

The Economics of Disaster Mitigation in the Caribbean

Quantifying the Benefits and Costs of
Mitigating Natural Hazard Losses

La Economía de la Mitigación de Desastres en el Caribe

Resumen Ejecutivo Disponible en Español

WORKING PAPER



**Inter-American
Development Bank**



**International
Monetary Fund**



**Organization of
American States**



The World Bank

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Mitigating Natural Hazard Losses

Lessons Learned from the 2004 Hurricane Season

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**Inter-American Development Bank (IDB)
International Monetary Fund (IMF)
Organization of American States (OAS)
The World Bank**

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ACRONYMS

CAPRADE	Comité Andino para la Prevención y Atención de Desastres
CARICOM	Caribbean Community and Common Market
CEPREDENAC	Centro de Coordinación para la prevención de los Desastres Naturales en América Central
CDB	Caribbean Development Bank
CDERA	Caribbean Disaster Emergency Response Agency
CDM	Caribbean Strategy on Comprehensive Disaster Management
CDMP	Caribbean Disaster Mitigation Project
CHAMP	Caribbean hazard Mitigation Capacity building Program
CHS	Committee on Hemispheric Security – OAS
CIDA	Canadian International Development Agency
CRED	Center for Research on the Epidemiology of Disasters
DDI	Disaster Deficit Index
DRI	Disaster Risk Index
ECLAC	Economic Commission for Latin America and the Caribbean
ECCU	East Caribbean Currency Union
EIA	Environmental Impact Assessment
EM-DAT	Emergency Disaster Database
FONDEN	Fondo Nacional de Desastres Nacionales (México)
GDP	Gross Domestic Product
GFDL	Geophysical Fluid Dynamics Laboratory
GIS	Geographical Information Services
IASP	Inter-American Strategy for Policy on Vulnerability Reduction, Risk Management, and Disaster Response
IDB	Inter-American Development Bank
IDEA	Americas Programme of Instituto de Estudios Ambientales
IFIs	International Financial Institutions
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
ISDR	United Nations International Strategy for Disaster Reduction

LAC	Latin America and Caribbean
LDI	Local Disaster Index
NASA	National Aeronautics and Space Administration (USA)
NGO	Non Governmental Organization
NHVI	Natural Hazard Vulnerability Indicator
NOAA	National Oceanic and Atmospheric Administration (USA)
OAS	Organization of American States
OECD	Organization for Economic Co-operation and Development
OFDA	Office of U. S. Foreign Disaster Assistance – USAID
OSDE	Office for Sustainable Development and Environment
OVE	IDB Office of Evaluation and Oversight
PCDPPP	Pan Caribbean Disaster Prevention and Planning Program
PVI	Prevalent Vulnerability Index
PVO	Private Voluntary Organization
RHA	Región Huetar Atlántica
RMI	Risk Management Index
SIDS	Small Island Developing States
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
UTSIG	Unité de Télédétection et de Systèmes d'Information Géographique - Geographic Information System Processing Unit
VCA	Vulnerability and Capacity Assessment
WB	World Bank

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PREFACE

Following the devastating hurricanes Gilbert and Hugo, the international community began to realize the importance of identifying vulnerability and risk to natural hazards, specifically in the hurricane-prone Caribbean region. In 1993, the Organization of American States (OAS), in association with the United States Agency for International Development (USAID), embarked on a six-year, US\$5 million program designed to (i) assist countries in the region to overcome the lack of data on hazard vulnerability, (ii) include the private sector in hazard assessment and (iii) develop a more integrated approach to risk management for the region as a whole.

In 2004, five years after the completion of the OAS/USAID program, the region was subjected to one of the worst hurricane seasons in its history in terms of the number and severity of storms. Over 90% of the housing stock and infrastructure in Grenada was damaged or destroyed. Over 2,000 people lost their lives in Haiti. The Southern coasts of Jamaica and the islands of the Bahamas were also badly hit. In addition, several other islands sustained lesser but nevertheless significant damage to buildings and infrastructure. In response to such devastation, the international community has again been struggling with numerous questions and complex problems left in the wake of such catastrophic events. On February 7, 2005, the Jamaican Ambassador, H.E. Gordon V. Shirley, Chairman of the Ad Hoc Working Group on Natural Disaster Reduction of the OAS, called a meeting to discuss the preparation of a study on the cost-benefit relationship between disaster mitigation expenditures and avoiding loss in the Caribbean countries.

In that meeting the Ambassador presented an overview of the recent institutional, economic and social impacts of natural hazard events in the Caribbean region. The issues addressed included: (i) the lack of focused efforts regarding risk identification, mitigation and risk transfer; (ii) recovery funds; (iii) capacity building through mitigation and (iv) roles for the Caribbean leaders and multilateral institutions. He highlighted, in particular, the fact that development is limited by the need to reprogram loan funds to facilitate recovery efforts and the need for consideration of mitigation in terms of costs and benefits.

The Ambassador suggested the creation of a working group to include the International Monetary Fund (IMF), Inter-American Development Bank (IDB), World Bank and the OAS that would put together a paper promoting the benefit of investing in mitigation in the context of the damages suffered by four countries (Bahamas, Grenada, Haiti and Jamaica) due to the impact of Hurricane Ivan.

Each of the participating institutions brings to the working group a unique set of experiences and knowledge related to their work with the countries in the hemisphere in dealing with natural disasters and the associated risks. The IMF recognizes the impact of natural hazards in the region but has limited expertise in the area. Its primary focus is public policy that promotes macroeconomic stability and fosters economic incentives for disaster mitigation given the behavior of countries, donors and International Financial Institutions (IFIs) in the past. It is interested in disaster reconstruction through donations and concessional loans that do not jeopardize long-term fiscal sustainability. The World Bank has worked with the OAS and the Caribbean Community and Common Market (CARICOM) on catastrophic insurance

mechanisms, and will be undertaking a major review of hazards/vulnerability by sector in the region. World Bank finance experts are raising the issue of repetitive losses. The IDB includes proactive disaster risk management in country programming, identifies disaster risk in project cycle and analyzes potential project-induced risks due to natural hazards. Its Disaster Action Plan was approved in March 2005 for funds to mainstream disaster risk management. Its efforts to examine disaster management issues are decentralized, with focal points related to the issue throughout the individual departments and country offices. The OAS has supported member states, IFIs and regionally specialized agencies on natural hazard risk management for over 20 years dealing with mitigation strategy definition and implementation, risk and vulnerability. It recognizes the past political constraints, the opportunity presented by post-disaster situations and the offer of political leadership to engage country representatives.

In determining what form the joint effort should take, there was a consensus among the working group that, in order to take advantage of upcoming high level hemispheric political and sector meetings, the paper should be of a policy nature. While it is true that the issues addressed in this policy paper are pertinent to the Caribbean, it needs to be emphasized that this is not meant to be a comprehensive overview of all subregions or all hazards in the hemisphere. The Caribbean is vulnerable to hazards other than hurricanes. Earthquakes, among other hazards, also threaten the region but were not within the scope of this project. The general goal of this paper, as directed by the Committee on Hemispheric Security (CHS), is to focus discussion on the small island developing states (SIDS).

INTRODUCTION

The 2005 Atlantic hurricane season has begun as the busiest ever recorded. By mid-July 2005, hurricanes Arlene, Bret, Cindy, Dennis and Emily killed more than 150 people, destroyed almost 30,000 homes and caused over US\$45 billion in damages. For countries like Grenada, Haiti and others, still staggering from hurricanes Jean and Ivan of 2004, the implications of the 2005 hurricanes are alarming. For example, only a part of the 90 percent of entire housing stock and infrastructure damaged or destroyed in 2004 in Grenada had been repaired before the start of the 2005 season. The recent damages will obviously make reconstruction efforts there and elsewhere all the more difficult.

The start of the 2005 hurricane season reinforces the widely held view that the frequency and severity of hurricanes in the region are increasing. So too is the rise in human and economic losses. For example, the financial cost of natural disasters in the Latin American and Caribbean region overall has risen from US\$700 million per annum two decades ago, to more than US\$3.3 billion per annum. This mirrors a global trend. The Germany-based insurance company Munich Re estimates that the annual cost of natural disasters worldwide has climbed from US\$75.5 billion during the decade of the 1960s, to US\$659.9 billion during the 1990s. Munich Re recently concluded that 2004 was the most expensive natural catastrophe year in insurance history. The economic losses in 2004 were US\$145 billion. Many insurance companies have concluded that these economic losses will increase, due to the combined risks of climate change and the rapid expansion of mega-cities, particularly in developing countries.¹ Consequently, the impact of natural disasters on the Caribbean economy cannot be exaggerated. As noted by a minister of economy from one of the Caribbean islands, the two greatest impacts on the Caribbean economy are natural disasters and oil prices.

The disastrous 2004 hurricane season left the regional and international policy communities with numerous questions. Among them:

- *What are the macro-economic consequences of investing in ex-ante mitigation as compared with ex-post reconstruction and rehabilitation?*
- *What could be the likely macro-economic implications from a similarly intense hurricane season in the future, and is additional indebtedness viable given the present situation?*
- *What is the current state of disaster management capabilities in the region related to 1) public and private sector effectiveness in natural hazard mitigation conditioned by cost and by the ability to govern, and 2) collaboration of the private sector where the public sector will not act?*
- *How do policy makers use the available natural hazard information, including international hazard indexing schemes for long term risk management, and what are the lessons learned from the donor community's experience in natural hazards risk management related to socio-economic and financial burdens immediately before, during and after natural hazard events?*

¹ Munich Re, 2005, Topics Geo 2004.

As indicated by the growing number of hazard-related casualties and economic costs, it is evident that a change in the approach to disaster risk management is necessary. Relying primarily on disaster response is costly both in the short and long-term.

This document seeks to provide at least partial answers to these questions in light of their significance to the peoples and economies of the region and to their future development. It seeks to identify the costs and benefits of investment in mitigation in a manner that incorporates the effect on the development and growth potential of the countries and to communicate these to policy makers in the region at a time when they are pre-disposed to receive such information.

This document is a collaborative effort among the Inter-American Development Bank (IDB), the International Monetary Fund (IMF), the Organization of American States (OAS) and the World Bank (WB). The project was coordinated by the Ad Hoc Working Group on Natural Disaster Reduction of the OAS under the leadership of its chairman, the Permanent Representative of the Government of Jamaica. It represents what will be, hopefully, the beginning of a continuing discussion at a policy level of the major international development assistance organizations in the hemisphere on specific actions to be taken for investing in mitigating the impact of natural hazard events in the context of economic development.

NATURAL HAZARDS AND NATURAL DISASTERS IN THE CARIBBEAN

During the past century the region has experienced over 150 natural “disasters”, more than 130 of which were associated with hurricanes, tropical storms and flooding². It should be noted that extreme natural events do not constitute “*disasters*.” A natural “disaster” is defined not by the occurrence of an event, but by its impact. Were the infrastructure and the housing stock of the Caribbean designed to better cope with the impact of the frequently occurring, if not predictable, natural events, they would not constitute disasters nor generate the need for external assistance.

An important factor distinguishing “developed” from “developing” countries is the extent to which the former have developed the capacity to “mitigate” the impact of natural events. While less developed countries have tended to focus almost exclusively on emergency response and reconstruction, more developed countries have typically seen the need to complement traditional emergency management with actions that emphasize mitigation and other forms of risk management. The process by which a country learns to minimize the impact of natural hazard events is developed incrementally over time. Like other learning processes, the rate of improvement can be accelerated by taking advantage of the know-how and best practice techniques developed elsewhere and by adapting the methods of those more advanced in the field.

Today, it is technically possible to design economic and social infrastructure to withstand the effects of tropical storms, hurricanes, floods and all but the severest of earthquakes. If not available or accessible within the region, the technical expertise exists internationally. More developed countries have designed their housing stock and infrastructure to more effectively withstand the effects of extreme natural events. Over the past three decades, while the number of extreme natural events encountered by developed and developing countries has roughly been the

² More than half of the expected rainfall in Caribbean countries comes from severe weather events.

same, three-quarters of the disasters and 99% of the human casualties have been in developing countries (Rasmussen, 2004). In the Caribbean region this has meant an increase in economic losses and donor fatigue.

DISASTER MANAGEMENT IN THE CARIBBEAN BEFORE 1990

In the Caribbean, the capacity to respond to natural disasters has been evolving, benefiting from a transfer of information and know-how from more developed countries, and from strategic capacity building at the regional level, financed by bilateral and multilateral donors.

In spite of an extended pattern of natural events, disaster management practices in the Caribbean had, prior to 1990, focused principally on preparedness, response and reconstruction. The passage of hurricanes Hugo and Gilbert in the late 1980's served as a turning point and had the effect of focusing the attention of the policy makers in the Caribbean and the international community on the importance of investing in improving the capacity of the countries in the region to mitigate the effects of these events.

At the time several shortcomings were identified. Among the more important were the following:

- *Growing risk management issues including an assessment of the extent of vulnerability particularly to high impact, low probability events, an over emphasis on public sector participation and inadequate involvement of the private sector, and an absence of integrated strategies for risk management.*
- *An inadequate understanding of the long term macro-economic consequences of reprogramming resources away from development projects, and of additional "borrowing" to finance reconstruction.*
- *An inadequate understanding of the long term macro-economic consequences of the financial burdens as a result of natural disasters, the market failure of the insurance industry, lack of progress in introducing risk pooling, and the absence of contingency fund arrangements in concert with the international financial institutions*

While there has been a general awareness of areas and communities that were prone to flooding in each of the countries, prior to 1990 there were few scientific studies undertaken to identify the magnitude of extreme weather events and possible return periods. In the absence of this type of information, and in the face of strong competition in the land market, many marginal areas were developed as either housing or industrial sites. Lessons from more developed countries have reinforced the importance of technical studies aimed at pinpointing risk-prone areas and for disseminating reliable information in respect of these areas to the public and to technical agencies in order to guide development away from them and toward safer locations. In these countries, this type of information has been essential to the development of tools used by the insurance industry to assess catastrophic risks based on location and overall exposure.

Prior to 1990, Caribbean disaster management efforts were centered in the public sector. While public-sector capacity is clearly essential to effective disaster management and has yielded significant results, there are inherent limitations when this is to the exclusion of the private sector. In general, the public sector in many Caribbean nations is both understaffed and under-

funded. This inhibits the ability to design and enforce natural hazard mitigation measures such as building codes and land-use zoning – two examples of governance issues. In the Caribbean, as in other developing regions, the public sector has characteristically been reluctant to invest scarce resources in measures designed to mitigate the impacts of infrequent natural hazards with very long and uncertain return periods.

The fact that disaster-management efforts were not integrated in the development planning processes in most Caribbean islands can be attributed to the lack of an integrated institutional framework and the traditional sectoral fragmentation of development planning and investment. From an institutional perspective, the bureaucratic impediments to communicating across agency lines, to the sharing of data and to cooperating in the use of scarce resources in the countries of the region have presented significant obstacles to an integrated approach to development in the region.

In the event of a natural disaster, the pattern in the Caribbean has been for the recovery and reconstruction activities to be funded principally by diverting resources that were previously earmarked for development projects to relief measures. Characteristically, this has negatively affected external balances, increased indebtedness and retarded economic and social development.

THE PROGRESS SINCE 1990

In the late 1980s, key bilateral and international donors collaborated in the establishment of the Pan Caribbean Disaster Prevention and Planning Program (PCDPPP). This project was the first in the region that put disaster mitigation on the agendas of national disaster offices. Following the devastation from hurricanes Gilbert and Hugo, major programs were undertaken, beginning with the OAS and United States Agency for International Development (USAID) Caribbean Disaster Mitigation Project (CDMP) in 1993, followed by programs of the Caribbean Disaster Emergency Response Agency (CDERA), Caribbean Development Bank (CDB), and other bilateral donors, aimed at assisting the countries with:

- Overcoming the lack of data on hazard vulnerability,
- Mobilizing the support of the private sector in hazard assessment, and
- Developing a more integrated approach to risk management.

In addition, a growing number of multinational and local private sector firms have begun to realize that many areas in their enterprises were exposed to risk from natural hazards and have therefore begun to design disaster prevention and recovery plans. In the public sector, the creation of a Disaster Mitigation Facility for the Caribbean at the CDB and the promotion of the Caribbean Strategy on Comprehensive Disaster Management (CDM) by CDERA concentrate on mainstreaming disaster risk management into national development planning, and building capacity in regional and national institutions.

In September, 1998, Hurricane Georges struck St. Kitts & Nevis, resulting in loss of human life, destruction of over 50 percent of the country's sugar crop, destruction or serious damage to 85 percent of the housing stock, and critical impairment of its main hospital. Additionally, the severe damage or destruction of harbor facilities, hotels, and airports impacted tourism, which,

combined with the sugar industry, accounted for 68 percent of total exports of good and non-factor services. As a response to this, in December 1998, the World Bank approved two credits and three loans totaling US\$19.08 million for the Commonwealth of Dominica, St. Kitts & Nevis, and St. Lucia in support of the first phase of the Organization of Eastern Caribbean States' (OECS) Emergency Recovery and Disaster Management Program. The program consists of individual lending operations in five countries phased over approximately six years and supports physical investments, capacity building, institutional strengthening, and community preparedness. The OECS disaster management program aims to: (i) protect and strengthen key social and economic infrastructure before disasters strike so as to reduce the likelihood of loss of life and assets; (ii) strengthen the capacity of national emergency management agencies to enable them to perform more effectively; (iii) increase the ability and interest of the private insurance industry to share disaster-related risks and to improve and support the enforcement of building codes and sound land-use planning and; (iv) organize, train, and equip community-level disaster committees to enhance their role in disaster preparedness and recovery. The program provided additional assistance to the national emergency management agencies (or their equivalent) to assist them in preparing for and managing emergency situations³.

Since 2002, the Caribbean Hazard Mitigation Capacity Building Program (CHAMP) – a Canadian International Development Agency (CIDA) funded project, implemented by CDERA with support from the OAS – has been assisting countries in the region with the development of national-hazard mitigation policies, creation of appropriate policy implementation programs through a comprehensive hazard mitigation planning framework and the development and implementation of safer building training and certificate programs.

At present it is recognized that:

- The countries cannot afford to not invest in mitigation given the relationship of natural disaster losses to all aspects of the economy.
- National governments must take the lead in natural hazard risk management,
- International financial assistance is essential to overcome vulnerability,
- The countries must break the cycle of lurching from one natural disaster-induced crisis to the next,
- There are limits to which the countries can scale up to avoid damage, and

This evolution toward investment in mitigation by the countries in the Caribbean, and the actions taken by countries in other regions of the hemisphere, is reflected in the commitment by the OAS member states in 2003⁴ to further the Inter-American Strategy for Policy on Vulnerability Reduction, Risk Management, and Disaster Response (IASP).

³ The World Bank. December 1998. World Bank Finances Emergency Recovery and Disaster Management Program for the Caribbean.

<http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/LACEXT/OECSEXTN/0,,contentMDK:20014812~menuPK:339314~pagePK:141137~piPK:141127~theSitePK:339287,00.html>

⁴ OAS CP/doc. 3737/03.

ORGANIZATION OF THE DOCUMENT

This document reviews investment in mitigation and options for implementation in the Caribbean in 2005, with an emphasis on quantifying the cost and benefits of expanding the region's effort to implement mitigation techniques. The implicit question which is addressed is *“What is required to implement an effective disaster mitigation programme in the Caribbean?”* and, specifically, *“What is required to bring the Caribbean to a state where its buildings and infrastructure are effectively able to withstand the effects of the extreme natural events that are common in the region without disaster conditions being experienced, and what are the economic costs associated with this attainment?”*

The discussion of this question is organized into five chapters presented by the collaborating institutions and a concluding chapter on the way forward.

The first chapter was prepared by the IMF and discusses the macroeconomic consequences of disasters in the Caribbean and their implications for economic policies. The key findings are:

- Natural disasters are likely to be more common, as a consequence of natural hazard events. Their impact in the region cannot be exaggerated because of the inherent exposure of the countries to hurricanes and other events exacerbated by their heavy dependency on tourism and commodity exports;
- The impact of natural disasters is particularly devastating to the poorest countries and low income households;
- Government policy can play an important role in mitigating the impact of natural hazard events through prudent fiscal stimuli within the overall fiscal constraints, the implementation of precautionary mitigation measures, and structural reforms in the labor markets and the financial sector; and
- The undertaking of precautionary measures by authorities could be supported by grants and concessional loans from donors and International Financial Institutions (IFIs) in order to promote efforts for self-protection.

The second chapter was prepared by the IDB and examines risk identification and indexing techniques and their use in hazard management at the national and regional level including their potential use in long-term risk management by the countries of the region. The key findings are:

- Human activity has important implications for vulnerability to natural hazards in the region. Principal causes of vulnerability include rapid and uncontrolled urbanization in hazard-prone areas, the persistence of widespread urban and rural poverty, the degradation of the region's environment resulting from the mismanagement of natural resources, inefficient public policies;
- Development programs should attempt to bolster financial preparedness and the reduction of losses. This would enable affected countries to cope with hazards autonomously and provide incentives for risk reduction. Furthermore, it would guarantee that other important development goals are not jeopardized by the need to reallocate resources, disaster after disaster, to costly emergency and reconstruction activities, which could have been largely avoided through appropriate risk management;
- Risk assessments are fundamental for the preparation of any risk reduction strategy. Given that decision makers see risk in different ways, risk indicators and risk

management options must be tailored to the intended audience if the expected impact is to be obtained. If decision makers are provided with the right information that documents the economic and social costs of the natural hazard-risks their constituencies face, they have the opportunity to make more efficient decisions on how to manage these risks; and

- The research on disaster management undertaken or sponsored by regional agencies or funding institutions or the IFI's need to reach a wider readership than the select public and non-public agencies and institutions.

The third chapter was prepared by the World Bank and examines the approaches employed by the countries of the region to address the socio-economic and financial burden that result immediately prior to, during and after the devastation and the lessons derived from the Bank's experience in natural hazard risk management in the region. The key findings are:

- Financial costs of natural disasters over the past thirty years in the Latin America and Caribbean (LAC) region have been estimated to be between US\$ 700 million and US\$3.3 billion per annum. Their negative consequences further enhance the vulnerability of low-income households and reverse the gains of economic growth;
- Detailed risk assessments should be carried out. This information should be the basis for developing an efficient, cost-effective risk management strategy in national and sectoral development planning;
- Countries need to develop and introduce targeted risk financing strategies for dealing with catastrophic events that can have a severe impact on their economies. The strategy would address the funding gap caused by the need to recover economic losses and meet social obligations and other responsibilities following a catastrophic event; and
- Country-specific, high priority mitigation measures should balance between upgrading emergency preparedness, investing in physical risk mitigation measures, strengthening the institutional capacity to manage hazards and introducing a risk financing strategy.

The fourth chapter was prepared by the OAS and examines the processes currently available for generating natural hazard information, the costs and benefits associated with investing in mitigation, and the options available to the countries of the region for mitigating risks to natural hazards in the context of development processes. The key findings are:

- Policies and practices must be oriented towards the generation of needed natural hazard information as a public good to deal with existing vulnerability and new developments;
- International development assistance should be used in all its stages to address natural hazard risk management issues; and
- National development processes must incorporate investment in mitigation sector by sector to address known vulnerability and achieve broader development goals.

The fifth chapter was also prepared by the OAS and examines the linkage between the effectiveness and institutional integrity with which natural disaster risk mitigation policies are implemented and the institutional capacity of the implementing agencies by examining the relationship between institutions, governance and performance in achieving policy objectives in the context of the Caribbean. The key findings are:

- In spite of a growing knowledge that disaster mitigation is cheaper than disaster response, current mitigation expenditures are still relatively small;

- Implementing risk management demands good governance and strong institutional coherence;
- A serious obstacle to effective disaster risk management, and in particular to investing in mitigation, is the decoupling of, or failure to link, the long term benefits that derive from an investment in mitigation, and its costs. This decoupling has an obvious time dimension: cost is realized immediately when a mitigation measure is implemented, whereas the benefit – in terms of future losses avoided – only is realized if and when an extreme event occurs. In addition, benefits may accrue to a group or individuals different than those who invested in the mitigation in the first place;
- It is safer to manage the risk than to worry about uncertainty. Managing the risk includes: risk reduction, insuring against risk and promoting resilience;
- Proactive measures are an indicator of good governance. The ability of a government to manage risk can be used to measure government effectiveness and institutional integrity;
- Only countries that have good governance as exemplified by the capacity and undertaking to commit to risk reduction of high impact but relatively – in reference to their period in office – infrequent natural hazard events will be able to do long term planning and make disaster mitigation investments in all the development sectors

The document concludes with a chapter that distills the essential points of the five papers, underlining the implications for the Caribbean and pointing to the way forward.

Chapter I:

The Economic Consequences of Natural Disasters in Caribbean Countries

INTRODUCTION

Natural disasters have become, and will likely be, more common, intense and damaging.

The number of natural disasters, including wind storms, floods, droughts and earthquakes, increased threefold in the 1990s compared to the 1970s, so did people affected by them (CRED 2005). Economic losses soared five times during the comparison period, reaching \$1.1 trillion (in 2002 prices) in their cumulative losses over the last three decades. Extreme natural disasters also show a similar pattern, doubling their frequencies and costs over the same period (Table below). Even allowing for possible biases to overstatement, there seems to be a broad consensus that the frequency and magnitude of natural disasters have indeed risen and will likely continue to rise during this century, due to environmental degradation, climatic changes, population growth, and rapid urbanization (UN 2002, Benson and Clay 2003a).

Table. Natural catastrophes in the world

Decade	1950-59	1960-69	1970-79	1980-89	1990-99	last 10 years
Number of events	20	27	47	63	91	63
Economic losses in US\$ billion (2004 values)	44.9	80.5	147.6	228	703.6	566.8
Insured losses	--	6.5	13.7	28.8	132.2	101.7
<u>Memorandum item:</u>						
Economic losses (in percent of world GDP)	0.06	0.08	0.11	0.12	0.24	0.16

Sources: Munich Re (2004) and IMF estimates

Natural disasters are particularly devastating to developing countries and the poor due to their disproportionate effects on them. Rasmussen (2004) reports that, of more than 6,000 natural disasters and over 5 billion disaster victims recorded between 1970 and 2002, three-fourths of the events and 99 percent of the human casualties took place in developing countries. The adverse impact of natural disasters could be long lasting if disaster victims are caught in a vicious circle of poverty trap.

The importance of natural disasters in the Caribbean economy cannot be exaggerated.

Caribbean countries are, on average, more exposed to natural hazard events than other countries, in their frequency and the extent of their damages (Appendix A, Rasmussen 2004, ECLAC 2000, Crowards and Coulter 1998). This inherent vulnerability has been exacerbated by the fact that most Caribbean countries are insufficiently diversified, small-island economies, heavily dependent on tourism and commodity exports.

This paper discusses economic consequences and policy implications of natural disasters in the Caribbean. Section One discusses possible channels and directions of macroeconomic effects of natural disasters and summarizes their stylized facts, drawing on existing empirical studies. Section Two discusses the implications of natural hazard events for economic policies, including *ex-post* mitigation policies and *ex-ante* protective measures. Section Three summarizes and concludes.

1. MACROECONOMIC EFFECTS OF NATURAL DISASTERS

Conceptual Framework

The analysis of economic impacts of natural disasters faces several methodological challenges. The size and duration of the effects depend on a variety of factors, including the type and magnitude of the disasters, economic conditions at the onset of the disasters, and policy responses to them (Otero and Marti 1995, UNDP 2004, Benson and Clay 2000). Due partly to severe data constraints, an eclectic analysis has been most common, relying on a mixture of partial, quantitative and qualitative techniques (Benson and Clay 2000). For example, the UN disaster assessment guidelines distinguish between a disaster's primary effects (referring to direct and indirect damages to tangible assets and flows of goods and services) and its secondary, macroeconomic effects without attempting to incorporate feedbacks from policy responses (ECLAC 2003, Otero and Marti 1995). Similarly, a series of case studies on natural disasters, undertaken jointly by the World Bank and the Overseas Development Institute, recognizes the difficulty of isolating the impact of natural disasters from other factors (Freeman et al., 2002).

Notwithstanding these caveats, there are commonly identified short-term effects of natural disasters and widely agreed transmission channels.

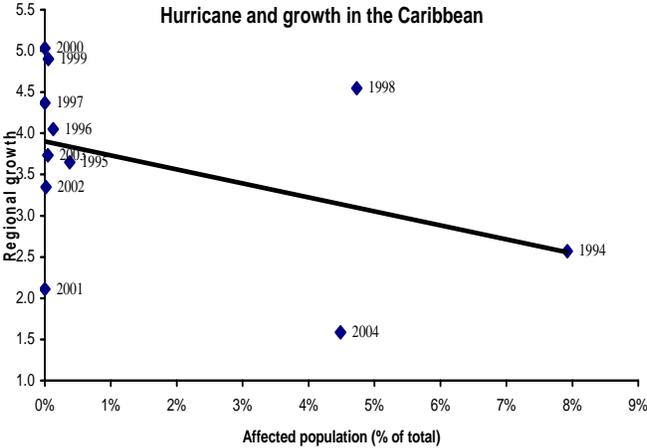
- *Declines in overall and sectoral GDP:* Agriculture, fishing, and tourism industries are typically affected heavily by natural hazards while other sectors, including transportation, utilities, and other services sectors, could also be vulnerable, depending on the incidence and nature of natural hazards. By extension, natural disasters tend to make output more volatile than otherwise.
- *Adverse impact on public finances:* The fiscal balance deteriorates in the wake of natural disasters as the domestic tax base contracts and expenditure needs rise. This deterioration usually adds to public debt, which could affect macroeconomic performance beyond the short-term, including higher inflation and lower investment.
- *Deterioration in the balance of payments:* The current account balance weakens as natural disasters impair export capacity (ports, merchant fleets, or highways) and curtail tourist activities. They also increase imports due to reconstruction needs and disruptions in domestic supplies. Foreign grants, remittances or reinsurance payments from abroad often mitigate the adverse impact but are usually insufficient to offset the initial damage. While private capital inflows could also help mitigate the deterioration in the balance of payments, they are unlikely to offset it or to be immediately available in developing countries.
- *Inflation and depreciation pressures:* In reflection of the weaker current account and, potentially, investors' concerns about future earning losses of local companies, the exchange rate is likely to be under depreciating pressure. Inflationary pressures are also likely to build up due to an excess of money holdings in the face of reduced incomes and wealth and possibly concerns about currency depreciation and monetization of the increased budget deficits.

- *Negative regional spillover effect:* Natural catastrophes could affect countries that have not been hit directly. Typical channels of the spill-over effects include regional input-output networks (damages to shared ports and disruptions in cross-border supply chains) and financial linkages (rise in sovereign credit spreads and cross-border exposure of banks and insurance companies).

There are also longer-term macroeconomic effects, the extent and direction of which depend crucially on policy response. There are a variety of transmission channels including: environmental damage on agriculture, fishing, and forestry; destruction of infrastructure such as schools and ports; crowding out of productive public spending and broad investment activities through higher interest rates and the diversion of public resources to disaster relief and reconstruction; and more broadly, the worsening of fiscal and external balances that may trigger inflation, loss of confidence, capital flight, and banking and/or balance of payments crises. The International Monetary Fund (IMF) (2003) cites numerous studies showing that exogenous shocks and the associated policy responses have contributed to the accumulation of unsustainable external debt in many developing countries.

Empirical Findings

Many empirical studies show a negative contemporaneous growth impact of natural disasters. Crowards (2000) finds that real GDP growth in the Caribbean slowed down on average about three percent in a disaster year during a review period of 1970-1997, often followed by a sharp rebound in the following year and a moderate slump afterwards. Major factors behind this slowdown include: damages to infrastructure and plants, losses of agricultural output, and reduced tourist arrivals. Rasmussen (2004) reports that, in his analysis of 12 large natural disasters in the East Caribbean Currency Union (ECCU) during 1970-2002, the median reduction in output caused by natural disasters was 2.2 percent, mostly reflecting damages to agricultural production. This finding is similar to that of Charveriat (2000), which estimates that a median decline in real GDP was nearly two percent for 35 cases of natural disasters in the Caribbean and Latin American countries. It is notable that output impact in the Caribbean is not limited to countries hit directly by natural disasters. The simple plot chart to the right (Hurricane Growth in the Caribbean) shows a significant negative correlation between real GDP growth in the Caribbean and human losses from hurricanes, which are the most frequent and severe natural disaster in the region. This is a broad indication of spill-over effects within the region, although the precise magnitude would depend upon other relevant factors, such as world oil prices and an international business cycle are considered.



Natural disasters tend to increase output volatility as well although the extent of the direct effect appears to be modest. The World Bank (2002) finds that while natural disasters appear to

have a significant impact on output volatility in the Caribbean, their direct impact on consumption volatility is statistically insignificant. Likewise, Rasmussen (2004) concludes that it is unlikely for natural disasters to have a large impact on output volatility in the ECCU. This apparently weak link between natural disasters and volatility of major macroeconomic aggregates in the Caribbean might reflect the influences of other relevant factors, including apparently acyclical public consumption (Auffret 2003a), a dearth of credit and insurance (Auffret 2003b), generally high output volatility in small states (Easterly and Kraay, 2000), and terms of trade disturbances and volatility in macroeconomic policy (WB 2002). Relatively large remittances in the region, some 10 percent of GDP, could also mitigate the adverse economic impact of natural hazards (Mishra 2005).

The balance of payments almost invariably deteriorates in the wake of natural disasters.

Rasmussen (2004) shows that the median weakening in the external current account following natural disasters was a staggering 10.8 percent of GDP in the ECCU, probably reflecting the region's high degree of trade openness and access to international capital. Economic Commission for Latin America and the Caribbean (ECLAC) (2000) considers 42 large natural disasters in Latin America and the Caribbean between 1972 and 1999 and estimates that about one third of the estimated damages are, on average, reflected in the deterioration of the balance of payments. Benson et al. (2001) finds that the share of agriculture in an economy is an important indicator of the magnitude of the deterioration in the trade balance. Rasmussen (2004) and Crowards (2000) show that the adverse effects on the external current account last, on average, two to three years in the Caribbean.

Natural disasters tend to raise fiscal deficits, but the empirical evidence is rather weak. The fiscal deterioration in the wake of natural disasters typically entails marked increase in expenditures (emergency assistance and reconstruction efforts) and relatively small reductions in government revenues and grants. However, Crowards (2000) reports that, due to inherent volatility of government expenditures, the only discernable relationship between natural disasters and public spending in the Caribbean is the tendency for higher capital spending during the disaster year followed by compressions in current expenditures afterwards. Similarly, Auffret (2003a) shows that the level of public consumption in the Caribbean is much less sensitive to natural disasters than those of output, investment and private consumption. These findings are consistent with Benson and Clay (2003b) that reports little evidence of direct impacts of natural disasters on fiscal balances in selected disaster countries, perhaps due to strict budgetary constraints imposed by lack of financing opportunities. Rasmussen (2004) also reports that the fiscal impact of natural disasters is unclear in the ECCU with a large variation in the outcomes.

Evidence of the long-term growth effects of natural disasters is weak and under dispute.

There has been relatively little empirical research in this area. Among the few available studies, Skidmore and Toya (2002) find no long-term relationships between natural disasters and growth in their cross-section regressions over the period between 1960 and 1990. Albala-Bertrand (1993) studied large-scale natural disasters in Peru, Nicaragua, Honduras, Guatemala, the Dominican Republic, and Ecuador and concludes that capital losses from natural disasters are unlikely to have lasting effects on growth. Both the World Bank (2002) and Rasmussen (2004) reach a similar conclusion, possibly due to important roles played by economic policy and other economic factors in influencing long-term growth. Benson and Clay (2003b) however dispute the validity of such findings, pointing out fundamental difficulties in establishing the empirical

links between long-term growth and disaster proneness. ECLAC (2000) raises a similar objection.

2. POLICY OPTIONS FOR MITIGATING THE ADVERSE EFFECTS OF NATURAL HAZARDS

With a natural disaster essentially being an extreme form of supply shock, economic literature provides useful guidance on how to absorb the shock, what measures could be used, and what should be considered in the choice of the measures. When a country is hit by a negative shock, it must first decide the appropriate mix of adjustment and financing. Many factors need to be considered in such a decision including: the magnitude and duration of the shock, the country's initial fiscal, balance of payments, and debt positions, the exchange rate regime, the impact of the shock on poverty, the rate of return on expenditure relief and reconstruction, and the availability and the terms on which financing is available (IMF 2003). Governments could also undertake precautionary measures against the risk of future natural hazards, considering the likelihood of their recurrence. This section discusses a variety of broad policy measures, which could be undertaken to mitigate the adverse effects of natural hazards.

Mitigating Macroeconomic Policy

The government could help absorb the negative shocks through countercyclical fiscal policy. The fiscal policy could entail increases in transfers and spending programs or reductions in taxes to boost, for example, private investment. Given the primary nature of the adverse shock that damages the productive capacity of a country, targeted expenditure programs to restore capital stock seem to be a more effective fiscal instrument than a broad demand stimulus package although there is a distinct need for strengthening the social safety net targeted at disaster victims. If the rise in deficit is followed by an offsetting surplus after recovery, such fiscal policies could phase out an adjustment burden across time with minimum disturbances to macroeconomic stability.

In this regard, an important caveat is that a country's fiscal flexibility will need to be subject to restraint, the extent of which depends on its initial fiscal position, financing options, and debt sustainability. While a natural catastrophe is a rare event of a highly temporary nature, most natural disasters carry considerable uncertainties about the pace of recovery and the risk of their recurrence. This uncertainty points to the need for extreme caution—especially for Caribbean countries, nearly all of which are extraordinarily highly indebted (Sahay 2005)—in weighing the merits of financing against the costs of adjustment even in the case of apparently temporary shocks. The experiences of commodity exporting countries, in which terms-of-trade shocks are comparable to natural disasters in their frequency and magnitude, show that the cost of borrowing to tide the country over till the return of favorable external conditions has often rapidly encumbered the countries (IMF 2003). Not coincidentally, many oil exporters have institutionalized asymmetry in their fiscal flexibility between cyclical downturns and upturns (Davis et al. 2003).

Fiscal constraints of most Caribbean governments have greatly been eased by financial supports of (IFIs) and bilateral donors. The World Bank has supported natural disaster reconstruction projects across the region, and in recent years has expanded its investments in hazard mitigation projects in the countries of the Organization of Eastern Caribbean States.

Similarly, the IMF has, since 1962, through its emergency assistance facility, provided assistance to 24 member countries affected by 27 separate natural disasters (Cashin and Dyczewski 2005, see Appendix B). Moreover, the IMF has recently decided to introduce a subsidy element to its emergency assistance for natural disasters at the same concessionary terms as those for emergency assistance for post-conflict countries.

While monetary policy could also play a role in disaster mitigation, room to maneuver in this area is relatively limited. In general, monetary accommodation will likely be inflationary, given the real, rather than monetary, nature of natural disasters and an attendant decline in money demand although there could be a scope for non-inflationary easing depending on the economic cycle at the onset of natural disasters. Monetary relaxation, even when justified, should be used temporally and judiciously, in close coordination with fiscal and exchange rate policy in order not to jeopardize price stability. Broadly speaking, a mix of monetary tightening and fiscal relaxation should be a preferred instrument for countries with a flexible exchange rate regime. In countries with little monetary discretion due to a regional currency union or a currency peg, it would still be important not to add to pressures to the exchange markets through, for example, a sharp reduction in reserve requirements. Such monetary relaxation could undermine public confidence in the national currency, which, together with the adverse balance of payment impacts of natural disasters, could lead to excessive losses in international reserves and endanger the fixed exchange rate arrangements.

Precautionary Policy Measures

Governments could undertake several precautionary measures against the risk of future natural hazards, including market insurance, self-insurance, and self-protection. The main difference between market and self insurance is whether the insurance involves the pooling and spreading of the risks although the distinction cannot be always made clearly in practice (World Bank 2002). Ehrlich and Becker (1972) distinguishes between insurance and protection in terms of a reduction in the size of a loss (sprinkler systems against the loss from fires) or the probability of a loss (burglar alarms against the probability of illegal entry). While insurance tends to deter self-protection through “moral hazard” insurance could encourage, rather than discourage, self-protection if insurance costs are sufficiently negatively related to the amount spent on self-protection, such as in the case of lower insurance premiums applied for sturdier houses (Ehrlich and Becker, 1972). Self protection measures that could be undertaken by governments include the identification and management of natural hazard risks at a national level and policy measures promoting investment in disaster prevention and mitigation.⁵

While market insurances could, in principle, fully shift natural hazard risks of an economy to others, their practical usefulness is still limited especially in developing countries. The insurance instruments include international reinsurance contract and capital markets such as catastrophe bonds, weather derivatives, or real GDP-indexed derivatives (Borzenstein and Mauro, 2002). However, practical difficulties frequently arise in most developing countries, including in the Caribbean – local insurance markets provide only limited coverage for natural hazard risks. Households have few incentives or resources for insurance, and insurance premiums are usually expensive due to underdeveloped local insurance markets and a limited

⁵ Following sections discuss a variety of self-protection measures extensively

access to international reinsurance markets (Gurenko and Lester 2004, IMF 2003, and Vermeiren 2000). Even in developed countries, the capital and insurance markets cannot fully absorb the catastrophic risk due to the extreme and infrequent nature of catastrophes (Lewis and Murdock 1996, Jaffee and Russell 1997). A pragmatic approach in this regard could be the tapping of local insurance markets, supplemented by government-supported regional insurance pools along the lines of the Caribbean Catastrophe Insurance Pool proposed by the World Bank (Cashin and Dyczewski 2005 and Pollner 2001).

Governments could help provide self-insurance to the public directly or indirectly as an alternative or supplement to market insurance. For example, government could provide self-insurance to key public assets through the provision of traditional insurance and, more broadly, to the economy as a whole through taxpayer-funded contingency funds like the Fondo Nacional de Desastres Nacionales (FONDEN) of Mexico (Freeman et al. 2003). While this specific self-insurance will not provide for the full cost of post-disaster reconstruction, this arrangement will help ensure that sufficient funds be available for immediate disaster relief and rehabilitation (Cashin and Dyczewski 2005). Other forms of broad self-insurance include the conduct of prudent fiscal policy and an accumulation of international reserves beyond what is normally deemed necessary (Lee 2004).

More broadly, labor market reform and financial deepening could also contribute to the mitigation of natural hazard risks. Adverse effects could be absorbed with less friction if people in disaster regions could find jobs relatively easily in other places, although direct damages from disasters, especially to the poor, would still require targeted rehabilitation efforts.⁶ In this regard, there is room for further reform of the labor markets in the Caribbean, including deregulation and deeper integration within the regional labor markets (World Bank 2005). The deepening of the financial sector could also help spread the costs of natural disasters across time. Ramcharan (2005) shows that economic damages from earthquakes arising from the lack of diversification are smaller in more financially developed countries, based on the Emergency Disasters Database (EM-DAT) data of Center for Research on the Epidemiology of Disasters (CRED) from 1900-2003.⁷

To the extent that many natural hazards in the Caribbean are recurrent in nature, there seems to be a convincing case for strengthening precautionary measures in the Caribbean. At present, the public sector in most Caribbean countries does not typically provide for contingencies against catastrophic events due to the perceived high opportunity costs of such arrangements (Cashin and Dyczewski 2005, Auffret 2003b). However, on the one hand, the

⁶ The adjustment mechanisms to regional shocks have been studied widely including Eichengreen (1993) on the role of migration in the US and Europe in absorbing regional shocks, and Blanchard and Katz (1992) on the role of labor markets in U.S. regions, and Decressin and Fatás (1995) and Obstfeld and Peri (1998) on the relative role of labor participation in Europe and in the US. Emigration is an extreme form of labor mobility, which plays an important role in the Caribbean as a regional stabilizer due to substantial and stable inflows of remittances from emigrants (Mishra 2005).

⁷ Asdrubali et al. (1996) and Athanasoulis and Wincoop (2001) reports similar findings on the importance of the capital markets in the absorption of idiosyncratic regional shocks in the United States. More broadly, Aghion et al. (2005) develops an economic growth model, where the extent of financial development affects long-term growth by relieving a shock-prone economy from liquidity constraints and hence by inducing countercyclical long-term investment, and provides empirical evidence that financial deepening mitigates vulnerability of growth to exogenous shocks.

frequency and magnitude of natural disasters are rising, as described earlier, increasing demand for disaster relief and reconstruction expenditures. On the other hand, external aid resources are limited, as evidenced by the crowding out of donor spending by post-disaster funding (Freeman et al 2003). These adverse trends suggest that, notwithstanding other pressing expenditure needs, Caribbean countries would need to weigh in favor of undertaking disaster risk mitigation measures since such preventive actions normally cost less than post-disaster measures over the medium term, particularly in the case of recurring natural hazards such as hurricanes and drought.

The need for such precautionary measures is reinforced by the apparent prevalence of the so-called Samaritan's dilemma—underinvestment in protective measures with the expectation that others will provide support if disaster occurs (Freeman et al., 2003). Concerns about this dilemma could become pressing in the near future, if not already so, given finite willingness of donors to provide financial support and the rising trend in the frequency and magnitude of natural disasters. In this regard, grants and concessional loans from IFIs and bilateral donors, designed to finance post-disaster mitigation and reconstruction costs, might need to be made partly contingent on the undertaking of precautionary measures by the authorities (Gurenko and Lester 2004; Cashin and Dyczewski 2005).

3. SUMMARY AND CONCLUSIONS

Due to global trends, natural disasters have become an increasingly important factor affecting the Caribbean economy. The Caribbean is one of the most disaster prone regions in the world due to its geography and the size and economic structure of the countries in the region. Widely acknowledged short-term effects of natural disasters include sharp losses in output, deteriorations in fiscal and external balances, and instability in prices and exchange rates. Empirical evidence of their long-term impact on economic growth is relatively weak and largely mixed, possibly reflecting the importance of policy response and other economic factors for long-term growth. The short and long-term impacts are often devastating to those directly hit by natural disasters, especially the poor creating a vicious circle of poverty.

Government policy could play an important role in mitigating the adverse effects of natural hazard events. Upon the occurrence of natural disasters, governments could undertake selective fiscal stimulus within the overall medium-term fiscal constraints and, to a limited extent, temporary monetary easing. Given the increasing natural hazard risks, even more important, and potentially more effective, would be precautionary measures. These include the budgetary provision of contingency funds, the creation of regional insurance pool, and, more broadly, the conduct of prudent fiscal policy. Structural reforms in the labor markets and the financial sector could also help better protect the economy against the vagaries of nature by enhancing labor mobility and helping spread the costs of natural disasters. The undertaking of precautionary measures by authorities could be supported by grants and concessional loans from donors and IFIs in order to promote efforts for self-protection.

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CHAPTER II: Natural Hazard Risk Identification, Risk Indexing, and Risk Management at a National Level

INTRODUCTION

Understanding risk opens options for reducing the potential impacts of natural hazards. It facilitates the inclusion of risk mitigation and prevention in decision making. It also helps in choosing financial protection mechanisms. If risk is reasonably quantified, countries can choose between mitigation investments or financial instruments to cope with potential losses. While it is possible to make policy decisions without probabilistic estimates, the failure to quantify risk constrains the decision-making process (Freeman *et. al.*, 2003, p. 38).

Risk indicators and, more broadly, risk information that can be interpreted by non-experts are necessary inputs for decision makers to efficiently manage natural hazard risks. Hazard assessment (frequency, magnitude and location of natural hazards), vulnerability assessment (population and assets exposed to natural hazards), and risk assessment (a function of hazard and vulnerability) lead to the development of risk indicators. These indicators are key tools for mainstreaming risk management. This chapter elaborates on the development and use of risk indicators in a proactive approach to risk management in Latin America and the Caribbean.

The region is faced with a large variety of natural hazards. In the case of the Caribbean, more than half of the disasters have been due to wind storms, while flooding has been the second major natural event causing disasters. Nearly half of the disasters in South America have been related to flooding, while the two other important triggering events have been landslides and earthquakes. Central America faces the biggest variety of hazards, with about one-third of its disasters related to floods, one-fourth to wind storms, one-fifth to earthquakes and the rest to volcanic eruptions and other hazards (Charvériat, 2000, p. 36).

The implication of the variation in exposure to hazards in combination with the differences in capacity to manage risk among countries in the region means that risk indicators must be developed on a country basis and that response must be tailored to the specific situation of the country. Risk indicators also have to be tailored to the decision makers who would use them. However, many risks and circumstances are shared between groups of countries creating rich opportunities for collaboration and the sharing of experiences.

1. RISK INDICATORS

Reasons for the Construction of Indicators

Indicators of the risk that the region faces from natural disasters are necessary for decision makers. They seek to represent a complex reality using summary values that are generally numerical. A good indicator would be utilized by decision-makers as a policy development and planning tool. Even though natural hazard risk has not often been taken adequately in projects and development planning, there is nothing intrinsically difficult about either appraising natural

hazard-related risks or monitoring and evaluating risk reduction activities (Benson and Twigg, 2004b, p. 3).

The identification of risks from natural hazards and the development of risk indicators can be used to define needed prevention and mitigation measures and to locate public and private investments in safe areas (IDB, 2000, p. 15). An example could be the location of electricity generating facilities and power transmissions lines in areas where they are less likely to be destroyed by the identified risk factors, such as earthquakes, floods and other hazards. This was the case with the Inter-American Development Bank (IDB) financed Electric Development Program III in Costa Rica (IDB, 2000, p. 15).

Human activity has important implications for vulnerability to natural hazards in the region. It has been observed that the principal causes of vulnerability include rapid and uncontrolled urbanization in hazard prone areas, the persistence of widespread urban and rural poverty, the degradation of the region's environment resulting from the mismanagement of natural resources, inefficient public policies, and lagging and misguided investments in infrastructure (IDB, 2000, p. 1). Vulnerability is also related to geography, particularly in coastal regions of continental countries and island states. Climate change, the rise in sea levels, and more extreme weather events lead to the suggestion that climate change and disaster management should be integrated into general development planning (CDERA, 2004).

Box 1. The Latin America DesInventar Methodology

This methodology was initiated by the Network for Social Studies on Disaster Prevention in Latin America (LA RED) in 1994. It seeks to record all discrete events that have resulted in adverse effects on life, property and infrastructure triggered by natural and man-made phenomena. The data are geo-referenced to the smallest available political-administrative unit in a given country, usually the district or municipality. By collecting disaggregated data, DesInventar enables the recording of individual, localized, small-scale disasters as well as the impacts of large-scale hazard events at the local level.

To date, 17 countries have developed national DesInventar disaster databases with up to 30 years of data. Those countries are: Argentina, Chile, Peru, Ecuador, Venezuela, Colombia, Panama, Costa Rica, Nicaragua, Honduras, El Salvador, Guatemala, Mexico, the Dominican Republic, Trinidad and Tobago, Jamaica and Guyana. Subnational databases have been developed for the departments of Antioquia and Valle del Cauca and for the city of Pereira in Colombia and for the state of Florida in the United States.

Local disasters with very limited direct impacts are included (e.g. the destruction of one house or a household affected by the loss of their harvest as a result of a frost), as well as those with more widespread impacts (e.g. earthquakes affecting metropolitan districts). These databases have been developed by national governments, international organizations, universities, scientific organizations and nongovernmental organizations (NGOs). Data are obtained from the media and government agencies and existing databases. Once collected, data are verified nationally for consistency. Shared definitions are used for some key hazards, while for others local specificity is more important. The challenge of uniformity between the databases remains, limiting the capacity for international comparisons.

The databases developed under the DesInventar program have been an important source of information for analytical studies financed by the IDB such as those for the Regional Disaster Policy Dialogue.

Source: Pelling (ed.) 2004 p 43

Types of Indicators

- a. Natural Hazard Vulnerability Indicator. This risk index, developed by Wagner et al. (2001), tries to incorporate in one measure vulnerability and the likely socioeconomic impact of disasters. As defined by the index, vulnerability “is the product of the disaster-affected population relative to the total population times the disaster-related economic loss relative to GNP in each country” (IDB 2004 p 6). Using this measure, as shown in Figure 1, natural disasters are particularly damaging in the Caribbean countries (Jamaica and the Dominican Republic), the Central American countries (Nicaragua, Belize, Honduras and El Salvador), and in Bolivia in the Andean region (IDB, 2004, p 6).

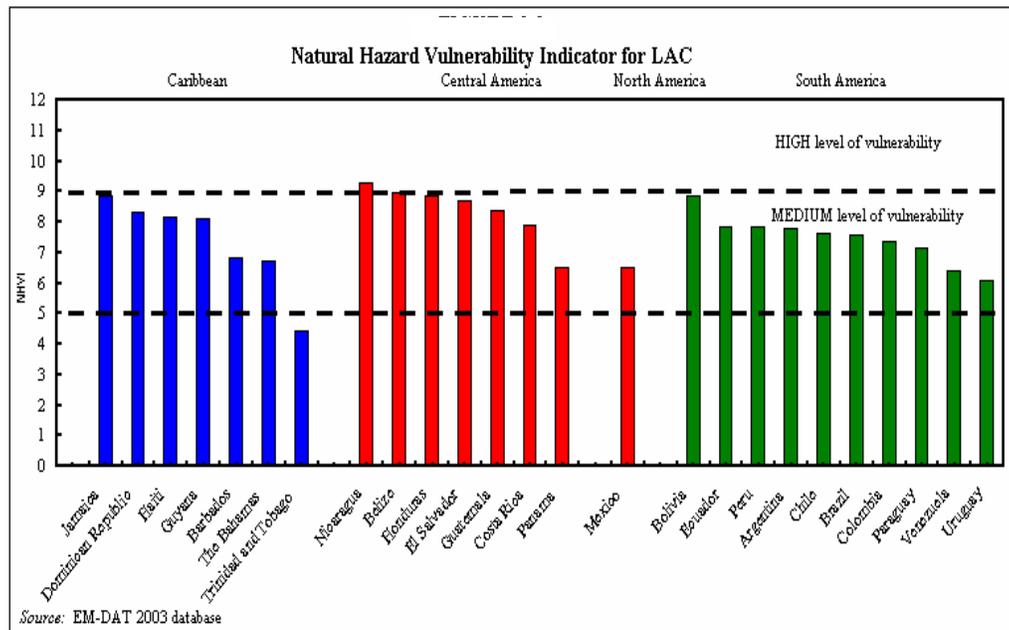
Table 1. Types of Risk Indicators

GLOBAL RISK INDICATORS			
NAME	DEVELOPED BY	PURPOSE	COMPONENTS
Natural Hazard Vulnerability Indicator	Wagner <i>et. al.</i>	Tries to incorporate in one measure vulnerability and the likely socioeconomic impact of disasters	Disaster affected population ; Total population ; Disaster-related economic loss; GNP in each country
Disaster Risk Index	UNDP	Seeks to measure the relative vulnerability of countries to three key natural hazards —earthquakes, tropical cyclones and floods	Levels of mortality from disaster events is its main metric
Hotspots Indices	Columbia University and the World Bank	To identify geographical areas at relatively high risk from one or more natural hazards	Risk of mortality, the risk of economic loss and GDP
AMERICAS INDICATORS			
NAME	DEVELOPED BY	PURPOSE	COMPONENTS
Disaster Deficit Index	IDB	Compares possible economic losses from disasters against a country’s financial capacity	Different hazards which are calculated in probabilistic form according to the historical registry of the intensity of the phenomena and the actual physical vulnerability of the elements exposed to such phenomena; Expected annual loss; Economic resilience representing the possible internal and external funds available to government
Local Disaster -Index	IDB	Evaluates the social and environmental risks stemming from recurrent small-scale disasters	Deaths tolls, number of affected people and damage to housing and crops
Prevalent Vulnerability Index	IDB	Reflects susceptibility due to the degree of direct exposure of the physical infrastructure and people	Includes Population measures; Capital stock; Imports and exports; Gross domestic fixed investment; Dependents as proportion of working age population; Unemployment; Debt servicing; Human Development Index; Gender-related Development Index; Social expenditure, % of GDP; Governance Index; Insurance of infrastructure and housing; Environmental Sustainability Index
Risk Management Index	IDB	Serves to characterize the risk management performance of a country	Public policy in the areas of Risk identification; Risk reduction; Disaster management; Governance and Financial protection

- b. Disaster Risk Index (DRI). This index, developed by the United Nations Development Programme (UNDP), seeks to measure a country’s relative vulnerability to three key natural hazards - earthquakes, tropical cyclones and floods (UNDP). It uses levels of mortality from disaster events as its main metric. Human deaths are important, but in developing countries the impacts of disasters on infrastructure and the environment are

also critical to development prospects. This shortcoming has been recognized by Pelling (2004). Among the recommendations for the improvement of the DRI is the need for more appropriate data collection on disaster events. Work on national disaster databases is ongoing in Latin America and the Caribbean. One example of this is documented in Box 1.

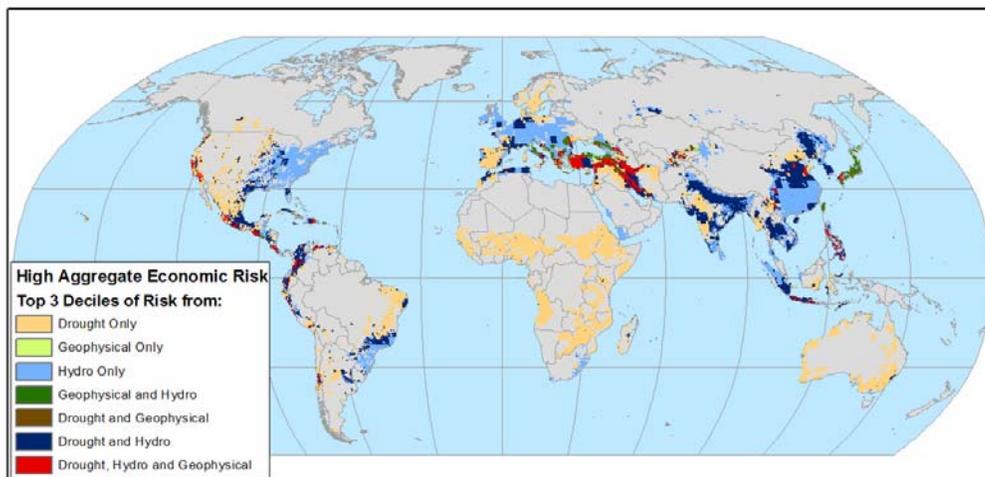
Figure 1



Source: IDB 2004 p 6

- c. Hotspots indexing has been implemented by Columbia University and the World Bank. The Hotspots project developed three indices of disaster risk. These indices mapped the risk of mortality, the risk of economic loss and the risk of economic loss as a proportion of GDP with subnational resolution for individual types of hazard. (Pelling 2004 p 2). The purpose of the hotspots project was to identify areas at relatively high risk from one or more natural hazards. However, the weakness of this approach is that it is based on grids of the world as the geographical basis and not the countries. Figure 2 shows the worldwide distribution of economic losses from natural hazards. It would indicate that in Latin America and the Caribbean, especially in the Central American countries and the Caribbean basin, economic losses stem from multiple hazards.
- d. Indicators for the Americas. The global indices discussed above are complemented by the Americas program sponsored by the IDB. It has produced four indices that describe individual components of national disaster risk and applied them to 12 countries in the Americas (Cardona 2005). The indices for the Hotspots and DRI projects were built using historical data. In the case of the Americas Program, disaster risk was modeled from a range of input variables. Its methodology may be used in other countries beyond the original twelve in Latin America and the Caribbean.

Figure 2: The global distribution of risk of economic loss, by hazard type



Source: Pelling 2004 p 24

As work goes forward on improving the four risk indicators discussed above it would be useful to consider the criteria in Box 2 in assessing the quality of indexing and indicator methodologies.

Care needs to be taken that there is not too much emphasis placed on quantitative measures at the expense of valuable qualitative information of risk. The former sometimes seem more appealing because they are easier to fit into computer models and iterated for analysis than qualitative data. Therefore evaluating natural hazard risk is a multifaceted concept and, as noted by Benson and Twigg, “reliance on quantified measures of risk has almost certainly contributed to a tendency to focus on technocratic, rather than socially engineered, mitigation...” (Benson and Twigg 2004b p 18).

Box 2. Criteria for Assessing the Quality of Indexing and Indicator Methodologies

1. Validity: the effectiveness with which it measures its target.
2. Reliability: the replicability of results.
3. Specificity: the indicator or index should only measure the phenomenon it intends to.
4. Measurability: input data should be available and easily obtained.
5. Comparability: outputs should be available for comparison between units and over time.
6. Cost-effectiveness: that the results justify their investment in time and money.
7. Redundancy: that each input variable should measure a discrete phenomenon.

Source: Pelling 2004 p12

2. NATURAL HAZARD RISK ASSESSMENT FOR PLANNING AND FINANCING – THE IDB’S AMERICAS PROGRAM

An evaluation of the IDB disaster policy concluded that natural disasters are, in many countries, a sufficiently important development problem to warrant analysis, programming, and consistent attention over time. Strategies should be elaborated at the country level to counteract the

Box 3. IDB Disaster Risk Management Indicators Program of the Americas

In April 2005, the Board of Directors of the IDB approved the *Bank Action Plan for Improving Disaster Risk Management*. It will include a Disaster Risk Management Indicators Program for the Americas, to consolidate and provide continuity to the state-of-the art indicators of disaster risk and risk management performance, developed during a period of two years with support from the Japanese Special Fund. With a national level resolution, the indicators will identify the high-risk countries in the region and, in a preliminary fashion, the developmental and technical assistance needs for strengthening countries' risk management systems. These indicators, collected at specified intervals in cooperation with centers of excellence and other partners, will be used to measure countries' progress over time. The program will establish monitoring and evaluation processes for tracking progress in the countries' risk profiles, as well as for the effectiveness of efforts to promote the soundness of the risk management systems of Bank borrowing member countries. This initiative aims to fulfill the Bank's mandate to enhance awareness of this threat to development and to encourage countries to allocate scarce resources to improve their risk management.

institutional and incentive distortions that thwart disaster risk management and limit investment in prevention, mitigation, and preparedness (IDB 2004 p ii).

The IDB is making major efforts to include risk management and the reduction of vulnerability in its programming exercises with the countries. The Bank shows leadership in getting countries to adopt a comprehensive approach to risk reduction. It has established an Action Plan with regard to disaster risk management and its financing, as illustrated in Box 3.

Unlike most existing risk indices, the new indicators developed under the Americas Program can be easily interpreted by a wide range of decision makers in different fields, rather than only by experts. Countries can use these indicators irrespective of whether international financing is needed before or after a disaster. The pilot study draws on two decades of data from 12 nations (Argentina, the Dominican Republic, Jamaica, Chile, Ecuador, Mexico, Colombia, El Salvador, Peru, Costa Rica, Guatemala, and Trinidad and Tobago) in Latin America and the Caribbean.

This chapter looks in detail at four of the Americas Program Indicators:

- The Disaster Deficit Index (DDI) compares possible economic losses against a country's financial capacity. The index highlights the budgetary implications of natural hazards and underscores the need to consider insuring public and private assets, establishing loss reserves, securing contingent credits and investing in prevention and mitigation. This indicator is useful for finance ministries
- The Local Disaster Index (LDI) evaluates the social and environmental risks stemming from recurrent small-scale disasters, looking at death tolls, number of affected people and damage to housing and crops. Municipal leaders and private sector entities planning investments in certain regions will be interested in this index.
- The Prevalent Vulnerability Index (PVI) reflects susceptibility due to the degree of direct exposure of the physical infrastructure and people. It also reflects the social and economic fragility conditions that lead to indirect impacts.

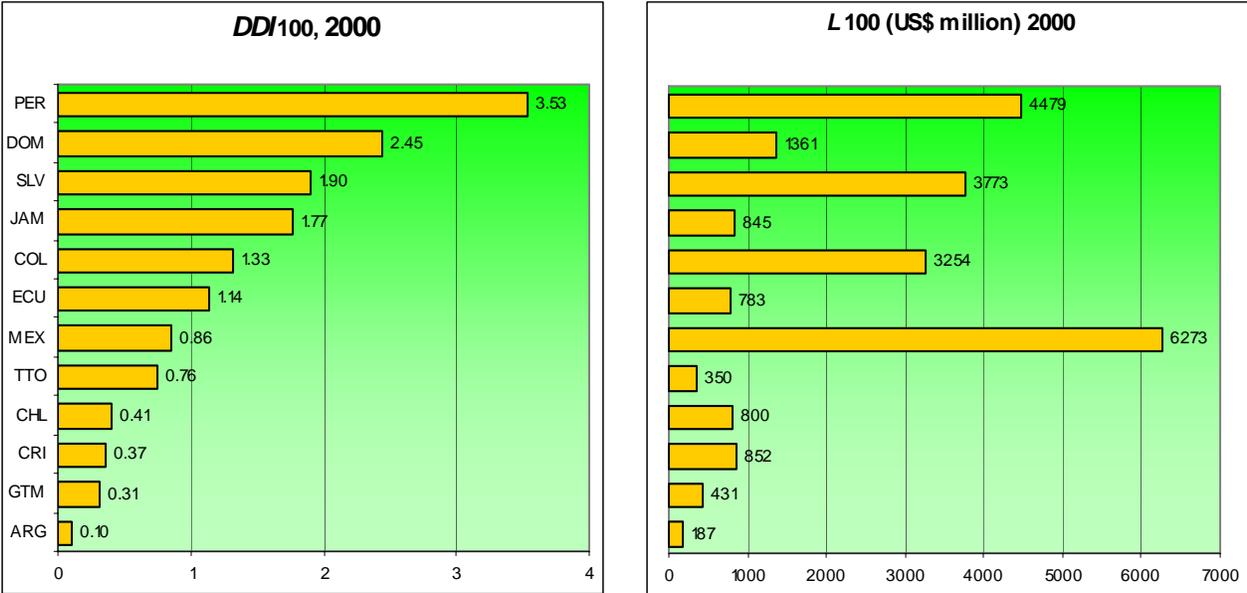
- The Risk Management Index (RMI) is used to measure the performance of risk management. The index is based on the analysis of four public policies, each of which has eight proposed indicators. Together, these serve to characterize a country’s risk management performance. This indicator is useful for disaster risk management organizations and government entities responsible for institutional efficiency in the country.

Disaster Deficit Index

This index illustrates the economic losses the analyzed country could suffer when faced with a catastrophic event and the implications in terms of resources needed to confront the situation. Construction of this index requires a predictive analysis based on historical and scientific evidence and establishing the ranges of the value of potentially affected elements. This requires the definition of some arbitrary reference point in terms of the severity or period of return of dangerous phenomenon.

The left side of Figure 3 presents the DDI for countries using a 100 year period of return (five percent probability of occurrence in ten years). To the right, the maximum loss, *L*, for the government⁸ is presented for the same period.

Figure 3. Disaster Deficit Index (DDI) and loss (L) in 100 years



Source: Cardona 2005 p 11

Half of the countries studied have an index greater than 1.0, which indicates that they would not be able to collect the funds needed for reconstruction after a 100 year event. The most critical situation is faced by Peru, the Dominican Republic and El Salvador.

⁸ Government responsibility was restricted to the sum of losses associated with public sector buildings and housing for the lowest income population.

Local Disaster Index

The LDI accounts for the relative weight and persistence of the effects attributable to phenomena that give rise to municipal scale disasters. It is made up of three subindicators calculated with data from DesInventar (Box 1) on the number of dead, affected persons and losses in the municipalities caused by the three generic types of event identified: landslides and mud flows; seismic-tectonic events; floods and storms and other events.

Figure 4 shows the index from 1996 - 2000 obtained by adding together the three components related to deaths (K), affected persons (A) and economic losses (L). The total is the sum of the subindices, each of which has an equal weight. Sensitivity analyses were carried out that showed that the outcome is robust with different weights. In a few cases, the country ranking was affected by one or two positions when the weights were drastically changed. For future applications, the countries and other users of the indicators may naturally assign different weights to the individual indices according to the priorities they place on the various factors affecting vulnerability.

The total LDI index is highest for Guatemala, Argentina and the Dominican Republic. During this period Colombia and Ecuador show a greater incidence and regularity in the distribution of deaths between municipalities; Guatemala and the Dominican Republic show this for the number of affected persons. The Caribbean countries fare comparatively well in this comparison.

Source: Cardona 2005 p 14

Figure 4. Total Local Disaster Index (LDI)

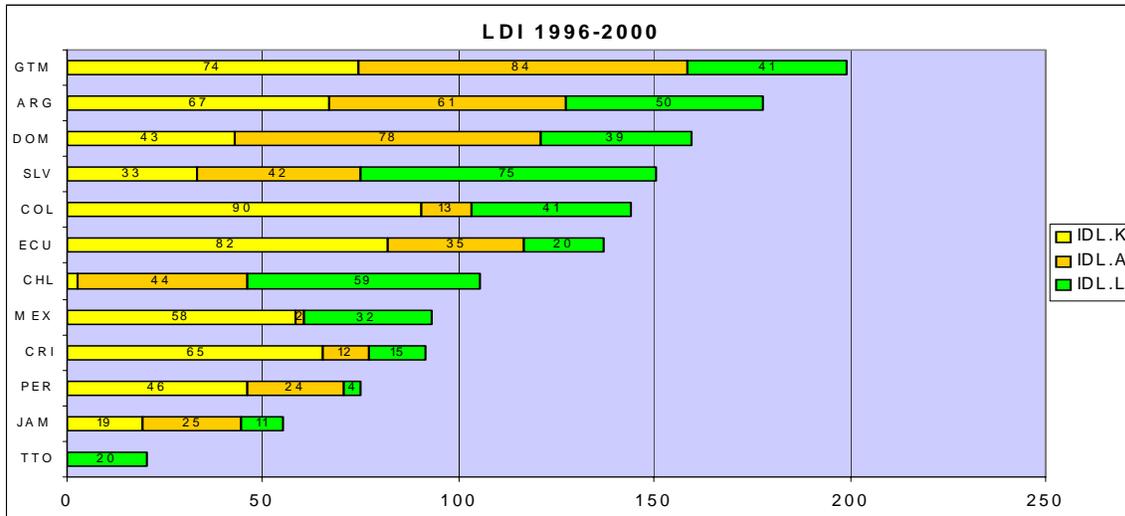
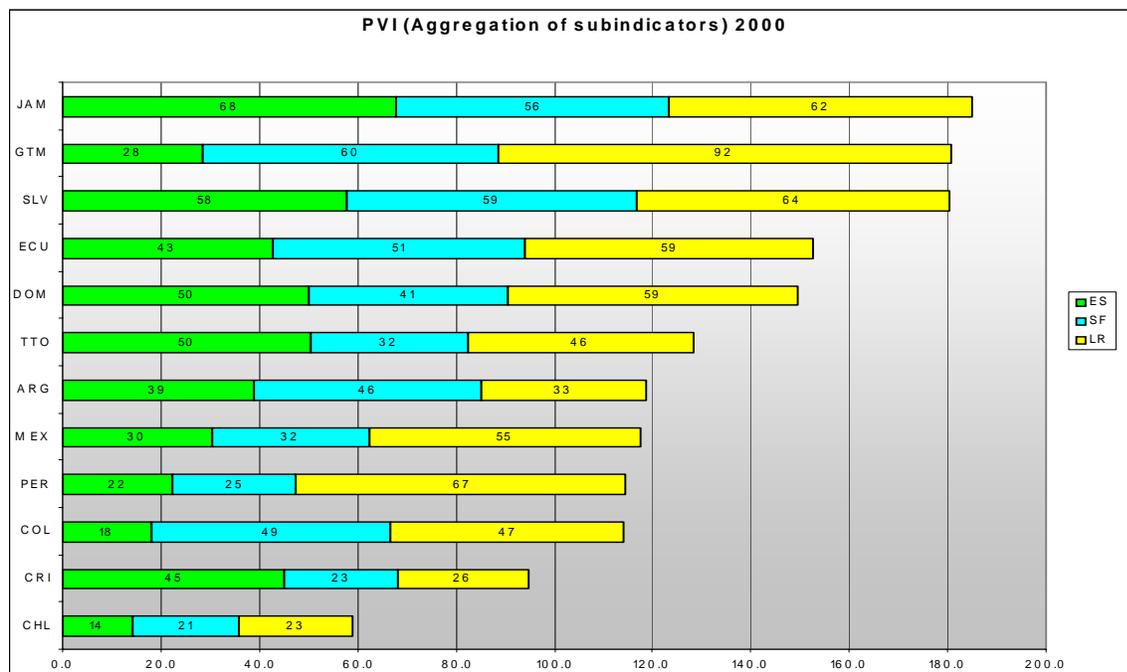


Figure 5. Total Prevalent Vulnerability Index (PVI)



Source: Cardona 2005 p 20

Prevalent Vulnerability Index

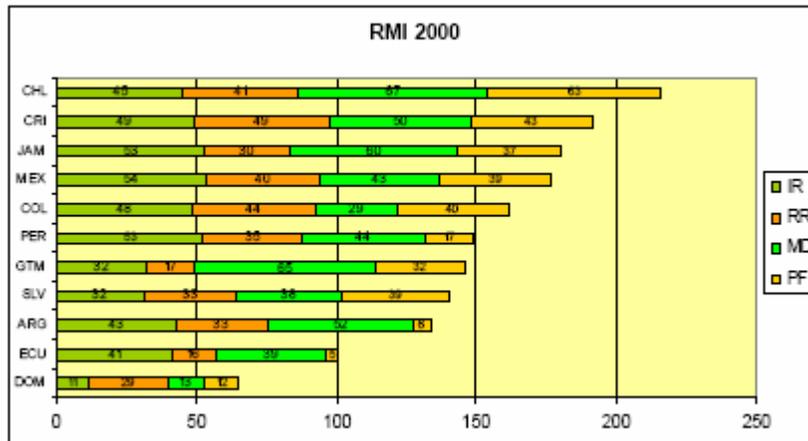
Figure 5 illustrates the PVI values, by country, for 2000 determined by adding together the three components (subindicators): exposure-susceptibility (ES), social fragility (SF), and lack of resilience (LR). On the whole, the index reflects susceptibility due to the degree of direct exposure of the physical infrastructure and people. It also reflects the conditions of social and economic fragility that lead to indirect impacts. Among the countries examined, it appears that Jamaica, Guatemala and El Salvador are especially vulnerable. Chile and Costa Rica seem to have a low vulnerability.

The inclusion of the PVI in the system of indicators is justified to the extent that the execution of effective prevention, mitigation, preparedness and risk transfer actions helps to reduce risk. This evaluation may be useful for ministries of housing and urban development, environment, agriculture, health and social well-being, economy and planning.

Risk Management Index

This index is used to measure the performance of risk management. Figure 6 illustrates the value of RMI for eleven countries in 2000 obtained by summing the four components related to risk identification (IR), risk reduction (RR), disaster management (MD) and financial protection (PF). The evaluations were carried out mainly by the risk management authorities themselves. This subjective analysis resulted in a ranking where Chile, Costa Rica and Jamaica fared the best, and the Dominican Republic and Ecuador the worst.

Figure 6. Total Risk Management Index (RMI)



Source: Cardona 2005 p 26

3. USE OF RISK INDICATORS FOR FINANCIAL PLANNING

The Challenge for the Countries

A country's risk from natural hazard events needs to be factored into the financial capacity of the country to finance its reconstruction obligations after a disaster (Freeman *et. al.* 2003 p 39). Box 4 illustrates the challenge natural hazard risk produces for government fiscal operations and the type of adjustments that may be needed in the short term.

Box 4. Immediate Fiscal Challenges for Jamaica after Hurricane Ivan

Hurricane Ivan hit Jamaica in August 2004. It presented challenges for both revenue collection and expenditures for the remainder of the fiscal year. Prior to the hurricane, returning the government's fiscal operations to a surplus was a critical part of the medium-term sustainable development strategy. At the end of August 2004, revenues were on target and expenditures were 0.7 percent below budget. Because of the hurricane, revenue collections for September were below target due to the cessation of business activities in many sectors and closure of some revenue offices in the pre and post Ivan period. At the same time there were additional demands on expenditures budgeted for both relief efforts and reconstruction. Financing was expected from reallocation, grant receipts from external sources and donations from private sector partners. Due to the high level of indebtedness, the country was not in a position to borrow for reconstruction

Source: Davies 2004 Presentation at the Jamaican Embassy, Washington, DC, Oct. 2004

When disasters occur, reconstruction is typically financed through budgetary transfers, use of reserve funds, diversion of current loans or grant funds and new borrowing. The use of each one of these sources offers challenges for the countries. Budgetary transfers and diversion of loan or grant funds are painful because these actions reduce funding for programmed development projects. The use of reserve funds is coupled with the politically difficult task of keeping such funds at the needed levels in the middle of other government spending needs, and new borrowing increasing indebtedness. Box 5 summarizes the reserve fund scenarios in Colombia and Bolivia.

The establishment of a financial protection mechanism implies consideration of risk factors and is part of what can be described as an ‘*ex ante* risk management strategy’. This tool implies an understanding of probability and taking into consideration an unknown future. Setting up a reserve fund or buying insurance requires spending monies today to make allowances for probable future disaster events. This is problematic, more so in developing countries where there are large immediate demands on government funds. As Freeman *et al.* (2003) put it “[t]o use *ex ante* risk management tools, a policymaker must bridge the psychological gap of weighing the cost of current expenditure against future unknown but predictable consequences. This is often a hard gap to cross” (Freeman *et. al.* 2003 p 62).

Even when using a combination of all the reconstruction financing options described above, countries with historically high incidences of natural disaster may still face significant shortfalls in their ability to finance post-disaster reconstruction. They thus need to constantly reexamine their financial strategies to finance potential disaster related reconstruction. Actions which might increase vulnerability need to be factored into the calculation, as may be the case due to increased urbanization in disaster prone areas.

Reducing the risk of disasters should begin with investments in prevention and mitigation. Financing options should be used to cover the losses after a disaster. Many mitigation investments (such as large scale seawalls to protect against hurricane flooding) are public goods. The state will need to become the driving force behind these projects. However, the private sector bears responsibility for most of the structural mitigation investments (e.g., constructing housing and industrial facilities that are resistant to earthquakes). The government and private sector are also accountable for implementing nonstructural mitigation and prevention measures to reduce risk. Government and private sector mitigation behavior has important ramifications, which affect the cost of implementing financial instruments to handle loss after a disaster. The role of donors and international financial institutions in this instance should be to provide funding both for structural mitigation and nonstructural mitigation and prevention measures.

Programming Development Assistance

The integration of natural hazard risk as a component in the preparing country strategy papers and project programming has received increased interest from the international financial institutions. According to the evaluation of the IDB Disaster Policy 1995-2002, for example, only two

Box 5. Reserve Funds in Colombia and Bolivia

Colombia has a national reserve fund designed explicitly for coping with natural disasters. The fund was established in 1984 after the Popayán earthquake, and its annual funding has been subject to political will. At the end of the 1980s and the beginning of the 1990s, it was an average of US\$5 million a year, but at the time of the 1999 earthquake it was exhausted. Municipal governments across Colombia also keep reserve funds. It is estimated that the reserve funds held in Bogotá and Medellín are each larger than the national one.

Bolivia has passed legislation to set up a natural disaster reserve fund. The goal of the fund is to guarantee that Bolivia has sufficient resources to meet the local counterpart requirement to access borrowing from the international financial institutions. The initial US\$10 million is being provided from unused funds held at the Housing Ministry.

Source: Freeman *et. al.* 2003 p 61

Box 6. IDB Support for Disaster Risk Mitigation in the Atlantic Coast of Costa Rica

In February 2005 the IDB announced the approval of a US\$16 million loan to Costa Rica for the first phase of a sustainable development program in the Atlantic Huetar Region (RHA), a province with potential for tourism and production, but also with high levels of poverty and vulnerability to natural disasters. The main goals are to promote economic and social development projects, reduce risks of disasters, improve natural resource conservation and management, and strengthen governance at the municipal and regional levels.

The program will support measures to reduce the region's vulnerability to natural risks and mitigate the economic and social impact of disasters. Among other activities it will finance the mapping of the risk of floods in key watersheds, the expansion of the region's network of hydro-meteorological stations, the development of early warning systems, the prevention of settlements in high-risk areas and the construction of small-scale flood control infrastructure.

Source: www.IDB.org

country strategy papers explicitly included disaster risk as a priority for country development, while an additional four papers mentioned the need for disaster prevention (IDB 2004). Currently, three new country strategies are under preparation by the IDB that give high priority to proactive disaster risk management.

Other international financial institutions are similarly incorporating disaster risk into their country strategy processes. The Asian Development Bank's new Disaster and Emergency Assistance Policy requires that before a Country Strategy and Program is prepared, there must be a Country Environmental Analysis and a "risk and vulnerability assessment." At the World Bank, there are about 15 Country Assistance Strategies that address disaster risk management. The Hazard Management Unit of the World Bank is currently developing tools to systemize the process of integrating natural hazard risk management into the country programming process. The Caribbean Development Bank (CDB) has worked with its borrowing member countries to improve their disaster policies which would then impact their borrowing (Provention Consortium 2005b).

Mitigation Investment in Projects

The incorporation of natural hazard risk indicators into the programming of joint activities by the countries and the international financial institutions helps to promote proactive disaster risk management. When potential projects are being analyzed, the indicators may warn about the risks and guide the inclusion of mitigation measures in project design, or lead to recommendations to not finance particularly risky projects. With regard to lending to the private sector, disaster risk indicators may point to required insurance coverage.

Training and analysis, especially at the local level, will build a knowledge base and deploy the tools that will help to assess risk, hazards, and vulnerabilities with regard to natural disasters. The information gathered in this way can be used in project decisions by the government, private sector and the IFIs.

The IDB is supporting its borrowing member countries in risk identification, prevention and mitigation. Box 6 illustrates what the Bank is doing to help Costa Rica reduce its vulnerability to

natural hazards risks and mitigate the economic and social impact of disasters in the Atlantic region of the country.

Box 7. Using Risk in Highway Reconstruction and Maintenance

The agency responsible for national highways in Colombia considers the probabilistic losses from natural hazard events in its budgeting process. This agency is responsible for highway maintenance and reconstruction after a disaster. For each segment of the highways, it has prepared a probabilistic estimate of future losses from natural hazard events. These estimates, created with the help of the University of the Andes, are used to set the agency's annual maintenance and reconstruction budget. For years in which the natural hazard events are less than estimated, budgeted funds are used to reduce vulnerability through increased maintenance. For this agency, the link between mitigation and risk reduction is clearly defined. The agency understands its contingent exposure to loss and can therefore plan its resources to manage that risk.

Source: Freeman et. al. 2003 p 38

The importance of incorporating risk of natural hazards into the budgetary and planning process of a highway project is highlighted in Box 7.

4. CONCLUSIONS AND RECOMMENDATIONS

The growing number of casualties and economic costs related to the effects of natural hazards in the region continues to make the case for a change in the approach to disaster risk management. It is costly, both in the short and the long term, for countries to rely mainly on disaster response. If decision makers are provided with the right information that documents the economic and social costs of the natural hazard risks their constituencies face, they have the opportunity to make more efficient decisions on how to manage these risks.

A proactive stance to reduce the toll of disasters in the region requires a comprehensive approach that includes both pre-disaster risk reduction and post-disaster recovery. Such an approach involves the following set of activities: risk analysis to identify the kinds of potential impacts faced by people and development investments as well as their magnitude; prevention and mitigation to address the structural sources of vulnerability; financial protection and risk transfer to spread financial risks over time and among different actors; and post-disaster rehabilitation and reconstruction to support effective recovery and to safeguard against future disasters.

Risk assessments are fundamental for the preparation of any risk reduction strategy. They may be carried out both on national and local levels through risk indicators. Decision makers see risk in different ways. Thus, indicators of risk and risk management options have to be tailored to the intended audience if the expected impact is to be obtained.

Risk assessments will be needed when mitigation and prevention constitute a first line of action in order to reduce potential losses from natural hazards. The measurement of the profitability of mitigation should be adopted. The relevant institutions in the region should use cost benefit analysis in investment decision making. Whereas some attention has been given to integrating mitigation in project design, little public sector support has been directed at encouraging

mitigation in the household sector. Fiscal incentives should be employed to widen home insurance affordability; examples in this respect include making premiums tax deductible and removing value added taxes (Jones and Campbell 2004).

Much of the disaster risk management research work undertaken or sponsored by regional agencies or funding institutions, such as United States Agency for International Development's Office of U. S. Foreign Disaster Assistance (USAID/OFDA), UNDP, Organization of American States (OAS), Caribbean Disaster Emergency Response Agency (CDERA), the *Centro de Coordinación para la prevención de los Desastres Naturales en América Central* (CEPREDENAC) and the *Comité Andino para la Prevención y Atención de Desastres* (CAPRADE) or the funding institutions needs to reach a wider readership than a few select public and non public agencies and institutions. Even though this research may be presented at public forums, abstracts of important research findings should be sent to all public sector managers of significant assets, as well as to associated planning professionals within the specific field of study, and within the regional grouping most associated with the study area. The Internet would be the method of choice for dissemination.

A long-term risk management approach should be adopted by the countries. It should consist of a balance between mitigation investment and *ex-ante* and *ex-post* funding mechanisms. Mitigation measures should be approached as investments rather than costs. Under current risk management practices in many regions including the Caribbean, affected governments bear a large portion of disaster risk. Part of that risk should be transferred to the private sector.

The international donor community should support the effort of moving from an *ex-post* approach to proactive risk management. It will require the provision of the right information in a timely fashion, and by making available financing for risk identification and reduction programs in the region. Instead of focusing resources on post-disaster assistance, development programs should attempt to bolster the reduction of losses and financial preparedness. This focus would give autonomous coping capacities to the countries affected and provide incentives for risk reduction. But it would also guarantee that other important development goals are not jeopardized by the need to reallocate resources, disaster after disaster, to costly emergency and reconstruction activities, which could have been largely avoided through appropriate risk management.

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CHAPTER III: Natural Hazard Risk Management in National and Sector Development Planning

INTRODUCTION

Rainstorms, hurricanes, earthquakes, and other weather phenomena can have a devastating effect on property, human welfare and natural resources. With a yearly average of at least one major hurricane and numerous tropical storms, the economies of the Latin America and Caribbean (LAC) region have been greatly affected by the consequences of recurring natural disasters. Financial costs of natural disasters over the past thirty years in the LAC region have been estimated at between US\$ 700 million and US\$ 3.3 billion per annum while losses from a single hurricane event incurred by individual countries have exceeded annual GDP. While natural hazards are felt across sectors and social classes, their negative consequences further enhance the vulnerability of low-income households and reverse the gains of economic growth.

Main Natural Disasters in the Caribbean (1979-2001)			
Year	Country (Hazard Type)	Persons Affected	Damage US (000's)*
1979	Dominic (David and Frederick)	72,100	\$44,650
1980	St. Lucia (Allen)	80,000	\$87,990
1988	Dominican Republic (Flood)	1,191,150	/
1988	Haiti (Gilbert)	870,000	\$91,286
1988	Jamaica (Gilbert)	810,000	\$1,000,000
1989	Montserrat (Hugo)	12,040	\$240,000
1989	Antigua, St. Kitts/Nevis, Tortolla, Montserrat (Hugo)	33,790	\$3,579,000
1991	Jamaica (Flood)	551,340	\$30,000
1992	Bahamas (Andrew)	1,700	\$250,000
1993	Cuba (Storm)	149,775	\$1,000,000
1993	Cuba (Flood)	532,000	\$140,000
1994	Haiti (Storm)	1,587,000	/
1995	St. Kitts & Nevis (Luis)	1,800	\$197,000
1995	US Virgin Islands (Marilyn)	10,000	\$1,500,000
1998	Dominican Republic (Georges)	975,595	\$2,193,400
2000	Antigua/Barbuda, Dominica, Granada, St. Lucia (Jenny)	/	\$268,000
2001	Cuba (Michelle)	5,900,012	\$87,000
*valued at the year of the event. Source: OFDA/CRED International Disaster Database (EM-DAT) 2002. #USAID/Jamaica 2000, Hurricane Lenny Recovery in the Eastern Caribbean			

Efforts to address the socio-economic and financial burden of natural disasters in the LAC region has primarily consisted of *ex post* conventional financing of emergency reconstruction by means of actions taken immediately prior to, during or shortly after the devastation either on a multi-lateral or bilateral level. By virtue of its mandate of poverty reduction, the World Bank has played a key role in bilateral and multilateral efforts to provide assistance to disaster-affected areas in the LAC region. To date, the World Bank's portfolio for disaster related assistance in LAC comprises 43 projects and amounts to about US\$ 3 billion (Annex 1: World Bank Portfolio of Natural Disaster Natural Disaster Reconstruction Projects).

In recent years, a new paradigm has increasingly gained prominence in the field of natural hazard assistance, *natural hazard risk management*. Both the high opportunity cost stemming from reallocating scarce resources earmarked for development projects to emergency relief and construction efforts; and the shrinking financial resources available from the donor community have encouraged the emergence of a new paradigm in natural disaster assistance, *natural hazard risk management*. This new approach, now recognized worldwide

and incorporated as one of the Millennium Development Goals, promotes a more proactive approach based on planning and investing for addressing the potential impact of natural hazards on an *ex ante* basis.

This paper discusses the key lessons of the World Bank's experience in natural hazard⁹ risk management in national and sector development planning with a focus on the Latin America and Caribbean region. Section One will present the World Bank framework for natural hazard risk management in national and sector development planning. Section Two will discuss the key lessons of the World Bank's experience in natural hazard risk management in national and sector development planning; and Section Three will conclude with a set of recommendations to minimize the impact of natural catastrophes on countries at risk.

1. A STRATEGIC FRAMEWORK FOR NATURAL HAZARD RISK MANAGEMENT

The traditional World Bank response to natural disasters has been a two-fold *ex post* approach: (1) the financing of emergency reconstruction projects on a bilateral and multilateral basis, Emergency Projects (ERLs); and (2) the reallocation of funding from ongoing Bank projects to emergency funding. Over the last thirty years, the World Bank's contribution to natural disaster reconstruction and mitigation projects amounted to about US\$ 12 billion with lending for all disaster related operations amounting roughly to US\$ 38 billion over the same period. Between FY 1980 and FY 2000, the World Bank has supported 102 reconstruction projects including 36 in the LAC region ranging from flood rehabilitation projects in Argentina to disaster mitigation projects in Honduras and Nicaragua following the devastation caused by Hurricane Mitch.

In recent years, a new paradigm has increasingly gained prominence in the field of natural hazard assistance, *natural hazard risk management*. Several factors have motivated this new pattern including (1) growing empirical evidence of the limitations of traditional natural catastrophe assistance in terms of timeliness, efficiency of resources allocation as well as long term impact on hazard risk mitigation; (2) the high opportunity cost stemming from reallocating scarce resources earmarked for development projects to emergency relief and construction efforts; and (3) the shrinking financial resources available from the donor community.

This innovative approach, now recognized worldwide and incorporated as one of the Millennium Development Goals, is based on planning and investing for addressing the potential impact of natural hazards on an *ex ante* basis. It seeks to incorporate natural hazard management into economic planning and focuses on (1) investing towards reducing the potential devastation of natural disasters *ex-ante*, *disaster risk mitigation*; and (2) identifying market arrangements to take into account events that cannot be addressed through structural or preventive damage reduction and events that have the potential to yield large economic casualties, *catastrophe insurance*.

The World Bank Hazard Management Unit was established in 1998 with the primary objective of disseminating natural hazard management both within the World Bank Group and with client countries and other international financial and development institutions. The World Bank hazard

⁹The focus of this paper is on earthquakes, floods and landslides and excludes droughts, forest fires, or pest infestations which require a different set of risk management techniques.

risk management framework aims to serve as framework to help design and finance country-tailored hazard risk management strategy. It is based on five pillars which provide the World Bank's client countries with an operational template to gradually and systematically invest in upgrading their systems¹⁰:

- ***Pillar 1. Risk identification and assessment:***

The first pillar of the strategy rests on the critical importance of a thorough understanding of existing vulnerabilities, including their location and severity, for the development and prioritization of investment programs for risk management. A broad range of activities contributes to the identification and understanding of natural hazard risks including hazard data collection and mapping, technical studies and participatory workshops, vulnerability assessments, risk assessments and post disaster assessments;

- ***Pillar 2. Risk mitigation:***

Risk mitigation projects entails financing vulnerability reduction investments and mainstreaming non-structural interventions such as enforceable building codes and land use planning techniques into municipal norms, standards and planning processes. Activities to reduce future vulnerabilities would typically include the development and enforcement of building standards, environmental protection measures; land use planning that recognizes hazard zones, and resource management practice, etc.;

- ***Pillar 3. Emergency preparedness:***

Emergency preparedness deals with planning and actions undertaken in advance of a possible or probable disaster to protect life and economic losses with a focus on the most vulnerable populations. Emergency Response Planning Exercises, Emergency Preparedness, Public Awareness, Communication and Information Management Systems and Technical Emergency Response Capacity are the key components of the World Bank's emergency preparedness framework;

- ***Pillar 4. Catastrophe risk financing or transfer:***

Bank projects increasingly include risk transfer mechanisms including catastrophic insurance and risk pooling mechanisms to shield governments and their populations from events that have the potential to cause large economic losses. Such arrangements typically comprise *ex-ante* funding arrangements, catastrophe insurance pools, reserve funds and a contingent capital facility;

- ***Pillar 5. Institutional capacity building:***

Institutional capacity building focuses on developing the ability of individuals, institutions, and societies to plan, own and control effective natural hazard risk management strategies. Several initiatives conducted either at the national or at the regional level contribute to the development of institutional capacity building including decentralized emergency management systems, community participation, legislative

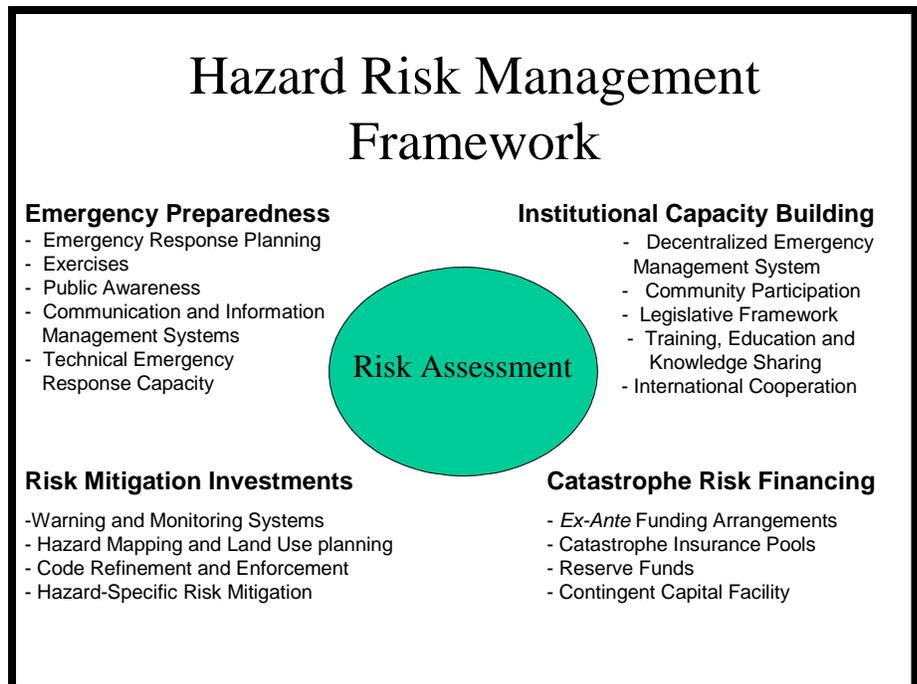
¹⁰World Bank, 2004, "Preventable Losses: Saving Lives and Property Through Hazard Risk Management: A Comprehensive Risk Management Framework for Europe and Central Asia."

framework, training, education and knowledge sharing as well as international cooperation.

The underlying principles of the framework are that both loss of life and the economic impact of disasters can be reduced by advance planning and investment in national and sector development programs, that it is cost effective to do so, and that doing so is a government responsibility. To develop an affordable and efficient hazard risk management strategy for natural hazard risk management in national and sector development planning, the following basic questions need to be addressed:

- **Pillar 1. Risk identification and assessment:** What is the country’s hazard exposure? What are the economic and social losses? What is the probability of loss exceedance? Where is the risk concentrated?
- **Pillar 2. Risk mitigation:** What structural and nonstructural measures are suitable and affordable to mitigate physical damage? What are the priorities for intervention, considering risk to lives, livelihoods, and the need for emergency facilities? How best can these measures be financed and sustained?
- **Pillar 3. Emergency preparedness:** Is the country sufficiently prepared to respond to emergency situations organizationally as well as technically? Do the existing coordination and response mechanisms function under stress? How efficiently are public, nongovernmental, and bilateral and international aid institutions integrated in the emergency response system?
- **Pillar 4. Catastrophe risk financing or transfer:** What is the country’s financial capacity to absorb catastrophic events? Is there a funding gap? What are the most suitable financial instruments with which to address the funding gap?

1. **Pillar 5. Institutional capacity building:** What is the country’s capacity to manage emergencies at different levels of government? Is an institutional framework and coordination mechanism in place that allows strategic planning and decision-making at the central, regional,



Source: World Bank Disaster Management Facility

and local levels? Are technical, social, and economic considerations integrated adequately in the investment decision process?

2. KEY LESSONS IN NATURAL HAZARD RISK MANAGEMENT

World Bank studies based on recent natural catastrophes in the LAC region¹¹ help to identify lessons learned from the implementation of disaster risk management strategies supportive of economic development in the areas of *(i) disaster risk mitigation; and (ii) catastrophe risk financing.*

(i) Key lessons in disaster risk mitigation:

In practice, World Bank disaster risk mitigation programs in the LAC region have been applied through projects aimed at housing reconstruction such as (1) the Mexico City Earthquake Reconstruction and Rehabilitation project that highlighted the importance of integrating better quality materials and hazard resistant standards into architectural designs; and (2) Brazil's Rio Flood Reconstruction project that included voluntary relocation of families in risk area underscored the need for an integrated approach to prevent illegal reoccupation.

Components of successful natural disaster mitigation projects have been identified as¹²:

- (i) Strong borrower ownership;
- (ii) Appropriate institutional framework (existing agencies perform better than ad hoc new ones);
- (iii) An integrated approach that addresses short term as well as long terms problems;
- (iv) A systematic application and enforcement of hazard resistant standards and;
- (v) Flexibility of project design, procurement and disbursement procedures.

(ii) Key lessons in catastrophe risk financing

Bank projects in natural disaster related assistance increasingly promote risk transfer mechanisms including catastrophic insurance and risk pooling mechanisms. The role of the World Bank in managing catastrophic exposure of client governments generally comprises (1) assistance in identifying and understanding financial risk exposures; (2) assistance in designing national risk management strategies, including the retention and transfer of risks; (3) assistance with the design and choice of hedging instruments, reserve pools and access to reinsurance and international capital markets.

Key lessons for sustainable catastrophe insurance schemes in disaster prone countries are listed as¹³:

¹¹ Responses to Earthquakes in Columbia, building community capacity to mitigate disasters in Honduras and financing vulnerability reduction in Nicaragua.

¹² World Bank, May 1999 "Learning from World Bank's Experience of Natural Disaster Related Assistance"

¹³ John Pollner, 2001. "Catastrophe Risk Management: Using Alternative Risk Financing and Insurance Pooling Mechanisms."

- (i) The importance of instilling risk management practices at the individual country level by better controlling 'exposure' through regulatory actions aimed at vulnerability reduction programs particularly for the low income sectors;
- (ii) The need to better understand the financial exposure and the timing of the financial needs in case of a disaster, so as to tailor risk financing mechanisms to the actual needs;
- (iii) The need for an appropriate regulatory framework for emergency budget appropriation and execution in case of emergency;
- (iv) Ensure that the local insurance sector has sufficient capital (net of reinsurance cover) to withstand large losses;
- (v) In the context of small economies, subregional diversification and exploitation of the latest risk transfer techniques (including pooled capital), can allow for risk diversification and economies of scale while helping to buffer the disruptive supply effects of worldwide disasters on domestic markets; and
- (vi) Multilateral development institutions have a key role to play in setting the basis for *ex ante* regulatory requirements to ensure financial solvency and risk reduction.

3. RECOMMENDATIONS

I) Review hazard risk management practices in high-risk countries. Countries that face a high risk of natural disasters should review their current practices for managing natural hazards and develop targeted programs for building capacity and mitigating risk.

II) Carry out detailed risk assessments. Highly vulnerable countries should conduct detailed risk assessments geared toward providing projections of the average annual expected loss and the probable maximum loss from a single catastrophic event. This information should be the basis for developing an efficient and cost-effective risk management strategy in national and sector development planning.

III) Integrate hazard risk management into the economic development process. Emergency planning and risk mitigation need to be an integral part of both the rural and urban development process with participation by all stakeholders. Hazard information needs to be incorporated into land use plans and enforced by local governments in order to reduce the vulnerability of towns and cities. Buildings and infrastructure in high-risk areas need to be reviewed for hazard-specific performance criteria to reduce the level of damage and ensure that essential services will function under emergency conditions. Particular attention needs to be given to adequate construction codes and their enforcement. Consideration should be given to adopting cost-effective and sustainable flood protection measures (such as improving dikes, retrofitting dams with larger spillways and gates, enlarging floodways, and revising current operating rules of dams). Flood management should be seen within the overall framework of river basin and catchments water management plans.

IV) Adopt country-specific, high-priority risk mitigation measures. Specific risk management measures need to be adopted based on a country's hazard exposure. These measures should strike a balance between upgrading emergency preparedness, investing in physical risk

mitigation measures, strengthening the institutional capacity to manage hazards, and introducing a risk financing strategy.

V) Develop a catastrophe risk financing strategy. Countries need to develop and introduce targeted risk financing strategies for dealing with catastrophic events that can have a severe impact on their economies. The strategy would address the funding gap caused by the need to recover economic losses and meet social obligations and other responsibilities following a catastrophic event. Developing a risk financing strategy is particularly important for smaller countries with high debt levels.

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CHAPTER IV: Natural Hazard Mitigation Options and Their Implementation Through National Development

This chapter draws on work covering natural hazard mitigation options and their implementation through development processes at the national level. It addresses issues dealing with natural hazard mapping, vulnerability assessments and risk management in development assistance for the economic and social sectors and examines options for mitigating the impacts of natural hazard events through national development.

In the first section, the issues include the presently available processes to generate natural hazard information, an essential technical component of mitigation options, and their relationship to the concept of a public good, to development projects, and to the resources needed to sustain them.

The second section describes options for natural hazard mitigation beginning with vulnerability assessments and risk identification as part of development policy, planning and assistance thus making the mitigation of natural hazards a factor in development decisions. The discussion emphasizes that vulnerability reduction and risk management, rather than emergency preparedness, are central to shaping development policy, programs and projects to reduce losses.

The third section focuses on implementation of options for mitigating the impact of natural hazard events. Included are concepts for risk reduction using national and sector policy, program and project processes, and their sequencing. Risk factors related to financial, economic and physical risk are discussed, observations related to available and proposed options are presented, and examples of the benefits and costs of investing in specific mitigation projects – including “what if” scenarios.

Countries have the primary responsibility to deal with the vulnerability of their populations and their economic and social responsibility.

National territories – countries or more specifically, sovereign states – have the responsibility, first and foremost, to deal with natural hazard risk management. It is increasingly clear that international development entities including lenders, donors and development assistance agencies do not assume responsibility for the natural hazard vulnerability created by or associated with the goods and services stemming from their development assistance. Sovereign states are the focus of international, hemispheric and regional efforts to deal directly with natural hazard risk management.¹⁴

Given that the international development community does not assume responsibility for natural hazard risk, the countries, lead by the ministries of finance and planning, must assume that responsibility.

¹⁴ The Organization of American States (OAS) member states have adopted the Inter-American Strategic Plan for Policy on Vulnerability Reduction, Risk Management and Disaster Response (IASP), CP/doc.3737/03 corr.1, and have participated in United Nations conferences on the theme of natural disaster reduction.

Natural hazard events provoke the predominant catastrophic losses in OAS member states.

Natural hazard events provoke the most prevalent and costly types of disasters that are faced by Caribbean and Latin American countries. The present discussion does not include hazards such as industrial accidents, civil unrest, and terrorism. Certainly mitigating the impact of a natural hazard event shares elements in common with dealing with broader security issues, consequence management and the need for external assistance in case of an event. But natural hazard events differ considerably from other hazard types as to what can be done both about the hazardous event itself as well as the related exposure. Most developing countries have concentrated on natural disasters in an *ex-post* context and on improving the preparedness for and response to the next event. Far too often this fixation has overshadowed the more relevant concern for the causes of the vulnerability and efforts to modify either the hazardous event itself or its impact in order to reduce losses.

Natural disasters constitute a major constraint to national development.

Natural disasters are seen as a major constraint to carry out national development plans, programs and projects¹⁵. Mitigating the possible impacts of natural hazard events should be addressed before attempting to transfer the risk. Thus, it is important to discuss the structure and function of natural hazard mitigation options and their implementation as part of national development processes including those supported by international development assistance.

1. NATURAL HAZARD INFORMATION – A NECESSARY BUT NOT SUFFICIENT COMPONENT OF MITIGATION IMPLEMENTATION

At present, there is growing availability of natural hazard information, but it is generated not on demand but through well intentioned initiatives to supply such information.

Sovereign states and their supporting multilateral, bilateral, non-governmental organization (NGO), private voluntary organization (PVO) and private, for profit partners have developed fairly sophisticated processes to develop the information necessary to condition development actions for priority themes over the past four decades of modern development in the Americas. Natural hazard information is a rather new and a rather low ranking theme for development organizations and institutions.

Much of the available natural hazard information is supply driven. It is generated with or without specific requests and is often prepared for science and engineering research purposes. In the foreseeable future, there will not be a sufficient number of supply-driven activities to cover the need for natural hazard information. While there is certainly a growing availability of natural hazard information¹⁶ with a growing number of partners in the public, academic, development lending and assistance, financial risk management, and private consulting area, these are

¹⁵ The IASP and UN conference findings also point out the impact of natural disasters on development.

¹⁶ Although during the past four decades of increased production of natural hazard information, particularly map-based information, and particularly at the micro zonation level, there are few countries in the hemisphere with data bases identifying the hazard information available, much less facilitating accessing the information.

insufficient in light of the calls for mainstreaming natural hazard risk management in development.

Natural hazard information should be seen as a public good.

Today, it is increasingly difficult to put forward national endeavors to produce goods and services for the common good and even more so at the regional level.¹⁷ There is an increasing need for natural hazard information that can only be satisfied with international development assistance. Issues of public domain, access, cost, reliability, and accuracy should be discussed openly in public forums by all stakeholders and concrete decisions made as to how to provide the necessary information. Current national and international policies that promote natural hazard information as a “need to know” item, a value-added item, and a market economy commodity available for a fee, if not for profit, need to be modified.

The development process should play the dominant role in creating a demand for natural hazard information.

Development processes that identify, define and prepare development actions should generate a demand for natural hazard information to shape development decisions. There are still far too few instances where the owners and operators of vulnerable infrastructure are asking for such information. This is due in great part because such information is not seen as necessary to shape development decisions. In other words, there are examples of supply-driven application of natural hazard information but only a few examples of a sector or community seeking to apply natural hazard information to evaluate their vulnerability.¹⁸ In turn this situation is due to a lack of transparency, visibility and accountability in dealing with natural hazard risk.

Owners and operators should be demanding and generating natural hazard information.

Government and private sector entities that own and operate social and economic infrastructure are increasingly being asked to make risk management decisions but without the needed natural hazard information. A policy that makes natural hazard information a public good is essential to defining vulnerability and risk in order to identify options for mitigation implementation.

Under existing circumstances there will not be a sufficient supply of natural hazard information.

There is no reasonable expectation that the array of necessary natural hazard information will be made available through new development¹⁹ loan and grant initiatives. This is particularly true of information needed to deal with the natural hazard vulnerability of the poor, dispossessed, and displaced populations and their working and living environments. In addition, there is no

¹⁷ Birdsall, Nancy. ‘Seven Deadly Sins: Reflections on Donor Failings.’ Working Paper Number 50, Center for Global Development, December 2004

¹⁸ There are isolated examples of sector specific audits, such as the one undertaken in a small number of Caribbean countries for the electrical energy, education and health sectors.

¹⁹ Development activities in this context include traditional agriculture, energy, tourism, transportation, and urban infrastructure, environment projects, social projects, and natural disaster mitigation and reconstruction projects.

reasonable expectation that natural hazard information related to existing energy and transportation, or lifeline infrastructure such as potable water, education and health facilities will be generated except through a demand basis with the owners and operators of the infrastructure prioritizing the use of the necessary resources for its generation.

Poor populations and poorer sovereign states must be the beneficiaries of systematic and comprehensive production of natural hazard information with outside assistance.

The needed natural hazard information can be generated on a demand basis.

A systematic and comprehensive approach to natural hazard information must be put in place through broad international support for the concept of natural hazard information as a public good. Priority hazards and geographical locations must be determined that address the issues of public domain, access, cost, reliability, and accuracy. The roles of the particular international, national and sub-national public and private sector participants can be quickly defined in accordance with their particular development expertise and interests – by sector, river basin, community-based development program, etc.

The present lack of such information does not reflect the lack of knowledge, experience or expertise of these participants. Rather, it reflects the absence of natural hazard risk management as part of development approaches and practices. It will be necessary to gather, analyze and disseminate relevant natural hazard information at the appropriate level of detail (scale, severity and return period) commensurate with the level of the decision to be made regarding vulnerability and risk.

Natural hazard information should be managed at two levels.

The use of natural hazard information needs to be managed at two different levels responding to two different situations. The first level refers to the population, particularly the poor, who must deal daily with multiple risks but who have limited knowledge and understanding of risk management. The second level refers to the population that does have knowledge and an understanding of risk management, but chooses not to be proactive in risk reduction. For the first level, natural hazard information must be used to educate the population to better understand risk, and for the second level, the natural hazard information can be used to present incentives for taking actions. These incentives can be built around passive actions such as zoning, building codes and mandatory insurance that are part of societal processes and reflect use of natural hazard information, or elective actions that are left at the discretion of the population.

2. IMPLEMENTATION OF THE MITIGATION OPTION THROUGH INTERNATIONAL DEVELOPMENT ASSISTANCE – THE INITIAL IMPLEMENTATION OPTION IN THE DEVELOPMENT CONTEXT

In the past natural hazard risk mitigation has not been an objective of development policy.

At the policy level, discussion of investment in natural hazard risk mitigation in development is a fairly recent occurrence in political and development circles. Risk management of natural hazards has not been an explicit objective of development. At the country strategic action plan and program definition level, the definition of acceptable levels of risk and justification in

investment in vulnerability reduction has been absent. In most cases, “best local practices” have been the accepted, adopted criteria. And at the project level, while great strides had been made toward integrated, multi-sector development approaches to natural resource management, particularly coastal areas, these approaches have been and are, knowingly or unknowingly, rather blind to the impact of natural hazard events. This is particularly important given the link between a robust economy, good development, resilient infrastructure, poverty reduction and sound environmental management.

The technical challenges of natural hazard mitigation are well understood, but obstacles remain to implementation.

The technical challenges of disaster mitigation are well understood. Significant progress has been made in better understanding of natural hazard risk through hazard mapping and vulnerability assessment. Most countries have development guidelines, land use plans and building codes. Yet, there is a need to address the persistent obstacles of public perception, political expedience and institutional weakness if any headway is to be made in reducing the vulnerability of population, infrastructure and economic activities.

The most common reaction from the political directorate in the Caribbean to programs that would insist on more stringent building and development standards still is: "Our nation is too poor to afford those higher standards." Examples of past damage and destruction from the Caribbean region indicate that this is a myth. It is cost-effective to invest in mitigation of natural hazards, and developing countries cannot afford to waste scarce development resources on rebuilding damaged infrastructure. (See the box on Lessons Learned from Failed Caribbean Infrastructure.)

The International Finance Institutions’ policy towards natural hazard risk management has evolved over the past decade toward a more proactive stance.

By the end of the last decade, IFIs in the region had made significant public statements linking disaster losses and existing vulnerability to development practices, and to the need for risk management. The characteristics of evolving international development assistance directly related to shaping disaster reduction in the region continue to be:

- Increased use of private capital for both public and private development projects;
- Few funds available for natural hazard vulnerability and risk studies compared with the exposed populations and infrastructure;
- Competition with other special development issues;
- Few public sector specialists with experience in natural hazard risk management;
- An emerging profile of national development by program whereby development is defined by activities for which international assistance is available;
- The growing occurrence of for sale rather than no cost hazard, vulnerability and risk information; and
- The consequences of viewing natural disaster losses as an environmental sector issue, a sector where no one is responsible if everyone is not responsible.

**Lessons Learned From Failed Caribbean Infrastructure:
Four case studies carried out from the CDMP**

There are several factors that determine the capacity of a building to withstand the effects of natural hazards. For example, decisions made throughout the life of an infrastructure project or a building - from planning, design and construction, through ongoing maintenance - affect the resilience and, consequently, the life span of these investments. To better understand the causes of building and infrastructure failure, the OAS – United States Agency for International Development (USAID) Caribbean Disaster Mitigation Project (CDMP) carried out four case studies of public structures that suffered damage from tropical storms. The purpose of this study was (1) to examine the decision making process underlying the design and construction of the facility to determine whether the failures could have been prevented by appropriate design and construction principles and by effective use of hazards and vulnerability information in the planning and implementation of the project and (2) to calculate the incremental cost of designing and building it to standards that would have allowed the building to withstand the hazards withstood the hazards, and to compare this cost with the actual reconstruction costs and the original project cost.

Case Construction Date Location	Event/Outcome	Original vs. Reconstruction costs (1975 US\$ unless otherwise noted)	Opportunity Costs
Deepwater Port 1974-1978 <i>Dominica</i>	<ul style="list-style-type: none"> • Hurricane David (1979) • Category 5 hurricane • Damaged portions of revetment, the port buildings and approach trestles 	Original = \$5,676,000 Reconstruction = \$2,310,000	Mitigation at the time would have increased original construction costs by 10-15%. The reconstruction cost was 41% of the original cost.
Higher Education Building 1975 <i>Jamaica</i>	<ul style="list-style-type: none"> • Hurricane Gilbert (1988) • Winds in excess of 145 mph • Roof badly damaged 	Original = \$685,000 Reconstruction = \$28,800	Estimated expenditures at the time of construction to prevent damage would have cost \$13,000 (1.9% of original construction costs and 45% of reconstruction costs)
Bridges 1960's and rebuilt after 1994 flood. <i>St. Lucia</i>	<ul style="list-style-type: none"> • Heavy rain/flooding from tropical depression 1994 and 1996 • Bridge failure • In 1996 reconstructed bridges destroyed due to faulty or insufficient reconstruction efforts 	(For Troumassee Bridge) Original = \$185,000 Reconstruction= \$32,100	\$120,000 was spent to repair and reduce the size of the waterway under the Troumassee Bridge. Those modifications were the chief cause of the reconstructed bridge's destruction.
Hotel 1992 <i>St. Thomas</i>	<ul style="list-style-type: none"> • Hurricane Marilyn • Category 2 hurricane • Severe roof damage, roof tiles broken from flying debris, collateral damage to swimming pool and grounds 	Original = \$28,000,000 (1992 US\$) Reconstruction = \$5,300,000 (1992 US\$)	Additional mitigation costs would have been less than \$28,000 (0.1% of the original cost)

A review of the four case studies indicates that the failures were in large part preventable. A study of hazards, and of appropriate construction standards, would have avoided most of the damage and would have increased the original project cost by less than 0.5% (Grand Palazzo Hotel) and 12 % (Dominica Deep Water Port). In all cases, the cost of rebuilding after the disaster was more than double the mitigation cost, and in the case of the Manley Library, reconstruction costs came to 20 times the mitigation cost.

Clearly, additional mitigation measures taken at the time of the original construction would have led to significant savings over the costs of reconstructing the facilities. It should be noted that the cost of reconstruction is a conservative estimate of the losses suffered by a failed project, since it does not include various indirect and secondary losses associated with the interruption in the functioning of the damaged facility.

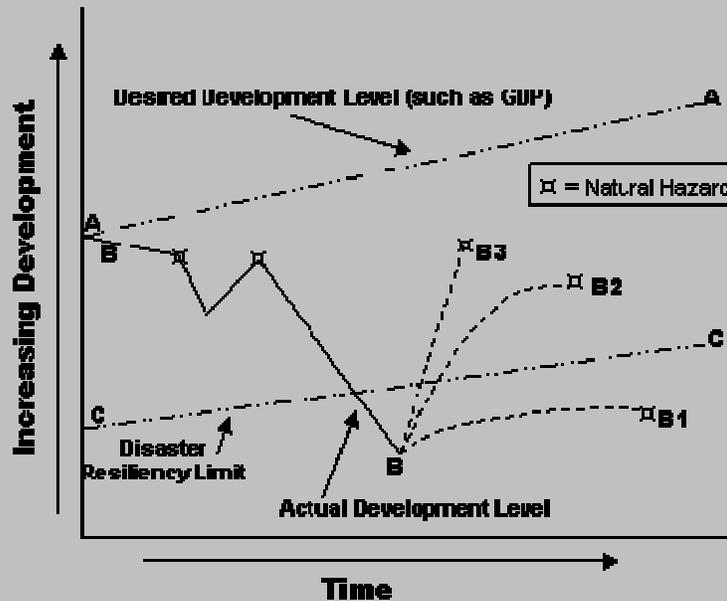
Perhaps more importantly, as poverty alleviation has emerged as the principal development problem to be addressed, the relationship of the poor to disaster reduction has been marked by:

- A lack of understanding of the relationship of the vulnerability of the poor to natural hazards and to other threatening circumstances;
- A lack of recognition that physical and economic risk management may have more to do with poverty alleviation than financial risk management; and
- The ever emerging realization that the poor will need assistance, including subsidies.

Development, Disasters and Mitigation

A country may plan for increasing its development level (line A-A) as measured by a preferred unit such as GDP. The actual development level may be impacted by a natural hazard event (*) such as an earthquake, drought, hurricane or volcanic eruption. The impact causes a decline in the actual development level ((line B-B). The impact of the event may actually be so severe that the resulting level of development falls below the disaster resiliency level (C-C) and the country must declare an international appeal for assistance – a disaster. The affected population then becomes dependent on external assistance. The post-disaster recovery may lead to approaching the desired development level (B₃) but most often leads to a prolonged, significant drop in development (B₂) or even an extended dependency on outside assistance (B₁).

Investing in mitigation increases the distance between the actual development level (line B-B) and the disaster resiliency level (line C-C) allowing the country to use development resources for development, not for disaster relief and reconstruction. Natural hazard events are inevitable, but disasters are not.



Source: Adapted from Bender, Stephen. "Disaster Preparedness and Sustainable Development." Science and Technology in the Developing World: Liberation or Dependence? Indiana Center on Global Change and World Peace, Indiana University Center on Philanthropy, Program on Scientific Dimensions of Study, Indiana University, Bloomington, Indiana, 8-9 October 1992. 6 pp.

Natural hazard risk mitigation options must be considered in the development process.

Natural hazard risk mitigation options should be dealt with as part of the process of development assistance. There are three points during the development assistance process when risk to natural hazard events should be considered:

- 1) The review of country eligibility for assistance;
- 2) The project preparation process including identification, appraisal and design; and
- 3) The project approval, implementation, monitoring and evaluation process.

The earlier in the development process that natural hazard risk mitigation options are considered, the more likely an acceptable level of risk will be achieved²⁰.

Natural hazard risk mitigation must be seen in the context of the process of development, not as an adjunct action to be applied once development decisions are made.²¹ Mitigation must be considered before preparing for and responding to expected or unexpected losses and the resulting emergency. It must go beyond sector strategies for providing financial assistance in case of catastrophic loss and address the root causes of the vulnerability. Each development action must be seen as an opportunity to mitigate against possible losses to natural hazard events. (See the box on Development, Disasters and Mitigation.)

The context of approaching natural hazard risk mitigation options can be seen in two major groupings: Existing vulnerability and new development actions.

There are two major groupings of populations and infrastructure at risk. One is existing populations and their economic and social infrastructure. In most instances over 90% of the vulnerable population and infrastructure to be dealt with tomorrow exist today. The other grouping is the population and infrastructure associated with “new” development activities²². International development assistance deals with both groupings. In some instances lenders, donors and development assistance agencies are encouraging countries to deal with risk management issues through stand alone “mitigation” activities as well as in post-disaster reconstruction. This approach broadly addresses the exposure of existing infrastructure in OAS member states. It responds to the fact that much of the existing vulnerability of populations and infrastructure is directly related to failed development practices. But development planning is primarily dealing with new actions. There, also, natural hazard risk mitigation options must be considered.

This initial option for mitigating risk focuses on support from the international community in the country’s efforts to identify and decide upon acceptable levels of risk for both existing

²⁰ For a detailed discussion of consideration of risk in development planning and project preparation, see “Incorporating Natural Hazard Assessment and Mitigation into Project Preparation – Report to CIDIE members by the OAS,” OAS 1987, and *Primer on Natural Hazard Management in Integrated Regional Development Planning, Chapter 1 Incorporating Natural Hazard Management into the Development Planning Process and Chapter 2 Natural Hazard Risk Reduction in Project Formulation and Evaluation*. OAS 1990

²¹ For a complete discussion of the topic, see OAS 1987 op. cit.

²² Development activities in this context include traditional agriculture, energy, tourism and transportation projects, and urban infrastructure, environment, and social program areas covering voluntary and forced social, economic and environmental migration and resettlement.

infrastructure and populations, as well as for new development actions. There are far too few experiences at present to draw many conclusions at the policy level on the effectiveness and efficiency of incorporating risk reduction into new development actions or investment in reducing existing vulnerability. Issues include existing indebtedness, borrowing capacity and development priorities. But it does appear evident at this point that many OAS member states will be looking to the international development community for grants and other instruments that will not affect their capacity for accessing resources for traditional development through infrastructure, environment and social projects.

In the end, mitigating losses due to natural hazard risk is an exercise in trade-offs between competing demands for investment capital. It is critically important to understand whose risk is the subject of those trade-offs.

Using Environmental Impact Assessments (EIAs) and other development planning mechanisms to promoting natural hazard risk mitigation options presents issues and opportunities.

Several issues and opportunities are related to using development planning mechanisms and international development assistance for mitigating the risk to natural hazard events. Before this type of mitigation strategy can be selected, the development process, at one point or another, has to produce the vulnerability assessment and risk identification,²³ if not also the natural hazard information.

For some institutions, the EIA process offers a defined process, particularly if it is rigorous in assessing who and what is at risk and why. The Caribbean Development Bank (CDB) has elected to include natural hazard risk management as a formal part of the EIA process. At each step of the process, the possibilities of natural hazard events impacting the project are assessed as are the impacts of the project on ecosystem structure and function. Of particular importance is the role of naturally occurring mitigation elements such as mangroves, sea grass bends and reeds in dealing with natural hazard impact. Risk to natural hazard events can be examined in the EIA process, but that examination will now and in the future be subject to EIA strengths and weakness, including the cost of taking into account environmental impacts in the broader development view.

In other instances, natural hazard risk evaluation is carried out apart from the EIA process. Such an evaluation may use emerging risk indices and call for vulnerability and specific risk evaluations if initial determinations find natural hazard risk to be an issue. Like the EIA process, the evaluation is meant to shape the development decision.

Vulnerability reduction may be the central focus of the proposed development project.²⁴ In such cases, target populations and infrastructure are defined at the outset, and acceptable levels of risk

²³ Vulnerability assessments can be quite general or specific, as can risk analyses. In the context of the development process, it is always preferable to match the level of vulnerability and risk information with the role it will play in the development decision at any particular stage of the process.

²⁴ Mitigation projects along with disaster reconstruction projects are now defined as a discrete lending or grant program by some international financing institutions, bilateral agencies and NGOs.

with the corresponding actions to be taken are identified. Most prevalent among the experiences to date are community level vulnerability and capacity assessments focusing on essential social and economic infrastructure that, whether owned and operated through the public or private sector, is crucial to community well being, particularly for the poor. (See the box Incorporating Mitigation in International Development Assistance.)

Chapters 1, 2 and 3 of this document discuss the use by international development assistance institutions of their own policy and programming processes, and the related documents produced by the national government with their assistance. These processes and documents focus on risk reduction (both in qualitative and quantitative terms) as a development goal, as a policy objective, as a visible decision management element, as a transparent and accountable program and a project element, and as an element for program and project contingency in case of loss. What is less clear at this point, given the responsibility that national governments and the private sector must bear for vulnerability, is the role that conditionality and technical requirements for assistance related to risk management will play. Lending and donor institutions are now more likely to move toward, rather than away from, imposing or requiring equivalency to set norms and performance standards regarding technical criteria for projects.²⁵

At the community-development level, programs, such as the Vulnerability and Capacity Assessment (VCA) of the International Federation of the Red Cross, have begun to use established community-based development activities to assess natural hazard vulnerability based on local analysis as well as natural hazard information from outside sources. These assessments lead to a discussion of a community's ability not only to deal with the natural hazard event but to also lessen the vulnerability of the community's citizens and infrastructure.

Incorporating Mitigation into International Development Assistance

“Our research revealed that, while greater investment in risk reduction would make economic and moral sense, risk reduction remains a relatively low priority within donors’ relief and development plans, processes and practical implementation. This conclusion emerged from our discussions with donors...”

La Trobe, S. and Venton, P. *Natural Disaster Risk Reduction – The policy and practice of selected institutional donors*. Tearfund 2003

Measuring Mitigation ...” finds that many of the standard tools currently used by aid agencies to design projects could also be used to assess risk emanating from natural hazards and potential returns to mitigation. These include a variety of tools for economic, environmental and social appraisal, as well as risk and vulnerability analysis and logical framework analysis. In most cases, they are designed to take interacting hazard-risk-vulnerability issues into account. Often, all that is needed is a shift in emphasis when they are being applied or a more explicitly integrated approach that brings individual methods together. There is nothing intrinsically difficult about either appraising natural hazard-related risks or monitoring and evaluating risk reduction activities.”

Benson, C. and Twigg, J. *Measuring Mitigation – Methodologies for assessing natural hazard risks and the net benefits of mitigation – a scoping study*. ProVention Consortium 2004

²⁵ For an example see *Gestión de riesgo derivado de amenazas naturales en proyectos de desarrollo – Lista de preguntas de verificación (“Checklist”)*, IDB, 2005.

3. IMPLEMENTATION OF NATIONAL MITIGATION OPTIONS – USING THE NATIONAL DEVELOPMENT AGENDA AS AN OPPORTUNITY FOR INVESTING IN MITIGATION

Lessening the impact of natural hazard events should be considered before transferring the risk.

For some, investment in risk mitigation options brings to mind, first and foremost, risk transfer schemes such as insurance and catastrophic bonds (cat bonds) limiting the amount of financial loss. Certainly in the agricultural sector climate variability has prompted in industrialized and lesser development countries alike the creation of risk transfer schemes, generally through insurance and futures markets. These options deal with financial risk through the purchase of set selling prices or payments in case of loss due to unexpected or uncontrollable climate impacts, and are sometimes accompanied by shifts in production techniques. But while these options may provide short term relief for the producer, they may not address the broader economic and physical risks associated with scarcity of products and damage to production infrastructure, both built (irrigation systems) and natural (pastures).

More generally, mitigation options are meant to reduce vulnerability to a specified, acceptable level. The question is, “Whose risk is to be reduced, by what means, who pays and who benefits?”²⁶ Mitigation options must consider not only financial, but also economic and physical risk.²⁷ (See the box on the Importance of Financial, Economic and Physical Risk in Defining Mitigation Options.)

The benefits of investing in mitigation are demonstrable.

Although there is more research and documentation to be done, it is sufficiently clear at present that investing in mitigation brings demonstrable benefits. Analysis based on damage to structures indicate that investments in the order of two to ten percent of the construction cost at the time of construction can avoid damages equal to the cost to rebuild. (See the box on Reducing Natural Hazard risk in critical infrastructure and the earlier box on Lessons Learned from Failed Caribbean Infrastructure.)

Linking benefits and costs to achieve investment in mitigation by governments address broader development issues.

Mitigation options need to consider the various types of risk and the most effective means of lessening the vulnerability of priority groups. In the context of strengthening democracy, transparency and good governance, the issue of resilience of critical facilities at the local level, production systems, and production infrastructure essential to the national development plans must be addressed. Damage to water and sanitation systems, schools and hospitals, roads and power

²⁶ The damage to a bridge by a natural hazard event represents a loss to the owner/operator of the structure, usually defined in financial terms, but also secondary losses due to lack of access or increased cost of getting goods and services to market (economic risk) and indirect losses due to lost business and social opportunities.

²⁷ Compensating the owner/operator for the financial loss of the bridge will do nothing for those who suffer secondary and indirect losses, even if reconstruction of the bridge is carried out in a timely fashion.

Reducing Natural Hazard Risk in Critical Infrastructure - The Case of Schools:

Hurricane Ivan's impact on Grenada created several opportunities to compare the costs and benefits of investments in disaster mitigation. Retrofitting schools to make them resistant to a class 3 hurricane was included in a World Bank funded disaster management project (i). Prior to the hurricane, retrofitting St. Marks Secondary school was planned for an estimated cost of \$EC 377,160. The work was not started on time, and the school suffered severe damage. Rebuilding the school will cost \$3,595,893, or approximately 10 times more than what it would have cost to make the school resistant to a hurricane of Ivan's strength.

With schools damaged and out of service for a prolonged time, education suffers. Grenadian students had to be sent to neighboring islands to avoid interruption in their schooling. In some countries, schools are designated as hurricane shelters, which creates an additional justification for ensuring that schools be built to resist natural hazards.

Resistance to natural hazards should be an integral part of the design and construction of all buildings, especially those that will house critical functions such as hospitals, schools, and shelters. It is estimated that mitigation against natural hazards, in the case of a hurricane, adds less than 5 percent to the capital cost of the entire project at the time of initial construction, and, in the case of an earthquake, less than 10 percent (Caribbean Disaster Reduction Mitigation Project -CDMP, 1998). Those who plan and design buildings need to ask themselves the following questions to determine whether mitigation is cost-effective:

1. What is the anticipated lifetime of the structure being built?
2. What are the intended uses of the building?
3. Will it be used as a shelter?
4. What hazards are the building exposed to?
5. How often is each type of hazard expected to occur within the lifetime of the structure?

(i) Source: Grenada Emergency Recovery and Disaster Mitigation Project, 2000, financed by the World Bank.

As OAS member states compete intra- and inter-regionally to attract investment through trade agreements and build infrastructure linkages to gain comparative advantages, the private and public sectors alike must consider the need to reduce vulnerability to production, transformation and market access infrastructure.

Addressing risk factors can lead to lower costs for development capital.

Consideration of these risk factors is also relevant to, and is now helping to shape, third party (meaning extra-national government) analysis and determination of investment and credit worthiness. Country risk indexing schemes such as The World Bank's Hot Spots analysis, the Inter-American Development Bank's Indicators analysis, the United Nations Development Programme's (UNDP) Disaster Risk Index and various private sector risk indexes have an application to identify and shape disaster preparedness and response mechanisms. But their application to highlighting mitigation investment areas is also apparent.

In addition, perceived risk generates an additional cost of investment capital, a cost as high as perhaps an additional 4%. This amount may actually be less than the cost of reducing the vulnerability to natural hazards. Not investing in mitigation creates, on the one hand, a hidden subsidy that may bring short term benefits, both political and financial. The full cost of this subsidy is paid when the damage occurs, and often the costs of damage created by natural hazard

The Importance of Financial, Economic and Physical Risk in Defining Natural Hazard Risk Mitigation Options

Financial risk

Management of financial risk pertains ordinarily, but not exclusively to public sector borrowing (most often with international lending, bilateral and development assistance institutions) and the highest economic echelon of private sector business, industry, commercial and residential holdings in the country.

In general the international finance community is risk adverse to natural hazard losses, but manages its risk by first reducing the possibility of its own financial losses. This is done by assuring that the guarantees for financial compensation in case of losses does not depend on the integrity of the physical assets or income stream, but on other assets. IFIs use the national central bank and the good faith and credit of the sovereign state. Private capital markets such as investment banks use financial or physical assets which will be little affected, if at all, by natural hazard events. Bilateral programs are more risk neutral and usually ask for no guarantees.

In general the national public sector, and often by default the public sector at the sub-national and local levels, are risk neutral or conditionally risk adverse by declaring as policy that they are self-insured. If assets and services are lost or damaged by natural hazard events, the government will repair, rehabilitate, and reconstruct. Depending on the country and its experiences, there are few if no national reserves to deal with such direct losses and the country may be conditioned and expecting receipt of international disaster assistance, preferably grants, to compensate for the losses. The private sector, at varying levels, acts on its perceived risk and knowledge of risk management strategies, and deals with financial risk primarily through insurance.

Economic risk

Management of economic risk pertains primarily to the public sector at the national, sub-national and local levels and focuses on the secondary and indirect losses due to natural hazard events.

Governments are generally risk neutral towards economic risk, and, almost without exception, are ill suited or unprepared to offer assistance or compensation in the case of loss of publicly or privately owned or operated economic and social infrastructure and services. Generally, there are few if no reserves for 1) assistance or compensation for indirect or secondary losses due to damage or destruction of bridges, roads, electrical power plants, water supply and sanitary sewer systems, 2) assistance or compensation for indirect or secondary losses due to loss of access to medical attention, education, public records for business transactions, etc. nor 3) assistance or compensation to affected citizens because of direct losses sustained in the private sector. Only the highest economic echelons of the private sector cover indirect and secondary losses through insurance.

Physical risk

The management of physical risk can be associated first and foremost with the physical assets of individual citizens, particularly the poor, and of the public sector.

Although the highest economic echelons often reduce their physical risk, poorer populations may be aware of their physical vulnerability but are without recourse to alter the risk whether it is business or residential property. In some instances physical risk may be addressed on a mandatory basis in order to lower the cost of managing financial and economic risk. But for the general population, physical risk is most likely managed, if at all, through passive societal measures such as zoning, codes and permits. The public sector often exempts itself from following passive and active structural and non-structural risk management measures and opts if possible only for financial risk management options.

events is paid, not only by the project itself, but also by those impacted through secondary and indirect costs, and often the poor.

The cost of using development resources to rehabilitate, reconstruct and replace damaged assets is high. Loans already programmed for priority development projects are reprogrammed to meet post-disaster needs. This source of capital can represent up to 80% of the internationally lent capital available for reconstruction. Total international disaster assistance falls short of meeting the requests for capital – often less than 20% of the total capital requested by the affected country for reconstruction is actually provided in the form of new financing. Opportunities are lost to attract additional investment, both private and public.

The agenda for creating a mitigation agenda at the national level are simple and straight forward.

The following points should be taken into consideration for a cost-effective agenda at the national level²⁸. Such actions will improve both the commitment, and the technical and institutional capacity for mitigation:

- Focus on priority hazards,
- Focus on priority sectors, and
- Choose simple and practical information collection and analysis systems.

Actions such as these will improve both the commitment, and the technical and institutional capacity for mitigation (See the box on the Caribbean Strategy on Disaster Management.)

The outputs that are most likely to attract the attention of donors, if not their support, and therefore bridge the gap between hazard assessment and project preparation are:

- Early identification and integration of mitigation issues,
- Practical and cost-effective solutions to persistent problems, and
- Government commitment to implementation beginning with the enforcement of technical standards.

The Caribbean Strategy on Disaster Management

The Caribbean Strategy on Disaster Management prepared by Caribbean Disaster Emergency Response Agency (CDERA) promotes comprehensive disaster management that, “involves recognition of the important linkages between disaster management, the environment, and physical and social development.” Key issues call for mitigation, among other disaster management actions, as a national and regional concern and that it is a priority within the context of development; a clear allocation of responsibilities, possibly within a legislative framework; and investment in mitigation activities.

The policy issues to be addressed by the Strategy on Disaster Management include:

- Commitment to a program of implementation at the national and regional levels and support for the necessary increases in resource allocation, and
- Re-articulation of national development approaches to include a stronger focus on hazard reduction.

Source: CDERA. Caribbean Strategy on Comprehensive Disaster Management. 2004

²⁸ Taken from OAS 1987 op. cit.

Investment in natural hazard mitigation means changes in development processes must be undertaken now.

Investment in mitigation at the national level means that:

- Countries will avoid risking future growth by investing in mitigation;
- National capacity building in mitigation as part of development can become a south-south activity;
- Implementing mitigation practices through infrastructure, social (including Social Investment Funds), environment and disaster reconstruction programs and projects in each sector in each country is a priority of national governments, and the private sector alike;
- Evaluation methodologies for examining investment efficiency in lessening the vulnerability of the poor are adjusted to in light of the fact that, at present, existing criteria will not justify needed investments;
- Tools and studies, both existing and new, are designed and carried out to specify who and what is vulnerable to which hazards, why, what can be done about it, and when; and
- Sector plans, including those with a regional scope, beginning with education and health sectors, are funded for assuring the life safety and the continuity of service of these essential lifeline elements at the community level.

Investment in mitigation as part of international development assistance means that:

- The policy of “best local practice” in development assistance is held against standards, norms and performance criteria that are commensurate with 1) acceptable levels of risk, 2) visible, verifiable levels of accountability, and 3) available scientific, technical, social and economic information concerning hazards, vulnerability and risk;
- Support is given to policy development and implementation for justifying vulnerability reduction of the poor; and
- Support for implementing mitigation practices through infrastructure, social (including Social Investment Funds), environment and disaster reconstruction programs and projects follows each country’s priority.

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CHAPTER V: The Role of Good Governance and Institutional Integrity in Reducing Risk

Chapter Five examines the role of institutions and governance in supporting risk mitigation policies. Although empirical analysis in this particular area is thin, an extensive body of literature exists regarding the relationship among institutional quality, indicators of good governance, and policy effectiveness in other sectors. Given the economic consequences of disasters set out in Chapter One, this chapter draws upon the economic literature, in particular, in highlighting the primacy of good governance. Some commentators (Easterly and Levine, 2001; Rodrik, Subramanian and Trebbi, 2004) conclude that strong institutions are *the* key determinant in explaining why some economies grow more quickly than others (“institutions trump everything else.”). Conversely, commentators note that countries with weak institutions – where, for example, corruption is pervasive, policy coordination is weak, property rights are ill-defined and the rule of law is absent – will almost always face slow rates of growth.

Interest in defining good governance in general, and teasing out the ingredients of strong institutions, is enriching other disciplines. For example, a key conclusion of the Camdessus World Panel on Financing Water Infrastructure (2003) is that the underlying cause of the quickening global water crisis comes not from bad policies, but bad governance. Studies examining the performance of environmental objectives similarly are focusing on governance issues like institutional incoherence among federal and sub-federal levels in meeting pollution-abatement goals, or lack of coordination at the global level among different institutions and treaties. (Esty-Ivanova, 2002; Speth, 2002).

If disaster mitigation is cheaper than disaster response, why are current mitigation related expenditures still relatively small? Investments intended to increase resilience against the impacts of disasters, as well as accelerate disaster response times, are significantly less than expenditures intended for post-disaster activities. The World Bank (2002) estimates that for each dollar spent on risk mitigation two dollars are saved in post-disaster recovery expenditures. Despite various cost-benefit calculations measuring mitigation versus post-recovery measures, barriers to mitigation policies are significant. Obviously, mitigation-related policies may be relatively less costly but nevertheless constitute a significant financial burden for smaller, developing countries. The IDB, for instance, estimates that \$2 billion is necessary for each Central American country to be able to withstand another event similar to Hurricane Mitch (Dayton-Johnson, 2004).

A serious obstacle to effective disaster risk management and, in particular, to investing in mitigation is the decoupling of, or failure to link, the benefits that derive from an investment in mitigation and its cost. This decoupling has an obvious time dimension: cost is realized immediately when a mitigation measure is implemented, whereas the benefit – in terms of future losses avoided – is only realized if and when an extreme event occurs. In addition, benefits may accrue to a group or individuals different than those who invested in mitigation in the first place. A typical example illustrating both the time and social-actor dimensions of decoupling is the case of a government that is faced with the option of building a seawall to protect a coastal town from the next 50 year storm. The benefit from that investment is likely to be reaped well into the

"The mistaken belief that Government can do it all results in a high burden on government that is often unfulfilled. Business and community organizations should continually evaluate how capable their governments are to fulfill the important responsibility of facilitating readiness and planning to respond to a catastrophic event. Failure to evaluate this capability and to motivate a 'lagging' government has resulted in needless deaths and very high losses. Blaming an unprepared government after a disaster comforts only the political 'opposition', while leaving victims to fend for themselves¹.

¹Oliver Davidson, May 31, 2005 speaking ahead of the Caribbean media Exchange on Sustainable Tourism's CMExPress workshop held in Antigua on June 14, 2005.

future when another government, possible from the opposition, might be in power. As a result, it is highly unlikely that the present government will make the investment.

Risk Management Demands Good Governance and Strong Institutional Coherence. Among the most important challenges in supporting risk-mitigation policies relates to the question of timing. Mitigation policies by definition entail *ex ante* rather than *ex post* actions. Addressing known developmental priorities, which all Caribbean countries face today, will almost always receive higher support than allocating scarce financial resources to a future disaster that is highly likely but nevertheless uncertain. In short, institutional resistance to *ex ante* disaster-related policies remains high, partly because of uncertainty but largely because the economic and developmental implications of natural disasters have not been internalized by policy-makers.²⁹

However, assuming policy support for risk mitigation policies is high, *ex ante* programs nonetheless require exceptionally high levels of policy cohesion that translates into institutional cooperation and coordination. Indeed, *ex ante* actions demand a higher degree of policy coherence among an array of institutional actors. For example, risk mitigation policies presuppose the existence of clear and unambiguous property rights, reflecting more general rule-of-law governance issues, within which appropriate building codes and zoning regulations can be effectively enforced. Mitigation policies also demand a transparent and well-functioning financial regulatory framework which is conducive to supporting well-functioning insurance and reinsurance markets. By comparison, *ex post* disaster response actions usually involve a smaller group of actors, including emergency response and often event-specific reconstruction agencies.

²⁹ As argued in Section One, natural disasters have impacts that are similar to other kinds of economic shocks. Notwithstanding the limitations of cost estimates, it is clear that the economic implications of disasters are enormous. They are also rising. Munich Re estimates that the annual cost of natural disasters worldwide (2002 figures) have risen steadily from US\$75.5 billion in the 1960s to US\$138.4 billion in the 1970s to US\$213.9 billion in the 1980s and to US\$659.9 billion in the 1990s. Munich Re warns that "2004 is the most expensive natural catastrophe year in insurance history to date," with economic losses estimated at US\$145 billion for the year, of which insured losses rose to US\$44 billion (Munich Re, 2005). Munich Re also notes that economic losses will continue to rise over time because of the combined risks posed by climate change and the rapid expansion of megacities, particularly in developing countries. A recent study of sixteen disaster-prone countries in Latin America and the Caribbean (Auffret, 2003) from 1970-1999 shows that disasters are followed by a significant drop in rates of economic output and investment, a moderate decline in the rate of growth of consumption, and a deterioration of the current account of the balance of payments.

Some Common Challenges in Identifying and Managing Risk: Given the relatively thin empirical literature that examines the link between institutions and risk mitigation, reference to other disciplines sheds some light in explaining challenges in increasing disaster mitigation. Clearly, institutions responsible for promoting macroeconomic stability or lowering the impacts of greenhouse gas emissions differ from institutions responsible for reducing the effects of natural disasters. However, an institutional challenge common to economic, environmental and natural disaster areas entails anticipating, reducing and managing covariate risk³⁰ and uncertainty.³¹

Better to Manage Risk than Worry About Uncertainty: A useful way to think about these challenges is to refer to the economic literature, especially to the distinction posed by Frank Knight³² between risk and uncertainty. Knight assumes that *risk* refers to circumstances in which the decision-maker can assign mathematical probabilities to the randomness of events. By contrast, *uncertainty* refers to situations in which randomness cannot be expressed by way of mathematical probabilities³³.

All decision-makers prefer risk to uncertainty, and their life has gotten easier in recent years. Progress in modeling the frequency, severity and trajectory of hurricanes and other weather-related events has improved markedly in the past twenty years. As noted in the previous chapters, work by the World Bank, Inter-American Development Bank (IDB), Organization of American States (OAS), the US Federal Emergency Management Agency, National Aeronautic and Space Administration (NASA), national agencies and research organizations has improved the accuracy of hazard and vulnerability assessments, including using geographic information systems (GIS) to map and assess hazards, as well as relying more on hazard, climate, infrastructure vulnerability and other kinds of models. Indeed, climate sciences have undergone a “quiet revolution” in the past three decades by increasing their reliance on ever more sophisticated computer-based models capable of weaving a number of disciplines, including meteorology, oceanography, hydrology, classical physics, fluid dynamics, chemistry, applied mathematics, and numerical analysis³⁴.

³⁰ A covariate is a variable that may affect the relationship between two variables of interest but is not of intrinsic interest itself. In an analysis of covariance, the relationship between the dependent variable and the covariate is first adjusted for, before the effects of the other factors are examined.

³¹ Work by the Intergovernmental Panel on Climate Change (IPCC) and the 2005 Millennium Ecosystem Assessment report have provided new insights into the relationship between environmental risks, more basic scientific uncertainty and policy making. The area of policy and science is particularly useful, including how dissenting or minority opinions are handled in scientific panels.

³² Frank Knight (1921/2002) *Risk, Uncertainty and Profit* (1921). Following Knight’s examination of economic decisions made in uncertain conditions for which a degree of randomness in outcomes is likely, the *expected utility hypothesis* opens a range of theoretical work of relevance to governance and risk, including the theory of risk aversion. Freidman-Savage (1948) asked why individuals may assume low probability, high-payoff risks (using lottery tickets as an example) and insuring themselves against mild risks with mild payoffs (for example, flight insurance), arguing that behavior exhibits doubly inflected utility curves, depending on differing circumstances.

³³ Following Knight’s work in the early 1940s, the debate remains unresolved as to whether the risk-uncertainty distinction is valid. Davidson (1991) and others argue that it is, noting that Knight’s view of uncertainty is relevant in understanding randomness, particularly randomness over time.

³⁴ See Geophysical Fluid Dynamics Laboratory (GFDL), “Why Climate Models are Imperfect and why they are Crucial Anyway,” US National Oceanic and Atmospheric Administration (NOAA), <http://www.gfdl.noaa.gov/>

Risk Models Improve but Probably Lag Behind Uncertainty: At the same time, models are just that: their results can only be applied with confidence if their parameters, data quality accumulated over time, structure of the model and sensitivity of conclusions to variations and uncertainty are taken into account. This is obviously extremely difficult in the area of oceans, climate and the likely trajectory of tropical storms affecting the Caribbean region. Uncertainties in modeling the interaction between oceans, temperatures and climate variables remain hugely complex, despite the advance of super-computers.³⁵ Moreover, models still struggle with how to handle random events, as well as differentiating known risk from holes in knowledge more generally.³⁶ What this means practically is that not even the strongest institutions are capable of anticipating improbable events. For example, the scientific community broadly accepts that climate change will likely increase the frequency and severity of *pre-existing* tropical storm patterns. Little thought was given to predicting the risk of hurricanes in the Southern Atlantic, since they had never occurred there before, until one hit the coast of Brazil for the first time ever, in March 2004.³⁷ Given the complexity demanded in orchestrating mitigation policies to anticipate well-known risks – for instance, while it is unknown if a hurricane will or will not strike Brazil in the foreseeable future, it is highly unlikely that no hurricane will strike the Caribbean region in the fall of 2005 – uncertainty creates formidable obstacles to even the strongest institutions.

Identifying the Impacts of Natural Disasters: It is difficult to capture all economic implications of natural disasters. Most cost estimates reflect the institutional make-up of a country and, in particular, the presence of insurance institutions. One useful framework (U.S. National Academy of Sciences, 1999) differentiates total impacts from losses, costs and damages thus:

- *Impacts*, taking into account market-based effects – including damages to property and losses in economic activity – and non-market effects, ranging from environmental impacts to psychological effects;
- *Losses*, comprising direct losses affecting economic and social infrastructure -- buildings, crops, ports, electricity transmission lines, ports, etc. – as well as natural resources; and indirect losses, including losses over time in employment, business interruption, changes in consumption, and a contraction in investment and trade;
- *Costs*, more narrowly comprised of cash payouts issued by insurers and governments to reimburse some of the losses suffered by individuals and businesses; and
- *Damages*, comprised of physical destruction, including number of deaths and injuries or the number of buildings destroyed.

³⁵ For example, climate models still lack meaningful calculation of a statistical climate equilibrium state capable of taking into account such variations as changes in jet-streams, longer fluctuations (example, El Niño), and longer-term ocean circulation variations and glacial ice changes.

³⁶ Advances continue in Monte Carlo simulations to quantify probabilities and uncertainty. However, simulations are particularly limited when empirical data is limited; results can be arbitrarily over-specified and misleading.

³⁷ Tropical cyclone Catarina struck the southern coast of Brazil in March 2004. It was the first hurricane ever recorded in the South Atlantic.

Risk Reduction-Mitigation Measures: As noted in previous chapters, a wide range of risk-mitigation measures have evolved over the years. These have been grouped (Dayton-Johnson, 2004) into three categories:

1. **Risk Reduction**, including diversifying vulnerable productive assets, for instance by moving production outside of vulnerable areas or diversifying production into some non-farm-gate revenue streams; adopt building codes for individual households and public buildings (such as earthquake or hurricane-resistant construction) as well as economic infrastructure; or resettling vulnerable populations outside of high-risk locations like floodplains, mountain sides or other areas. Such action requires institutions to adopt and enforce a number of regulations, from zoning to construction codes, as well as have the power and capacity to negotiate with private-sector holders of economic infrastructure like ports, transmission lines, airports and other operators that in some cases may be administered by private operators; and action to reduce moral hazards associated with post-relief payments, by enforcing building codes, and introducing penalties for non-compliance.
2. **Insuring Against Risk**, including increasing insurance and reinsurance coverage for private households and commercial interests. There are numerous obstacles to expanding insurance coverage. In general, insurance markets in many developing countries are thin in poor neighborhoods. More specifically, the insurance sector in developing countries faces a number of market failures, including:
 - high-risk buyers tend to be over-represented among consumers (problems of adverse selection);
 - firms in developing countries in general lack access to international capital markets, leading to price gouging among disaster insurance providers;
 - reinsurance companies tend to exit developing country markets after disasters.

Given these and other market failures, institutional challenges include creating the necessary market conditions to allow new-entry insurance providers; and creating an enabling financial market regulatory setting within which risk-sharing arrangements involving the insurance, reinsurance, pooling structures, capital markets generally and regulatory oversight agencies can cooperate.

3. **Promoting Resilience:** Risk mitigation cannot rely solely on *ex ante* policies. Damages from disasters will be high, despite the best preventive measures. However, effective disaster response and relief actions obviously require a high degree of *ex ante* preparations. These entail coordinating myriad institutions, from medical and emergency response services to education and other public services. Striking the right institutional balance between vertically integrated policies and institutional plurality to ensure flexibility and accountability is difficult.

Good Governance and Institutional Challenges: Addressing the three clusters of mitigation-related policies – risk reduction broadly defined, risk insurance and resilience -- pose formidable governance challenges. The breadth of diversification-related measures and resilience-related measures pre-supposes good governance and the rule of law in general, as well as strong

institutions in their own right, coupled with policy coherence to ensure a coordinated approach among different agencies. Similarly, effective and flexible disaster risk insurance options such as those identified in Chapter III require well-functioning financial markets at the domestic level, as well as sub-regional coordination.

Governance challenges in supporting effective risk mitigation programs require general or systemic good governance measurements, as well as specific demands related to policy coherence and institutional coordination. Various indicators are now broadly accepted in capturing the components of good governance. One that is among the most comprehensive, by Kaufman, Kraay and Mastruzzi (World Bank, 2004), defines and measures six indicators of governance, which are expressed in Table One for the countries of the Caribbean.³⁸

Table 1. Governance Indicators for 1996-2002

Dataset 2002 Country	Voice and Accountability	Political Stability	Government Effectiveness	Regulatory Quality	Rule of Law	Control of Corruption
Antigua and Barbuda	54.5	74.1	70.1	71.6	82.0	77.8
Bahamas	86.9	83.8	88.1	86.1	88.1	88.7
Barbados	91.4	74.1	87.1	83.0	89.2	85.6
Belize	72.2	69.2	55.2	59.8	56.2	50.0
Dominica	80.8	65.4	65.5	73.7	71.6	71.1
Grenada	70.2	65.4	67.0	66.0	61.9	74.7
Guyana	69.2	29.2	47.4	40.7	42.3	38.1
Haiti	15.2	14.6	2.1	17.0	1.0	0.5
Jamaica	65.2	43.2	54.6	64.9	45.9	39.2
ST. Kitts and Nevis	78.3	N/A	56.7	60.3	63.4	69.6
ST. Lucia	79.8	N/A	56.7	60.3	63.4	69.6
ST. Vincent and the Grenadines	78.8	N/A	56.7	60.3	71.1	69.6
Suriname	58.6	59.5	53.1	27.8	46.9	62.4
Trinidad and Tobago	66.2	45.4	68.0	70.6	64.4	57.2

* Numbers are Percentile Ranks from 0 to 100

The empirical literature examining the relationship between disaster mitigation policies and good governance and institutional quality is thin. One study (Lavell, 2004) identifies some indicators of good governance and management systems needed to support disaster prevention and risk reduction goals. The study cautions that no uniform definition of “good governance” in disaster

³⁸ Source: D. Kaufmann, A. Kraay, and M. Mastruzzi 2003: Governance Matters III: Governance Indicators for 1996-2002. The governance indicators presented here reflect the statistical compilation of responses on the quality of governance given by a large number of enterprise, citizen and expert survey respondents in industrial and developing countries, as reported by a number of survey institutes, think tanks, non-governmental organizations, and international organizations.

reduction exists. However, general principles of good governance include equity, public participation, subsidiarity, transparency, accountability, rule of law, effectiveness, efficiency, and responsiveness. The same study notes that effective governance demands both vertical and horizontal coordination among different agencies, in order to elevate and communicate risk reduction as key policy objectives. Good governance also demands assigning clear institutional accountability to enforce disaster reduction plans, ensure high levels of participation among different civil society groups, as well as sub-federal administrative agencies, including municipalities. Without going into detail, the study also suggests that the private sector should be involved in framing risk mitigation goals.³⁹

Another study (ActionAid, 2003) isolates one key institutional quality indicator – proxies of institutional transparency – to measure the effectiveness of disaster mitigation and response measures. Those proxies included:

- Pluralistic institutions
- Accessibility of information and general measures of transparency
- Local democratic processes
- The existence of free and open media
- The level of undue influence over institutions by one group [or geographic region]

The study argues that institutional transparency and accountability, as well as actions to promote public participation correlate positively with good risk management and provision of post-disaster support to marginalized groups.

Control of Corruption – the Construction Sector: The above indicators of good governance apply in different ways to risk mitigation policies, and more work is needed to determine specific ways in which governance indicators are measured against the performance of mitigation-related institutions. In general, diversification-related activities noted above require institutional accountability in the construction sector, as well as strong and independent oversight from public officials charged with zoning and the enforcement of building standards. As a recent Organisation for Economic Co-operation and Development (OECD) report notes, “corruption manifests itself in a wide variety of ways,” not least in the construction sector and more generally in sectors that entail high levels of public procurement and oversight. (OECD, 2003) The *Global Corruption Report 2005* of Transparency International notes that corruption in the construction sector is particularly high in many countries. Impacts of corruption in the sector

³⁹ Similarly, at the 2005 Kobe conference, a number of existing governance and policy indicators related to risk reduction were identified, as well as a number of normative indicators that would be needed (by 2015) in order to improve the policy integration of risk reduction and mainstream objectives.

³⁹ Three governance indicators were identified at Kobe:

- Multi-layer disaster risk management institutions, including policy frameworks, legal and regulatory frameworks, plans, structures and mechanisms in place in countries;
- National and regional platforms established that are multi-stakeholder, multi-sector and multi-level; and
- Disasters are reduced over time together with the vulnerability of populations.

Both these indicators, as well as those prescribed for the 2015 target date, appear to be normative, and are not supported by empirical evidence or even elaboration of the suggested components to be contained therein. However, one of the most relevant relates to “multi-sector platforms,” suggesting a high degree of commitment to public participation among civil society and private sector groups, as well as a targeted commitment to rights to access to information.

include high mortality rates resulting from collapsed buildings in hazard areas and longer-term economic losses due to shoddy infrastructure construction. Transparency International estimates that bribery in the construction sector costs US\$300 billion annually.

Governance and Disaster Risk Management in Haiti

Reactive or Proactive Measures: an indicator of governance:

On May 9, 2005, the Reuters AlertNet Foundation reported (1) that a Haitian official “called for international help and money to move thousands of people to safer homes before the looming hurricane season as weekend floods killed 11 in the capital. Interior Minister Georges Moise said a large number of people could die if not relocated from areas vulnerable to mudslides or flash floods”. This desperate appeal was made less than 2 months before the start of the hurricane season, and against the background of last year’s tragic floods in Fond Verettes and Gonaives. According to Reuters, “officials at the civil protection office said the flooding was worsened by the obstruction of drains by dirt and debris. The flood-struck neighborhood is below street level. Minister Moise said the interior ministry wanted to build shelters for potential flood victims”.

Cleaning drains prior to the rainy season can alleviate localized flooding, but long-term reduction of risk of flooding requires substantially more time than a few months. Flood prone areas have to be identified, and the extent to which the population can be affected needs to be determined. Installing a reliable early warning system to evacuate people to designated shelters may be an option, but it requires a very effective emergency communication and enforcement system, and special shelters need to be constructed. Removing populations at risk to areas that are not prone to flooding is a costly and lengthy process and is conditional on government making available suitable lands not presently occupied.

The need for good governance to implement risk reduction:

The challenges are enormous, especially for a poor country like Haiti where perhaps more than 1 million people live in marginal areas that can be flooded. Yet, Haiti is not devoid of resources that could be used for reducing risk to families living in these areas. The Ministry of Planning and Overseas Cooperation has a very well-equipped, EU funded, Unité de Télédétection et de Systèmes d’Information Géographique - Geographic Information System Processing Unit (UTSIG), which has the capacity to map all flood prone areas and to identify safe areas for shelters and for relocation of population. International donor funding is available to plan and implement a series of measures that can start making contributions to reducing risk, such as investing in early warning systems, strengthening local emergency management, relocation of high risk populations, retrofitting public buildings to be used as shelters, and constructing dedicated shelters.

To have a chance at overcoming the enormity of the challenges posed by a vulnerability that has accumulated over years of mis-government, and has been exacerbated by extreme poverty, a country needs to re-introduce a long term planning horizon, and needs to include vulnerability reduction and disaster prevention measures in its ongoing development plans and projects. This requires a strong institutional and managerial capacity in the public sector, and an ability to engage civil society in supporting preventive and pro-active measures. In short, good governance is an integral part of the solution.

¹ <http://www.alertnet.org/thenews/newsdesk/N09697120.htm>

Supporting Transparency -- Access to Information: Among the most important elements to counter corruption and ensure overall accountability is transparency. In addition to the Kaufmann *et al.* table above, a number of specific indicators that measure institutional transparency exist, including the existence of formal and codified access-to-information laws designed to guarantee citizens the right to public information. Worldwide, approximately 50 countries, including Belize, Jamaica and Trinidad and Tobago, have adopted these formal laws; a number of countries in the region are considering them. (Freedom of Information Foundation;

Global Survey, May 2004) In general, such laws help to guard against abuse, as well as check against mismanagement and corruption. Moreover, such laws can help identify risk mitigation programs that favor certain classes or geographic areas over others.

Freedom of the Press: Another proxy of transparency is freedom of the press. The 2005 Freedom House global ranking for the “Freedom of the Press” survey ranks all countries of the Caribbean as having “free” press, with the exception of the Dominican Republic (“partly free”) and Haiti and Cuba (“not free”)⁴⁰. It is generally accepted that a free and independent press is an important keystone of democracy, and, in its absence, citizens are unable to participate in democratic processes.

Land Tenure Reform and Property Rights: Among the proxies to measure rule of law more generally are land tenure and property rights. In general, the countries of the Caribbean have differing levels of formal land tenure systems, including some countries with high rates of “family lands” that are often untitled. (For example, in St. Lucia, as much as 45 percent of total land is considered to be family lands.) Many countries of the Caribbean also have relatively weak formal systems covering land titles and deeds, survey maps and property registration. For example, an estimated 55 percent of Jamaica’s land area lacks formal deeds. In addition, land administration systems in the Caribbean tend to lag behind quickly expanding private real estate markets. Practical problems arising from unclear or ambiguous land title systems include the absence of insurance coverage, the probable absence of a variety of other formal governmental interventions in enforcing zoning and building codes and obstacles to the participation of house owners with damage or destruction in post-disaster credit and reconstruction programs.

Squatter Settlements and General Impacts on the Poor: The issue of ambiguous land titles and its relationship to risk mitigation policies is particularly pressing for squatter settlements.⁴¹ Usually, squatter settlements are located on vulnerable or marginal lands (including steep slopes and flood plains) and often lack access to clean water, sanitation and other public services. Inhabitants in squatter settlements are poor, and, as noted above, poor households in the Caribbean and other developing countries are particularly vulnerable to natural disasters in much the same way that they are susceptible to a variety of external shocks. Recent estimates (UNDP, 2004) find that while only 11 percent of people worldwide are exposed to droughts, earthquakes, epidemics, floods and hurricanes/wind storms, 53 percent of all disaster-related deaths occur in low-human development countries. Often, the worst affected by disasters are those populations about which governments know the least: inhabitants of slums and shanty-towns and the rural poor. Moreover, developing countries in general have a larger informal market compared to industrialized countries. For instance, an estimated one-third of the gross domestic product of Mexico City is found in the unregulated sector. Impacts of disasters on the poor and informal sectors, while proportionately higher compared to impacts on richer population segments, are nevertheless extremely hard to capture.

⁴⁰ The survey notes that country rankings “examine the legal environment for the media, political pressures that influence reporting, and economic factors that affect access to information.”

⁴¹ The United States Agency for International Development (USAID) funded program to help low-income families in Grenada rebuild after hurricane Ivan experienced significant obstacles and delays due to deficient and conflicting land titling, and had to be reprogrammed to overcome this problem

Opportunities for Re-establishing the Linkage between Benefits and Costs: Opportunities for re-establishing the coupling/linkage between costs and benefits can use the same set of sectors and levels. Only governments that have good governance, as exemplified by the capacity and commitment to commit to risk reduction of high impact but relatively – in reference to their period in office – long return period natural hazard events, will be able to make this type of investment. Governments might look at incentives that come through third party risk indexing or rating schemes, such as those being developed by the IDB. These can be used to document an administrations mitigation effort through periodically measuring progress. Donors may offer governments improved access to technical assistance and loans based on documented progress using the indexing and rating systems. Furthermore, International Financial Institutions (IFIs) may offer opportunities to participate in risk transfer schemes with mitigation as requirement or condition precedent for participation⁴²

Table 2. Governance Indicators

Author/year	Measures of institutions	Dependent variables	Scope of analysis	Findings
Rodrik et al. /2002	Rating of institutional quality with respect to enforcement of property rights and the strengthen of rule of law	GDP per capita on a PPP basis	Systematical estimation of a series of regressions in which outcomes are related to geography, integration in to the trading system	Institutional quality has a positive and significant effect on integration
Easterly (2001)	Institutional quality index	Outcome of ethnic conflicts	Analysis of the link between quality of institutions and its outcome on ethnic conflicts	Institutional factors interact with ethnic diversity as they affect whether conflict is destructive or contained by the rule of law Overall, good institutions lower the risks of wars and genocides
Gaviria et al. /2000	Conflict management institutions	Growth	Test Rodrik assumption that institutions for conflict management are associated with the ability to react to economic shocks	High level of political constraints and intermediate levels of political particularism are associated with a quick recovery time from economic shocks
Campos and Nugent (1998)	Composite and comparative index of institutional development	Growth	Latin American countries from 1960-1986; use of Solow model to explain variation in growth rates	The central and common characteristic of relevant institutions is that they give agents a voice or stake in the system. This in turn reduces the amount of rent-seeking

Drawing Lessons from other Disciplines: In each of the areas noted above, as well as other proxies of good governance, empirical analysis would be extremely helpful in understanding more clearly the applicability of good governance indicators to risk mitigation performance. In light of the absence of research in this area, it is useful to refer to studies in the economic literature (Table 2) that have examined the relationship between institutions and development (compiled by OECD DAC 2004).

⁴² The World Bank is exploring a catastrophic risk pool for the Caribbean region based on demonstrable mitigation actions.

Summary and Conclusions

In summary, natural hazard events are inevitable, and good governance and social responsibility are essential factors in enabling the implementation of preventative measures to reduce the hazards' impact and promoting preparedness to deal with the aftermath of catastrophic events. Only good governance and a commitment to social responsibility can overcome the natural tendency of politicians and individuals in resource-strapped developing countries to focus exclusively on the short-term. Governments struggling to meet poverty reduction commitments are not going to support spending the limited resources their communities or countries have on an unknown future, no matter how strongly anticipated it may be. This is where *ex ante* disaster-related policies run head-first into democratic institutions.

Democratic processes and electorate-controlled administrations tend to focus on the present needs of the people and elected officials with relatively short periods of time in which to serve their constituencies. Because mitigation does not provide immediate returns for an elected government, it requires a certain level of understanding and foresight to effectively put risk-reduction measures into practice. Both politicians and the public need to be educated about the importance of long-term planning and the counter-intuitive cost-effectiveness of mitigation policies for long-term development of their countries. Without that understanding coupled with good, transparent governance and institutional integrity, successful risk reduction and the advancement of the societies in question will be difficult, if not impossible.

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THE WAY FORWARD

OVERVIEW

For the past forty years, the international community, in addressing disasters, has put an emphasis on preventing the loss of life. Today, fewer lives are being lost, but, unfortunately, survivors face a grim future with extreme difficulties recovering from the fallout of natural hazard events. Looking to the future, the international community is faced with difficult questions, the first of which is, “How do we get out of this cycle of devastation following a major hazard event?” and, more specifically, “How do we ensure that life in the developing world can return to a state of normalcy following the natural hazard event?”

Government policy can play an important role in mitigating the impact of natural disasters. When a natural disaster occurs, governments can undertake selective fiscal stimuli within the overall medium-term fiscal constraints and, to a limited extent, temporary monetary easing. Given the increasing risk of natural disasters, even more important and potentially more effective would be precautionary mitigation measures including the budgetary provision of contingency funds, the creation of a regional insurance pool and more broadly, the conduct of prudent fiscal policy. Structural reforms in the labor markets and the financial sector can also help buttress the economy against the vagaries of nature by enhancing labor mobility and helping spread the cost of natural disasters. The undertaking of precautionary measures by authorities could be supported by grants and concessional loans from donors and International Financial Institutions (IFIs) in order to promote efforts for self-protection.

In the end there is political as well as economic value for both the countries and the international community to invest in mitigation. Incentives for mitigation have a role to play, but they must be distinguished from subsidies. One subsidy is using risk, rather than investing in mitigation to lessen natural hazard vulnerability as a component of a project’s cost. Too often infrastructure projects are designed and built without an understanding of their high vulnerability to natural hazard events. Not investing now in meeting norms and standards that will make the infrastructure resilient to natural hazards reduces the immediate cost of the project, but creates liabilities for those who will be called upon to finance reconstruction after a future disaster. It will always be necessary to demonstrate the benefits and costs of mitigation. And these benefits and costs, economic and otherwise, must be linked to accountability, transparency, visibility and governance.

It is important to remember that after an international appeal for disaster relief, the countries are largely left on their own to deal with the fiscal, economic and physical realities of the losses caused by natural disasters. In many instances, the countries of the region either do not want or cannot qualify for additional loans, but they need international assistance primarily on a non-reimbursable basis. Philanthropy is needed, but its proceeds will not cover all the needs. Instead, governments must look ahead to the type of collaboration that demonstrates meaningful attention to natural hazard risk management issues and partnering with international development finance and development assistance communities in effective, efficient investment in mitigation.

Understanding risk opens options for reducing the potential impacts of natural hazards. Risk indicators and, more broadly, risk information that can be interpreted by non-experts are necessary inputs for decision makers to effectively manage natural hazard risks given the reality that the region is faced with a large variety of hazards. The variety of hazards in combination with the differences in capacity to manage risk among countries in the Latin America and Caribbean (LAC) region means that risk indicators must be developed on a country basis and also that responses must be tailored to the specific situation of the country. However, many risks are shared by groups of countries and this allows for collaboration and sharing of experiences.

Countries can avoid risk to future growth by investing in mitigation. They need to adopt country-specific, sector specific, high priority mitigation measures. These should balance between upgrading emergency preparedness, investing in physical risk mitigation measures, strengthening the institutional capacity to manage natural hazard events and introducing a risk-financing strategy. At the national level, in the interest of setting a cost effective agenda, there needs to be a focus on priority hazards and priority sectors along with simple and practical systems for information collection and analysis. National capacity building that links mitigation to development can become a south-south activity.

Mitigation options need to consider the various types of risk and the most effective means of lessening the vulnerability of priority groups, particularly the poor. Addressing the issue of improving the resilience of critical local infrastructure and production systems as well as infrastructure essential to national development plans are critical in the context of strengthening democracy, transparency and good governance. Mitigating risk is essential to successful implementation of development options and to access and attract the resources needed to sustain their implementation. The developing countries of the region are now in a position where third party entities are identifying, monitoring and indexing a nation's vulnerability to natural hazard events. These actions represent another facet of natural hazard vulnerability as an underlying factor of development decisions by both the countries and the international community.

Decision makers need to be provided with the correct information that documents the economic and social costs of the natural hazard risks faced by their constituencies. Risk assessments are fundamental for the preparation of any risk reduction strategy. They may be carried out both nationally and locally through risk indicators. Cost-benefit analyses that show the profitability of mitigation would also be a useful tool in promoting risk management and should be used by relevant institutions in the region. Such information gives authorities the opportunity to make more efficient and effective decisions on how to manage these risks. The dissemination of information should also extend beyond decision makers. Existing research on disaster management undertaken or sponsored by regional agencies, funding institutions or the IFIs needs to reach a wider readership than select public and non-public agencies and institutions. The Internet as well as sector-specific plans and programs are available choices of technology dissemination.

A proactive stance to reduce the toll of disasters requires a comprehensive approach which includes both pre-disaster risk reduction and post-disaster recovery. Such an approach would involve the following activities:

1. Risk assessment to identify the kinds of potential impacts faced by people and development investments as well as their magnitude.
2. Prevention and mitigation to address the structural sources of vulnerability
3. Financial protection and risk transfer to spread the risks over time and among different actors
4. Post-disaster rehabilitation and reconstruction to support effective recovery and safeguard against future disasters.

A long-term risk management approach should be adopted by the countries. It should consist of a balance mitigation investment with *ex-ante* and *ex-post* funding mechanisms. Mitigation measures should be approached as investments rather than costs. Countries need to develop and introduce targeted risk financing strategies for dealing with catastrophic events that can have a severe impact on their economies. Under current risk management practices, governments of the region bear a large part of the natural hazard risk. Part of this should be transferred to the private sector commensurate with the private sector's ownership and/or operation of production infrastructure and utilities.

The international donor community should support the effort of moving from an *ex-post* approach to proactive risk management. It will require the provision of the right information in a timely fashion and making financing available for risk identification and reduction programs in the region. Instead of focusing resources on post-disaster assistance, development programs should attempt to bolster the reduction of losses and financial preparedness. This would guarantee that important development goals are not jeopardized by the need to reallocate resources, disaster after disaster, to costly emergency reconstruction activities which could have been largely avoided through appropriate risk management. Bridging the gap between hazard assessment and project preparation is possible by appealing to donors with (1) early identification and integration of mitigation issues (2) practical and cost effective solutions to persistent problems and (3) government commitment to implementation beginning with the enforcement of technical standards.

Hazard risk management needs to be integrated into the economic development process. All stakeholders need to be involved in a process which incorporates emergency planning and natural hazard risk mitigation. Hazard information needs to be incorporated into land-use plans and those plans need to be enforced by local governments in order to reduce the vulnerability of towns and cities. Buildings and infrastructure in high-risk areas need to be reviewed against hazard-specific performance criteria to reduce the level of damage and ensure the functioning of essential services under emergency conditions. Attention needs to be given to adequate construction codes and their enforcement. For example, consideration should be given to adopting cost-effective and sustainable flood protection measures. Flood management should be seen within the overall framework of river basin and water catchment management plans.

New studies must be designed and carried out to identify who and what are vulnerable to which hazards, what can be done about it and when. "Best local practices" must be examined to ensure that they are commensurate with an acceptable level of risk, have visible and verifiable levels of accountability and make use of the viable scientific, technical, social and economic information concerning hazards, vulnerability and risk. Little public sector support has been directed at

encouraging mitigation in the household sector. Individuals and communities often believe that they are doing what needs to be done based on what they know. Fiscal incentives, such as making premiums tax deductible and removing value added taxes, should be employed to widen home insurance affordability. Encouraging mitigation does not mean that traditional practices are necessarily wrong or inadequate. Careful consideration of such practices needs to be made to insure that by implementing a more sophisticated or modern solution implementers do not discard an equally viable if not better solution already in existence. The difficult task will be convincing communities that they are not making use of the best available practices that will serve to benefit those potentially affected.

Sector plans need to be funded for assuring life safety and continuity of service at the community level beginning with education and health.

RECOMMENDATIONS

The key conclusion of the report is that hazard risk management must be integrated into the economic development process. Mitigation options need to increase programs and projects that reduce the vulnerability of priority groups, particularly the poor. Addressing the issue of improving the resilience of critical local infrastructure and production systems essential to national development plans are critical in the context of strengthening democracy, transparency and good governance. Overall, the report makes a compelling economic and developmental argument that investments intended to mitigate the impacts of hurricanes, flooding and other disasters before they occur through resilience-related technical activities are more cost effective than relying solely on post-disaster relief efforts.

A finding of the International Monetary Fund is that government policy in the Caribbean countries plays an important role in mitigating the impact of natural hazard events through prudent fiscal stimuli within the overall fiscal constraints, and supporting the implementation of precautionary mitigation measures, as well as structural reforms in the labor markets and the financial sector. The undertaking of precautionary measures by national authorities could be supported by grants and concessional loans from donors and IFIs in this direction. Another key conclusion of the report is that regional programs in a number of areas, including technical standards, the sharing of information, as well as regional insurance pooling programs, are timely and merit support of donors.

The report recommends action in six areas:

1. **Natural Hazard Information:** As part of the concept of the public good, there is a need for collaboration and coordination between national government agencies, regional and international development assistance agencies, the private sector, professional associations and the research community in preparing and distributing necessary natural hazard information based on shared hazard type and geographical location priorities. *Implementation Action Example:* In consultation with each economic and social sector, national planning authorities should identify specific priority geographical locations, hazard types and infrastructure types for which natural hazard information will be prepared in a coordinated manner using national, regional and international inputs.

2. **Technical Norms and Standards:** Develop and implement technical norms and standards for capital projects that define acceptable levels of risk to natural hazard events. This must become an integral part of the development process. *Implementation Action Example:* Under the coordination and responsibility of the public sector, design and implement, with private sector participation, effective enforcement of building design and construction norms and standards, including the detailed articulation of the mechanisms for checking that the appropriate norms and standards are being achieved at the concept stage, the preliminary design stage, the detailed design stage and the construction stage.
3. **Housing:** Using existing information, knowledge and expertise, invest in mitigating the vulnerability of existing communities. *Implementation Action Example:* With priority given to poorer communities, and redirecting, as necessary, international public and private community development assistance together with regional research and technical contributions, appropriate entities will identify and carry out pilot projects for small scale community relocation using approaches developed through a regional design competition for community sites of 30-100 houses.
4. **Education and Health:** As part of the concept of the public good, assign priority to investment in school and health facility mitigation at all levels by the public and private sector alike. *Implementation Action Example:* Building on pilot experiences and on growing support from the international community, appropriate national entities will complete and/or update infrastructure vulnerability audits of sector infrastructure and prepare retrofit programs for implementation through national and community-based public and private sector projects with international support.
5. **Energy, Transportation, Telecommunications and Water and Sanitation Infrastructure:** Place authority and responsibility for investing in mitigation on the owners and operators of vulnerable infrastructure. *Implementation Action Example:* On a sector basis, working through regional intergovernmental organizations supported by IFIs, development assistance agencies and professional organizations, responsible national entities will create and implement, at the appropriate level (authority, company, concession), a program for infrastructure vulnerability assessment, local capacity building, skills training and investing in cost-effective mitigation measures.
6. **Agriculture and Tourism:** Support the private sector owners in complementing existing actions on emergency preparedness with support in creating and implementing vulnerability reduction actions for protecting investments and employment. *Implementation Action Example:* On a sector basis, working through regional and national government and sector organizations supported by international specialized development assistance agencies and professional organizations, appropriate national sector entities will coordinate the preparation and dissemination of mitigation guidelines and offer technical assistance to individual entities for their investment programs and business operations.

ANNEXES

Annex 1 – IMF

Appendix 1-A

Fund Emergency Assistance for Natural Disasters, 1962-2004

Country	Year	Event	Purchases	
			In millions of U.S. Dollars	In percent of Quota
Egypt	1962	Crop failure	24.0	26.7
Yugoslavia	1963	Earthquake	30.0	25.0
India	1966	Drought	187.5	25.0
Nicaragua	1973	Earthquake	14.5	44.4
Chad	1974	Drought	3.4	21.5
Dominica	1979	Hurricane	1.3	50.0
Dominican Republic	1979	Hurricane	22.2	31.8
St. Lucia	1980	Hurricane	2.3	50.0
St. Vincent and the Grenadines	1980	Hurricane	0.5	25.0
Yemen, P.D.R.	1982	Floods	16.8	25.0
Yemen, Arab Republic	1983	Earthquake	10.7	50.3
Madagascar	1986	Cyclone	19.0	25.0
Mexico	1986	Earthquake	320.1	25.0
Solomon Islands	1986	Cyclone	1.5	25.0
Ecuador	1987	Earthquake	48.2	25.0
Bangladesh	1988	Floods	96.8	25.0
Jamaica	1989	Hurricane	48.1	25.0
Pakistan	1992	Floods	261.4	25.0
Bangladesh	1998	Floods	138.2	25.0
Dominican Republic	1998	Hurricane	55.9	25.0
Haiti	1998	Hurricane	21.0	25.0
Honduras	1998	Hurricane	65.6	50.0
St. Kitts and Nevis	1998	Hurricane	2.3	25.0
Turkey	1999	Earthquake	501.0	37.5
Malawi	2002	Food shortage	23.0	25.0
Grenada	2003	Hurricane	4.0	25.0
Grenada	2004	Hurricane	4.4	25.0

Source: Cashin and Dyczewski 2005

Appendix 1-B

Worldwide Incidence of Natural Disasters, 1970–2002

	All Recorded Disasters					With Estimates of Persons Affected			With Estimates of Damage		
	Number of Events	Number of Events Divided by Land Area		Number of Events Divided by Population		Number of Events	Cumulative Affected in Percent of Population		Number of Events	Cumulative Damage in Percent of Annual GDP	
		Index	Rank	Index	Rank		Total	Rank		Total	Rank
All countries	6,480	100	76	100	76	4,511	62	76	2,036	21	76
Advanced economies	1,511	23	70	39	91	742	7	119	742	3	104
Caribbean	162	599	23	387	23	114	65	66	58	37	46
ECCU6	44	1,212	5	770	6	31	85	58	18	66	19
Antigua and Barbuda	7	1,198	3	883	4	6	248	7	2	22	34
Dominica	8	803	8	890	3	6	125	27	4	118	7
Grenada	4	886	7	348	12	2	1	127	3	23	32
St. Kitts and Nevis 1/	7	1,465	2	1,295	2	4	33	70	4	132	6
St. Lucia 2/	8	988	6	451	8	5	64	52	2	67	13
St. Vincent and Grenadines	10	1,931	1	755	6	8	41	67	3	35	23
Other Caribbean	118	190	36	131	35	83	52	71	40	17	63
Bahamas	5	38	37	170	20	2	1	128	2	13	49
Barbados	6	1,051	4	193	19	5	3	117	3	7	67
Belize	10	33	41	457	7	7	131	25	7	51	16
Dominican Republic	23	36	39	29	69	14	62	53	4	17	40
Guyana	6	2	128	67	39	3	89	42	2	4	77
Haiti	36	98	23	47	50	30	83	46	4	9	62
Jamaica	23	160	17	82	33	15	74	49	13	50	17
Netherlands Antilles	2	188	14	90	31	1	20	78	1	1	122
Trinidad and Tobago	7	103	21	48	47	6	5	104	4	1	119
Other	4,807	49	84	75	79	3,655	74	67	1,236	23	73
GDP per capita of top-20 3/	...	...	4.2	...	5.5	...	...	1.4	...	...	1.9

Sources: Rasmussen (2004). EM-DAT for data on natural disasters, including estimates of the number of people affected and the value of damage; World Bank, World Development Indicators for data on land area; IMF, World Economic Outlook database for data on GDP and population.

Note: The sample contains 150 countries after omitting countries without at least one natural disaster associated with a cost estimate and/or missing information on GDP (24 advanced economies, 15 Caribbean countries, and 111 other developing countries). Simple unweighted averages are used for country groupings. Rankings are in descending order, with "1" indicating the most exposed to natural disaster.

1/ Using St. Kitts National Emergency Management Agency's damage estimate for 1998 Hurricane Georges would have implied a ranking of "2" in the last column.

2/ Excludes EM-DATs damage estimate for 1988 Hurricane Gilbert. If included this would have implied a ranking of "1" in the last column.

3/ In thousands of US\$ in 2002.

Annex 2 – IDB

Appendix 2-A

Key Elements of Risk Management					
Pre-Disaster Phase				Post-Disaster Phase	
Risk Identification	Mitigation	Risk Transfer	Preparedness	Emergency Response	Rehabilitation and Reconstruction
Hazard assessment (frequency, magnitude and location)	Physical/structural mitigation works	Insurance/reinsurance of public infrastructure and private assets	Early warning systems. Communication systems	Humanitarian assistance	Rehabilitation/reconstruction of damaged critical infrastructure
Vulnerability assessment (population and assets exposed)	Land-use planning and building codes	Financial market instruments (catastrophe bonds, weather-indexed hedge funds)	Contingency planning (utility companies/public services)	Clean-up, temporary repairs and restoration of services	Macroeconomic and budget management (stabilization, protection of social expenditures)
Risk assessment (a function of hazard and vulnerability). Risk indicators: O Financial O Institutional O Social/environmental, nacional O Local	Economic incentives for pro-mitigation behavior	Privatization of public services with safety regulation (energy, water, transportation, etc.)	Networks of emergency responders (local/national)	Damage assessment	Revitalization for affected sectors (exports, tourism, agriculture, etc.)
Hazard monitoring and forecasting (GIS, mapping, and scenario building)	Education, training and awareness about risks and prevention	Calamity Funds (national or local level)	Shelter facilities Evacuation plans	Mobilization of recovery resources (public/multilateral /insurance)	Incorporation of disaster mitigation components in reconstruction activities
<p>Building and Strengthening National Systems for Disaster Prevention and Response: These systems are an integrated, cross-sectoral network of institutions addressing all the above phases of risk reduction and disaster recovery. Activities that need support are policy and planning, reform of legal and regulatory frameworks, coordination mechanisms, strengthening of participating institutions, national action plans for mitigation policies and institutional development.</p>					

Appendix 2-B



Natural Disasters

List of major projects 1995-2002

Inter-American Development Bank
Washington D.C.

IDB. PORTFOLIO OF 49 NATURAL DISASTER RELATED LOANS, 1995-2002

Loan #	Title	Country	Year	Classification	Total Project Amount US\$ (1000s)	IDB Loan Amount US\$ (1000s)	% disbursed IDB loan as of Dec 2002	Natural Disaster %1	Loan Objective	Comments
AR-0136	Environmental Management of the Matanza-Riachuelo River Basin	Argentina	1997	Prevention	500,000	250,000	12.11%	72%	To improve management of the Matanza-Riachuelo Basin's natural resources through coordination of environmentally related actions. Four sub-programs: (1) industrial pollution control; (2) flood control works; (3) solid waste mgmt; and (4) urban rehabilitation.	The program will provide critical drainage and flood works, and will largely resolve the flooding problem in the most flood prone areas.
AR-0242	Emergency Flood Rehabilitation Program	Argentina	1998	Rehabilitation/ Reconstruction	500,000	300,000	68.61%	100%	To provide support for the economic and social recovery of affected zones through activities to attenuate the impact of the flood, reconstruction and rehabilitate economic and social infrastructure, and mitigate damage from similar catastrophes in the future.	Three components of the program: (1) Mitigation (\$30 mn.) (2) Reconstruction (\$430 mn.), and (3) Prevention (\$5 mn.).
BA-0019	Coastal Infrastructure Program	Barbados	2001	Prevention	24,200	17,000	....	59%	To support the sustainable development and improvements for shoreline preservation and management.	Global and regional changes and their effect on the coastal environment of Barbados are related to fluctuations in temperature, oceanographic current circulation, meteorological variations and natural hazards from hurricanes and tropical storms.
BH-0031	Infrastructure Rehabilitation Program	Bahamas	2001	Rehabilitation/ Reconstruction	43,000	30,000	32.80%	100%	Rehabilitation of basic infrastructure damaged by Hurricane Floyd.	Phase I - rehabilitation or reconstruction of specific works damaged or destroyed by Hurricane Floyd Phase II - includes other specific works designed to replace works that have been repeatedly damaged by storms over the years.
BL-0015	Hurricane Rehabilitation and Disaster Preparedness	Belize	1999	Prevention	32,222	21,333	27.22%	100%	To reduce the country's vulnerability and improve its response capacity to natural disasters.	The program has two components (1) a structural component that addresses measures needed to reduce the vulnerability of Belize to damages from winds, rains and storm surge; (2) an institutional component.

BL-0018	Emergency Reconstruction Facility Following Hurricane Keith in Belize	Belize	2000	ERF	25,000	20,000	100.00%	100%	To restore basic services to the population affected by Hurricane Keith.	The project will provide resources for urgent activities needed to restore services to the affected population including: the removal of debris, repair and stabilization of damaged roads, bridges, drainage structures and city streets.
BO-0040	National Irrigation Program (PRONAR)	Bolivia	1995	Prevention	32,900	25,600	58.92%	100%	To bring about an institutional and legal rearrangement of the water-resources sector and the irrigation subsector to create the requisite elements for managing and coordinating actions in the subsector, enhance the efficiency of investments and foster the rational and sustainable use of water resources.	
BO-0098	Improvement Program For The Ventilla-Tarapaya Highway and Transportation Sector Support	Bolivia	1999	Rehabilitation/ Reconstruction	71,000	52,000	23.26%	1%	To help improve the competitiveness of the country's productive sectors, in the context of growing domestic and international trade, by enhancing the level of service on the basic highway system, and reducing costs for users. Specifically, to upgrade the characteristics and structural capacity of the Ventilla-Tarapaya-Potosi section, by undertaking roadway improvements, paving and rehabilitation, and increasing the usability of its access roads, in accordance with proper safety standards.	Provides the possibility to conduct studies to identify vulnerable areas, however does not discuss any specifics.
BO-0206	Disaster Prevention Program	Bolivia	2002	Prevention	3,000	2,700		100%	To help the Bolivian government to operate its national disaster prevention and risk reduction system (SISRADE) more effectively. Specifically, (1) strengthen the institutional structure of SISRADE, and (2) to raise public understanding of risk.	
BO-0217	Emergency Support for Water Production at the Sama Mountain Biological Reserve in Tarija	Bolivia	2002	ERF	2,778	2,500		100%	To provide Bolivia with the resources necessary to cover the immediate costs of restoring water services to the population of the communities affected by the fire at the Sama Mountain Biological Reserve in Tarija.	Project components: (1) Restore quantity and quality of potable water supply - \$1 mn. (2) Restoration of water production capacity in Sama Mountains - \$874,000 (3) Studies to assess damage and prevent disasters - \$260,000 (4) Project Mgmt. - \$400,000

BR-0234	Flood Control Program in Campinas	Brazil	1996	Prevention	33,000	19,800	100.00%	100%	To reduce the damage caused by flooding in the city of Campinas, thus helping to improve the city's socio-economic and environmental situation, particularly the living conditions of families residing along the banks of watercourses.	No mention specifically of natural disasters, however the primary objective is to mitigate damage caused by flooding.
CA-0034	Tri-National Program for Sustainable Development in The Upper Lempa River Basin	El Salvador	2001	Prevention	17,500	14,000	....	7%	To improve the quality of life of the inhabitants of the upper Lempa River basin, through actions that promote sustainable development in the target area and that seek to break the cycle of poverty and destruction of natural resources.	Disaster prevention and mitigation including two sub-components: (i) Interventions at the subbasin level, restoration of degraded areas and protection of vulnerable areas; and (ii) Prevention, early warning, and monitoring systems for natural phenomena.
CA-0034	Tri-National Program for Sustainable Development in The Upper Lempa River Basin	Guatemala	2001	Prevention	7,000	4,500	....	19%	To improve the quality of life of the inhabitants of the upper Lempa River basin, through actions that promote sustainable development in the target area and that seek to break the cycle of poverty and destruction of natural resources.	Disaster prevention and mitigation including two sub-components: (i) Interventions at the subbasin level, restoration of degraded areas and protection of vulnerable areas; and (ii) Prevention, early warning, and monitoring systems for natural phenomena.
CA-0034	Tri-National Program for Sustainable Development in The Upper Lempa River Basin	Honduras	2001	Prevention	6,795	3,300	....	19%	To improve the quality of life of the inhabitants of the upper Lempa River basin, through actions that promote sustainable development in the target area and that seek to break the cycle of poverty and destruction of natural resources.	Disaster prevention and mitigation including two sub-components: (I) Interventions at the subbasin level, restoration of degraded areas and protection of vulnerable areas; and (ii) Prevention, early warning, and monitoring systems for natural phenomena.
CO-0243	Emergency Reconstruction Facility Following the Earthquake in the Coffee Belt	Colombia	1999	ERF	355,000	20,000		100%	To resume basic services to the population stricken by the earthquake in the coffee belt.	Provide resources for urgent activities including debris removal, building demolition, the inspection and stabilization of buildings and bridges, temporary housing and, in general, repair of the infrastructure of services such as drinking water and sanitation.

DR-0131	Local Road Maintenance and Rehabilitation Program, Phase II	Dominican Republic	1998	Prevention	60,000	48,000	15.86%	100%	To ensure sustainability of local road maintenance. Specifically, (i) consolidate modernization of the institution responsible for the local roads systems, (ii) promote new implementation arrangements (iii) help devise new alternative ways to ensure steady, permanent funding of maintenance plans; and (iv) help fund a portion of the annual investment plans for rehabilitation and maintenance of local roads and bridges.	Negative environmental impacts, identified in the environmental and social impact report, are small and can be reduced or prevented altogether. The following kinds of impact are possible: disputes over land use, erosion, negative effects on the groundwater supply or water quality, and on the landscape or unique habitats.
DR-0135	Reconstruction and Improvement Program in the Wake of Hurricane Georges	Dominican Republic	1998	Rehabilitation/ Reconstruction	117,000	105,000	90.05%	100%	To restore parts of the country's infrastructure and economic flows that were hard hit by Hurricane Georges, with an emphasis on aid to the poor, disaster prevention, and involvement of the populace in preventative initiatives.	
DR-0145	Sector Facility; Disaster Prevention and Risk Management Program	Dominican Republic	2002	Prevention	6,661	5,000		100%	To help the country to improve its capacity to reduce and manage risks of disasters.	Component I: Local disaster prevention and risk management. Objective is to enable eight municipalities to better understand and manage their risk of disasters and to provide the national authorities with a test model for supporting local risk management.
EC-0143	Slope Protection Program for Mt. Pichincha	Ecuador	1996	Prevention	25,000	20,000		68%	To control runoff, flooding and mudslides on the eastern slopes of Mt. Pichincha.	
EC-0182	El Nino Emergency Program	Ecuador	1997	Rehabilitation/ Reconstruction	231,000	105,000	100.00%	100%	To restore socioeconomic development in areas affected by El Nino.	
EC-0187	Supplementary El Nino Emergency Program (Coastal Highway System)	Ecuador	1999	Rehabilitation/ Reconstruction	60,000	48,000	91.28%	100%	To reopen the coastal highway network damaged by El Nino. In addition, studies and final designs for the works to be undertaken in an-after-the-emergency' stage will be prepared, covering reconstruction activities to be financed under a new operation.	
EC-0200	Metropolitan Quito Environmental Sanitation Program (Phase I)	Ecuador	2002	Prevention	50,000	40,000	....	33%	To reduce flooding, mudslides and landslides, to expand water and sewer services in MDMQ priority areas, and to build institutional capacity for efficient management of EMAAP-Q water and sewer services.	

ES-0087	Housing Program	El Salvador	2001	Prevention	142,700	95,500	....	14%	To support the Government of El Salvador in developing and introducing a set of sustainable housing policy instruments.	Component 5 includes risk prevention (municipal environmental maps and studies on natural disaster-resistant construction technologies).
ES-0119	Agribusiness reengineering project	El Salvador	1997	Prevention	31,250	25,000	0.81%	68%	To promote higher incomes from agricultural and forestry activities by developing greater efficiency and higher value added.	
ES-0120	Local Development Program II	El Salvador	2001	Prevention	77,800	70,000	20.64%	74%	To improve the living conditions of poor people living in vulnerable municipalities and communities.	
ES-0129	Multiphase Program for Sustainable Roads in Rural Areas	El Salvador	2001	Rehabilitation/ Reconstruction	136,700	105,000	11.89%	100%	To promote passenger and freight transportation by rehabilitating a portion of the tertiary road system in rural areas, establishing new systems for road maintenance, and modernizing the transportation sectors institutional structure.	Under PNCSAR, priority is given to roads serving the most impoverished areas and areas vulnerable to natural disasters.
ES-0148	Emergency Reconstruction Support Program Following the Earthquake of January 2001	El Salvador	2001	ERF	25,000	20,000	100.00%	100%	To contribute to efforts to restore basic priority services to the population affected by the earthquake.	Program resources will be used to remove debris or rent private, unimproved lots with an option to purchase and subsequent temporary housing on these permanent residence sites, prevention measures to stabilize hillsides in order to ensure the population's safety.
ES-0150	Emergency Reconstruction Support Program Following the Earthquake of February 2001	El Salvador	2001	ERF	25,000	20,000	92.05%	100%	To help restore basic priority services to the population affected by the earthquake.	
GU-0133	Program for Natural Resource Management in Upper Watersheds	Guatemala	2002	Prevention	44,450	40,000	....	10%	To improve natural resource management in upper watersheds by means of a strategy to support adjustment and/or conversion of production by small producers in rural areas.	The third component of the program consists of activities and investments to reduce vulnerability to natural disasters, to manage risk, and to develop criteria for valuation of the environmental services provided by watersheds.
GU-0137	Emergency Program in Response to Natural Disasters	Guatemala	1998	Rehabilitation/ Reconstruction	44,470	40,000	98.84%	100%	To prevent, avoid and reduce the effects that, as a result of the natural disasters that hit Guatemala in the last six months.	El Nino resulted in landslides, avalanches, high water in rivers, and mudflows. Hurricane Mitch caused severe damage.

GU-0155	Urban Poverty Reduction Program	Guatemala	2002	Prevention	52,000	46,800	....	48%	To help reduce poverty in urban areas of the Department of Guatemala by improving living conditions of residents of urban shantytowns.	Only mention of natural disasters states the lack of appropriate channeling of rainwater increases vulnerability to natural disasters in settlements located on steep slopes.
HO-0131	Social Investment Program (FHIS III)	Honduras	1998	Rehabilitation/ Reconstruction	55,600	50,000	94.64%	95%	Damage evaluation; infrastructure emergency reconstruction; community participation.	
HO-0143	Emergency Road and Water-Supply Infrastructure Project	Honduras	1998	Rehabilitation/ Reconstruction	28,700	25,800	99.19%	100%	To alleviate the economic, social, and environmental impact of the damage caused by Hurricane Mitch to Honduras's road and water-supply infrastructure.	
HO-0146	Post Hurricane Housing Program	Honduras	1999	Rehabilitation/ Reconstruction	11,550	10,390	25.12%	78%	To support in an initial stage the Government's strategy to develop housing solutions for those low-income households made homeless by Hurricane Mitch.	
HO-0164	Road Infrastructure Project	Honduras	2000	Rehabilitation/ Reconstruction	31,700	26,800	24.20%	93%	To supplement the financing approved by the Bank's Board of Executive Director in January 1999 for the emergency road and water-supply infrastructure Program (HO-0143).	
HO-0179	Multiphase Program for Natural-Resources Management in Priority Watersheds - Phase I	Honduras	2001	Prevention	27,800	25,000	5.30%	11%	To spur processes that can achieve sustainable rural development, by strengthening natural-resources management in central government agencies and at the local level. To improve watershed management.	Module 4 (\$1.3 million) will support the role of the Standing Committee on Emergency Management (COPECO). Increase disaster prevention and management capacities.
JA-0123	Emergency Reconstruction Facility (ERF); Following Torrential Rains in Jamaica	Jamaica	2002	ERF	20,000	16,000	29.49%	100%	To address the temporary reconstruction, stabilization, and repair of infrastructure within five parishes declared disaster areas as a result of heavy rains during the May/June 2002 period as well as to strengthen the country's ability to respond to emergencies.	The program will provide resources for urgent activities needed to restore basic infrastructure services.
ME-0137	Housing Finance Program	Mexico	2000	Prevention	1,170,000	505,000	....	1%	To improve the efficiency of Mexico's formal housing finance system and facilitate its expansion to lower income segments of the population.	Request developers to evaluate soil contamination and natural hazards.

ME-0179	Mexico Valley Sanitation Program	Mexico	1996	Prevention	1,035,000	365,000	0.87%	31%	To help solve drainage problems in the Mexican Valley metropolitan area (ZMVM) in order to prevent catastrophic floods; reduce wastewater pollution to improve health conditions; and slow environmental degradation.	
NI-0064	Multi-Phase Low-Income Housing Program; First Phase	Nicaragua	2002	Prevention	50,300	42,500	....	1%	To improve housing conditions of low and moderate-income households by providing subsidies, deepening markets, and strengthening institutions in the sector.	As part of the investment component the program addresses the needs related with environmental vulnerability of low-income housing settlements by introducing an instrument that orients construction of safe areas and strengthens municipalities' capabilities.
NI-0068	Road Rehabilitation and Improvement Program	Nicaragua	1995	Rehabilitation/Reconstruction	223,000	75,000	100.00%	34%	To advance economic and social development by improving the country's road infrastructure and institutionally strengthening the subsector. The purpose is to afford a sound infrastructure for the transport of goods and persons and to promote foreign and domestic trading, to be accomplished through the anticipated reduction in transportation costs and more efficient maintenance.	p. 43 "While Nicaragua is located in an area of considerable seismic activity and is prone to torrential rains and flooding, one can never predict where phenomena of this kind will occur. The program does not include measures to mitigate the effects of such eventualities."
NI-0099	Pan-American Highway Rehabilitation Program	Nicaragua	1999	Rehabilitation/Reconstruction	81,600	50,000	94.00%	91%	(i) to support rehabilitation of the Pan-American Highway, (ii) to support implementation of a sustainable road maintenance mechanism.	
NI-0108	Program to Fight Poverty and Strengthen Local Capacity	Nicaragua	2000	Prevention	55,645	50,000	8.75%	5%	To help fight poverty by providing funding for basic social infrastructure through delegation and participation that improves access by the poor. Specifically, to strengthen community and local government capacity for implementing and maintaining basic.	Included in component 2; Strengthen of local technical capacities, training for NGOs and other local actors on issues including natural disaster mitigation. Component 3 FISE is responsible for contracting technical assistance.
NI-0141	Socioenvironmental and Forestry Development Program II (POSAF II)	Nicaragua	2001	Prevention	38,000	32,700	11.01%	11%	To improve socio-economic conditions and living standards of resident of priority Nicaraguan watersheds and lessen the impact of natural disasters in these basins, through the sustainable use and development of renewable natural resources.	A lot of mention of prevention and mitigation throughout the loan

PE-0188	El Nino Emergency Program	Peru	1997	Prevention	215,000	150,000	98.85%	89%	To carry out activities to prevent or mitigate the impact of the El Nino phenomenon and to rebuild the physical infrastructure damages and restore services interrupted by it.	It is considered an Emergency Program but in the loan document money is distributed for prevention and reconstruction projects.
PE-0215	Earthquake Emergency Program	Peru	2001	ERF	20,000	20,000	100.00%	100%	To provide relief in earthquake struck areas (Earthquake 23. June 2001 southern Peru).	
PN-0149	Multiphase Program for Sustainable Development of Bocas del Toro	Panama	2002	Prevention	469,000	42,200	....	1%	To foster conditions for the sustainable development of the Bocas del Toro region through support for activities and investments that will yield economic, social, and environmental benefits.	Phase I will focus on building management capacity for the productive use of natural resources in a sustainable manner, and for reducing vulnerability to natural hazards.
PR-0112	Emergency and Infrastructure Rehabilitation Program	Paraguay	1998	Rehabilitation/Reconstruction	40,000	35,000	73.18%	100%	To support the rapid restoration and reopening of the infrastructure destroyed or damaged by the effects of El Nino and prevent future damage from similar phenomena; and to improve the response capacity of the institutions in charge of dealing with emerge.	
VE-0122	Emergency Program for Torrential Rains, Flooding and Landslides	Venezuela	2000	ERF	40,000	20,000		100%	To restore basic services and to take urgent measures to avert additional losses to persons and property from torrential rains, floods, and landslides mainly in the central littoral of the country.	

Note: ¹ = % of total project amount apparently devoted to natural disaster related expenditure.

Technical cooperation projects (> US\$ 150,000) related to natural disasters, 1995-2002

Number	Title	Country	Year	Total Project Amount (US\$ 1000s)	IDB Amount (US\$1000s)	Classification	Type of Risk
TC-98-03504-AR	Development of a Digital Cartographic Information System	Argentina	1999	150	150	Prevention	Natural disaster (general)
TC-96-01-08-1	National Geographic Information System	Bahamas	1997	1,292	992	Prevention	Natural disaster (general)
TC-99-02-01-1-BL	Strengthening of the National Emergency Management Organization	Belize	1999	180	150	Prevention	Windstorm
TC-98-10-46-8-BO	Institutional Strengthening in the Area of Digital Cartography	Bolivia	1999	150	150	Prevention	Natural disaster (general)
TC-98-01-24-3-CO	Chinchina River Watershed Management Plan	Colombia	1998	390	150	Prevention	Natural disaster (general)
TC-99-03-03-1-CO	Demolition Debris Management and Disposal in the Coffee Belt Region affected by the Earthquake	Colombia	1999	150	150	Emergency Assistance	Earthquake
TC-99-09-01-6-CO	Solid Waste Management and Disposal in the Coffee Belt Region of Colombia	Colombia	2000	950	740	Prevention	Earthquake
TC-96-03-269	Design and Feasibility Studies of the Rio Grande de Tarcoles Integrated Watershed Management Program	Costa Rica	1997	868	749	Prevention	Flood
TC-98-09-49-5	Program of Reconstruction and Improvements after Hurricane "Georges"	Dominican Republic	1998	750	750	Emergency Assistance	Windstorm
TC-99-10-02-9	Flood-related disaster prevention and mitigation in the lower Rio Lempa watershed	El Salvador	1999	150	150	Prevention	Flood
TC-99-08-02-4-ES	Sustainable Development Upper Lempa River Basin	El Salvador	1999	175	150	Prevention	Natural disaster (general)

TC-00-09-02-6-ES	Sustainable Development Lower Lempa River	El Salvador	2001	374	299	Prevention	Flood
TC-01-04-02-9	Apoyo a la Ejecución y Seguimiento del Programa de Reconstrucción	El Salvador	2001	938	750	Reconstruction	Earthquake
TC-99-08-0-23-GU	Sustainable Development Upper Lempa River	Guatemala	1999	175	150	Prevention	Natural disaster (general)
TC-01-04-00-1	Uso SIG en Desastres Naturales	Guatemala	2001	165	150	Prevention	Natural disaster (general)
TC-98-11-98-7-HO	Evaluation of Disaster Damage: Tegucigalpa Water and Sewerage	Honduras	1998	150	150	Reconstruction	Windstorm
	Reconstrucción Pos Huracán Mitch	Honduras	1998	150	150	Reconstruction	Windstorm
TC-99-08025-HO	Sustainable Development Upper Lempa River	Honduras	1999	175	150	Prevention	Natural disaster (general)
TC-99-03-00-4	Strategic Planning for the Reconstruction of Tegucigalpa	Honduras	1999	451	410	Reconstruction	Windstorm
TC-99-03-00-7	San Pedro Sula Emergency Recovery Program Technical Cooperation for flood protection works	Honduras	1999	440	400	Reconstruction	Flood
TC-98-12-00-9	Program to Support the National Reconstruction Process	Honduras	1999	1,100	1,000	Reconstruction	Windstorm
TC-99-05-04-4	Apoyo Rehabilitación Infraestructura Dañada	Honduras	1999	150	150	Reconstruction	Windstorm
TC-98-01-30-0	Cooperación Técnica Para la Formulación del Programa Nacional de Ordenamiento Territorial (PRONOT)	Honduras	2000	732	652	Prevention	Windstorm
TC-01-12-02-0	Gestión financiera del riesgo de catástrofes	Honduras	2002	165	150	Prevention	Natural disaster (general)
TC-98-11-24-2	Reconstrucción Posterior Huracán Mitch	Nicaragua	1998	150	150	Emergency Assistance	Windstorm

TC-99-09-02-0	Assessing Vulnerability to Natural Disasters/and land use planning, Planning use of land affected by Hurricane Mitch.	Nicaragua	1999	160	150	Reconstruction	Windstorm
TC-99-12-044-NI	Danish Trust Fund for Consulting Services, Special contribution for the reconstruction of countries affected by Hurricane Mitch	Nicaragua	2000	175	150	Reconstruction	Windstorm
TC-98-01-49-1	Formulación del Programa Nacional de Ordenamiento Territorial (PRNOT)	Nicaragua	2001	765	650	Prevention	Natural disaster (general)
TC-02-08-01-5	Multi-Phase Low-Income Housing Program, First Phase: Preparation of Environmental Risk Maps	Nicaragua	2002	300	300	Reconstruction	Natural disaster (general)
TC-98-06-48-3	Strategy for Sustainable Development of the Panama Canal Watershed	Panama	2000	3,238	1,000	Prevention	Natural disaster (general)
TC-95-05-16-8	Preparation of the Management Plan and Feasibility Studies for the Rimac River Basin Environmental Management Program	Peru	1996	830	740	Prevention	Flood
TC-97-11-24-4-PE	El Nino Rapid Early Warning System Demonstrative Project	Peru	1998	150	150	Prevention	Flood
TC-97-08-35-8	Zonificación Ecológica-Económica para al Desarrollo Sostenible de la Cuenca Alta del Río Madre de Dios	Peru	1998	150	150	Prevention	Flood
TC-97-11-24-4	Predicciones Desastres - Proyecto El Niño	Peru	1998	150	150	Prevention	Flood
TC-95-07-50-2	Ayuda de Emergencia para OECS	Regional	1995	150	150	Emergency Assistance	Windstorm
TC-96-02-15-4-RG	Digital Mapping and Geographic Information Systems Pilot Project	Regional	1997	889	608	Prevention	Natural disaster (general)
TC-99-06-00-6	Strengthen Regional Dialogue in the post Mitch Process	Regional	1999	200	150	Prevention	Windstorm

TC-97-12-38-3-RG	Study on the Prediction and Amelioration of Socio-Economic Impacts of el Nino Southern oscillation (ENSO) in Latin America and the Caribbean	Regional	1999	1,538	998	Prevention	Flood
TC-97-09-46-3	Mitigación Desastres en Centroamérica	Regional	1999		1,110	Prevention	Natural disaster (general)
TC-00-02-02-0-RG	Participación Comunitaria y Educación en la Salud para el Combate al Dengue	Regional	2000	356	291	Prevention	Natural disaster (general)
TC-01-09-018-RS	Practical Applications of Financial Instruments for Natural Disasters in Latin America	Regional	2001	170	150	Prevention	Natural disaster (general)
TC-00-07-03-1	Updating Wind and Earthquake Codes for ACS Countries	Regional	2001	150	150	Prevention	Natural disaster (general)
TC-01-03-04-4-RG	Disaster Relief and Conservation	Regional	2001	150	150	Prevention	Natural disaster (general)
TC-01-01-07-2-RG	Program to Combat Desertification in South America	Regional	2002	1,090	1,000	Prevention	Natural disaster (general)
TC-00-04-01-7-UR	Integration of INE and Cadastral Spatial Data Base to Support Rural Infrastructure Planning and Management	Uruguay	2001	420	350	Prevention	Natural disaster (general)
TC-98-11-91-1-UR	Spatial Information System for National Infrastructure Management and Planning	Uruguay	2001	900	750	Prevention	Natural disaster (general)

Annex 3 – The World Bank

Appendix 3-A

World Bank Portfolio of Natural Disaster Natural Disaster Reconstruction Projects in the LAC Region Approved Since 1980.

Project ID	Project Name	Country	Lending Instrument Type	Closing Date	Lending Project Cost	IBRD Comm.Amt. (\$m)	IDA Comm. Amt. (\$m)	TOTAL Amt (\$m)	Grant Amt (\$m)
P007100	Guayas Flood Control	Ecuador	Investment	30-Jun-00	150	59	0	59	0
P006051	Flood Rehabilitation Project	Argentina	Investment	31-Mar-98	270	0	0	0	0
P006003	Road Maintenance and Rehabilitation Sector Project	Argentina	Investment	30-Jun-00	756	340	0	340	0
P037006	Water Sector Institutional Strengthening	Trinidad and Tobago	Investment	30-Jun-99	33.1	25	0	25	0
P008237	Inparques Project	Venezuela	Investment	30-Jun-04	95.9	55	0	55	0
P039455	Watershed and Environmental Management Project	St. Lucia	Investment	31-Dec-97	7.1	2.6	2.7	5.3	0
P007713	Water Resources Management Project	Mexico	Investment	30-Jun-05	186.5	186.5	0	186.5	0
P006052	Flood Protection Project	Argentina	Investment	31-Dec-05	420	200	0	200	0
P046052	Ceara Water Pilot Project	Brazil	Investment	30-Jun-02	12	9.6	0	9.6	0
P054667	El Nino Emergency Assistance Project	Peru	Investment	31-Dec-00	430	150	0	150	0
P055571	El Nino Emergency Recovery Project	Ecuador	Investment	31-Dec-00	66	60	0	60	0
P055935	El Nino Emergency Flood Project	Argentina	Investment	31-Dec-04	60	42	0	42	0
P055974	El Nino Emergency Assistance Project	Bolivia	Investment	31-Mar-01	27.5	0	25	25	0

P058129	Emergency Fire Prevention & Control Project	Brazil	Investment	31-Dec-04	27	15	0	15	0
P057271	El Nino Emergency Assistance Project	Guyana	Investment	29-Mar-02	10.2	0	9	9	0
P069633	Dominica Emergency Recovery & Disaster Management Project	Dominica	Investment	31-Dec-02	6	2.53	1.8	4.33	0
P063201	Hurricane Georges Emergency Recovery Project	Dominican Republic	Investment	30-Jun-03	125.2	111.1	0	111.1	0
P062668	Emergency Recovery & Disaster Management Project	St. Kitts and Nevis	Investment	31-Oct-03	57	8.5	0	8.5	0
P070430	Emergency Recovery & Disaster Management Project	St. Lucia	Investment	31-Oct-03	7.65	3.04	3	6.04	0
P064083	Hurricane Emergency Project	Honduras	Investment	30-Jun-00	200	0	200	200	0
P064084	Hurricane Emergency Project	Nicaragua	Investment	30-Jun-00	50	0	50	50	0
P064634	Transport Sector Rehabilitation Project - Supplemental Credit	Honduras	Investment	N/A	20	0	20	20	0
P069772	Supplemental Credit for Honduras FHIS IV Project	Honduras	Investment	N/A	22.5	0	22.5	22.5	0
P065263	Colombia Earthquake Recovery Project	Colombia	Investment	30-Jun-04	377	225	0	225	0
P064913	NATURAL DISASTER MITIGATION	Honduras	Investment	2-Jan-07	12	0	10.82	10.82	0

P069922	GD Grenada Emergency Recovery & Disaster Management Proj	Grenada	Investment	15-May- 05	11.79	5.06	5.01	10.07	0
P057538	Road Reconstruction and Improvement Project	Honduras	Investment	31-Mar- 06	106.8	0	66.5	66.5	0
P064887	Natural Disaster Management Project	Mexico	Investment	31-Dec- 04	658.35	404.05	0	404.05	0
P064916	Natural Disaster Vulnerability Reduction	Nicaragua	Investment	31-Mar- 05	16.05	0	13.5	13.5	0
P074543	Foot & Mouth Disease Emergency Recovery Loan	Uruguay	Investment	30-Jun- 05	24	18.5	0	18.5	0
P067986	SV-Earthquake Emergency Rec. & Health Services Extension Project	El Salvador	Investment	30-Apr- 07	165.7	142.6	0	142.6	0
P076830	Jamaica Emergency Recovery Loan	Jamaica	Investment	30-Jun- 02	150	75	0	75	0
P069923	Emergency Recovery and Disaster Management Project	St. Vincent and the Grenadines	Investment	31-Jan-06	6.81	3	2.91	5.91	0
P077602	Tax Administration Institutional Development Project	Mexico	Investment	30-Jun- 07	82	52	0	52	0
P073389	Mainstreaming Adaptation to Climate Change Project	Caribbean	N/A	30-Sep- 07	10.95	0	0	0	5
P086469	LC Disaster Management Project II	St. Lucia	Investment	31-Dec- 09	8.9	3.7	3.77	7.47	0
P064914	Forests and Rural Productivity	Honduras	Investment	31-Jan-10	32.76	0	20	20	0

P088080	Housing and Urban Technical Assistance Project	Mexico	Investment	30-Jun-08	7.77	7.77	0	7.77	0
P092692	Grenada Hurricane Ivan Emergency Project	Grenada	Investment	30-Jun-08	10	5	5	10	0
P090159	Emergency Recovery and Disaster Management	Haiti	Investment	31-Dec-08	12	0	12	12	0
P082429	Disaster Vulnerability Reduction First Phase APL	Colombia	Investment	N/A	416	260	0	260	0
P070658	OECS/Barbados Catastrophe Risk-Mgt. and Insurance Reform Project	OECS Countries	Investment	N/A	6.78	2.49	1.66	4.15	0
Total					5155.31	2474.04	475.17	2949.21	

Annex 4 – OAS

Appendix 4-A

List of Projects Office of Sustainable Development (OSDE) (Available on the website)

Caribbean Disaster Mitigation Project (CDMP)

<http://www.oas.org/CDMP/>

Caribbean Hazard Mitigation Capacity Building Programme Champ (CHAMP)

<http://www.oas.org/cdera/champ/>

Coastal Infrastructure Design, Construction and Maintenance Project

http://www.oas.org/cdcm_train/backgrnd.htm

Disaster Reduction of University Campuses in the Americas Program (DRUCA)

mhtml:http://www.oas.org/nhp/DRUCA/DRUCA.eng.mht

EDUPLANhemisferico

<http://www.oas.org/main/main.asp?sLang=E&sLink=http://www.oas.org/usde>

General Study on the Vulnerability of Road Segments to Natural Hazards of the Pan American Highway and its Complementary Corridors in Central America (2001)

<http://www.oas.org/usde/publications/Unit/oea88e/begin.htm>

Mechanisms for Mutual Assistance in Case of Damage and Vulnerability Reduction of Transportation Infrastructure in Central America, Working Document,

<http://www.oas.org/usde/publications/Unit/oea84e/begin.htm>

Natural Hazards Project (NHP)

<http://www.oas.org/main/main.asp?sLang=E&sLink=http://www.oas.org/usde>

Post-Georges Disaster Mitigation in Antigua/Barbuda and St. Kitts/Nevis

<http://www.oas.org/pgdm/>