster management purposes, the institute has few connections to the NRM angle.

D.3 Regional Projects and Programs

CDMP

CDMP, the Caribbean Disaster Management Project, started in 1993, and is probably the largest regional effort at comprehensive disaster management to date. Funded by USAID, and implemented by the OAS, its primary objective was the adoption of disaster mitigation and preparedness techniques, technologies, and practices by the public and private sectors in targeted communities. Its approach was based on pilots in a few countries, followed by visits and workshops to share information, and attempts to replicate and adapt successful pilots, or lessons from them, in other countries. This approach worked well. The most successful parts dealt with training, information sharing, mitigation policy and planning, involvement of the private sector, and community preparedness and prevention.

One of the conclusions of the CDMP is that community-based activities should be a major emphasis of future disaster mitigation programs. In particular in the Dominican Republic, these components were most successful. Another component that was deemed likely to be sustained on its own after the end of the CDMP was policy work on mitigation in St. Lucia. While the CDMP itself was quite successful, it observed major bottlenecks in the general implementation of disaster mitigation in the region, most notably the weakness of government institutions and organizations, and the lack of donor coordination. The project confirmed that the private sector can be a valuable part of disaster mitigation efforts, but that effective government guidelines and coordination would make such involvement much more effective.

After its formal end in 1999, the CDMP results remain on the website, which still contains a wealth of very valuable information. A follow-up effort building on the CDMP is underway in Antigua and St Kitts and Nevis,

including the production of comprehensive hazard maps for droughts, inland floods, storm surges, coastal erosion, wind hazards and volcanic hazards.

CPACC/MACC

CPACC (Caribbean: Planning for Adaptation to Global Climate Change) is implemented by the OAS, and financed by the GEF (through the World Bank). Its overall purpose is to support Caribbean countries in preparing to cope with the adverse effects of global climate change, particularly sea level rise, on coastal areas through vulnerability assessment, adaptation planning, and capacity building. It follows a regional approach, being executed through the cooperative effort of all twelve participating countries (members of CARICOM), the University of the West Indies Centre for Environment and Development, and several regional institutions through a combination of national pilot/demonstration actions and regional training and technology transfer. The approach seeks to strengthen regional cooperation and institutions and provide cost-effective means for adaptation planning, data collection, and sharing of information, skills, and project benefits.

CPACC has nine components (not all implemented in all of the countries): (1) Design and Establishment of Sea Level/Climate Monitoring Network Page (2) Establishment of Databases and Information Systems Page (3) Inventory of Coastal Resources and Use Page (4) Formulation of a Policy Framework for Integrated (Adaptation) Planning and Management Page (5) Coral Reef Monitoring for Climate Change Page (6) Coastal Vulnerability and Risk Assessment (7) Economic Valuation of Coastal and Marine Resources (8) Economic and Regulatory Proposals and (9) Enabling the preparation of national Communication in Response to Commitments to the UNFCCC.

CPACC has met most of its objectives (see the CPACC website for details); a follow-up exercise (MACC) is currently being planned, which aims to mainstream climate change concerns in these countries into their regular policies and activities. As part of MACC, a Caribbean Climate Change Center (CCCC) will be established to sustain the efforts and create a regional center of expertise on issues related to global climate change.

PCDPPP

The Pan Caribbean Disaster Preparedness and Prevention Project (PCDPPP), which started in 1981 and ended in 1991, was the first regional effort to improve national and regional disaster management. It was a joint project of UNDRO (the United Nations Disaster Relief Organization), CARICOM, PAHO/WHO, and the Red Cross. It was also supported by USAID, Canada, the UK, and the EU. Its original acronym was PCDPP; the third P was added when Prevention was added to its mandate. Amongst its accomplishments was the establishment of a number of central government disaster management organizations. Recognizing the need to institutionalize the work, CDERA was established (see above).

D.4 International Organizations and Donors

Many international organizations and donors are involved in disaster management in the Caribbean. Naturally, they tend to take a more regional look at these problems than the nations themselves, and have thus initiated many regional initiatives, including some of the projects and institutions mentioned above.

Bilateral donors

Many bilateral donors have been and are actively involved in disaster management activities in the Caribbean, notably the Americans (USAID), British (DFID), Japan, the Canadians (CIDA), French, and Dutch. USAID has supported many disaster management activities in the Caribbean, most notably the OAS-implemented CDMP (see below)

CDB

The Caribbean Development Bank is actively involved in a variety of sectors in Dominica and St. Lucia (the Dominican Republic is not a member country. It often works together with the World Bank (and acts with World Bank lines of credit).

ECLAC

The UN Economic Commission for Latin America and the Caribbean (ECLAC) has interesting information on vulnerability to natural hazards.

EU DIPECHO

DIPECHO coordinates the disaster management activities of the European Community Humanitarian Office (ECHO). In the Caribbean, there are a number of projects, mostly in cooperation with other agencies, including PAHO, the Red Cross/IFRC, regional and national institutes like CDERA and UWI, but also with local NGOs.

FAO

Has extensive experience with sustainable agriculture practices, amongst others in context of SIDS (see website). Interesting policy work: A new Framework for Conservation-effective Land Management and Desertification Control in Latin America and the Caribbean. The concept is that soil erosion can only be controlled by new land management practices that convincingly increase production or decrease costs or labor to the benefit of the land user, whilst simultaneously controlling land erosion ("soil conservation by stealth").

IDB

The Interamerican Development Bank is a major lender to the Dominican Republic (Dominica and St. Lucia are not member countries). In the Dominican Republic, its commitments are about twice those of the World Bank.

Recognizing the great impacts of natural hazards on the economies in this region, and the need to prevent disasters, rather than just respond to them, the IDB has been quite involved in disaster management activities. On a generic level, the IDB has developed an Action Plan on "Facing the Challenge of Natural Disasters in Latin America and the Caribbean", highlighting a number of important lessons in disaster prevention. Currently, the IDB is implementing, amongst others, a host of mitigation measures in the Dominican Republic, in the context of post-Georges reconstruction, and in close coordination with the World Bank.

OAS

The Organization of American States has been involved in disaster management and mitigation in the Caribbean, including the OECS countries as well as the Dominican Republic, for a very long time, and has a wealth of expertise. It often serves as the implementing agency for regional disaster management projects funded by other donors (e.g. CDMP, CPACC, MACC).

PAHO

The Pan American Health Organization has traditionally been quite involved in disaster management and prevention. Its focus on health means that little attention has been paid to interactions with the natural environment, and more on disaster preparedness and response.

IFRC

The International Federation of Red Cross and Red Crescent Societies (Red Cross) has always been very active in disaster response, and is more and more taking on preparedness and even mitigation as well. One of its strengths is the high level of local organization, with many Red Cross committees at the local level. Some community level preparedness initiatives now also cover disaster mitigation, including sustainable natural resource use.

UNEP

Useful information about small island states and the environmental challenges they face is collected at the UNEP small islands website (see web sources). UNEP's Caribbean Environment Program promotes regional co-operation for the protection and development of the marine environment of the Wider Caribbean Region. It contains some information about the impact of development (including settlement, tourism, fisheries, pollution, inland land use changes) on coastal zones, and the role of the natural coastal structures (including reefs, mangroves, and beaches) in protecting against storm surges. It stresses the importance of inland land use changes on the coastal environment, particularly through sedimentation. It also contains information on the major conventions dealing with these issues, in the Caribbean and globally. The UNEP CEP projects do not yet explicitly aim to address natural hazard risk, but it is likely that they are indeed contributing to the sustainability of natural coastal protection against storm surges.

World Bank

Traditionally, the World Bank has been involved in many post-disaster reconstruction projects, to ensure that economic activity can recover as quickly as possible. This is reflected for instance in the Bank's work in the Dominican Republic, particularly throughout the seventies and eighties (see the Table B.2), which contains several road maintenance and rehabilitation or reconstruction projects, usually initiated after a major disaster. In recent years, the attention to disaster prevention and mitigation has grown, and such components are important aspects of more recent post-disaster recovery projects. The World Bank is currently running a regional emergency recovery and emergency management project for the OECS countries. Unfortunately, its way of working requires all loan components to be agreed upon with each individual country government, so that in practice, the regional components are rather limited.

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- Stephen Stichter, Environmental Specialist, amongst others former manager of CDMP (Caribbean Disaster Management Project)

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